Movin' Out:
Crime displacement and HUD's HOPE VI Initiative

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Executive Summary

The purpose of this project was to conduct an evaluation of the impact on crime of the closing, renovation, and subsequent reopening of selected public housing developments under the U.S. Department of Housing and Urban Development (HUD)'s HOPE VI initiative. No studies have specifically considered the effects of redevelopment of public housing under the HOPE VI initiative on the spatial distribution of crime. The current research aimed to remedy that deficiency through an examination of crime displacement and potential diffusion of benefits in and around three public housing developments. The developments were selected from a candidate set of six HOPE VI sites in Milwaukee, Wis., and Washington, D.C., all of which were in the process of being redeveloped with HOPE VI funds during the study period.

Displacement refers to changes in crime patterns that occur because offenders adapt their behavior to changes in opportunities for offending. In the context of the proposed work, opportunity changes are the result of large-scale public housing redevelopment. Anecdotal evidence suggests that, when HOPE VI developments are demolished and construction begins on new housing, residents are typically moved to other public housing sites in the same city. Our assumption was that crime would move with those residents to the new public housing locations, or to other nearby areas offering similar criminal opportunities.

Three central research questions thus guide this report:

1. Does the closing of a large high-poverty public housing development under HOPE VI influence patterns of crime in and around that development, and if so, how?

2. Does crime displacement or diffusion of benefits result during the time that the development is closed for rebuilding, and does crime return to previous levels when the development reopens?

3. Do different methodologies for examining crime displacement and diffusion of benefits from public housing developments yield similar results, and which is most appropriate for studying displacement in this context?

The work entailed a statistical analysis of potential displacement or diffusion of crime from three selected sites, after the redevelopment timeline of each site was established. Three methods were employed: a point pattern analysis, a Weighted Displacement Quotient (WDQ), and time series analysis. The methods were compared following their application in each site. The results indicate that displacement of crime did not appear to be a significant problem during or following redevelopment under the HOPE VI program in these three sites. Instead, a diffusion of benefits was observed to some extent in each site.

We found a clear indication in all three sites that crime dropped at some point during redevelopment and that redevelopment affected crime in surrounding areas in some

way—usually by decreasing it. The effects in the buffers (the areas searched for displacement or diffusion of benefits) varied, but for the most part, we observed a diffusion of benefits from the target sites outward. Additional investigation into subtypes of crime would help to bring more specificity to the results (e.g., whether any crime prevention methods implemented during redevelopment should target specific types of crimes that are more vulnerable to displacement). In addition, in no site did we find any return to pre-intervention crime levels following the intervention period in either the target site itself or in the buffer areas. This indicates that the positive effects—the drops in crime—lasted at least as long as the study period, which was generally one to two years beyond the end of the intervention period.

The project also aimed to compare different methods for studying displacement. The point pattern analysis had limited use in the present context, but we concluded that it would have more utility if a specific crime such as homicide, robbery, or burglary, were studied as opposed to studying a class of crimes such as personal or property crimes. The method is also quite involved, but efficiencies are gained once analyses are set up for one context, making it easier to apply the method in additional contexts (e.g., for additional time period comparisons, different areas/site boundaries, or types of crime).

While it cannot replace more rigorous statistical analyses and testing, the typical constraints felt by most practitioners on time and resources make the WDQ best suited for their context. The WDQ is intuitive, easy to calculate, and does not require a long series of data. It is appropriate for use in exploring the possible effects of an intervention to determine whether more sophisticated analyses are worthwhile. While there are drawbacks to the use of the WDQ—it is only descriptive, it can only indicate relative (not absolute) effect sizes, and it is dependent on the parameters selected (time periods and displacement areas selected)—it is nonetheless a useful intermediate tool in the study of displacement.

Where skilled statisticians are available and a quantification of the changes in crime levels is desired, the time series analyses methods presented here produce more rigorous results. Our results also demonstrated the desirability of the structural Vector Autoregression (VAR) over the traditional time series method typically used in displacement research—single series Autoregressive Integrated Moving Average (ARIMA) modeling. The VAR was preferable based on the simultaneous modeling of the three study areas, as opposed to modeling each area individually.

Finally, to the extent that the three HOPE VI sites in two cities are representative of other actual and possible HOPE VI sites, the results are applicable to other public housing sites undergoing this type of large-scale redevelopment, especially given the comparability of results we found across sites *and* methods. The consistency with which we found evidence of diffusion from the sites is an indication that redevelopment under HOPE VI does indeed lead to diffusion of crime reduction, whether via changes directly attributable to HOPE VI in the target area or indirectly by encouraging additional investment in the larger neighborhood of the HOPE VI site, leading to additional redevelopment efforts in areas surrounding the HOPE VI site itself.

Based on our findings, we expect that housing authorities that undertake such large-scale public housing redevelopment efforts as are common under HOPE VI will likely see a diffusion of benefits to nearby areas, and those nearby areas may experience reductions in crime levels similar to that experienced in the redevelopment site itself. Localities considering large-scale redevelopment, either under the HOPE VI program or following a similar process, might look at specific crimes that may be displaced, such as personal crimes (as was the case in Milwaukee) and enact policies that serve to prevent displacement

specifically of those crimes from occurring.

Studying displacement from public housing is an important undertaking, and the possibility of displacement should be considered by housing authorities either already undertaking such efforts or considering whether to start large-scale redevelopment. While this research showed that diffusion of benefits is likely from redeveloped public housing, more work of this type—exploring different options for target area boundaries, intervention periods, and displacement areas—can provide more evidence of the best approaches to this type of effort and inform housing authorities of the most efficient ways to include studies of displacement and diffusion in their redevelopment efforts. Additional research in this vein that confirms the results here would add to the case presented by this research for the positive effects of HOPE VI on target sites and on surrounding neighborhoods.

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List of Acronyms

ACF	Autocorrelation Function
ARIMA	Autoregressive Integrated Moving Average
CSS	Community and Supportive Services
CNU	Congress for the New Urbanism
CPTED	Crime Prevention Through Environmental Design
DCHA	District of Columbia Housing Authority
GREAT	Gang Resistance Education and Training
HACM	Housing Authority of the City of Milwaukee
HOPE VI	Housing Opportunities for People Everywhere
HUD	U.S. Department of Housing and Urban Development
MTO	Moving to Opportunity
NIBRS	National Incident Based Reporting System
NIJ	National Institute of Justice
PACF	Partial Autocorrelation Function
PSN	Project Safe Neighborhoods
UCR	Uniform Crime Report
UI	The Urban Institute
VAR	Vector Autoregression
WDQ	Weighted Displacement Quotient

Chapter 1

Introduction

The purpose of this project was to conduct an evaluation of the impact on crime of the closing, renovation, and subsequent reopening of selected public housing developments under the U.S. Department of Housing and Urban Development (HUD)'s Housing Opportunities for People Everywhere (HOPE VI) initiative. No studies have specifically considered the effects on crime of redevelopment of public housing under the HOPE VI initiative. The current research aimed to remedy that deficiency through an examination of crime displacement and potential diffusion of benefits in and around five public housing developments. The developments were selected from a candidate set of six HOPE VI sites in Milwaukee, Wis., and Washington, D.C., all of which were in the process of being redeveloped with HOPE VI funds at the start of the research. Redevelopment of the Milwaukee sites under study took place from 2003–2009. Redevelopment of the East Capitol (now Capitol Gateway) site in Washington, D.C., started in 2001 and continued through 2010, the end of the research period. Redevelopment of the Arthur Capper/Carrollsburg site in Washington, D.C., started in 2000 and also continued through 2010, the end of the research period.

Displacement refers to changes in crime patterns that occur because offenders adapt their behavior to changes in opportunities for offending. In the context of the proposed work, opportunity changes are the result of large-scale public housing redevelopment. The investigation of crime displacement from public housing redevelopment sites naturally leads to consideration of two different modes of spatial displacement. In the first instance, displacement can occur when public housing residents move (or are moved) to new locations and crime moves with those individuals to their new residences. Crime displaced in this manner would be particularly expected in the case where large numbers of residents are moved *en masse* to a new location. A second mode of spatial displacement from public housing redevelopment sites occurs when crime itself moves out of the redevelopment site to nearby locations. In this case, the perpetrators of crime (e.g., drug dealers) might attempt to maintain their criminal activities in the same general area, but are forced out of the redevelopment site itself. Or, the criminal opportunity structure in the redevelopment site is changed with redevelopment but nearby areas still offer criminal opportunities and thus absorb the crime that would have otherwise been occurring in the redevelopment site itself.

At the outset of this research, our assumption was that crime would move via either or both modes of displacement: with relocated residents to their new neighborhoods, or to other nearby areas offering similar criminal opportunities. As part of previous research efforts undertaken by The Urban Institute (UI), police officials in other cities have reported

to UI that closing public housing under HOPE VI resulted in crime migration to other public housing developments in the city or county.

Because of limitations in the data that the research team was able to collect for this study, the ability to explicitly study both of these different modes of spatial displacement was limited to a certain degree. In neither Milwaukee nor Washington, D.C., were we able to obtain information on the locations of individual residents during and after the redevelopment process. Therefore, we did not have information on whether any specific neighborhoods received large numbers of displaced residents from the HOPE VI sites under study, nor were we able to assess whether those residents moving in after redevelopment were the same residents who moved out prior to redevelopment. These limitations were tempered somewhat, especially in Milwaukee, by one important factor: the housing authority there made a significant effort to keep residents within the redevelopment neighborhood and moved residents around among available units as construction took place elsewhere within the site. Therefore, while we did not have information on Milwaukee residents' new addresses, we had good reason to believe that many, if not most, remained on site, and were therefore able to test for both types of spatial displacement together.

In Washington, D.C., we learned from interviews with housing authority staff that residents were moved to any available public housing unit or given Section 8 vouchers. Those interviewed did not feel that critical masses of residents had all moved to the same areas but rather that residents were scattered to various locations throughout the city. The lack of data on residents and the scattering of residents throughout the city made testing the first type of spatial displacement—where crime moves with residents to their new neighborhoods—both impossible and, arguably, irrelevant. The second mode of displacement, however, was fully testable in both Milwaukee and Washington, D.C.

Three central research questions that recognize these limitations thus guide this report:

1. Does the closing of a large high-poverty public housing development, under HOPE VI influence patterns of crime in and around that development and if so, how?

2. Does crime displacement or diffusion of benefits result during the time that the development is closed for rebuilding, and does crime return to previous levels when the development reopens?

3. Do different methodologies for examining crime displacement and diffusion of benefits from public housing developments yield similar results, and which is most appropriate for studying displacement in this context?

From these questions and consideration of the types of spatial displacement that we were able to investigate, five main hypotheses were developed and tested in the course of the research:

H1: The closing of the HOPE VI redevelopment sites resulted in a reduction of crime and drug activity in the sites themselves.

H2: The closing of the HOPE VI redevelopment sites resulted in the displacement of crime to nearby areas.

H3: Crime will be low in the immediate areas of HOPE VI sites after their redevelopment and reopening under the HOPE VI initiative.

H4: Crime that is displaced as a result of the redevelopment of severely distressed public housing sites under the HOPE VI initiative will persist in the displacement areas after the HOPE VI development is reopened.

H5: The results obtained from the selected methodologies will be comparable, allowing UI to develop a framework of displacement methodologies that are appropriate in different situations.

UI's evaluation consisted mainly of a statistical analysis of crime displacement. First, to inform the statistical analysis, UI conducted interviews with local government officials and service providers to both gather factual information on the actual process of redevelopment in each site and to gain insight into the perceptions of those involved in the redevelopment as to the changes in both residents and crime levels in each site. UI then conducted an impact evaluation using three different methodologies: the conceptually simple Weighted Displacement Quotient (WDQ) (Bowers and Johnson, 2003), a point pattern analysis proposed by Ratcliffe (2005), and an interrupted time series design. These methods will be described more thoroughly below in Section 3. The use of these three complementary methodologies allowed UI to make a statement as to the most appropriate method for studying displacement within the context of each site.

This report first presents a discussion of theoretical arguments supporting and refuting the existence of displacement, methodological issues associated with studying displacement, and previous research on displacement. The report then provides an overview of the sites included in this study, description of each site's redevelopment timeline, a discussion of the methods used, and the results. Finally, the report discusses the findings, paying particular attention to the overall picture of displacement from each study site based on the comprehensive findings from three methods, and a discussion of the utility of each methodology employed in various contexts.

Chapter 2

Background

This chapter first provides a description of HUD's HOPE VI program. The chapter then provides an overview of the theory and literature on crime and public housing and spatial displacement, including methodological issues associated with the study and measurement of displacement and previous work on the topic.

2.1. HUD'S HOPE VI PROGRAM

Housing Opportunities for People Everywhere (HOPE VI) is a federal funding initiative begun in 1992 and designed to eradicate severely distressed public housing. At its inception, HOPE VI represented a radical change in housing policy with the idea that the worst public housing developments needed extreme changes: most HOPE VI sites are demolished and replaced with new, redesigned housing. The program also aims to reduce the concentration of extreme poverty that is typical in targeted public housing developments; to that end, current residents of HOPE VI redevelopment sites are given the opportunity to seek housing in other areas in the private market through a voucher system.

Revitalization under HOPE VI is achieved by addressing several aspects of public housing and concentrated poverty, including redesigning the physical features of public housing, encouraging resident self-sufficiency through comprehensive service provision; relocating public housing to create mixed-income neighborhoods; and using HOPE VI funds to leverage support from other sources, including nonprofits, government agencies, and local organizations (HUD, 2007). The goals under HOPE VI are realized differently by different Housing Authorities receiving federal monies, with each Housing Authority allowed wide latitude in its plans for redevelopment of severely distressed public housing. A unifying theme of funded sites, however, is design under New Urbanism principles. These principles advocate "compact, pedestrian-friendly, and mixed-use" development, mixed-income residential areas, and designs that encourage social interactions (CNU, 2001). These design principles mesh well with the idea of "defensible space" as defined by Newman (1996), and discussed in detail below.

2.2. CRIME AND PUBLIC HOUSING

Two main schools of thought inform this research on crime and public housing: (1) crime and space approaches, which include ideas from the Crime Prevention Through Environmental Design (CPTED) school and defensible space theory and (2) social disorganization

theory. Both of these approaches have a common focus: the importance of informal social control, manifested in this case as the ability of residents of public housing to control criminal behaviors. Newman's (1972; 1996) foundational work on defensible space suggested that the physical design of public housing was key in preventing crime. Likewise, Popkin and colleagues' (2004) review of HOPE VI acknowledged the often extremely unsafe conditions that existed in HOPE VI sites prior to redevelopment, tying public safety issues to poor physical design of the buildings themselves. Crime is more likely in buildings where many individuals share the same outside entry point and dwelling units are the only private space, allowing individuals to become anonymous and releasing individuals from responsibility for the control of common areas. Residents in high rises are also physically very far from the street, reducing their ability to control outside areas. Street designs likewise affect control of public housing environments. If large "superblocks" of public housing are linked to the surrounding area by very few streets and limited access points to the site are available, the ability to patrol and control the area is diminished.

Newman's work also recognized the role of social factors in crime prevention, and that work dovetails nicely with theories focused more keenly on socioeconomic context and its role in fostering social control. Joseph and colleagues' (2007) theoretical exposition identified the importance of interpersonal relationships in residents' ability to exert social control to improve safety and quality of life. Many factors influence the number and strength of such interpersonal relationships. Family disruption—including divorce or single parenting—can affect the ability of adults to form local networks, thereby decreasing local levels of social control (Felson, 2002; Sampson and Laurtisen, 1994). Such local control can take the form of recognizing strangers in the area, guarding each other's property, and providing supervision for youths (Sampson, 1997). Single and divorced persons, however, are more likely to live in primary-individual households and to spend more time outside of the home (a fact partially determined by sociodemographic factors like age). More time away from home means increased proximity to offenders and decreased guardianship of the home. Even if single or divorced residents are at home, the level of guardianship in these areas tends to be lower than in households where more than one person resides. Thus, "regardless of one's household family composition and even proximity to offenders, living in a community with low guardianship and surveillance may increase victimization risk" (Sampson and Wooldredge, 1987, p. 373).

Poverty can also contribute to increased social disorganization in several ways. High levels of poverty can leave residents lacking any of the resources necessary to organize in the neighborhood—residents may be unable to attract or harness resources that would allow them to make changes in the community. This lack of resources in turn can lead residents to become disengaged in the community, weakening social ties and informal networks. Neighborhood poverty can have the effect of increasing the isolation of residents from social mainstreams, furthering their inability to control, or even promoting the acceptance of, deviant forms of behavior (Massey, 2001; Morenoff, Sampson, and Raudenbush, 2001). Finally, high population density and concentrated unemployment have also been tied to decreased levels of social control.

These perspectives have guided the investigation of public housing and crime over the past several decades, and it is commonly recognized that the residents of the kinds of severely distressed public housing sites targeted by HOPE VI are disproportionately affected by crime. Researchers using victimization surveys and police crime data have documented both a high fear of crime among public housing residents and high violent offending rates in neighborhoods with public housing developments. DeFrances and Smith (1998) found

a higher level of more serious victimization among residents, and a HUD study (2000) revealed that firearm-related victimizations among public housing residents were more than double those for the general population.

Pyle (1976) suggested that areas with public housing tended to bring in a substantial number of offenders from surrounding areas, while more recent research by Fagan and Davies (2000) found that violent crime tended to be associated with public housing units. The authors, examining a variety of crime categories (rape, robbery, assault, murder, and lethal violence) in and around a public housing development in the Bronx, found that the proportion of total offenses was even greater in areas within 100 yards of the projects than in the public housing developments themselves. They also found that the rate of crime in public housing predicted crime rates in the larger census tract for rape, robbery, and murder, suggesting that crime diffused outward. Additionally, assault and lethal violent crime in the census tract predicted crime within the public housing units, leading the authors to conclude that crime also diffused inward as criminals seek out public housing areas for offending. Likewise, Dunworth and Saiger (1994) found higher rates for drug arrests and violent crime in areas with public housing compared to similar neighborhoods. This relationship between public housing and crime is supported by further evidence that the environment of many public housing complexes attracts drug trafficking and violence (Fosburg, Popkin, and Locke, 1996; Popkin, Levy, Harris, Comey, Cunningham, Buron, and Woodley, 2002).

Other researchers have studied the involvement of public housing residents in crime and violence, with a number of studies focusing on adolescents living in public housing. For instance, Sullivan (1989) demonstrated that reported crime among public housing residents tended to be more serious and often involved personal and drug crimes as compared to reported crime among residents not living in public housing. Popkin and colleagues (2000) studied criminal activity and youth involvement in three public housing developments. The authors described the daily life for residents of high-rise developments as being characterized by high levels of crime, violence, and disorder. Recent research by Ireland, Thornberry, and Loeber (2003) found further evidence that living in public housing was related to participation in violence. The authors reported that both the prevalence and frequency of self-reported violent offending was greater among public housing residents than those not living in public housing. They also suggested that the negative effects of living in these high-crime developments were reflected in the rising incidence of violent crimes as youth enter late adolescence.

Although the studies mentioned above analyzed crime in and around public housing, few studies have focused on assessing the impact of large-scale changes to public housing environments. Of the few studies located, only one—an unpublished thesis—examined changes in crime after relocation and redevelopment (Jones, 2002). The author examined the impact on calls for service after the Charlotte Court housing development in Lexington, Kentucky, was demolished and roughly 600 residents were relocated. Results showed that all crime types examined decreased around the development. To examine diffusion of benefits from the target area, two buffer zones were identified around the development. The first zone encompassed a half-mile radius around the Charlotte Court area, and the second zone encompassed a one-mile radius around the Charlotte Court area. The author found that crime decreased in both zones after residents were relocated, and concluded that closing the development resulted in a diffusion of benefits from the area of the development outward. Although the study findings supported the author's hypothesis, the study was limited in that it neither controlled for the influence of other variables on crime, nor used a

comparison area, making it difficult to conclude whether the findings reflect changes due to the closing of Charlotte Court.

The HOPE VI efforts and their effects—both intended and unintended—have been featured in mainstream media. In particular, a 2008 article in *The Atlantic* (Rosin, 2008) made a connection between residents who had been relocated from Memphis' HOPE VI efforts to new housing using Section 8 vouchers and increased levels of crime in those areas. Rosin argued that voucher holders clustered in new neighborhoods, forced to move wherever Section 8 housing was available. The article then suggested that the voucher holders' presence contributed to increasing crime rates in their new neighborhoods. The author did not conduct a statistical analysis of the relationship, however, and a rebuttal by housing and urban policy experts soon after the original piece's publication served to dismantle many of Rosin's conjectures (Briggs and Dreier, 2008). For one, Rosin failed to explore other possible explanations for the increase in crime in the voucher holders' "new" neighborhoods. She also overestimated the number of displaced residents in Memphis and the level of clustering of those residents who used vouchers in new neighborhoods. In fact, only a small percentage of households are granted vouchers and, as Briggs and Dreier's (2008) rebuttal pointed out, prior research had shown a low level of concentration of voucher holders across the 50 largest metro areas in the United States.

Other than Rosin's (2008) journalistic work on the topic, we know of no prior work on crime and public housing that focused specifically on the redevelopment of public housing under the HOPE VI initiative. Public housing is being renovated under this federal program nationwide, with the expectation that quality of life in the immediate and surrounding areas will be greatly improved. The question of the benefit of the program for communities specifically in terms of crime, however, has been left largely unanswered, and this research sought to address that question.

2.3. DISPLACEMENT

Not surprisingly, measuring displacement is complex—there are many types of displacement, and displacement is not easy to detect among the myriad reasons for fluctuations in crime rates. Barr and Pease's (1992) discussion on the movement of crime even suggested that the term "crime flux" was a more accurate description of moving crime patterns often termed "displacement." The criminological literature recognizes six types of displacement (Repetto, 1976; Hakim and Rengert, 1981):

1. Spatial: offenders commit crimes elsewhere;
2. Tactical: crimes are committed in a way that evades the impact of the law enforcement intervention;
3. Temporal: the same kind of crimes are committed at different times;
4. Target redirection: crimes are perpetrated against different targets;
5. Functional: perpetrators switch from one type of crime to another;
6. Perpetrator replenishment: new offenders may simply step in to fill the gap created by the intervention.

The range of possibilities for displacement constitutes a serious challenge to prevention and law enforcement activities, and displacement is often difficult to measure and assess. While this research recognized the complexities of possible crime displacement, this work focused only on the *spatial* displacement of crime. The intent was to examine whether criminals or potential offenders moved their activities to another location after the closing of selected HOPE VI redevelopment sites in Milwaukee, Wis., and Washington, D.C., and the subsequent reopening of the sites.

2.3.1. Spatial Displacement

Central to any crime prevention initiative is the expectation that the initiative will prevent crime. Local partners or evaluators typically measure changes in crime within the target area before and after the implementation of a program or intervention to examine whether crime was prevented. Also central to crime prevention is understanding and measuring whether and how crime was displaced from the target area as a result of the program. The issue of how to predict possible spatial crime displacement, and test for it after an intervention, is one that has been the focus of environmental criminologists for at least the past three decades (Brantingham and Brantingham, 1993; Cornish and Clarke, 1987; Gabor, 1981, 1990; Repetto, 1976; Sherman, Gartin, and Buerger, 1990).

Criminological and sociological theories support the concept of displacement through two general premises: (1) when some types of crime opportunities are reduced, others may increase; and (2) crime is opportunistic: potential offenders seek out opportunities for crime (Cornish and Clarke, 1990, 1987; Felson and Clarke, 1998). Displacement of crime, then, refers to changes in crime patterns that occur because offenders adapt their behavior as a result of some change in opportunities for offending. Change in opportunities can result from a variety of crime prevention activities—from police enforcement related activities (e.g., a new crime watch program) to physical changes to the environment (e.g., the closing of a liquor store). Recent work has shown mixed conclusions on the likelihood of displacement, and has suggested that diffusion of benefits should be the focus of criminologists' attention as well (Clarke and Weisburd, 1994). In this context, the redevelopment of HOPE VI public housing developments is seen as the "intervention," and while not wholly crime-prevention focused, it is expected that this type of redevelopment will reduce the levels of crime that plague severely distressed public housing.

As mentioned in Section 1, two different modes of spatial displacement from public housing are recognized. Displacement can occur when public housing residents move (or are moved) to new locations and crime moves with those individuals to their new residences. One significant study, the Moving to Opportunity (MTO) experiment, explored the changes in criminal and delinquent behavior among public housing residents who moved out of high-poverty areas. MTO employed a random design to assign volunteer families to one of three groups: a group that received housing vouchers that could only be used in low-poverty census tracts, a group that received regular Section 8 vouchers that could be used anywhere, and a control group that received no housing vouchers (Kling, Ludwig, and Katz, 2004).

Participants were followed over several years to assess the impacts of the program. While the results were necessarily complex for a long-term and large experiment of this kind, the findings on safety and delinquency are worth noting. Overall, many of those in the experimental group (who moved to lower poverty neighborhoods) felt safer and less stressed about the crime in their neighborhood (Kingsley and Pettit, 2008). Crime

rates were significantly lower in participants' new neighborhoods as well, for both the experimental and Section 8 groups.

Researchers also specifically looked at the delinquency of youths in all three groups and found that, in the long term, females and males fared differently in their new neighborhoods (Kling et al., 2004). Females in the experimental group tended to have more success than males, experiencing fewer lifetime arrests, especially for violent offenses. Males, on the other hand, had fewer arrests for violent offenses but increased arrests for property crimes and increased levels of other delinquent behaviors. In interpreting the results, the authors suggested that popular theories for explaining the neighborhood effects on behavior do not in fact accurately capture all of the neighborhood effects. Instead, theories from psychology that account for the different behaviors of males and females in reaction to new environments should also be considered.

The MTO findings are relevant to this work because they are tied to hypotheses about crime moving with residents to new neighborhoods. The MTO research suggests that in general, moving from high-poverty and high-crime public housing areas—like the sites studied for this research—to new neighborhoods with vouchers (even if no attempt is made to move to a particularly low-poverty neighborhood) results in improved safety outcomes. On the other hand, at the individual level, residents who move exhibit different behaviors in their new homes; they aren't universally more successful after the move, even when moving to places that have lower poverty rates.

So, crime may move with residents who represent potential victims or offenders, especially if they move to an area that already has high levels of crime. New residents to an area represent new potential victims. On the other hand, relocated residents might be committing crimes themselves, and in their new neighborhood, they might continue to commit crime. These residents would thereby increase the level of crime in the area of their new residence. Crime displaced in this manner would be particularly expected in the case where large numbers of residents are moved *en masse* to a new location, because individual offenders or victims might not effect a large change on the overall levels of crime in an area.

A second mode of spatial displacement from public housing redevelopment sites is observed when crime itself moves out of the redevelopment site to nearby locations. In this case, the perpetrators of crime (e.g., drug dealers) might attempt to maintain their criminal activities in the same general area, but are forced out of the redevelopment site itself (Caulkins, 1992). Or, the criminal opportunity structure in the redevelopment site is changed with redevelopment but nearby areas still offer criminal opportunities and thus absorb the crime that would have otherwise been occurring in the redevelopment site itself.

This work will focus mainly on the second mode of spatial displacement—crime moving to areas near the redevelopment site, instead of to displaced residents' new neighborhoods. While the work recognizes the importance of considering the first mode of displacement (crime moving with residents), we lacked the required data to make assessment of that mode of displacement possible.

2.3.2. Previous Research on Displacement

Prior research in this area has largely focused on displacement (usually spatial) that occurs as the result of a focused police enforcement effort or police intervention. The interventions are typically focused on small hot spots of crime—several square blocks at most—and have distinct periods of implementation. The prevailing view has been that the potential for spatial displacement is high, creating some hesitation to implement such focused in-

terventions. The literature, however, is limited, and those studies that have considered displacement have shown mixed results. Essentially, there is no clear or consistent finding in the literature regarding the likelihood that displacement will occur or what would be the expected magnitude of any displacement that might occur. In fact, Braga's (2001) review of studies on hot spot policing paid particular attention to those studies that considered displacement; the review found only one of five studies that looked for displacement concluded that displacement had occurred.

Within the past decade, a handful of studies have cautiously reported finding displacement, but findings overall remain mixed. Barclay, Buckley, Brantingham, Brantingham, and Whinn-Yates (1996) studied motor vehicle theft in suburban Vancouver, Canada. The authors used time series analysis to study displacement subsequent to a police bike patrol program, and considered displacement of crime to areas noncontiguous to the target area but well known for motor vehicle theft. They concluded that displacement did occur to one of the displacement areas they considered. Lawton, Taylor, and Luongo (2005) found evidence of displacement of drug crimes in their study of targeted police enforcement in Philadelphia. Using Autoregressive Integrated Moving Average (ARIMA) time series methods, the authors compared changing crime levels in the selected areas. In addition to the displacement of drug crimes, the authors found a diffusion of benefits for violent crimes. They argue that this dichotomy makes sense: violent crimes are not generally planned and are not location-specific. Drug markets, however, tend to be geographically-focused and are highly planned. The reaction of these different types of offenders to targeted police enforcement, then, was expected to be different.

Additional studies have found that instead of displacement, a diffusion of benefits from the intervention actually occurs in neighboring areas. Fritsch and colleagues' (1999) study of a yearlong focused police enforcement in Dallas, Texas, compared crime frequencies in target and comparison areas using t-tests. They concluded that no displacement had occurred to comparison areas as a result of the police efforts. Braga and colleagues' (1999) study of problem oriented policing in Jersey City, New Jersey, employed a randomized controlled experimental design to compare treatment and non-treatment areas. Using Poisson regression analysis, the authors determined that for most crimes, displacement had not occurred, but that for property crimes in particular, a significant amount of displacement had occurred. The authors pointed out that the level of displacement that occurred did not negate the drops in property crime that occurred in the targeted area. In addition, for other crimes, an apparent diffusion of benefits was noted.

Green Mazerolle, Price, and Roehl (2000) studied a civil remedy program in Oakland, Calif., to compare the difference between traditional police handling of problem properties and an alternative civil remedy method. They considered displacement within a 500-foot radius of each targeted property and found that while civil remedies appeared to reduce problems in the area—diffusing benefits to nearby areas—traditional policing actually created more problems in nearby areas, displacing problems. Smith's (2001) study of Richmond Va.'s Blitz to Bloom initiative, which involved a crackdown and cleanup of a targeted area, also found a diffusion of benefits in two of three displacement areas considered.

Weisburd, Wycoff, Ready, Eck, Hinkle, and Gajewski (2006), also in Jersey City, New Jersey, studied displacement and diffusion from two hot spots (one prostitution, one drug) targeted for increased police interventions. Their effort included extensive social observations in the target and "catchment" areas (where the authors searched for displacement and/or diffusion of benefits), which were used to measure the effects of the intervention.

The study found that benefits of the increased police efforts in the hot spots diffused to the catchment areas. While the authors recognized the limited generalizability of a study based on only two hot spots, the work did present a novel approach to measuring the effects of police interventions (social observation) and they suggested that the conclusions, specifically pertaining to prostitution and drug crimes, were "persuasive." The authors also pointed out that new ideas in routine activity and rational choice theories suggested that diffusion of benefits should actually be expected.

Finally, Braga and Bond (2008) looked at the effects of a targeted police strategy in Lowell, Massachusetts. That effort specifically targeted disorder, and the study looked at more serious crimes to determine the effects of policing disorder on those crimes. Like Weisburd et al. (2006), the study employed social observations to measure some of the impacts of the police efforts; calls for police service were used as official indicators of crime. While significant results indicated that there was no displacement, some nonsignificant results suggested "minor immediate spatial displacement of crime." The authors cautioned, however, that displacement was hard to measure and that other positive effects of the intervention outweighed any displacement that might have occurred.

Displacement, then, has been neither extensively studied nor universally identified, and there appears to be reason to question the traditional thought assuming and expecting its existence. In addition, if the number of studies focused on displacement of crime from targeted police interventions has been limited, the number that have considered crime displacement from public housing redevelopment efforts has been nearly non-existent. It is this gap in the literature that the present study aimed to fill.

2.4. CONCLUSION

The possibility of displacement—either spatial or otherwise—has been the focus of a good deal of debate among researchers and practitioners, with no clear consensus resulting on the potential for displacement, the best methods for measuring the phenomenon, or appropriate prevention methods. What was clear at the start of this research was that law enforcement agencies, housing authorities, and the neighborhoods they seek to protect would benefit from a greater understanding of what actually does take place when public housing is redeveloped under HOPE VI. Filling that need was the primary focus of this research, and its intent was to examine whether criminals or potential offenders moved their activities to another location after the closing and subsequent reopening of three HOPE VI redevelopment sites.

The next chapter discusses the data collected for each site and the methods used to search for displacement of crime or diffusion of benefits.

Chapter 3

Data and Methodology

The goal of this research was to examine crime displacement from five HOPE VI sites in two cities using three different methodologies (the WDQ, point pattern analysis, and time series analysis). Crime in each site was examined using official police records from the police departments in Milwaukee, Wis., and Washington, D.C., over a nearly 10-year period. In addition, a comparison group design was used whereby appropriate comparison areas were selected for each site and also examined over the same time period. The comparison sites were used to determine whether changes in crime levels, unrelated to HOPE VI or the redevelopment efforts in each site, were taking place citywide. The comparison site design allows researchers to more confidently attribute any observed changes in a study or intervention site to the intervention itself. The comparison sites were also assessed using official police records on crimes reported. In each site, police data were collected for the period 2000–2009 for use in the study. This allowed for at least one year before any site started redevelopment (the pre-period), and a varied number of months or years after redevelopment, determined by the redevelopment timeline (the post-period).

This chapter outlines the specific data that were collected for each site, the definition of site boundaries and displacement and comparison areas, and the redevelopment timeline. The chapter also presents the three methods used to examine displacement under this research study.

3.1. DATA

3.1.1. Qualitative Data

Qualitative data in the form of information about each site were collected via interviews with staff members of Housing Authority of the City of Milwaukee (HACM) and District of Columbia Housing Authority (DCHA). Staff members at both agencies were very helpful and were invaluable sources of information and documents on the HOPE VI applications and awards, redevelopment plans, residency requirements, perceived changes in each site, and progress made to date at each site. This information was used in determining the timelines for redevelopment in order to define pre-, during-, and post-intervention periods for use in the analyses.

Project staff had hoped to learn more about the residents for each site, including where each resident moved during the relocation period, what types of housing the residents were moved to when relocated, and which former residents returned to occupy newly built units. This information, however, was not readily available from either housing

agency; neither agency shared data on specific residents with project staff. The information on residents was desired in order to test for the first "mode" of displacement, where crime moves with residents to their new neighborhoods (see Section 1). The data on residents' new addresses after relocation would have allowed us to identify areas of possible crime displacement not adjacent to the sites themselves (e.g., sites to which crime might have moved because a number of residents left a HOPE VI site and most moved to the same new location), following the technique of Roman and colleagues' (2005) work in Miami.

In Milwaukee, where most residents were simply "shuffled" around to available units within the redevelopment neighborhood, this did not pose a large problem; there was not an obvious alternate location to which crime would be expected to be displaced. In Washington, D.C., DCHA staff reported that while they were not able to share information on where residents were relocated, most were not moved *en masse* to a new location; rather, they were scattered to available units throughout the city. Some residents, however, used housing vouchers for nonpublic housing units, and project staff learned anecdotally that many residents did relocate to similar areas where Section 8[1] units were available. Lacking information on residents, however, we were unable to identify specific public housing developments or neighborhoods in Washington, D.C., to which we might have expected to see crime displaced.

Project staff had also hoped to gather information on the changing demographics of residents in each site to incorporate into the time series analysis models. While data were collected on the demographics of each site prior to redevelopment and on the residency requirements of the new units, from this information, it was difficult to determine the demographics of the new units. We did not have specific resident information from either housing authority, Census data were outdated, and residents were continually moving in as the research progressed. We also collected the number of residents living in the different sites at different points in the redevelopment process. This helped us to delineate the different periods (e.g., pre, during, and post) for the various analyses but did not provide enough information to warrant incorporating them into the models themselves. Therefore, we were unable to collect enough information about each site for use in statistical modeling methods. The qualitative data collected, however, were very useful in informing the parameters selected for the models developed and in interpreting the results of the analysis efforts.

3.1.2. Police data

Address-level incident data were collected for the city of Milwaukee from the Milwaukee Police Department for the period January 2002-February 2010. Incident data included all "Group A" offenses as classified under the National Incident Based Reporting System (NIBRS). Addresses were geocoded using a streetfile provided by the City of Milwaukee with a 100 percent match rate. The offenses were classified by researchers into personal (violent) and property offenses. Personal offenses included homicide, sexual offenses, assault offenses, and kidnapping. Offenses were aggregated into monthly counts, giving project staff 110 months of data with which to conduct statistical analyses.

It should be noted that the police department in Milwaukee changed data systems in early 2005. This shift in systems created two data issues: one was that data were missing

[1]The federal Section 8 program, or the Housing Choice Voucher Program, provides assistance to low-income individuals and families in the form of rental subsidies for recipients. The program is administered through HUD.

for the last three months of 2004. Monthly totals for those months were imputed using data before and after the missing months. Second, the police department reported that due to changes in the data system, arrest data were not available prior to 2005. Because redevelopment activities started prior to 2005 in Milwaukee, the existing arrest data were not collected or used in the current research.

Address-level incident data were also collected for Washington, D.C., from the Metropolitan Police Department for the period January 2000 through September 2009. Incident data included all Part I offenses as classified under the Uniform Crime Report (UCR) system. All data were provided with X and Y coordinates, so no geocoding was necessary. As in Milwaukee, the data were classified by researchers into personal and property offenses, following the same scheme used for the Milwaukee data. In D.C., researchers had hoped to collect arrest data in order to assess in particular the levels of drug activity occurring in the HOPE VI sites and displacement areas over the study area. The only data readily available, however, were juvenile arrests. Those data were collected and processed, but too few arrests took place in any given site over the project period. For example, in Capitol Gateway, only 26 juvenile arrests for drug charges were recorded over the nearly 10-year study period. The number of arrests was therefore too low to warrant conducting any analyses using those data. Unfortunately, that meant that the research team was unable to evaluate changing drug crime levels in the sites.

3.2. METHODS

3.2.1. Identification of Boundaries and Time Periods

Prior to conducting any displacement analyses, the research team had to first identify the overall timeline of redevelopment for each site under study, determine the "intervention" point, define the site from which crime displacement might occur, and define the displacement areas—those sites to which crime might be displaced—and the comparison areas. Much of the previous work on crime displacement looked at targeted interventions by the police that generally covered a small geographic area and took place over a short, well-defined time period. The HOPE VI redevelopment projects, however, were not short, nor were the sites compact areas. Identifying site boundaries, displacement areas and time periods, then, was not an easy task given the length of the redevelopment projects and the size of the sites targeted for redevelopment.

Site boundaries

The process for identifying the site boundaries, the specifics of which are discussed in Chapter 4, included identifying all HOPE VI redevelopment sites and all public housing sites. Several factors complicated the delineation of the target areas, or the intervention site boundaries. HOPE VI sites are typically large and these kinds efforts often include redevelopment of nearby areas with funds from different sources, and public housing is often clustered within neighborhoods, what results is often overlapping or vaguely defined boundaries of public and other types of low-income housing being redeveloped using funds from HOPE VI and other sources. The boundaries of these sites were examined to determine which areas should be included in the "intervention" area and what should not be considered as part of the redevelopment efforts. As will be discussed later, site

definition was very difficult in Milwaukee but relatively straightforward in Washington, D.C.

Displacement of crime is most often studied by choosing an area to which crime will most likely be displaced—the displacement zone—and comparing levels of crime in that area with the target area (area where the intervention took place). The next step in searching for possible displacement or diffusion of benefits, then, is to identify the area or areas to which one can expect crime to be displaced, or to which benefits will diffuse—here, these areas are called the "displacement zones" or areas. The most common displacement area used is an area surrounding the target area; this particular design is sometimes described as a "buffer zone." This buffer-as-displacement zone can be concentric, reaching a set distance in all directions from the target area, or it can be contiguous to the target area but extending only in limited directions (Hamilton-Smith, 2002). Most research thus far has looked for immediate spatial displacement in areas contiguous to the target area (Braga, 2001). The size of the zone varies in the literature as well, and Bowers and Johnson (2003) suggest that there is a "displacement gradient" that describes displacement as decreasing with increasing distance from the target area.

Issues with choosing a displacement zone include choosing one that is not so small as to emphasize fluctuations in the data (too small a sample of crime events) or to not capture a fair amount of displacement that could be taking place. Conversely, it is also problematic to choose a displacement zone that is too large and "washes out" the displacement that is taking place, masked by larger crime trends in the area. The geographic features of an area should be taken into account in choosing a zone as well, as there may be a physical feature (e.g., a railroad, a river) that might prevent displacement from taking place in that direction. Bowers and Johnson (2003) also suggest the use of multiple displacement zones, increasing in distance from the target area, for comparison purposes. Alternatively, Ratcliffe (2005) identifies no displacement zone prior to studying displacement. His flexible methodology allows the researcher to study changing crime patterns across an entire study area and identify whether the changes are the result of displacement, given the researcher's knowledge of interventions that took place in the study area.

For this research, multiple displacement zones or areas were used. The displacement areas for both the Milwaukee and Washington, D.C., sites were drawn as concentric rings ("buffers") around the target area. We tested two zones for displacement in each site: one ring that was 1000' from each site, and one that was 2000' from each site. The two buffer areas were mutually exclusive; the area contained in the 2000' buffer did not include the 1000' buffer. This allowed us to determine whether displacement or diffusion of benefits occurred only within areas very close to the site, or if they had a wider reach.

In the selected study sites, comparison areas were selected based on recommendations from both HACM and DCHA. Comparison sites were other public housing developments that were similar to the redeveloped sites prior to their redevelopment. In Milwaukee, because the target area selected was so large, we included the area in a 3000' buffer surrounding the comparable public housing development as the comparison area. In Washington, D.C., only the actual area of the comparison public housing site was used. More detail on the target and comparison area characteristics is provided below in Section 4.

Intervention time periods

In addition to the geographic considerations necessary in studying displacement, there are temporal issues that need to be addressed. One is determining how soon displacement is

expected to occur after the start of an intervention. It is generally expected that displacement of crime will lag behind the introduction of an intervention to some extent. However, the lag period has not been well addressed in the literature, with prior research employing a variety of different lag periods, ranging from analyzing displacement from the start of the intervention (no lag period) (Smith, 2001) to analyzing displacement starting at the end of a problem-oriented policing strategy of indeterminate length (it ended when problems were thought to be resolved) (Braga et al., 1999).

A second temporal issue related to displacement is determining the duration of displacement. Researchers have employed a variety of post-intervention lengths in their analyses, ranging from analyzing displacement only during the crackdown (no residual displacement expected) (Smith, 2001; Ratcliffe, 2005) to analyzing displacement up to 20 months after an intervention (Bowers and Johnson, 2003). Bowers and Johnson (2003) suggest that small time periods of analysis are more subject to random fluctuations in crime and confound results. They recommend that a substantially long period of time before and after an intervention be used to study displacement and state that the length of the intervention and expected length of residual deterrence will both play a role in determining how long after the intervention displacement will be evidenced.

For this work, for each specific site and type of analysis, we needed to establish an "intervention" point, during and after which we could look for displacement. The WDQ and point pattern analyses were tested using different pre, intervention, and post periods for each site. The time series analysis, however, required that we delineate non-overlapping periods. For that analysis, we divided the timeline for each site into four major periods:

The "pre" period: Residents are living on site and the site is more than half occupied with residents during this period.

The "move-out" period: Relocation of residents takes place during this period, with the number of residents on site diminishing with time.

The "construction" period: Demolition of old units and buildings takes place, along with construction of new units, during this period.

The "move-in/stability" period: Residents begin to move back in and the site reaches stability in terms of the percentage of units that are occupied.

These periods were not easily delineated, even with the information contained in the detailed redevelopment timelines. One or more of these periods overlapped for all of the sites. For example, for some sites we identified different resident move-out periods from different sections of each site. We also identified different construction projects with different timelines at each site and different points of stabilization of residences on different parts of each site. For the various analyses, however, we could not have overlapping periods, so we chose the midpoint of the overlap period as the border between two periods (e.g., if the move-out and construction periods overlapped by six months, we chose three months prior to the end of the move-out period and after the start of the construction period as the boundary between those two periods).

The different time periods used for each site and each analysis are specified in the discussion of the results.

3.2.2. Analytic Methods

The first step of the research was to determine whether crime dropped in the HOPE VI sites and whether any search for displacement of crime or diffusion of benefits was appropriate. We conducted descriptive analyses of crime levels before and after redevelopment in each site and found that each experienced a significant decrease in crime levels and that we could proceed with the selected methodologies, described below.

Point pattern analysis

The first technique employed in the proposed research was Ratcliffe's (2005) point pattern analysis method. This method examines the geographic distribution of crime points in a selected study area at one time period and compares that it to the geographic distributions of crime points in the same area in a later time period. The method, as presented by Ratcliffe, does not require the identification of a specific intervention site but instead looks at patterns over a larger area. This type of point pattern analysis is designed to be flexible and to allow exploration of varying spatial patterns over time.

The method was presented as an intermediate step in a larger assessment of potential displacement; Ratcliffe suggests that the first step is identifying whether an intervention was associated with decreased crime in the target area. The next step would be point pattern analysis to determine whether spatial patterns of crime in and around the intervention area changed. If the patterns did change, further exploration could take place to determine what those changes were and what the possible cause of those changes was. This technique was thus conducted first, after it was determined that crime did in fact decrease in the study sites. The current research, however, included additional techniques for studying displacement regardless of the results of the point pattern analysis in order to conduct a comparison of the results of each technique.

Ratcliffe's method requires generation of a random point distribution in the study area. The distance from each random point in the study area to its nearest crime point is then calculated. This is repeated, with the random points remaining the same, for two sets of crime points at different times (e.g., year 1 and year 4). The random points are then ranked in order of smallest to largest distance to nearest crime point for each different set of crime points (e.g., the distances from each random point to crime at t_0 are ranked, and the distances from each random point to crime at t_1 are ranked separately). The two sets of rankings of random points are compared using Spearman rank correlation coefficients. This method is repeated multiple times using varying random point distributions (a Monte Carlo process). Once a set of Spearman rank correlation coefficients has been calculated, the distributions of coefficients can be examined for significance. If the specific significance level chosen was reached in that percentage of individual correlations, then the results can be considered significant. For example, if the chosen significance level is $p<0.01$, and at least 99 percent of the runs achieved that level of significance, the whole set of runs can be considered significant. Ratcliffe found that a set of 100 repetitions was appropriate in his study. The current study followed that example and used 100 repetitions for this analysis. Varying numbers of repetitions were tested but the results remained very similar in all sites.

Another issue is the number of points used in the analysis. Ratcliffe chose 100 points for his analysis of a burglary intervention in Canberra, which represented approximately 5 percent of the total number of crime points in his study. He cautions, however, against

using so many points that the pattern becomes regular within the study site, and so few that the number of degrees of freedom is restrictive when calculating the correlation between the two sets of distance rankings. The current research looked at spatial patterns in a much smaller area than an entire city, as Ratcliffe did, and tested different numbers of random points to compare results. Those results are presented below.

Ratcliffe also suggests a unique way to address edge effects that might occur when using this technique. The results might be affected when a random point is placed closer to the boundary of the site than to a crime point in either crime series (crime at t_0 and crime at t_1). In this case, it is conceivable that another crime might have occurred outside the boundary but closer to the random point than any crime at t_0 or t_1. To accommodate this fact, a flexible method of excluding random points was suggested by Ratcliffe: the distance of each random point to the border is compared with its nearest neighbor in both crime series. If it is closer to the border than to crime in either series, it is excluded and another random point is generated that meets the requirement. This process is continued until all random points are closer to crime at t_0 and t_1 than to the boundary. The boundary for random points, then, is dependent upon the spatial distribution of points in t_0 and t_1, and changes if the period under analysis changes (i.e., if a comparison is made between year 1 and year 2 and then between year 1 and year 4, the random point boundary is different for each of those two analyses).

These point pattern analysis methods can actually be applied without identifying an intervention because no prior knowledge of intervention location, length, or focus is required. However, knowledge of the redevelopment timeline informed the selection of periods for which the point pattern analysis was conducted. We compared a number of different time periods for each site in order to compare results.

The point pattern results are easily interpreted. Mean correlation coefficients that are significant and positive indicate no change in the spatial pattern of crimes examined. Coefficients that are significant and negative indicate a change in the spatial pattern of crimes, and would indicate that further investigation into the areas from and to which displacement might have occurred is warranted.

After suitable random point distributions were created for the analysis in each site using ArcGIS software, the nearest neighbor distance calculations, rankings, and correlations were computed in the statistical package R.

The following summarizes the process followed for point pattern analysis:

1. Define geographic area in which to look for point pattern changes
2. Prepare two sets of crime points within study area, at t_0 and t_1
3. Determine number of random points, x, to use and number of simulations, i, to conduct
4. Address edge effects:
   (a) Generate x random points within the selected study area
   (b) Calculate the distance of each random point to its nearest crime point at t_0
   (c) Calculate the distance of each random point to its nearest crime point at t_1
   (d) Discard any points that are closer to the edge of the study area than to a crime point at t_0 and t_1
   (e) Generate replacement random points for those that did not meet the criteria above
   (f) Repeat test process until all random points are closer to a crime point at t_0 and t_1 than to the edge of the study area

5. Calculate nearest neighbor distances and rank random points:
   (a) Calculate the distance from each random point to its nearest neighbor in the set of crime points at t_0
   (b) Rank the x random points in ascending order based on distance to nearest neighbor, save ranking at t_0 (e.g., 1, 2, 3, etc.)
   (c) Calculate the distance from each random point to its nearest neighbor in the set of crime points at t_1
   (d) Rank the x random points in ascending order based on distance to nearest neighbor, save ranking at Time 1 (e.g., 1, 2, 3, etc.)
6. Calculate the Spearman rank correlation coefficient between the two sets of rankings from t_0 and t_1
7. Determine the test statistic (or significance level) of the correlation coefficient
8. Repeat analysis process using same two sets of crime points for t_0 and t_1 i times
9. Compile i correlation coefficients and test statistics
10. Determine significance of correlations between patterns:
    (a) Select significance level
    (b) Determine whether appropriate percentage of correlation coefficients meet that significance level (i.e., if chosen significance level is 95% and 95% of correlation coefficients were significant at that level, the mean value of all i correlations is considered significant)

This outline of the process reveals the heavy computational requirements that can be needed if the number of crime points or random points in any given distribution is high. The next method presented is less computationally complex but requires the delineation of discrete target, displacement, and comparison areas.

Weighted Displacement Quotient

Bowers and Johnson (2003) developed the WDQ method to assist displacement research where lengthy time series pre- and post-intervention are not available. The WDQ was developed to identify the possible presence of displacement or diffusion, not the absolute size of any displacement or diffusion that might have occurred. The WDQ considers levels of crime in three areas—target (A), displacement (B), and comparison or control (C) areas. This method can be employed with point or aggregate data, with the most accurate results obtained from point data, because point data allow the development of target, displacement, and comparison areas that do not follow administrative boundaries. The most common method for identifying displacement zones (B) is to draw concentric rings around the target area (A). That is the method that was used in the current research because of the difficulties described above in identifying alternate locations to which displacement might have occurred.

The quotient has two parts: the *displacement measure*, which measures the change in crime in the displacement area relative to the change in crime in the control area over the same period and is the numerator shown in Equation 3.1, and the *success measure*, which measures the success of an intervention—the reduction (or slowed increase) of crime in the target area relative to a comparison area, and is the denominator in Equation 3.1. The displacement measure is divided by the success measure to calculate the final WDQ. The full formula is given as:

$$WDQ = \frac{Bt_1/Ct_1 - Bt_0/Ct_0}{At_1/Ct_1 - At_0/Ct_0} \tag{3.1}$$

where At_0 and At_1 are crime levels in the target area at t_0 and t_1; Bt_0 and Bt_1 are crime levels in the displacement area at t_0 and t_1; and Ct_0 and Ct_1 are crime levels in the comparison area at t_0 and t_1.

Prior to any search for displacement or diffusion of benefits, the researcher must first identify whether any positive changes in crimes levels occurred at the time of the intervention in the target area. The success measure (denominator) can be used to determine whether or not such a change occurred. If the success measure is negative, then crime in the site decreased, and the researcher can move to looking for displacement or diffusion. If the success measure is positive, crime in the site actually increased over the study period, and there is no theoretical reason to look for displacement of crime.

Interpretation of WDQ results is straightforward. The value of the WDQ is often within or near the range of -1 to 1. Larger values (positive or negative) indicate greater effects. The measure produces a positive score when there is a diffusion of benefits to the buffer area and crime has gone down. Positive values that are less than 1 indicate diffusion, or a positive effect on crime levels in the displacement area, that is smaller than the effect of the intervention in the target area. Values greater than 1 indicate that the positive effects on crime levels were greater in the displacement area than in the target area. A negative score indicates displacement of crime; values between 0 and -1 indicate that displacement did occur, but that the negative effect in the displacement area was less than the positive effect of the intervention in the target area. Values less than -1 indicate that the negative effects (increased crime) to the displacement area were actually greater than the positive effects in the target area.

Although using the WDQ provides a measure of "success" of the intervention, it is important to note that the measure is not a rigorous test of whether the intervention itself significantly contributed to any change in crime. The WDQ can only "suggest" success and examine possible displacement. With careful modeling of the intervention and possible lag times for displacement, time series modeling provides a more appropriate test of the impact of the intervention and a stringent examination of whether displacement occurred. It is very difficult, however, for researchers and practitioners interested in examining displacement to obtain time series crime data for a long period of time for a small neighborhood, and the desire of policy makers to know what works immediately or soon after an intervention is implemented often precludes researchers from using an interrupted time series design. This desire for very timely results makes the WDQ valuable apart from more sophisticated time series analyses.

Time series analysis

Single series ARIMA models The last stage of analysis employed a time series design. To date, few studies examining displacement have used a time series design because time series crime data covering a long period of time are needed to conduct the analysis (for exceptions, see Roman et al., (2005) and Lawton et al., (2005)). That length of data were available for the proposed study. Under this design, an outcome (crime) is observed at equally spaced intervals of time during a span in which some change in the underlying process generating the outcome (i.e., HOPE VI redevelopment) is hypothesized to occur. The series of observations is examined to see if the hypothesized shift in the underlying

process is observable as a shift in the observations. The observations from the period of time prior to the hypothesized change or intervention are treated as a baseline against which the post-intervention observations are compared.

Conventional linear models are inappropriate for use with time series data because those models assume that the data being modeled are independent observations. Time series data, by contrast, are serially dependent, with each observation being a realization of the same underlying process, and perhaps dependent upon the effects of earlier stages of that process. A more appropriate analytic technique with time series data is to estimate an ARIMA model to the time series that yields residuals that are "white noise" (i.e., independently and normally distributed with a mean of zero and constant variance). Intervention variables are typically included; these are usually dichotomous and simply divide the time series into different time periods that identify different stages of an intervention. Many intervention dummy variables denote only two time periods: pre-intervention and post-intervention, but additional dummy variables can be employed to identify more than one stage of the intervention. This research employed at least three intervention dummy variables in each model to identify periods of resident move-out, site construction, and resident move-in. The intervention periods used in each model are discussed as part of the results.

The generic ARMA(p,q) model thus takes the form:

$$Y_t = \alpha + \sum_{p=1}^{P} \beta_p y_{t-p} + \sum_{q=1}^{Q} \gamma_q \epsilon_{t-q} + \epsilon_t \tag{3.2}$$

where the term $\sum_{p=1}^{P} \beta_p y_{t-p}$ is the AR term, β_p is the AR coefficient, $\sum_{q=1}^{Q} \gamma_q \epsilon_{t-q}$ represents the lags of past shocks to the series, and ϵ_t represents the contemporaneous shocks or innovations in the model.

A common threat to the external validity of an interrupted time series design is the possibility that a change other than the hypothesized intervention affected the observed series at the same time that the hypothesized intervention occurred. The effects of the two interventions would then be conflated in the impact estimates. We examined a time series in a control area, an area unaffected by the intervention of interest (i.e., a nearby area with a large public housing development *not* undergoing redevelopment), to help guard against this type of error. For the selected study sites, comparable public housing developments were selected for use as control or comparison area.

Vector Autoregressive models In order to estimate the effects of HOPE VI on the areas surrounding each site—to look for displacement or diffusion effects—we estimated a structural Vector Autoregression (VAR) on three series for each site, expected to be endogenous: the target site, the 1000' buffer, and the 2000' buffer. The VAR model is a simultaneous equations model that has been especially useful in policy analysis applications. This model was selected based on the idea that crime in each site affects the areas immediately surrounding it, and crime in those areas affects crime in the site as well. The structural model takes into account contemporaneous and lagged effects; that is, it accounts for crime happening in nearby areas in the same month and in previous months.

VARs were first introduced in 1980 as a macroeconomic tool used largely for forecasting (Sims, 1980). While a standard time series model has one variable whose future values are predicted based on its previous values alone, VAR models can include any number of linear

variables. Stock and Watson (2001, p. 101) describe a VAR as "a *n*-equation, *n*-variable linear model in which each variable is in turn explained by its own lagged values, plus current and past values of the remaining *n*-1 variables." In developing a VAR model for each site, we used the results of the ARIMA time series analysis (e.g., the selected number of the lags and intervention variables) and modeled the site and each of the two displacement buffers together. The results of the structural VAR allowed us to determine whether the changes in the site via HOPE VI directly and/or indirectly affected crime levels in the displacement areas.

A generic VAR can take the form:

$$AY_t = \beta_0 + \sum_{p=1}^{P} \beta_i Y_{t-i} + \epsilon_t \tag{3.3}$$

where there are k variables in the system and where A is a k x k matrix of contemporaneous impact coefficients that is nondiagonal and where all values on the main diagonal are equal to 1. Y_t is a k x 1 matrix and β_i is a k x k matrix of autoregressive coefficients. ARIMA time series models were estimated using the statistical package R. VAR models were estimated using the statistical package Stata.

The next chapter provides an in-depth description of the sites selected for this study, including the redevelopment timeline for each site and the potential for displacement in each site.

Chapter 4

Research Sites

As stated earlier, five sites were selected from a candidate set of six sites: three in Milwaukee, Wis., and two in Washington, D.C. The candidate sites in each city were those that had been redeveloped using HOPE VI funds since 2000, although researchers later included a non-HOPE VI site in Milwaukee for reasons described below. The three Milwaukee sites were analyzed together due to their close geographic proximity to each other. The sites used for this study were selected based on the timing of the relocation of residents (e.g., some sites sat empty for years prior to redevelopment under HOPE VI), the progress of each site at the start of the current research project, the number of residents residing in the new development at the point of analysis, and the elapsed time since the start of the redevelopment process.

4.1. MILWAUKEE, WISCONSIN

Milwaukee's North Side This research focuses on three redevelopment sites in Milwaukee's North Side. That area of the city, once home to much of the city's middle class, saw significant changes during the 1980s, coinciding with the decline of the manufacturing sector and the rise of the crack cocaine epidemic. In the wake of these changes, these neighborhoods became nearly synonymous with unemployment, poverty, and crime. A series of government initiatives, including Weed and Seed, Gang Resistance Education and Training (GREAT), Safe and Sound, Project Safe Neighborhoods (PSN), and Children's Hospital's Project Ujima, aimed at reducing youth crime, began in the 1990s to combat this problem. These initiatives were reportedly successful in diminishing the presence of traditional gangs on Milwaukee's North Side. However, what remained was an area full of recalcitrant youth, decreased economic opportunities, and a continuing demand for narcotics. Violence was commonplace, as groups continued to vie for territory. The violence, combined with declining housing stock, made the area ripe for redevelopment and it was thus targeted by the Housing Authority of the City of Milwaukee (HACM) for improvement.

HOPE VI in Milwaukee By 2010, HACM had received five HOPE VI grants since the program's inception, the most recent of which was awarded in the 2008 funding cycle. The two most recent HOPE VI redevelopment sites in Milwaukee were targeted for this research, along with one non-HOPE VI site that underwent similar redevelopment and was in the same vicinity as the selected HOPE VI sites. HACM received $19 million for redevelop-

ment of the old Highland Park site (known as Highland Gardens/Highland Homes after redevelopment) in 2002 and $19.5 million in 2003 for redevelopment of scattered public housing sites in the city's Midtown neighborhood. The "scattered sites" consisted of single and multifamily homes (typically limited to two-four units each) located near other public housing redevelopment sites, including Highland Park. These units, however, were fully integrated into the neighborhood, located side-by-side with privately owned homes and spread throughout the neighborhood. The dispersed locations of the scattered sites complicated the analysis in Milwaukee, but these homes were nonetheless included in our analysis.

A third site, Cherry Court, was located within several blocks of the Highland Park site. That site was redeveloped as well, but not with HOPE VI funds. While the research initially focused solely on HOPE VI sites, Cherry Court was ultimately included in the analysis for several reasons: its redevelopment likely would not have taken place at the time it did were it not for the co-occurring, nearby HOPE VI activities; it was redeveloped following the same design principles as used in HOPE VI sites; it served as a base for service provision to residents in the 'scattered sites' redeveloped under HOPE VI, thereby linking it directly to the HOPE VI sites; and it was located very close to the Highland Park site and surrounded by the scattered sites, so it was reasonable to expect that changes at Cherry Court could have affected crime and violence occurring at Highland Park and among the scattered sites.

The redevelopment timeline Research staff visited Milwaukee in March 2008 and interviewed HACM staff members in order to learn more about the redevelopment timeline, residency requirements, changes in the sites, and public safety before and after redevelopment. According to HACM staff, throughout the redevelopment process, the agency made a conscious effort to minimize the burden on residents associated with moving several times. This included making every effort possible to both keep the number of moves for any resident at two (once to move out of older housing and once to move back in to newer housing) and to keep residents in the same neighborhood if they desired. This was possible in Milwaukee because a number of units in the immediate vicinity of the HOPE VI sites were vacant when the HOPE VI awards were made, and because the redevelopment projects there moved very quickly.

Figure 4.1 displays a timeline of events associated with the redevelopment of the all sites studied as part of this project. The Highland Park development was a "superblock" public housing development comprised of two high-rise towers and, on the same lot, 56 family units in barracks-style multifamily buildings. When the HOPE VI award was made for Highland Gardens, only one tower had residents, and it was not full. Families were first moved out of the barracks housing and offered public housing in the same area, if available, or in other parts of the city. The barracks-style units were demolished first, and a new mid-rise building was constructed in its place, named Highland Gardens. When that building was complete, residents were moved to Highland Gardens from both the Highland tower and from the old Cherry Court building. After Highland Gardens was complete, work began on both Highland Homes—newly constructed single family homes on the few blocks surrounding Highland Gardens—and on Cherry Court.

The Highland Homes were designed to foster a mixed-income community, with some homes sold at market rate and others reserved as public housing units (Thomas-Lynn, 2006). Later, work on the scattered sites began, with some units being demolished and completely rebuilt and some undergoing renovation. The locations of those homes were

not changed. Multiple construction projects took place in the neighborhood at once, and within a relatively short period of time, the neighborhood saw drastic changes in its housing stock and in its physical layout and design. The high-rise towers were demolished in 2007. Other physical improvements to the sites included the creation of more green space and the extension of streets that once ended at the edge of Highland Park through the greater Highland development (HACM, 2002). At the end of the study period (early 2010), work was complete on the scattered sites and only a few Highland Homes remained for sale.

Site boundaries In conversations with HACM, project staff also inquired about areas similar to the HOPE VI sites prior to redevelopment in order to identify a suitable comparison area. Identification of the site boundaries proved difficult in Milwaukee. Prior to conducting this research, we searched for all HOPE VI redevelopment sites. That search did not turn up information on Cherry Court in Milwaukee, which was technically not a HOPE VI site. When we gathered more in-depth information about the HOPE VI sites, however, it was clear that Cherry Court could not be excluded from the research. The detailed reasons for Cherry Court's inclusion in this research were outlined above. In addition, if Cherry Court had been excluded, it would have been in the displacement zone for Highland Park and as such would have skewed the results (i.e., we would not expect crime to be displaced *to* another redevelopment site).

The research team considered combining Highland Park and Cherry Court into one large redevelopment site, but still had to identify the site boundaries for the scattered sites project. As that project consisted of houses scattered around the Cherry Court and Highland Park sites, the decision was made to draw a boundary around all scattered sites, including Cherry Court and Highland Park within the site boundary. While this created a very large target site, and not all homes within the boundaries were being redeveloped under HOPE VI (some were privately owned residences), to create three different site boundaries—one for each redevelopment project—would have meant creating displacement zones that overlapped—a design that could not be supported theoretically. Overlapping displacement zones would have meant that the search for displacement would include areas *from* which we expected displacement, and it would have been hard to connect any identified displacement with a specific site.

While we had hoped to look for displacement of crime in other areas to which public housing residents moved during the redevelopment period, we lacked the data to do so in both cities. In Milwaukee, however, most residents did not leave the redevelopment neighborhood. If criminal opportunity in the target site was indeed reduced during the redevelopment process but residents were largely the same before and after redevelopment, we surmised that crimes would move to nearby areas outside the target area. The selected site boundaries contained most of the units among which residents were "shuffled." Therefore, in Milwaukee, we were still able to test for both modes of displacement—with residents to their new addresses or to areas near the site itself—together.

Figure 4.2 is a map of the Milwaukee sites included in this study, including the comparison area, Westlawn. The comparison area was chosen based on recommendations from the HACM of sites with similar housing stock (in this case, barracks-style housing), populations, residency requirements, and crime levels. All HACM staff interviewed pointed to Westlawn as the most appropriate comparison, and our investigation of those same characteristics confirmed the choice. Table 4.1 provides selected socioeconomic measures for 2000, just prior to the start of the HOPE VI awards, for the area containing most of the scattered sites,

Figure 4.1: Redevelopment Timelines for All Five Sites Studied

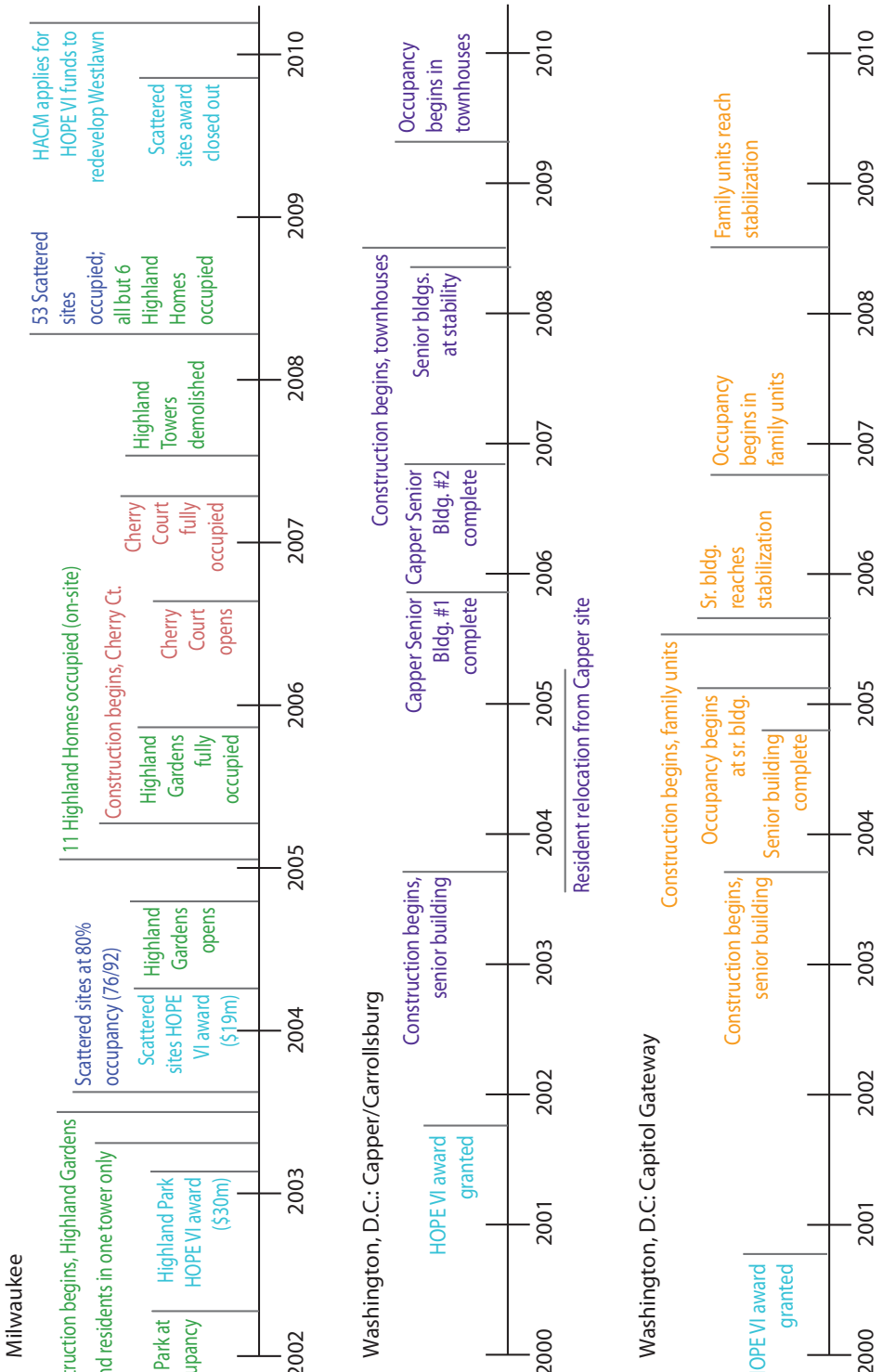


Table 4.1: Milwaukee Socioeconomic Indicators

	Area	
Socioeconomic Indicators, 2000	**HOPE VI Site**	**Westlawn**
Area (sq. miles)	1.62	1.96
Residential population	21,323	19,796
% population 12-17	13.0%	12.3%
% population 18-24	16.1%	9.2%
% population male	47.6%	45.1%
% population Hispanic	4.0%	2.7%
% population black	71.5%	59.7%
% housing units vacant	11.8%	4.1%
% high school graduates ($\geq$25)	57.9%	71.2%
% in labor force ($\geq$16)	56.0%	64.0%
% households receiving public assistance	12.4%	5.9%
% population below poverty level	42.3%	23.2%
All Part I Crimes, 2002 (count)*	3,331	1,943
Violent Crimes, 2002 (count)*	664	418
Property Crimes, 2002 (count)*	2,023	1,158

Source of socioeconomic data: US Census Bureau, 2000.

Source of crime data: Milwaukee Police Department.

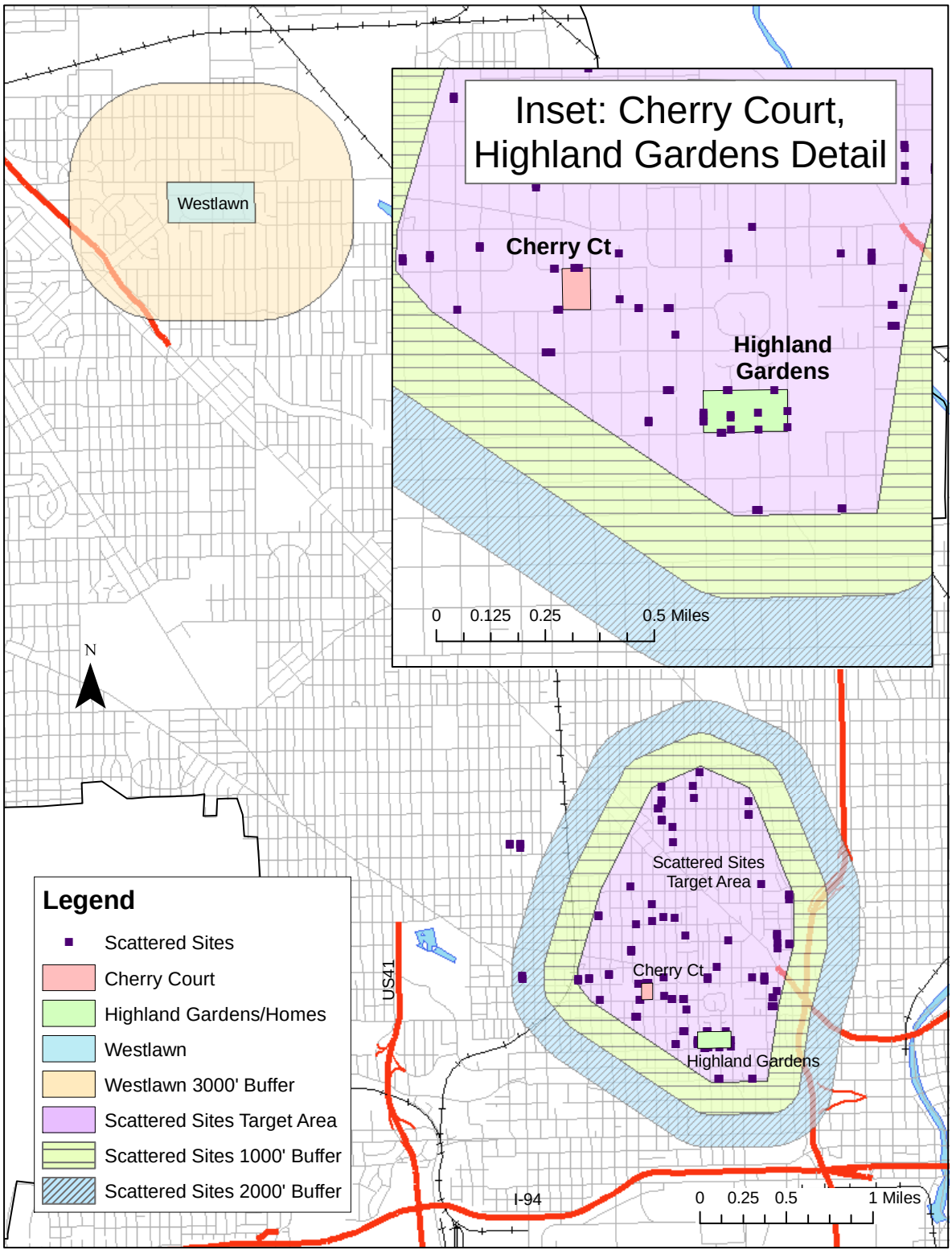
*Crime counts are reported for the Scattered Sites target area and the comparison area (Westlawn plus its 3000' buffer) only, not for larger census blocks used for reporting socioeconomic data.

Highland Gardens, Highland Homes, and Cherry Court, and for the comparison site.[1] The statistics provided are for the block groups containing the sites and thus contain a small amount of area not technically within the site boundaries. The census table reveals that the target area and the comparison area were similar in size, with similar populations: both had majority black populations and a similar proportion of residents between the ages of 12 and 24. The two areas differ somewhat on the economic status of their residents, with the HOPE VI site home to more households receiving public assistance and more residents living below the poverty level. In addition, the HOPE VI site had more crime than the Westlawn comparison area. Overall though, given the comparability on other measures, Westlawn was deemed an appropriate choice for a comparison area.

Residency requirements The residency requirements for the new HOPE VI units were different than for the old units; they were stricter and contained more requirements of residents. Each new site in Milwaukee had a resident council that could establish its own relationship with the police department, establish a neighborhood watch, conduct monthly meetings, address warranty issues with the housing units, and organize other speakers, workshops, or lectures to benefit residents. All residents had to complete a family self-sufficiency plan; participate in the resident council, attending a minimum of six council meetings per year; volunteer eight hours per month if they were not working or in school; and cooperate with management—described as being "willing to snitch" in order to maintain resident safety. In addition, youth had to cooperate with the HACM education specialist, providing report cards and school attendance records for review. Finally, residents of new units were required to complete training on caring for a new

[1]The comparison site actually comprises a 3000' buffer around Westlawn, to accommodate the fact that the scattered sites are spread out, making the target area relatively large.

Figure 4.2: Milwaukee Redevelopment and Comparison Sites



home and were required to pay their own utility bills.

HACM staff reported that many of the same residents displaced from the demolished units were moved into new units. Few residents were pulled from the city's overall housing waiting list in order to fill the new sites because most of the old residents planned on returning to the new units. The income requirements also did not change drastically. Furthermore, families were not shut out of the new residences because of changes in eligibility requirements. Therefore, while some residents of the original site did not meet the new residency requirements or were not interested in the extra education and training that were required of residents of the new units, because the requirements remained similar to those used prior to redevelopment, there was not a significant change in the demographics of the site.

Crime in the HOPE VI sites Research staff interviewed HACM staff members about public safety in the HOPE VI sites prior to and after redevelopment, including staff from the Housing Authority's public safety division. According to staff, before redevelopment took place, the area was densely populated and attracted a lot of "hangers on." There were a significant number of off-lease residents staying in the public housing units despite monthly inspections by HACM. While there was a lot of loitering and youth were involved in delinquent behaviors, there was reportedly limited narcotics activity at the Highland site. In the area surrounding the Highland site (scattered sites), the housing stock was older and break-ins were the major complaint of residents. At the Cherry Court site, however, narcotics were more prevalent and the Cherry Street Mob, a local gang involved in narcotics, was involved in much of the criminal activity in the area. Prior to redevelopment, the police force conducted a sweep at Cherry Court and took out many of the members of that group. Prostitution was also noted in the site prior to redevelopment.

During redevelopment, the HACM did experience some problems with vandalism and petty crimes in and around vacant homes awaiting or undergoing rehabilitation. Following redevelopment, staff reported a significant decline in crime and safety issues in an around the site. These changes in the crime levels in and around the site are the focus of the current research, and the trends, along with any possible displacement of crime or diffusion of benefits, were analyzed and are discussed below.

One trend that should be noted was the significant declines in crime experienced across Milwaukee as a whole at the end of the study period. Part I crimes in the first quarter were down nearly 10 percent over the same quarter in 2009, and down 27 percent over the same quarter in 2007 (Haggerty, 2010). These large crime drops likely had an effect on the levels of crime in the HOPE VI sites, and a measure of success for the redevelopment efforts in terms of crime will be whether crime in the sites dropped over and above the drop registered for the city as a whole. The citywide decreases were accounted for through the use of the comparison area.

4.2. WASHINGTON, D.C.

In the early 1990s, the DCHA was one of the lowest HUD-rated housing authorities, with one-fifth of its units uninhabitable due to lack of upkeep. It was placed into receivership status by a D.C. Superior Court judge in 1994 (Loeb, 2000). By the late 1990s, the authority had turned itself around and had begun revitalizing many of the worst pubic housing

developments in the city. The DCHA has received seven HOPE VI grants since the inception of the program, the most recent of which was awarded in the 2007 funding cycle.

Two HOPE VI sites in Washington, D.C., were selected for this research: the Capitol Gateway site (formerly East Capitol Dwellings and Capitol View Plaza I and II)[2] and the Arthur Capper/Carrollsburg site.[3] In Washington, D.C., site definition was straightforward—the sites had clearly defined boundaries that were used in the current research. The boundaries included the immediate area under redevelopment. This resulted in sites that were much smaller than the Milwaukee site. Figure 4.3 provides a map of the two sites selected for this study and their comparison areas. Two other sites considered in Washington, D.C.—Henson Ridge (formerly Douglass/Stanton Dwellings) and Glenncrest (formerly Eastgate Gardens)—were not included because research staff learned that the sites had been vacant for a number of years prior to the city receiving HOPE VI funds for their redevelopment. The vacancy of the sites predated the crime data available for the District, and thus no analysis could be performed on crime levels while residents were still on site prior to redevelopment.

Research staff interviewed DCHA staff members to get more in-depth information regarding the redevelopment process for both D.C. sites. Two main differences distinguished the Washington, D.C., HOPE VI experience from the Milwaukee experience. First, the redevelopment timeline in D.C. was much longer—it took longer from the time of the award until newly built units were available for move-in. Second, residents were scattered into other available units in the city—while many received vouchers for other housing, including non-public housing, because of the tight rental market at the time in Washington, D.C., many residents were forced to move into other public housing (Popkin et al., 2002). This meant that residents were moved to completely new areas of the city, in new neighborhoods.

In D.C., the research team was not able to obtain information on where residents were relocated. We were thus unable to identify possible displacement zones that were non-contiguous to the HOPE VI sites but that housed a large number of displaced HOPE VI residents. The long timeline further meant that many residents had already established themselves in the new neighborhoods and had lived there for several years by the time new units were available. By that time, many did not want to move back to their previous neighborhoods even though they had been redeveloped. In D.C., then, fewer residents of the new housing were residents of the sites before redevelopment. In Milwaukee, because the timeline was shorter and residents remained in the same neighborhood while they waited for the new housing to become available, many original residents occupied the new housing.

4.2.1. Capitol Gateway

In August 2000, DCHA received $30.8 million to redevelop the East Capitol Dwellings/Capitol View Plaza site, located on the border of the northeast and southeast quadrants. The site sat on East Capitol Street, a major thoroughfare into the District from Prince George's County, and was adjacent to a metro stop, just across the District border. The 577-unit barracks style housing was built in 1955 and was 30 percent vacant at the time of the HOPE VI application in 2000 (DCHA, 2000). The adjacent Capitol Plaza site consisted of two high-rise buildings,

[2]While this site was renamed as part of the development, this report will refer to the site both pre- and post-development as Capitol Gateway (its post-development name) to reduce confusion among readers.

[3]While the full name of this site is "Arthur Capper", in the text it will simply be referred to as "Capper."

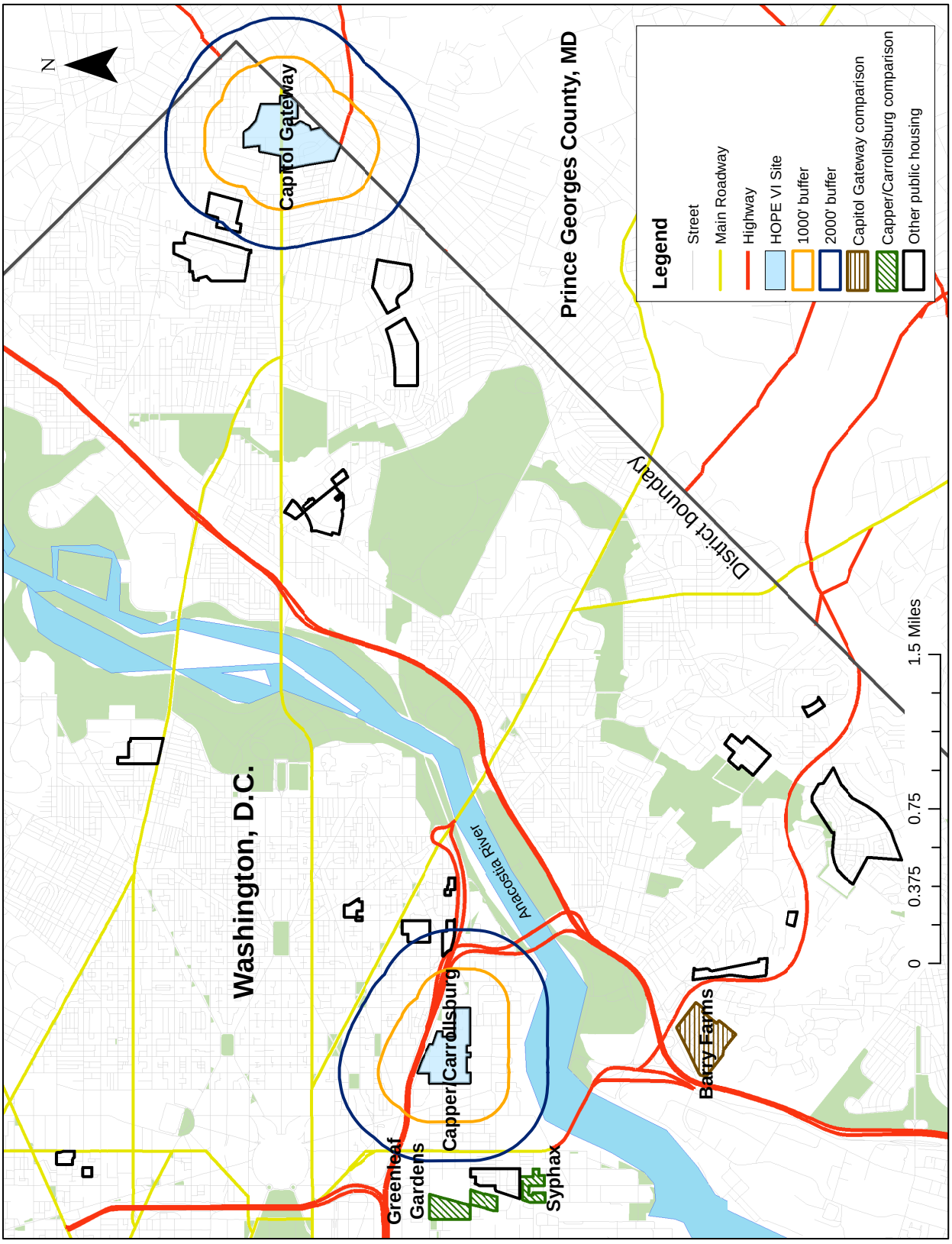


Figure 4.3: Washington, D.C. Redevelopment and Comparison Sites

with units in one building reserved for seniors. In addition to the deteriorating physical conditions of the building, the layout of the site contributed to public safety problems: buildings were isolated from the rest of the neighborhood, and winding streets and open spaces created locations on the interior of the site that were hard to police and provided convenient escape routes for criminals (DCHA, 2000). Drug use was also rampant (Popkin et al., 2002).

While homicides in public housing were dropping throughout Washington, D.C., in the late 1990s, homicides at East Capitol actually increased in 1998, contributing to the site's reputation as one of the most dangerous in the District. The well-publicized shooting death in July 1999 of a grandmother who lived at East Capitol and was shielding children from gunfire provoked public outcry about the lack of safety in some of the city's public housing developments, and reignited the DCHA's desire to renovate the East Capitol site in particular (Chan, 1999). The summer of the shooting, the receiver in charge of DCHA ordered near-constant police presence at the site to address safety issues, and the Authority shortly afterwards applied for HOPE VI funds to redevelop the site completely (Chan, 1999).

Figure 4.1 displays the timeline of redevelopment events for the Capitol Gateway site starting with the HOPE VI award in 2000. Resident relocation at Capitol Gateway began shortly after the award to DCHA was made and continued for approximately two years. During this time, an East Capitol Community and Supportive Services (CSS) Program was established to assist residents with relocation. CSS case managers also provided assistance to residents in finding employment, getting drug and alcohol treatment, improving their educational attainment, and accessing other services that might be required. Part of the goal was to help residents meet the move-in requirements for the new site. The senior building was constructed first, with move-in starting in February 2005. Family units, made up largely of townhouses, were open for occupancy beginning in September 2006. The new sites were designed to have no unit access through common areas—all access to units was from the outside. In addition, extensive lighting was put in, a small toddler playground was built, and the site did *not* include large outdoor areas for residents to congregate, such as a basketball court, to discourage loitering.

Table 4.2 provides socioeconomic indicators for the two D.C. sites and their comparison areas. The statistics provided are for the block groups of the sites as a whole and not for just the sites themselves. Nearly one-fifth of the population at Capitol Gateway was between the ages of 12 and 24 in 2000, and almost all were black. Less than half had earned at least a high school diploma and less than half were in the labor force. Nearly one-fifth of households were receiving public assistance and at least 40 percent were living below the poverty level. The comparison site, Barry Farms, was selected based on input from the DCHA to match the former East Capitol site. Barry Farms was considered based on the size of development, the characteristics of its residents, and the crime levels of the site and surrounding area. The Census data reveal that Barry Farms was similar to East Capitol in being home to a large young, black population. The poverty indicators suggested that Barry Farms was more economically disadvantaged than East Capitol and, given the size of the population, had higher crime levels than East Capitol.

In the search for a suitable comparison area, however, the research team focused on sites that were in the same area of the city as the East Capitol/Capitol Gateway development, but far enough away so as to limit the possibility that the comparison area could be "contaminated" by the HOPE VI efforts in the target site (i.e., a nearby site might also benefit from HOPE VI, skewing the statistical results). By this criterion, Lincoln Heights Dwellings and Richardson Dwellings were excluded—both are located very close to the

Table 4.2: Washington, D.C., Socioeconomic Indicators

Socioeconomic Indicators, 2000	Area			
	Capitol Gateway	Barry Farms	Capper/ Carrollsburg	Syphax/ Greenleaf
Area (sq. miles)	0.1	0.05	0.06	0.04
Residential population	3,839	1,796	1,853	1,958
% population 12-17	10.6%	15.3%	10.9%	7.6%
% population 18-24	8.6%	14.0%	9.8%	8.3%
% population male	45.3%	42.3%	45.6%	39.7%
% population Hispanic	0.6%	1.1%	0.0%	1.2%
% population black	97.0%	97.1%	97.1%	94.4%
% housing units vacant	32.6%	5.1%	6.7%	6.4%
% high school graduates ($\geq$25)	44.9%	49.2%	59.1%	57.7%
% in labor force ($\geq$16)	45.0%	38.0%	35.0%	37.0%
% households receiving public assistance	18.5%	38.8%	12.9%	16.9%
% population below poverty level	41.7%	73.5%	61.8%	53.4%
All Part I Crimes, 2000 (count)*	141	89	98	127
Violent Crimes, 2000 (count)*	58	48	45	62
Property Crimes, 2000 (count)*	83	41	53	65

Source of socioeconomic data: US Census Bureau, 2000.

Source of crime data: Metropolitan Police Department (DC).

*Crimes reported for the target/comparison areas only; not for larger census blocks used for reporting socioeconomic data.

Capitol Heights site. Other sites on the eastern side of Washington, D.C., were undergoing redevelopment (e.g., Glenncrest, Henson Ridge) or were less similar to Capitol Gateway than Barry Farms. Because we lacked data on residents' addresses after relocation, it is possible that at least some residents from East Capitol moved to Barry Farms. It was equally likely, however, that equal numbers of residents moved to other possible comparison areas; with incomplete information on residents, we were not able to assess whether Barry Farms or other potential comparison areas received former East Capitol residents. For those reasons, the research team, with guidance from DCHA, selected Barry Farms as the comparison site for Capitol Gateway.

4.2.2. Capper/Carrollsburg

The Arthur Capper/Carrollsburg site, part of which dates to 1958, was located in the city's southeast quadrant (Dupree, 2007). The site is separated from the rest of the city by the Southeast Freeway, which runs near the northern part of the site and on the other side of which is the economically better-off Capitol Hill section of the city. The site consisted of barracks-style housing and a high-rise for seniors. The site became a haven for drugs and crime, and efforts to renovate it in the 1970s did not solve the crime problem. In 2000, the neighborhood that was home to Capper/Carrollsburg had one of the lowest median income levels in the city (Wilgoren, 2003).

In 2001, DCHA was awarded $34.9 million to redevelop the Arthur Capper/Carrollsburg site. At that point, city officials and developers had already started to direct redevelopment funds and plans toward the so-called "Near Southeast" but little redevelopment had yet taken place. Three years later, the Washington Nationals decided to locate their new baseball stadium in the neighborhood, and new federal buildings had already been constructed in the area. The HOPE VI redevelopment was just one part of a larger revitalization of the neighborhood.

Figure 4.1 displays the timeline of redevelopment events for the Capper/Carrollsburg site starting with the HOPE VI award.[4] Redevelopment of the Capper/Carrollsburg site took the longest of the sites considered for this project. The plan included a one-to-one replacement of public housing units; for every unit demolished, a new one would be built. A CSS program was also established for the site to assist residents with the relocation process.

Phase I of resident move out of the barracks-style units started in 2003. Residents were moved from old senior buildings directly into the new ones, and one of the old senior buildings was the last to be demolished. The site was demolished piece by piece, as new units were built and began to be occupied. The new site contained a number of different elements, including townhouses and two mid-rise senior buildings. The senior buildings were the first to be finished and occupied, with construction on the townhomes following. At the end of the study period (end of 2009), occupancy had begun at the townhomes but units were still available for sale. Demand for the townhomes was high, as newly constructed homes available in close proximity to Capitol Hill were very attractive to many buyers. Some of the townhomes were sold at market-rate prices, but because of their location, they were lower in price than similar townhouses in different neighborhoods of the city, making their demand even higher.

During interviews with DCHA staff, the research team learned that at Capper/Carrollsburg, drug offenses in particular stayed local even through the redevelopment process. The perception of staff familiar with the area was that drug dealers simply moved a few blocks away from the redevelopment site to continue their existing drug markets. This makes sense in light of the fact that the site is located next to a highway, providing potential drug customers with an easy entry/exit point to drug markets/dealers in the area. This supports the idea of looking for immediate displacement around the site, and while this phenomenon was not identified specifically in Milwaukee or for Capitol Gateway, there was a strong likelihood that any drug markets in those two sites followed similar patterns—both are located near major thoroughfares or highways, which would contribute to keeping drug markets in the same vicinity as the sites themselves.

Table 4.2 provides socioeconomic indicators for the neighborhoods of the Capper/ Carrollsburg site and its comparison area, Syphax/Greenleaf Gardens. The comparison site was selected based on recommendations from DCHA staff, and the two sites were very similar on the selected measures shown here in 2000, prior to the HOPE VI award. The neighborhoods containing the sites each had just under 2,000 residents, with 15 to 20 percent of the population in each between the ages of 12 and 24. The sites both had majority black populations, had similar vacancy rates in 2000, and were well matched on economic measures as well. The socioeconomic indicators and the similarity in units available indicate that the selection of Syphax/Greenleaf was an appropriate one.

The next chapter presents the results of each of the three methodologies by site; the Milwaukee results are presented first, followed by results for each of the Washington, D.C., sites.

[4]It should be noted that much of the information collected about the Capper/Carrollsburg site and timeline came from http://www.jdland.com. That website is maintained by a resident of the area who has been documenting the changes in the Near Southeast since 2003, and who is known well by the DCHA. In fact, some DCHA staff members recommended that project staff visit the site for more detailed information about the changes that had taken place since the HOPE VI awards.

Chapter 5

Results: Milwaukee

The first step in analyzing the HOPE VI redevelopment sites for displacement or diffusion was to examine the change in crime levels before and after the redevelopment efforts. Figure 5.1 displays the same redevelopment timeline presented above and includes line graphs of all crime in the four main study areas (the site, two displacement buffers, and comparison area—Westlawn and its 3000' buffer). The figure also includes dotted lines that delineate the different study periods selected by the research team and explained in more detail below in Section 5.3. The timeline suggests that crime in the site and two displacement areas dropped throughout the study period, from 2002 through 2010. Crime in the comparison area remained relatively stable over the same period.

The timeline demonstrates the long nature of the intervention period—the period during which the site was redeveloped. It also highlights the fact that it is hard to identify a specific date on which the intervention started or ended. Because of this, the analyses presented below use varying lengths of pre- and post-intervention periods. The intervention periods, however, generally center around the period of September 2003 through November 2004, roughly the period of construction on Highland Gardens. Even though significant construction on Cherry Court and the scattered sites homes continued after Highland Gardens was finished, this period was chosen based on the idea that once one project within the larger target area was finished and began occupancy, the influence of that redevelopment would start to be felt throughout the site, as residents became more aware and convinced of the changes that were taking place in their neighborhood. The specific dates used as interventions are specified with each analysis.

Figure 5.2 provides crime density maps for four selected years in the study period: 2003, 2005, 2007, and 2009. The density maps were created using data covering a one-mile radius around the site in order to capture any hot spots that might be occurring nearby but just outside the site boundaries. These maps were used purely for descriptive purposes, to provide an indication of the changes that took place in each site. The maps were not used as part of any statistical analyses, nor were they used alone to draw firm conclusions regarding the changing crime patterns in and around the study sites. The maps reveal that the density of crime inside the site appears to lessen with time. Hot spots outside the site boundaries, especially to the south, remain in place, although they do lessen somewhat with time as well.

This examination of crime patterns reveals that crime decreased in the site following redevelopment activities, and that a search for possible displacement and diffusion was appropriate. The actual decrease in crime was quantified via the WDQ and time series

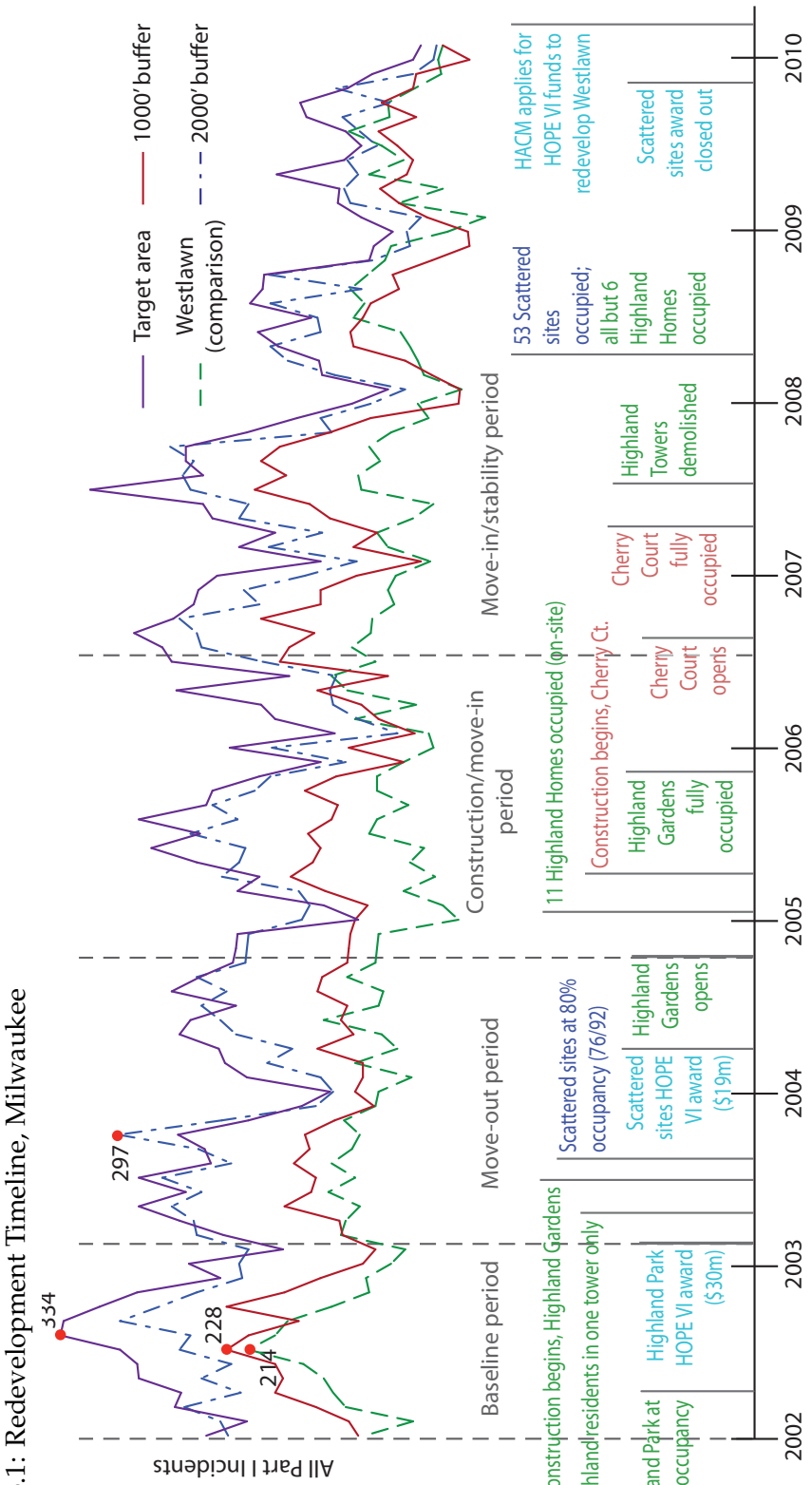


Figure 5.1: Redevelopment Timeline, Milwaukee

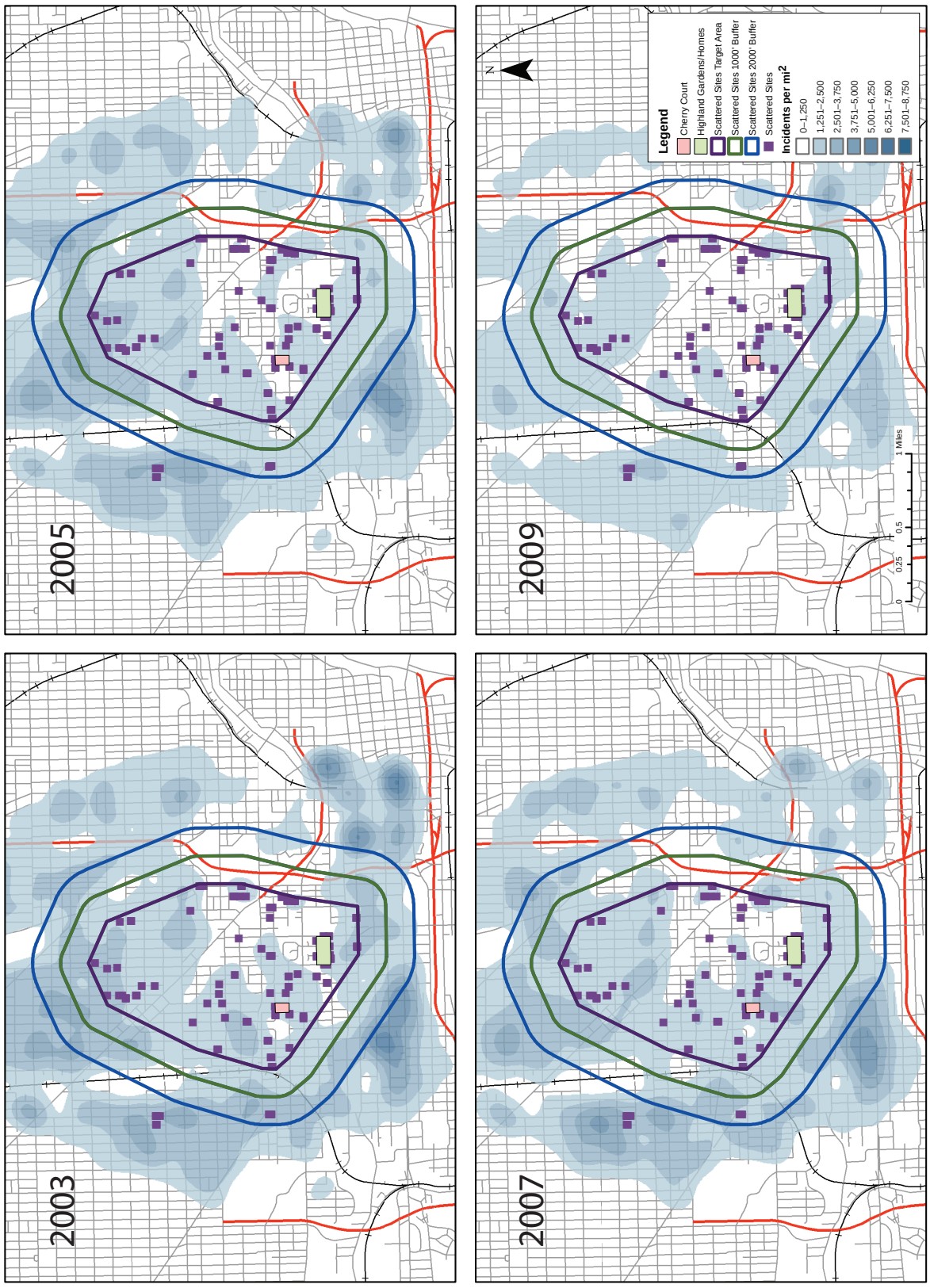


Figure 5.2: Density of Crime Over Time, Milwaukee

analyses, presented below. First, however, we conducted the point pattern analysis, the least restrictive method in terms of identifying a location in which to look for displacement, and a method described by Ratcliffe (2005) as an intermediate one, between first identifying a drop in crime in a target area following an intervention and more rigorous searches for displacement in specific locations.

5.1. POINT PATTERN ANALYSIS

We expected that in Milwaukee, point pattern analysis would be the most appropriate method for identifying possible displacement of crime that might have occurred. This was based on three reasons: the target area in Milwaukee covered a large area; residents were shuffled around within the site throughout the redevelopment period; and there were multiple redevelopment projects within the site boundaries, making it hard to identify specific target and displacement areas. Point pattern analysis was used to determine whether the pattern of crimes in the areas within and around the site changed, and the area examined for this analysis was the area within one mile of the site boundaries. Using a one-mile radius around the target area allowed us to capture any changes that occurred either within the target area boundaries or within a close distance of the boundaries; had we only used the target area itself, we would not have captured any crime displacement from the target site to just beyond its borders that might have occurred.

The point pattern analysis started with the identification of time periods and crime types to use for analysis. Because the redevelopment timeline was long, yearlong intervals were used as the pre- and post-intervention periods, comparing all crimes that occurred over one year before the redevelopment started to crimes that occurred in another full year, either during or after redevelopment. Table 5.1 provides each year that was used in the analysis and the number of crimes (all crimes and personal crimes) that occurred in the one-mile buffer area during that period. The number of crimes that occurred in the site over a year period was quite high, and the crimes covered the site quite densely. We feared that such a dense pattern of crimes would mask any changes in the spatial patterns, and the decision was made to focus only on personal crimes in Milwaukee, so that fewer crimes were included in the analysis.

Next, random point distributions were generated. First an appropriate number of points had to be selected. A higher number of points might have created a pattern across the study area that was too regular and might miss changes in the pattern that followed a regular—but different—pattern as well. Too few points, however, would mean fewer degrees of freedom when calculating significance of the correlation coefficients. Because of the large number of crime points in the target area even after restricting the analysis to personal crimes only, we started with random point distributions of 200 points each. Ratcliffe (2005), however, suggested that different numbers of random points could be used, so researchers tested distributions with different numbers of random points each, including 25 points, 50 points, 100 points, and 200 points. The results revealed that the mean correlation derived from the comparison of crime patterns in different years was very similar regardless of the number of points used, and the significance levels also did not change. Thus, only the results from the analyses using 200 random points are presented here.

With each number of random points (25, 50, 100, 200), the point pattern process was repeated 100 times, providing 100 different correlation coefficients for each possible combi-

Table 5.1: Reported Crimes in Study Area for Selected Years, Milwaukee

Year	Reported Crimes	
	All crimes	Personal crimes
2003	18,712	2,941
2005	16,869	2,548
2007	16,801	3,196
2009	11,805	2,992

Table 5.2: Mean Correlation Coefficients for All Year Combinations, Milwaukee

	2005	2007	2009
2003	0.60**	0.60**	0.60**
2005		0.61**	0.62**
2007			0.61**

$^{**}p < 0.05$

nation of years examined. The skew and kurtosis of each set of 100 correlation coefficients was examined, and both measures were below one for all possible year and random point number combinations examined. Table 5.2 provides the mean correlation coefficients between crime patterns for each year combination examined using random point distributions of 200 points each. Coefficients for all year combinations were highly significant and positive. This indicates that the spatial pattern of crimes did not change significantly across the study period.

It should be noted that the point pattern analysis only reveals changes in the pattern; if crime drops significantly but the pattern itself doesn't change, the point pattern results should indicate a positive and significant correlation. Therefore, while crime did drop in the target area, this analysis suggested that it did not move to other areas, indicating that displacement did not take place. The point pattern analysis is not well equipped to identify areas of potential diffusion of crime because of the fact that it doesn't look for drops in crime, only changes in the pattern. Diffusion of benefits is not necessarily associated with a change in the pattern of crimes, only with a decrease in crime in an area next to one receiving an intervention.

5.2. WEIGHTED DISPLACEMENT QUOTIENT

While the point pattern analysis suggested that there was no change in the spatial pattern of crimes and that displacement did not occur, the research team aimed to compare different methodologies for studying the same phenomenon and thus employed two other analysis techniques. The next technique tested was the WDQ.

The first step in the WDQ was to define time periods during which to look for displacement. We calculated the WDQ using several different sets of pre- and post-intervention time periods, and looked for displacement during the intervention as well. The intervention period used was September 2003 through November 2004, as discussed above. The WDQ is restrictive in its need for pre- and during/post-intervention periods to be of the same

Table 5.3: Weighted Displacement Quotient Results, Milwaukee

Pre/post length	t_0 (Pre-period)	t_1 (Intervention or post-period)	Type of crime	Success measure	WDQ	
					1000'	2000'
12 mo.	09/2002-08/2003	12/2004-11/2005	All	0.203	-	-
			Personal	0.012	-	-
			Property	-0.189	0.308	1.331
15 mo.	05/2002-08/2003	12/2004-03/2006	All	0.222	-	-
			Personal	-0.044	-0.396	-1.423
			Property	-0.129	0.288	1.549
15 mo.*	05/2002-08/2003	09/2003-11/2004	All	-0.048	0.124	-0.680
			Personal	0.036	-	-
			Property	-0.126	0.090	0.160
18 mo.	03/2002-08/2003	12/2004-05/2006	All	0.171	-	-
			Personal	-0.059	0.105	-0.018
			Property	-0.167	0.535	1.647

Note: Intervention period: 09/2003-11/2004
*Searched for displacement during intervention period.

length. Therefore, the timing of the intervention relative to the start of the period covered by the data can affect the length of the periods examined for displacement. In Milwaukee, the intervention began in September 2003, only 20 months after the start of our period of data coverage (January 2002). Therefore, we could not calculate the WDQ using pre- or post-intervention periods longer than 20 months. We calculated the WDQ for four different time periods, specified in Table 5.3: 12 months pre- and post-intervention; 15 months pre- and post-intervention; 15 months pre-intervention and the 15 months during the intervention itself; and 18 months pre- and post-intervention. The WDQ was also calculated for all crime, personal crime and property crime.

We also searched for displacement using two different buffers: a 1000' buffer and a 2000' buffer. The buffers were drawn to be mutually exclusive; the areas of the two do not overlap. This was done so that we could compare what was happening in either buffer without the results in either one being suppressed by what was going on in the other; for example, the 2000' buffer itself might not experience much change. If it contained, however, all of the 1000' buffer and there was significant change in the 1000' buffer, the calculations for the 2000' buffer might provide significant results. Those results would be due to activity mainly in the 1000' buffer, leading researchers to mistakenly conclude that there was an effect in the 2000' buffer that was independent from the 1000' buffer effects.

Table 5.3 provides the WDQ for each of the time periods and buffers considered. The table also provides the success measure, or the denominator of the WDQ. This figure indicates whether crime decreased in the area over the period of interest. If the success measure was positive, crime increased over the period and a search for displacement or diffusion was not warranted. The WDQ was thus not reported for those periods/areas for which the success measure was positive. The table highlights those periods/areas where displacement or diffusion were found to be larger than the direct effects in the target area (i.e., they were greater than 1 or less than -1).

In Milwaukee, for all crimes and personal crimes, the WDQ results were mixed, but for property crimes, a diffusion of benefits apparently occurred. In the "all crimes" category, for only one set of time periods studied—the 15-month pre-period and the 15-month intervention period—was the success measure negative, indicating a drop in crime in the target area over the time period of interest. In that period in the 1000' buffer, the WDQ was positive but less than one, indicating that diffusion did take place, but it was less than the effect in the redevelopment site. In the 2000' buffer during that time period, however, the

WDQ was negative but greater than -1, indicating that a small amount of displacement may have occurred. It should be noted that all success measures for the "all crimes" category (whether positive or negative) were close to zero, indicating very small increases in crime over the period.

For personal crimes, the success measure was positive in two of the time periods searched. For the 15-month pre- and post-intervention periods, the WDQ was negative in both buffer areas. For the 2000' buffer, it was less than -1, indicating that displacement did occur, and that the increase in personal crime in the 2000' buffer was greater than the decrease in the target area itself. For the 18-month pre- and post-intervention periods, both WDQs were close to zero, indicating that little to no change occurred in either buffer area.

For property crime, the WDQ indicated that a diffusion of benefits from the redevelopment site to the area within 2000 feet of the site took place, and those benefits were about equal to the direct effects of the redevelopment in the site itself (i.e., the value of the WDQ was near one). This was true for all but one set of time periods studied: the 15-month pre-period and the 15-month intervention period, for which the WDQ was near zero, indicating little to no change in crime occurred in the buffer area.

To summarize, the WDQ effort in Milwaukee had mixed results, with "all crimes" and personal crimes showing either no change or some signs of a minor amount of crime displacement. For property crimes, however, a diffusion of benefits was suggested with this methodology. For all crime types and all sets of time periods analyzed, the results were strongest in the 2000' buffer.

5.3. TIME SERIES ANALYSIS

Single series ARIMA model The first step in the time series analysis was to analyze the effects of the intervention in the redevelopment site alone in order to confirm and quantify the decrease in crime that was identified through descriptive means outlined above. The first step in developing an ARIMA model was to specify the appropriate lag structure. In order to do this, we examined four monthly crime series of interest, looking at data for "all crimes": the redevelopment site, the 1000' and 2000' buffers, and the comparison area (Westlawn and its 3000' buffer). Augmented Dickey-Fuller tests indicated that all four series were stationary. Initial investigations indicated that crime decreased significantly over the study period in the *comparison* area. To account for this drop in the comparison area, we decided to model the difference in crime between the target and the comparison areas. The differenced variable (the difference between the target and comparison areas) was used in order to account for the crime levels in the comparison area in a single series ARIMA model. Had we not used a differenced variable, we risked overestimation of the intervention effects relative to the comparison effects.

We next estimated the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) to determine the appropriate lag structure of the differenced crime measure for the target area. Using standard fit indices and diagnostics to evaluate possible model specifications once the lag structure was determined, we found that an AR(2) model was most appropriate, or an autoregressive model with twi lags.[1]

The original series of monthly crime in the redevelopment site and in the comparison site were tested for seasonality. While a strong seasonal trend was found, the actual model specification did not require a seasonal term. This was because the variable that was actu-

[1]The first lag is crime one month prior and the second lag is crime two months prior.

Table 5.4: Impact of Redevelopment of Highland Park, Cherry Court, and Scattered Sites: Results of ARIMA Model for All Crime

	All crime	
	b	*S.E.*
Constant	113.07*	9.93
Autoregressive lag 1	0.23*	0.10
Autoregressive lag 2	0.05	0.10
Move-out period	-17.16	18.87
Monthly Δ, move-out period	-0.01	1.38
Construction period	-8.54	18.86
Monthly Δ, construction period	-0.41	1.21
Stability period	17.31	15.34
Monthly Δ, stability period	-2.72*	0.47

Dependent variable: Difference between crime at target and comparison sites

log likelihood = -464.32; AIC = 948.63

*$p < 0.05$

ally modeled was the differenced variable (i.e., difference between target and comparison areas), and because the target and comparison area series had the same seasonality trends, those trends were "washed out" in the differenced variable.

The model thus included two lags for the monthly difference between the target and comparison area and three dummy variables. Those dummy variables were included to delineate different time periods in the redevelopment timeline. The four periods were:

Baseline, or pre-intervention: January 2002–January 2003

Move-out: February 2003–September 2004

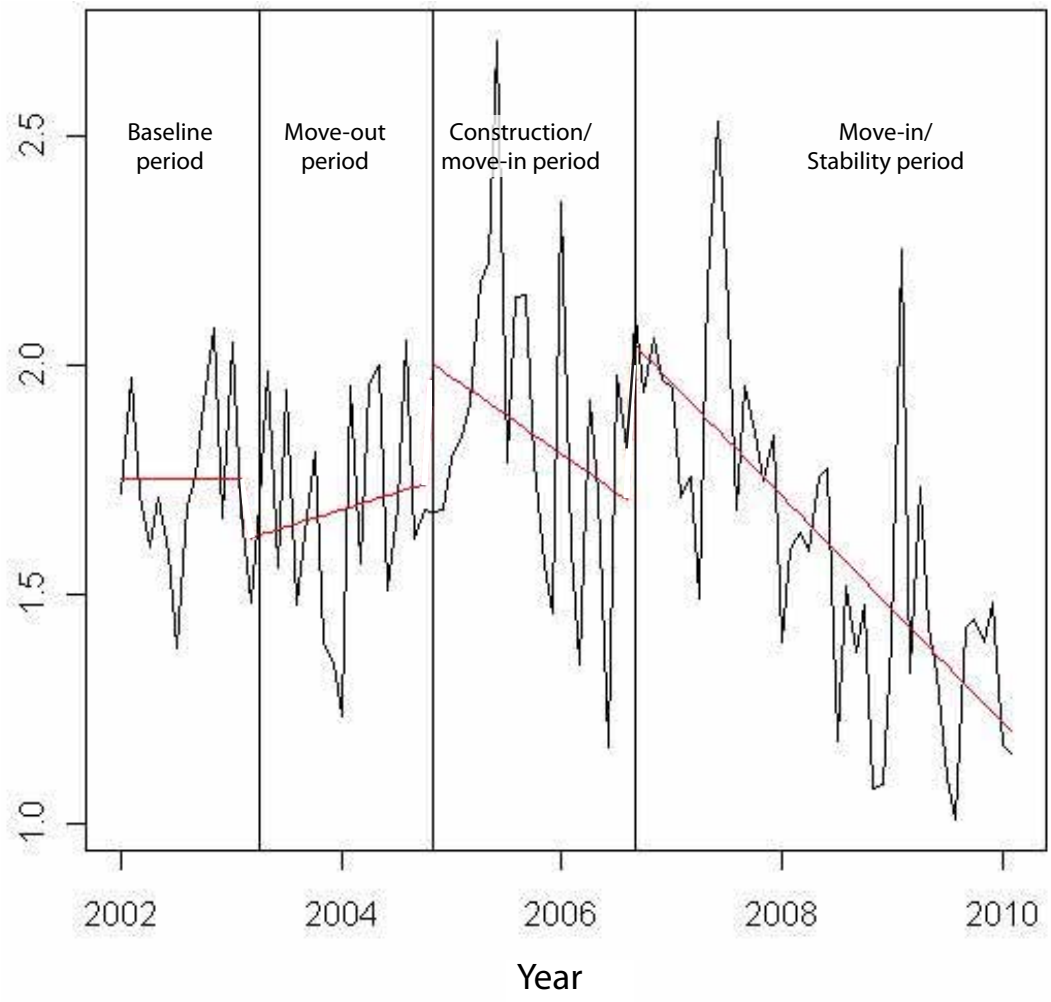
Construction/move-in: October 2004–July 2006

Move-in/stability: August 2006–February 2010

Also included in the model were dummy variables that identified the change in monthly crime levels during each specific period. These variables were included because from an examination of the trends in each area over the study period, it was clear that the effects of the intervention changed over time; that is, the effect of the intervention was not constant across all periods. The coefficients on the change-over-time variables identified any additional increase or decrease in crime that occurred during that time period, over and above the average monthly change specified by the coefficient on the intervention variables. If the coefficient on the change-over-time variable was near zero, then the rate of change from month to month during that period was the same (e.g., crime might have consistently dropped two crimes per month during the construction period). If the coefficient is significantly different from zero, it indicates how many additional crimes occurred (or did not occur) each month as the time period progressed (e.g., if the coefficient is -2, that indicates that every month, two fewer crimes occurred than in the previous month).

Table 5.4 shows the results of the model estimation using these three intervention dummies in an autoregressive model with two lags. Only two coefficients, the first AR

Figure 5.3: Monthly difference in crime between target and comparison areas and average month-to-month change for each time period, Milwaukee



lag and the coefficient for the change in crime over time during the stability period, were significant at the $p<0.05$ level. The significance of the lag coefficient is not important, as its value is close to zero. The significance of the coefficient for the monthly change-over-time variable for the stability period indicated that the program had little to no effect until after redevelopment had taken place and most residents had moved into new units. After that point, during the stability period, the area saw crime lowered every month by 2.7 reported crimes. This is demonstrated graphically in Figure 5.3, which shows the differenced crime measure and the average month-to-month change during each time period. These results are rather difficult to interpret; because of the long delay in effects identified by this model, it is hard to confidently connect those effects with the intervention itself. Instead, the changes might be the result of independent forces that were not associated with the intervention.

In order to test the sensitivity of the results to changes in measures, we also estimated the model using a ratio of crimes in the redevelopment site to crimes in the comparison site. This exercise yielded very similar results to those reported above using differences between redevelopment site and comparison area, indicating that the results were not very sensitive to changes in the type of crime measure used in the model.

Table 5.5: Impact of Redevelopment of Highland Park, Cherry Court, and Scattered Sites: Results of Structural VAR Models for All Crime

	Target Area		1000' Buffer		2000' Buffer	
	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err
Constant	127.46 **	29.42	67.48 **	21.10	78.17 **	27.95
Target area (no lag)	-	-	0.48 **	0.05	0.44 **	0.09
AR Lag 1, Target area	0.17	0.15	0.05	0.11	0.27 *	0.14
AR Lag 2, Target area	0.15	0.15	0.06	0.11	0.07	0.14
1000' buffer (no lag)	-	-	-	-	0.40 **	0.13
AR Lag 1, 1000' buffer	0.54 **	0.20	0.41 **	0.14	0.23	0.19
AR Lag 2, 1000' buffer	0.08	0.20	0.00	0.14	-0.15	0.19
AR Lag 1, 2000' buffer	0.05	0.15	0.16	0.10	0.16	0.14
AR Lag 2, 2000' buffer	-0.29 **	0.14	-0.11	0.10	0.07	0.13
Move-out period	-12.62	11.55	-9.18	8.28	4.67	10.97
Construction period	-26.86 **	11.82	-7.86	8.48	-13.69	11.23
Stability period	12.52	33.27	-6.71	23.86	-3.39	31.61
Monthly Δ, stability period	-1.48 **	0.47	-0.66 *	0.34	-0.99 **	0.45
R-square	0.70		0.67		0.69	

N=96 *p<0.10, **p<0.05

VAR The next step was to use appropriate time series methods to test for displacement or diffusion in buffer areas surrounding the redevelopment site. To do this, we estimated a structural VAR using three series: the redevelopment site, the 1000′ buffer, and the 2000′ buffer. Using the results from the single series ARIMA above, we modeled all three series together with two lags, all three intervention dummies, and the change-over-time variable for the move-in/stability period only, as it was the only change over time variable that was significant in the ARIMA model.

The VAR model here had six possible directional effects: the effect of the redevelopment site on each buffer area, each buffer area on the target site, and each buffer area on the other buffer. Estimation of the *contemporaneous* VAR models requires setting the value of some effects prior to modeling; otherwise the number of unknowns is too high and estimation of all coefficients is not possible. Because we were only interested in "outward" effects—the possible movement of crime outward from the redevelopment site to either buffer area, or from the 1000′ foot buffer to the 2000′ buffer—we set the effects of both buffers on the redevelopment site and the 2000′ buffer on the 1000′ buffer (the "inwards" directional effects) to zero. We therefore only estimated the contemporaneous effects of the target on both buffers and the 1000′ buffer on the 2000′ buffer (lagged effects were estimated in the inward and outward direction). The VAR results presented here include the parameter estimates for both the lagged and the contemporaneous (no lag) effects (Table 5.5).

The VAR results for the target area were similar to those from the single series ARIMA model. The model shows a significantly lower level of crime in the construction period than in the baseline period. While the model results indicate that crime is significantly higher in the stability period—after residents have moved back in—the significance of the monthly change in the stability period indicates that crime is still decreasing after residents have moved in, by about 1.5 crimes per month.

The results for the 1000′ and 2000′ buffers measure the direct and indirect effects of intervention on each of those buffers. The significance of the contemporaneous (no lag) target area term on both buffers indicates that changes in the target area indirectly affected both buffers, albeit to a relatively small degree. In other words, when crime went down in the target area, crime also went down in the buffer areas. While lagged crime in the target

area did not have a significant effect on the 1000' buffer, it was significantly and positively related to crime in the 2000' buffer. The 1000' buffer did not have any significant effects on the 2000' buffer.

The direct effects of the intervention on the buffer areas were measured via the time period dummy variables in the two buffer models. In both buffers, only the "monthly change over the stability period" term was significant, but it was very small in each model. This indicates that, as in the target area, the effects of the intervention were delayed but grew with time toward the end of the study period. The intervention's strongest effects, though, were felt in the target area.

The positive indirect effects identified through the model were an indication that diffusion of benefits took place. The model also identified a small but direct positive effect of the intervention on the buffers, one not mediated through the target area. In addition, as with the target area, the VAR model indicated that the effects on the buffer areas were delayed and built over time during the second half of the study period. This result indicates again that the intervention became more effective over time.

5.4. CONCLUSION

The three methodologies applied in the Milwaukee case presented mixed results. The point pattern analysis indicated that there was no change in the pattern of crimes prior to redevelopment to any period afterwards. The WDQ provided more specific, but somewhat unexpected, results. All of the success measures, whether positive or negative, were close to zero, indicating that little change in the target area had taken place over the period. The "all crimes" and "personal crimes" categories showed some minor evidence of displacement, but because the drop in those crimes in the target area was small, the amount of displacement was small as well. The analysis of property crimes indicated that there was a diffusion of benefits, and that the decrease in the number of property crimes in the buffer area was about equal to the decrease in the redevelopment area. Finally, the time series analysis did indicate that all crime dropped following the intervention, but that the drop was delayed and increased with increasing time from the end of the intervention. The VAR model revealed the same pattern of change in crime levels in the buffer areas—crime in the buffers decreased later in the study periods. The VAR also indicated that a diffusion of benefits occurred in the area surrounding the redevelopment site. The implications of these results will be discussed in more detail below; the paper now turns to an examination of crime, displacement, and diffusion in the two Washington, D.C., sites.

Chapter 6

Results: Washington, D.C.

Crime patterns in and around two sites in Washington, D.C., were analyzed for crime displacement or diffusion of benefits: Capitol Gateway and Capper/Carrollsburg. The results for each site are presented below.

6.1. CAPITOL GATEWAY

Figure 6.1 displays the same redevelopment timeline shown above and also includes line graphs of all crime in the four main study areas (the site, two displacement buffers, and comparison area—Barry Farms). The figure also includes dotted lines that delineate the different study periods selected by the research team and explained in more detail below in Section 6.1.3. The figure shows that crime in the site appeared to drop significantly beginning in 2003, and that crime in the two buffers also dropped, though not to the same degree as in the target area. Crime in the comparison area appeared to remain relatively stable until 2007, at which point monthly crime levels started rising.

As in Milwaukee, the intervention period was long, and in this case it was even longer than that experienced in Milwaukee. Again, this characteristic of such large-scale redevelopment projects makes it difficult to identify clear-cut start and end dates of the intervention. The intervention periods, however, generally center around the period of October 2002 through August 2006, roughly the period of construction of the senior building and the family units. The specific dates used as interventions are specified with each analysis.

Figure 6.2 provides crime density maps for four selected years in the study period: 2002, 2004, 2006, and 2008. The density maps were created using data covering a half-mile radius around the site in order to capture any hot spots that might be occurring nearby but just outside the site boundaries. These maps were used purely for descriptive purposes, to provide an indication of the changes that took place in each site. The maps were not used as part of any statistical analyses, nor were they used alone to draw firm conclusions regarding the changing crime patterns in and around the study sites. The maps reveal that the density of crime inside the site appeared to lessen with time. Most of the hot spots disappeared by 2006, but the 2008 map showed a slight resurgence in the crime densities, especially in the 2000' buffer on the Washington, D. C., side. After 2002, however, the target area itself had a very low density of crime.

This examination of crime patterns revealed that crime decreased in the site following redevelopment activities, and that a search for possible displacement and diffusion was

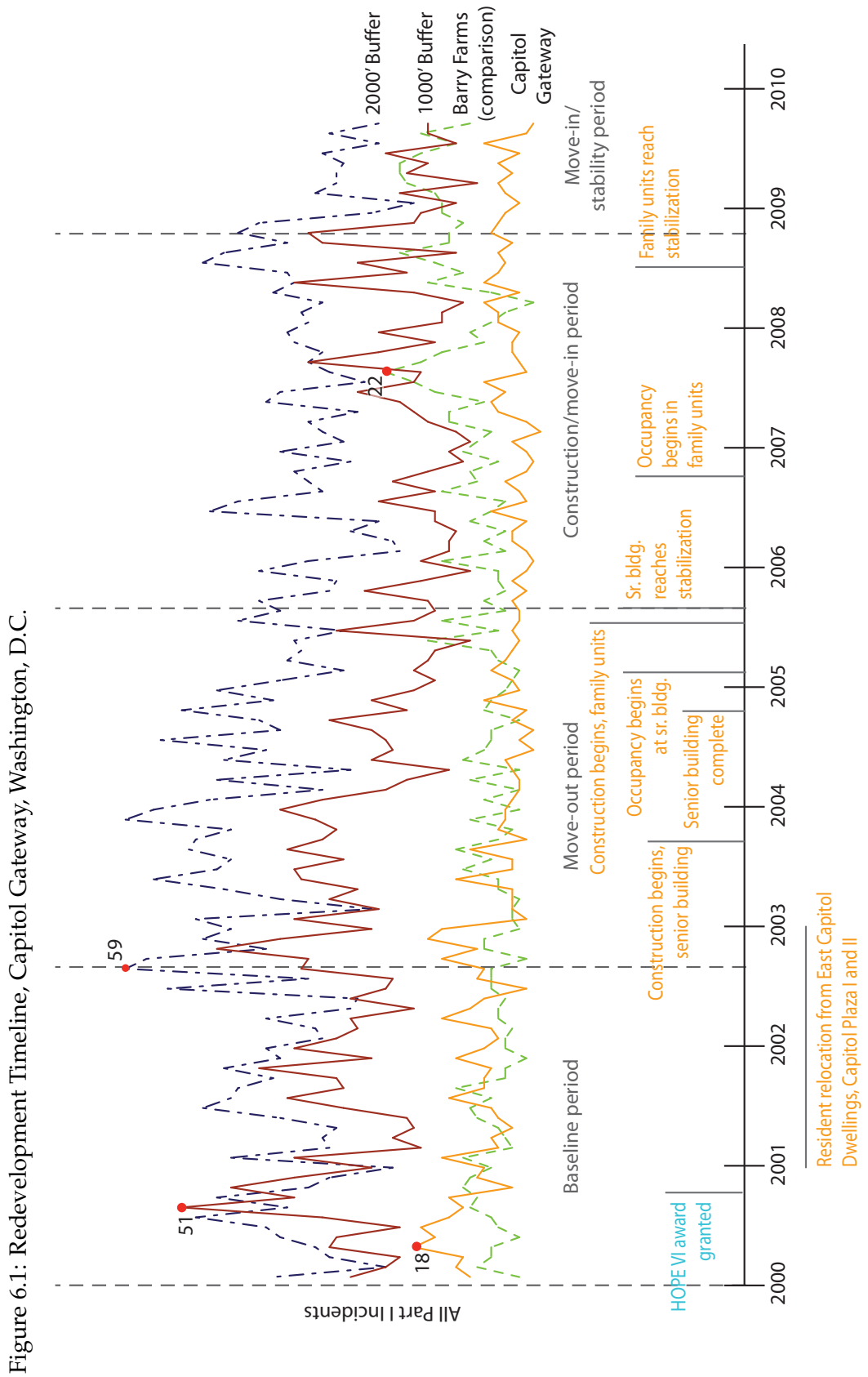


Figure 6.1: Redevelopment Timeline, Capitol Gateway, Washington, D.C.

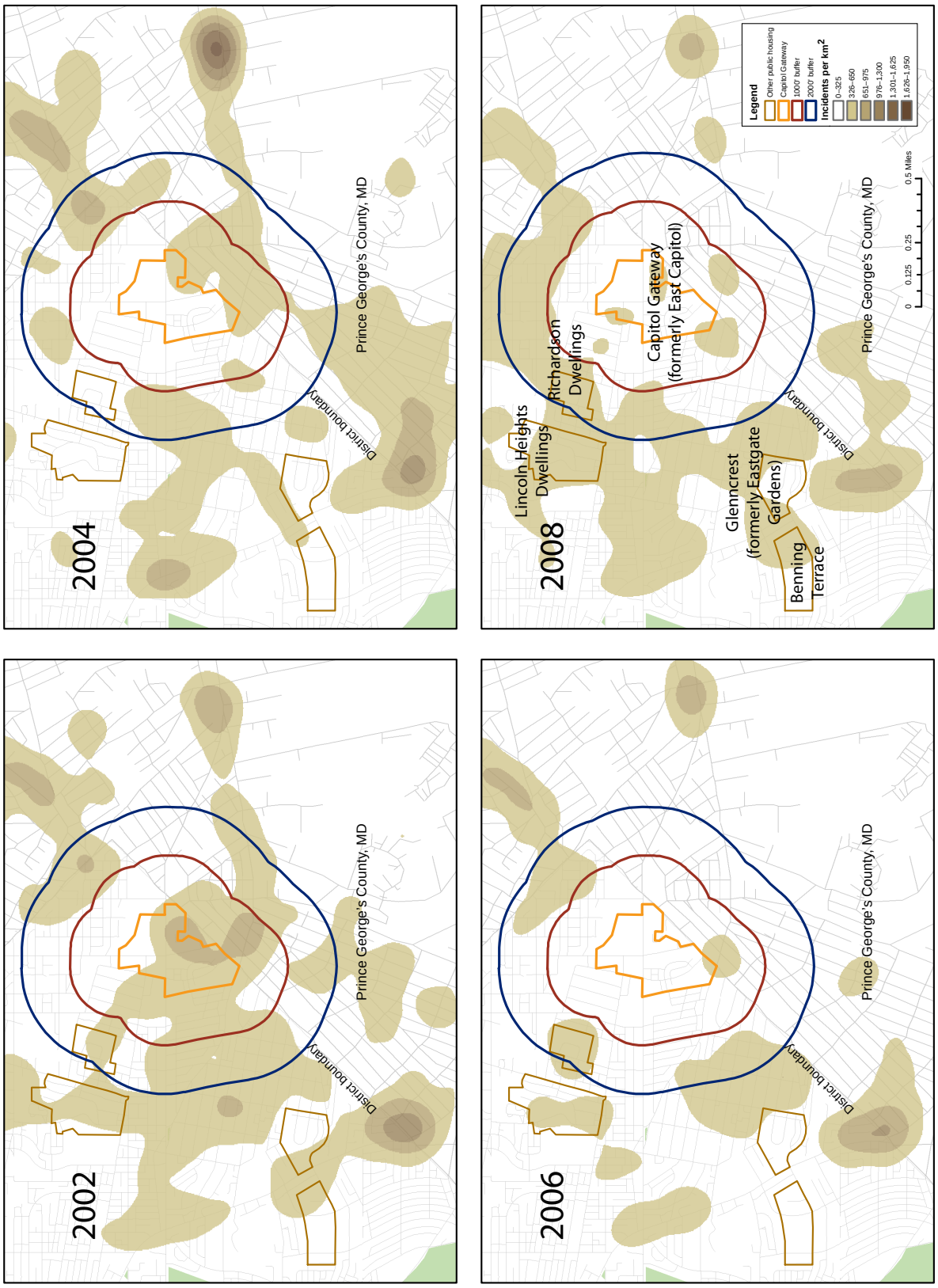


Figure 6.2: Density of Crime Over Time, Capitol Gateway

appropriate. The actual decrease in crime was quantified via the WDQ and time series analyses, presented below, but we started our consideration of displacement with point pattern analysis.

6.1.1. Point Pattern Analysis

Point pattern analysis was used to determine whether the pattern of crimes in the areas within and around the Capitol Gateway site changed, and the area examined for this analysis was the area within a half-mile of the site boundaries. Using a half-mile radius around the target area allowed us to capture any changes that occurred either within the target area boundaries or within a short distance of the boundaries; had we only used the target area itself, we would not have captured any crime displacement from the target site to just beyond its borders that might have occurred.

The point pattern analysis started with the identification of time periods and crime types to use for analysis. As in Milwaukee, yearlong intervals were used as the pre- and post-intervention time periods, comparing all crimes that occurred over one year before the redevelopment started to crimes that occurred in another full year, either during or after redevelopment. Because the data collected for Washington, D.C., did not extend through the end of 2009, the final year of data used for the point pattern analysis is actually the last full year of data, October 2008 through September 2009. Table 6.1 provides each year that was used in the analysis and the number of crimes that occurred in the half-mile buffer area during that period. Because the target area in the Capitol Gateway site is smaller than the site in Milwaukee, fewer crimes were included in each year, allowing us to look at the change in pattern of all crimes as opposed to just personal crimes.

Next, random point distributions were generated. First, an appropriate number of points was selected. The Milwaukee analysis covered a much larger geographic area, and 200 random points were included in each Monte Carlo simulation. The Capitol Gateway target area was much smaller, however, and fewer points were deemed appropriate. We tested distributions with different numbers of random points each, including 25 points, 50 points, and 100 points. With each number of random points (25, 50, and 100), the point pattern process was repeated 100 times, providing 100 different correlation coefficients for each possible combination of years examined. The skew and kurtosis of each set of 100 correlation coefficients was examined, and both measures were below one for all possible year and random point number combinations examined.

The results revealed that the mean correlations derived from the comparison of crime patterns in different years were very similar regardless of the number of points used—all correlations were just below 0.50. The significance levels, however, changed depending on the number of random points used. All mean correlation coefficients derived from the simulations using 100 random points each were found to be significant, while those from simulations using 25 random points each were all nonsignificant. Two correlations from the simulations using 50 random points were significant at the $p<0.10$ level, while the rest were significant at the $p<0.05$ level. Because the results were so similar, only the results from the analyses using 50 random points are presented here.

Table 6.2 provides the mean correlation coefficients between crime patterns for each year combination. Because the correlations were all positive, we can conclude that the spatial pattern of crimes did not change significantly across the study period, just as was the case in Milwaukee. As noted above in the Milwaukee point pattern analysis results, this methodology does not reveal changes in *levels* of crime, only in the spatial patterning

Table 6.1: Reported Crimes in Study Area for Selected Years, Capitol Gateway

	All Crimes
2001	1,242
2004	1,170
2007	976
10/08-09/09	880

Table 6.2: Mean Correlation Coefficients for All Year Combinations, Capitol Gateway

	2004	2007	2008-2009
2001	0.48**	0.45**	0.44*
2004		0.46**	0.44*
2007			0.47**

$^{**}p < 0.05$, $^{*}p < 0.1$

of crime. Because our examination of crime trends in the area around the redevelopment site revealed a drop in crime in the whole area (not just the target site), it is not surprising that the point pattern analysis did not show a significant change in the spatial pattern of crimes in and around Capitol Gateway. In addition, even though the maps over time (see Figure 6.2) indicate that crime went down in the target area, crime also went down in surrounding areas at the same time. Any changes that took place did so over a long period of time, and despite an overall lowering of crime in and around the Capitol Gateway site itself, the geographic patterns themselves remained similar over time (e.g., hot spots remained in the same place, even while they cooled).

As in Milwaukee, we concluded from the point pattern analysis that no crime displacement occurred from the Capitol Gateway site. The fact that the significance changed with the use of fewer numbers of random points while the coefficient values remained relatively stable indicated that 25 was likely too few points to use for the analysis and not that the pattern actually changed in any fashion.

While the point pattern analysis suggested that there was no change in the spatial pattern of crimes and that displacement did not occur in the Capitol Gateway site, for comparison purposes, the research team employed two more techniques. The next technique tested was the WDQ.

6.1.2. Weighted Displacement Quotient

The first step in the WDQ was to define time periods during which to look for displacement. We calculated the WDQ using several different sets of pre- and post-intervention time periods, and looked for displacement during the intervention as well. The initial intervention period used was October 2002 through July 2006, as discussed above. In Washington, D.C., the data covered a long enough period to examine a range of different pre- and post-intervention lengths, but because the intervention period was so long for the Capitol Gateway site, we were more interested in what happened during the intervention period, as opposed to immediately following the intervention. After the intervention, we surmised, any displacement effects that might have occurred may already have been washed out. We calculated the WDQ for four different time periods, specified in Table 6.3: 12 and 18 months pre- and post-intervention and 12 and 18 months pre-intervention compared to

Table 6.3: Weighted Displacement Quotient Results, Capitol Gateway

Pre/post length	t_0 (Pre-period)	t_1 (Intervention or post-period)	Type of crime	Success measure	WDQ	
					1000'	2000'
12 mo.	10/2001-09/2002	08/2006-07/2007	All	-1.38	2.92	3.58
			Personal	-1.07	1.39	1.86
			Property	-1.79	3.92	4.75
12 mo.*	10/2001-09/2002	10/2002-09/2003	All	-0.63	0.91	1.62
			Personal	-0.80	0.94	1.86
			Property	-0.03	-46.00	-60.00
18 mo.	04/2001-09/2002	08/2006-01/2008	All	-1.06	2.81	3.56
			Personal	-0.88	1.11	1.43
			Property	-1.36	4.22	5.33
18 mo.*	04/2001-09/2002	10/2002-03/2004	All	-0.42	-0.71	-1.18
			Personal	-0.65	0.61	1.39
			Property	0.20	-	-

Note: Intervention period: 10/2002-07/2006
*Searched for displacement during intervention period.

12 and 18 months during the intervention. The WDQ was calculated for all crime, personal crime and property crime.

As in Milwaukee, we searched for displacement in two buffers: a 1000' buffer and a 2000' buffer that were mutually exclusive. Table 6.3 provides the WDQ for each of the time periods and buffers considered. The table also provides the success measure, or the denominator, of the WDQ. WDQs were only calculated where the success measure was negative; if crime did not decrease during the study period, no displacement would be expected.

The WDQ results for Capitol Gateway across all types of crime and time periods were more consistent than for Milwaukee. All but one success measure was negative, indicating that for the most part, both property and personal crimes decreased in the redevelopment site over the study period. For both types of crime, the 12-month pre- and post-intervention periods produced WDQs that were positive and greater than one, indicating that a diffusion of benefits took place and that the decreases in crime in the buffer areas were at least as strong as the effects in the target area itself. When we compared crime levels for the 12 months before and 12 months *during* the intervention, we found mixed results. For all crime and personal crime, the WDQs were positive and at or greater than one, indicating that a diffusion of benefits took place immediately after the start of the intervention (while the redevelopment activities were continuing).

For property crimes, the success measure was negative but very near zero. The WDQs for property crimes in both buffer areas were negative and very large. In their presentation of the WDQ, Bowers and Johnson (2003) cautioned that the measure should not be used to quantify the *absolute* amount of displacement that occurred, only the amount relative to the target area; the large WDQ values should thus not be alarming. While the results for property crime during the first 12 months of the intervention indicated that displacement to the buffer areas did occur, the very small size of the success measure calls for caution in interpretation of these specific WDQs.

Examining the crime trends in the two buffer areas for property crimes alone, we found an increase in each buffer area from the first 12-month period to the second of approximately 17 percent (46 crimes in the 1000' buffer and 60 crimes in the 2000' buffer). We also examined the crime trends in the target and comparison areas, and found that over the period, crime in both areas was stable, dropping by only one crime in the target area and remaining the same in the comparison areas. In this case, then, value of the WDQ is effectively just the total observed increase in crime in each of the buffer areas. Therefore, we do not take

the large negative WDQs to be a strong indication that displacement of property crimes actually took place, but considered this result in concert with the results of the WDQs in other areas and time periods, and with the results of the other two methodologies. Because the success measure for property crimes for the *18-month* intervention period was actually positive, indicating that crime increased in the target area over the study period, we did not calculate WDQs for that area, but conclude that some displacement may have taken place immediately following the start of redevelopment. However, that displacement was later counteracted by a strong diffusion of benefits following the intervention.

The 18-month pre- and post-intervention periods yielded positive WDQs, providing additional evidence that a diffusion of benefits from the Capitol Gateway site to nearby areas took place. The 18-month pre- and during the intervention, however, revealed that some displacement might have occurred: the all crimes category had negative WDQ values less than negative 1. The personal crime category had small positive WDQ values, and the property crime category actually had a positive success measure, so no WDQs were calculated for that crime category. Taken together with the property crime results discussed above, it appears that any positive effects of the intervention on neighboring areas (i.e., diffusion of benefits) were lagged behind the actual intervention, possibly for several years. There may have been some displacement early on, but that disappeared as the redevelopment progressed. In addition, the values of the WDQ were larger for the 2000' buffer, so that the effects did not "wash out" towards the outer boundaries of the study area.

To summarize, the WDQ effort for Capitol Gateway had strong results, indicating a diffusion of benefits for most time periods and areas that was delayed until after the end of the intervention. The exceptions were the 12-month pre- and during intervention periods for property crime and the 18-month pre- and during intervention periods for "all crime," during which time some displacement of those crimes may have occurred. That effect, however, had disappeared by the end of the redevelopment period, by which point diffusion of benefits was observed.

6.1.3. Time Series Analysis

Single series ARIMA model The first step in the time series analysis was to analyze the effects of the intervention in the redevelopment site alone in order to confirm and quantify the decrease in crime in the redevelopment site that was identified through descriptive means outlined above. The first step in developing an ARIMA model was to specify the appropriate lag structure. In order to do this, we examined four monthly crime series of interest, looking at data for "all crimes": the Capitol Gateway site, the 1000' and 2000' buffers, and the comparison area (Barry Farms). Augmented Dickey-Fuller tests indicated that all four series were stationary. We next estimated the ACF and PACF for the target and comparison area series, and found them to be very similar.

Because of the similarity of the two series, the comparison area was used to determine lag length; we assumed that that series did not fundamentally change over the study period due to the intervention as the redevelopment site series likely did. If the intervention had an impact on crime in the redevelopment site, then it would become difficult to identify the appropriate natural lag structure using the monthly crime series for the redevelopment site itself. Ideally, if we had a series long enough pre-intervention, we could use that portion of the redevelopment site's crime series to determine the lag structure; unfortunately, the data available did not cover a long enough pre-intervention period. Using standard fit

indices and diagnostics to evaluate possible model specifications, we determined that an AR(2) model, or an autoregressive model with two lags, was most appropriate for both the redevelopment site series and the comparison area series.[1]

The series of monthly crime in the redevelopment site and the comparison site were tested for seasonality based on observed but unexplained correlations in the residuals starting at lag 6. In other words, crime for any given month was correlated to crime six months prior, supporting the idea that crime rates change with the seasons. We added a six-month seasonal lag to the model in order to address this issue; the term was significant and improved the model's performance.

The model thus included two lags for the monthly difference between the target and comparison area, a seasonal dummy variable, and three intervention variables. The intervention dummy variables were included to delineate different time periods in the redevelopment timeline. The four periods were:

Baseline, or pre-intervention: January 2000–September 2002

Move-out: October 2002–August 2006

Construction/move-in: September 2006–November 2008

Move-in/stability: December 2008–September 2009

Table 6.4 shows the results of the model estimations for both Capitol Gateway and Barry Farms. In the Capitol Gateway model, all three intervention coefficients were highly significant and all had virtually the same magnitude. The model suggests that each month after the intervention, the mean number of crimes per month was approximately five crimes lower than the site's overall mean of 9.5 crimes per month. This is a large drop in crime, and indicates that the intervention was successful at reducing crime at the site itself. Barry Farms, on the other hand, did not experience the same drop in crime during the intervention periods. Instead, crime was significantly higher in Barry Farms during and following the intervention. Because Barry Farms was several miles from the Capitol Gateway site, it was unlikely that the increase at Barry Farms was due to displacement of crime from the redevelopment activity at Capitol Gateway. The results from the Barry Farms site suggested that there may have been external factors pushing crime up in other public housing areas, just as HOPE VI was underway at Capitol Gateway. The estimated decrease in crimes from the Capitol Gateway model was thus probably conservative.

VAR The next step was to estimate a structural VAR using three series: the redevelopment site, the 1000' buffer and the 2000' buffer. The VAR model here had six possible directional effects: the redevelopment site on each buffer area, each buffer area on the target site, and each buffer area on the other buffer. Following the process used for the Milwaukee site, we only estimated the contemporaneous effects of the outward directional effects, or those of the target on both buffers and the 1000' buffer on the 2000' buffer (lagged effects were estimated in the inward and outward direction). The VAR results presented here include the parameter estimates for both the lagged and the contemporaneous (no lag) effects (provided in Table 6.5).

As in Milwaukee, the model for the target area was very similar to that developed using single series ARIMA results, and in the target area, crime dropped significantly following

[1]The first lag is crime one month prior and the second lag is crime two months prior.

Table 6.4: Impact of Redevelopment on Capitol Gateway and Barry Farms, Washington, D.C.: Results of ARIMA Model for All Crime

	Capitol Gateway		Barry Farms	
	b	***S.E.***	***b***	***S.E.***
Constant	9.50**	0.83	6.51**	0.66
Autoregressive lag 1	0.25**	0.09	0.10	0.09
Autoregressive lag 2	0.18*	0.09	0.24**	0.09
Seasonal dummy (6 mo.)	-0.01	0.10	-0.28**	0.09
Move-out period	-4.90**	1.08	0.58	0.88
Move-out/construction period	-4.70**	1.23	5.01**	0.98
Move-in period	-5.64**	1.62	8.91**	1.40

Capitol Gateway model: Dep. var = All crime, Capitol Gateway target area.
Log likelihood = -288.97; AIC = 593.94
Barry Farms model: Dep. var = All crime, Barry Farms.
Log likelihood = -301.6; AIC = 619.19
**p <0.05, *p <0.10

Table 6.5: Impact of Redevelopment of Capitol Gateway, Washington, D.C.: Results of Structural VAR Model for All Crime

	Target Area		1000' Buffer		2000' Buffer	
	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err
Constant	4.46 **	1.62	1.94	3.58	21.42 **	4.34
Target area (no lag)	-	-	0.30	0.20	0.27	0.24
AR Lag 1, Target area	0.20 **	0.09	0.27	0.20	0.43 *	0.24
AR Lag 2, Target area	0.19 **	0.09	0.29	0.20	-0.37	0.24
1000' buffer (no lag)	-	-	-	-	0.39 **	0.11
AR Lag 1, 1000' buffer	0.09 **	0.04	0.11	0.09	0.13	0.11
AR Lag 2, 1000' buffer	0.00	0.04	0.08	0.09	0.01	0.11
AR Lag 1, 2000' buffer	-0.01	0.04	0.20 **	0.08	0.17 *	0.10
AR Lag 2, 2000' buffer	-0.01	0.04	0.25 **	0.08	0.16	0.10
Move-out period	-2.75 **	0.89	-3.78 *	1.96	1.28	2.38
Construction period	-2.33 **	0.94	-3.71 *	2.08	-1.10	2.52
Stability period	-2.71 **	1.15	-4.86 *	2.54	-6.63 **	3.08
R-square	0.46		0.49		0.30	

N=115, *p<0.10, **p<0.05

the pre-intervention period. Two main results from the VAR are worth noting. First, there was a positive relationship between crime counts in each area and crime counts in the surrounding areas. Thus, all else being equal, if crime rose in one area, it would be expected to rise in all areas. It should be noted that all of the effects were relatively small and only the 2000' buffer had significant results (on the AR1 lag for the target area and the non-lagged 1000' buffer term) that measured crime moving "outward." The signs of most of the estimates were positive, however, supporting the conclusion that if crime dropped in one area, it would drop in adjacent locations as well. This relationship was not surprising, as an extensive criminological literature, both theoretical and empirical, has tied crime in a given location to crime in surrounding areas. This finding also indicated that we should expect positive spillover effects, or a diffusion of benefits, to areas surrounding Capitol Gateway.

The second thing to note is that HOPE VI appeared to have decreased crime in all three areas: directly in the target area and both directly and indirectly via changes in the target area, in the buffer areas. That is, HOPE VI decreased crime in Capitol Gateway, which led to decreases in crime in the surrounding areas (because crime in Capitol Gateway was positively correlated with crime in its neighboring areas), and HOPE VI decreased crime directly in the buffer areas, regardless of what happened in the target area (as indicated by the significant coefficients on the time period dummies in both buffer areas). The results also indicate that the effects were strongest in the target area and 1000' buffer areas, and those effects continued throughout the redevelopment period. Direct effects were felt less strongly in the 2000' buffer and were significant only in the last period, move-in/stability. In fact, the effects in the 1000' buffer were larger than for the target area. Finally, significant effects were found in the 2000' buffer only, indicating that the intervention's effects slowly moved outward from the target area during the study period.

Some of the measured impact of HOPE VI from the ARIMA model above did not come from HOPE VI's direct impact on Capitol Gateway. Rather, at least some of the observed impact came from an indirect feedback effect, where HOPE VI lowered crime in the surrounding areas, leading to lower crime in Capitol Gateway. In addition, the VAR model indicated that the effects on the buffer areas were delayed and built over time throughout the redevelopment period. This result indicates again that the intervention became more effective over time, and supports the results of the WDQ, which indicated small effects—even displacement of property crimes early on—and diffusion of benefits at the end of and following the intervention.

6.1.4. Conclusion

Two of the three methodologies applied in the Capitol Gateway case presented consistent results. The point pattern analysis indicated that there was no change in the pattern of crimes prior to redevelopment compared to any period afterwards, suggesting that no displacement or diffusion occurred. As was discussed earlier, however, the method does not identify drops in crime if those drops do not result in a change in the overall pattern. That appeared to be the case here, as crime dropped throughout the study area used for the point pattern analysis.

The other two methods provided evidence of diffusion of benefits, especially later in the study period. The time series identified a significant average drop of approximately five crimes per month during each different redevelopment period, indicating that HOPE VI was highly successful at decreasing the crime levels in the redevelopment site itself.

This was in addition to the trend in the comparison area that was actually increasing over the study period, indicating that while crime at Capitol Gateway was decreasing, crime at comparable sites elsewhere in the city was going up. The identified drop in crime, therefore, is likely a conservative estimate. The time series results thus confirmed what we found through descriptive analyses: that it was appropriate to search for displacement or diffusion based on the significant drop in crime at Capitol Gateway.

The WDQ effort revealed a possible initial displacement of property crime, especially during the early months of the intervention. WDQs for later periods, however, showed signs of diffusion of benefits to the buffer areas. The time series analysis did not pick up the displacement early in the redevelopment period, but those models took all crimes as the dependent variable, which may have masked the displacement of property crime alone. The VAR model, however, did provide support for the diffusion effects identified with the WDQs. Moreover, the VAR models revealed that the crime drop was strongest in the target area earlier in the study period, and the decrease diffused out to the 2000' buffer closer to the end of the study period.

The next section presents results for the last site under study, Capper/Carrollsburg.

6.2. CAPPER/CARROLLSBURG

Figure 6.3 displays the same redevelopment timeline shown above and includes line graphs of all crime in the four main study areas (the site, two displacement buffers, and the comparison area—Syphax/Greenleaf Gardens). The figure also includes dotted lines that delineate the different study periods selected by the research team and explained in more detail below in Section 6.2.3. The figure shows that crime in the site appeared to drop significantly in mid-2003 and that crime in the two buffers also dropped starting at the same point, though not to the same degree as in the target area. Crime in the comparison area appeared to remain relatively stable throughout the study period, with recurrent peaks throughout the period.

As in Milwaukee and the Capitol Gateway site, the intervention period was long, and the Capper/Carrollsburg redevelopment had the longest timeline of the three sites under examination. Again, this characteristic of such large-scale redevelopment projects makes it difficult to identify clear-cut start and end dates of the intervention. The intervention periods, however, generally center around the period of July 2003 through December 2006, roughly the period of construction of the first senior building. The specific dates used as interventions are specified with each analysis.

Figure 6.4 provides crime density maps for four selected years in the study period: 2002, 2004, 2006, and 2008. The density maps were created using data covering a half-mile radius around the site in order to capture any hot spots that might be occurring nearby but just outside the site boundaries. These maps were used purely for descriptive purposes, to provide an indication of the changes that took place in each site. The maps were not used as part of any statistical analyses, nor were they used alone to draw firm conclusions regarding the changing crime patterns in and around the study sites. The maps reveal that the density of crime inside the site appeared to lessen with time. By 2008, most of the crime hot spots appeared to have moved outside of the 2000' buffer area. After 2002, the target area itself had a very low density of crime, but there was a stable hot spot just to the northwest of the site that remained there throughout the study period.

This examination of crime patterns revealed that crime decreased in the site following

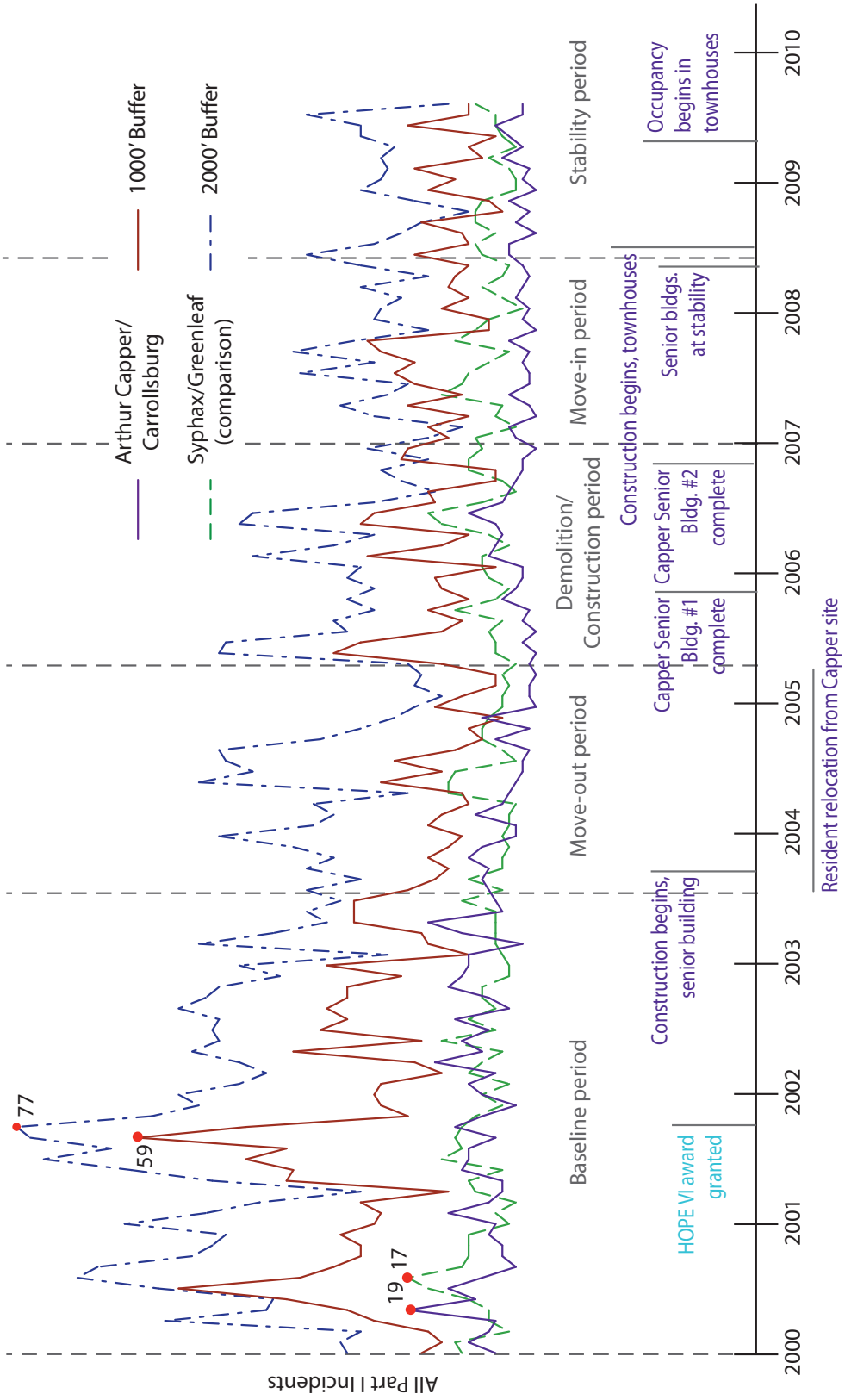


Figure 6.3: Redevelopment Timeline, Capper/Carrollsburg, Washington, D.C.

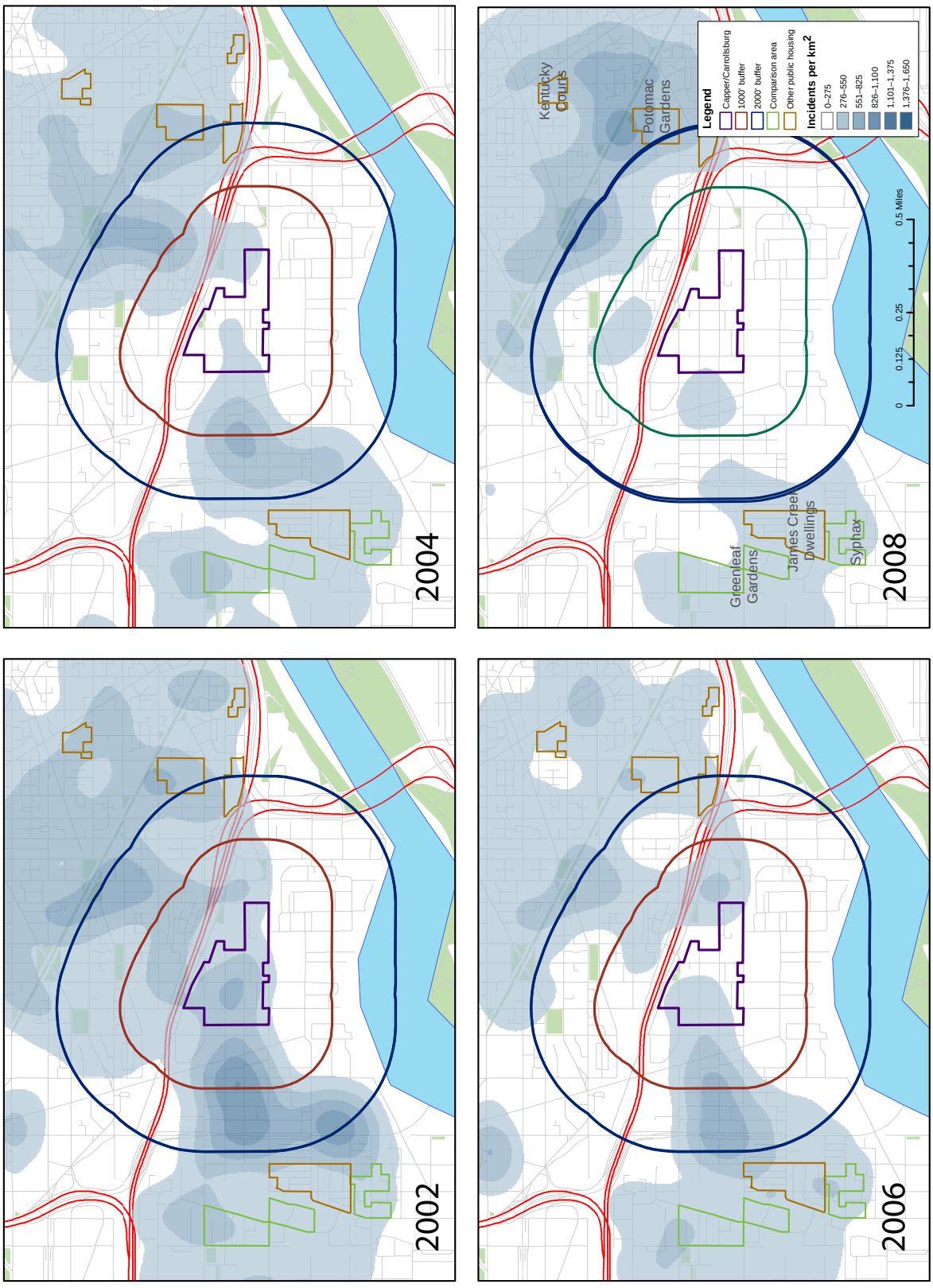


Figure 6.4: Density of Crime Over Time, Capper/Carrollsburg

redevelopment activities, and that a search for possible displacement and diffusion was appropriate. The actual decrease in crime was quantified via the WDQ and time series analyses, presented below, but we started our consideration of displacement with point pattern analysis.

6.2.1. Point Pattern Analysis

Point pattern analysis was used to determine whether the pattern of crimes in the areas within and around the Capper/Carrollsburg site changed, and the area examined for this analysis was the area within a half-mile of the site boundaries. Using a half-mile radius around the target area allowed us to capture any changes that occurred either within the target area boundaries or within a short distance of the boundaries; had we only used the target area itself, we would not have captured any crime displacement from the target site to just beyond its borders that might have occurred.

The point pattern analysis started with the identification of time periods and crime types to use for analysis. Because the redevelopment timeline was long, yearlong intervals were used as the pre- and post-intervention time periods, comparing all crimes that occurred over one year before the redevelopment started to crimes that occurred in another full year, either during or after redevelopment. As with Capitol Gateway, the final year of data used for the point pattern analysis was the last full year of data, October 2008 through September 2009. Table 6.6 provides each year that was used in the analysis and the number of crimes (all crimes) that occurred in the half-mile buffer area during that period. The Capper target site was small, with few enough crimes to allow us to look at the spatial patterns of all crimes together.

Next, random point distributions were generated. First an appropriate number of points was selected. As with the other two sites, we tested distributions with different numbers of random points each, including 25 points, 50 points, and 100 points. With each number of random points (25, 50, and 100), the point pattern process was repeated 100 times, providing 100 different correlation coefficients for each possible combination of years examined. The skew and kurtosis of each set of 100 correlation coefficients were examined, and both measures were less than one for all possible year and random point number combinations examined. Because the results were so similar, only the results from the analyses using 100 random points are presented here.

Table 6.7 provides the mean correlation coefficients between crime patterns for each year combination examined using random point distributions of 100 points each. All but one year combination was highly positively correlated; the remainder were positive but significant only at the $p<0.10$ level. All correlation coefficients had values near 0.50, as did the coefficients for the Capitol Gateway site. Because the correlations were all positive, even those that were not significant, we can conclude that the spatial pattern of crimes did not change significantly across the study period, as was the case in the other two sites. Our examination of crime trends in the area around the redevelopment site revealed a drop in crime in the target area and persistent hot spots of crime outside the target area. Therefore, it is not surprising that the point pattern analysis did not show a significant change in the spatial pattern of crimes in and around Capper/Carrollsburg. We concluded from the point pattern analysis that no crime displacement occurred from the Capper/Carrollsburg site.

Table 6.6: Reported Crimes in Study Area for Selected Years, Capper/Carrollsburg

	All Crimes
2002	1,361
2005	790
2007	820
10/08-09/09	751

Table 6.7: Mean Correlation Coefficients for All Year Combinations, Capper/Carrollsburg

	2005	2007	2008-2009
2002	0.50**	0.48**	0.46**
2005		0.49**	0.41*
2007			0.54**

**$p < 0.05$, *$p < 0.1$

6.2.2. Weighted Displacement Quotient

While the point pattern analysis suggested that there was no change in the spatial pattern of crimes and that displacement did not occur in the Capper/Carrollsburg site, the research team employed two other analysis techniques for comparison purposes. The next technique tested was the WDQ.

The first step in the WDQ was to define time periods during which to look for displacement. We calculated the WDQ using several different sets of pre- and post-intervention time periods, and looked for displacement during the intervention as well. The initial intervention period used was July 2003 through February 2005, as discussed above. In Washington, D.C., the data covered a long enough period to examine a range of different pre- and post-intervention lengths, but, as with the Capitol Gateway site, we were interested in what happened during the intervention period as well. We calculated the WDQ for four different time periods, specified in Table 6.8: 12 and 18 months pre- and post-intervention and 12 and 18 months pre-intervention compared to 12 and 18 months during the intervention. The WDQ was calculated for all crimes, personal crime and property crime.

As in the two other sites, we searched for displacement in two buffers: a 1000' buffer and a 2000' buffer that were mutually exclusive. Table 6.8 provides the WDQ for each of the time periods and buffers considered. The table also provides the success measure, or the denominator, of the WDQ. WDQs were only calculated where the success measure was negative.

The WDQ results for the Capper/Carrollsburg site were similar to those observed for Capitol Gateway. All success measures were negative, confirming that crime decreased over the study period. The results consistently indicated that a diffusion of benefits took place from the site, with two exceptions. First, for personal crimes during the first 12 months after the intervention period, the WDQ was negative. The same was true for the 18-month period following redevelopment for personal crimes. This pattern is similar to that observed for property crimes in Capitol Gateway, where a displacement effect was noted soon after the intervention started that disappeared with time following the intervention. It is unclear why this result occurred, but one thing to note is that in both of these instances, the success measure was very low, which could very well have skewed the results. One

Table 6.8: Weighted Displacement Quotient Results, Capper/Carrollsburg

Pre/post length	t_0 (Pre-period)	t_1 (Intervention or post-period)	Type of crime	Success measure	WDQ	
					1000'	2000'
12 mo.	07/2002-06/2003	12/2004-11/2005	All	-1.072	3.198	3.379
			Personal	-0.381	0.125	-3.258
			Property	-2.488	4.118	5.250
12 mo.*	07/2002-06/2003	07/2003-06/2004	All	-0.838	2.004	1.729
			Personal	-0.451	1.496	1.994
			Property	-1.711	2.682	2.464
18 mo.	01/2002-06/2003	03/2005-08/2006	All	-1.040	3.045	3.100
			Personal	-0.539	0.765	-0.739
			Property	-1.958	4.077	4.880
18 mo.*	01/2002-06/2003	07/2003-12/2004	All	-0.843	1.657	0.843
			Personal	-0.539	1.088	1.402
			Property	-1.337	2.103	0.701

Note: Intervention period: 07/2003-02/2005
*Searched for displacement during intervention period.

other factor to note in interpreting these findings is that other redevelopment projects were taking place in the larger area, and may have accounted for the apparent diffusion effects noted in this site.

To summarize, the WDQ effort for Capper/Carrollsburg had the strongest, most consistent results of the three sites. The WDQs showed a diffusion of benefits across several different time periods, and in both the 1000' and 2000' buffers. Contextual knowledge of the greater redevelopment area invites caution in interpreting these findings.

6.2.3. Time Series Analysis

Single series ARIMA model The first step in developing the Capper/Carrollsburg ARIMA model was to specify the appropriate lag structure. In order to do this, we examined four monthly crime series of interest, looking at data for 'all crimes': the Capper/Carrollsburg site, the 1000' and 2000' buffers, and the comparison area (Syphax/Greenleaf Gardens). Augmented Dickey-Fuller tests indicated that all four series were stationary. We next estimated the ACF and PACF for the redevelopment site and the comparison area but did not find them to be comparable. Thus, the lag structure for each series had to be determined independently. Using standard fit indices and diagnostics to evaluate possible model specifications for the target and comparison area series, we determined that an ARMA(1,1) model—a model with one autoregressive lag[2] and one moving average lag—was most appropriate for the redevelopment site series. An AR(3) model—one with three autoregressive lags—was found most appropriate for modeling the comparison area series.[3]

The series of monthly crime in the redevelopment site and the comparison site were tested for seasonality using the same six-month seasonality term that was used for Capitol Gateway. The inclusion of that term did not improve the redevelopment site model, however. We also tested the inclusion of a seasonal dummy indicating whether it was summer or winter; this did not improve that model either. Therefore, we decided not to include a seasonal term in the redevelopment site model. We tested the same terms on the comparison area series, however, and found that instead of a six-month seasonal lag, a five-month seasonal lag was significant. We also found that a dummy identifying

[2]The lag is crime one month prior.

[3]The first lag is crime one month prior, the second lag is crime two months prior, and the third is crime three months prior.

the three winter months (December, January, and February) and a dummy identifying the three summer months (June, July, and August), were significant. Those three seasonality terms were thus included in the model.

The redevelopment site model thus included one autoregressive lag and one moving average lag and four dummy variables indicating intervention time period. The comparison site model included three autoregressive lags, a five-month seasonal lag, a dummy for winter and for summer, and the four dummy variables indicating intervention time period. Five distinct periods were identified for the Capper/Carrollsburg site. Those periods were:

Baseline, or pre-intervention: January 2000–June 2003

Move-out: July 2003–March 2005

Demolition/construction: April 2005–December 2006

Move-in: January 2007–June 2008

Stability: July 2008–September 2009

Table 6.4 shows the results of the model estimations for both Capper/Carrollsburg and Syphax/Greenleaf Gardens. In the Capper model, all parameter estimates were highly significant. The four intervention terms were all negative, indicating that crime dropped at the site immediately following the start of redevelopment and continuing throughout the redevelopment period. The model suggests that each month after the intervention, the mean number of crimes per month was between approximately 4 crimes and 6.75 crimes lower than the site's overall mean of 8.5 crimes per month. This is a large drop in crime, and indicates that the intervention was successful at reducing crime at the site itself. One point to note regarding this finding is that while a drop in crime is a sign of success, the Capper timeline was also the longest, meaning that it had the longest period of time of all three sites considered with few residents on site. This likely played a role in keeping crime at the actual site low while redevelopment was taking place.

The moving average term was also found to be significant in the Capper model. One possible explanation for this is that the police may have been highly responsive to significant crime events in the Capper area. The moving average term would pick up that increased activity. For example, if there was a sudden shock in June (e.g., a rash of burglaries) and there were three more crimes for that month than expected, in July, there would be two fewer crimes than expected. This might be explained by a police presence defined by quick responsivity to serious crime events. Based on our knowledge of the overall area, which included redevelopment of the baseball stadium, increased construction, and development of office and retail space and market-rate housing, it is plausible that the police around Capper/Carrollsburg were more responsive throughout the study period.

In the comparison site, only one of the intervention terms was significant: the stability period. The other intervention terms were not significant. All four parameter estimates for the intervention dummies, regardless of significance, were negative, as was the case in the Capper/Carrollsburg model. They were, however, smaller in magnitude. The results of the comparison area indicate that it did not experience the same dramatic drop in crime during the redevelopment period that Capper/Carrollsburg did, providing more evidence that the crime drop in the target areas was connected to the redevelopment activities taking place there.

Table 6.9: Impact of Redevelopment on Capper/Carrollsburg and Syphax/Greenleaf, Washington, D.C.: Results of ARIMA Model for All Crime

	Capper/Carrollsburg		Syphax/Greenleaf	
	b	*S.E.*	*b*	*S.E.*
Constant	8.52**	0.57	7.90**	0.67
Autoregressive lag 1	0.76**	0.23	0.21**	0.09
Autoregressive lag 2	-	-	0.07	0.10
Autoregressive lag 3	-	-	-0.21**	0.10
Moving average lag 1	-0.68**	0.26	-	-
Seasonal lag (5 mo.)	-	-	0.20*	0.10
Winter dummy	-	-	-0.79	0.79
Summer dummy	-	-	2.60**	0.79
Move-out period	-3.91**	0.97	-1.48	0.99
Construction period	-5.26**	0.97	-1.24	0.99
Move-in period	-6.76**	1.01	-1.42	1.05
Stability period	-5.82**	1.08	-1.95**	1.12

Capper model: Dep. var = All crime, Capper/Carrollsburg target area;
Log likelihood = -288.66; AIC = 593.31.
Syphax model: Dep. var = All crime, Syphax/Greenleaf;
Log likelihood = -287.78; AIC = 599.56
**p <0.05, *p <0.10

VAR The next step was to estimate a structural VAR using three series: the redevelopment site, the 1000' buffer, and the 2000' buffer. The VAR model had six possible directional effects: the redevelopment site on each buffer area, each buffer area on the target site, and each buffer area on the other buffer. Following the process used for the other two sites, we only estimated the contemporaneous effects of the outward directional effects, or those of the target on both buffers and the 1000' buffer on the 2000' buffer (lagged effects were estimated in the inward and outward directions). The VAR results presented here include the parameter estimates for both the lagged and the contemporaneous (no lag) effects (Table 6.10).

As in the other two sites, the VAR model for the target area was similar to that produced by the ARIMA modeling. The most notable finding from the Capper/Carrollsburg VAR model was that the intervention produced large, statistically significant, and surprisingly consistent direct effects in all three areas—this means the intervention affected crime in each area regardless of what happened in the other two areas. In fact, the results seemed to indicate that the intervention had much larger direct effects on the buffers than it did on the target area: the effect was three times larger in the 2000' buffer than in the target area. While this may at first seem counterintuitive, crime in the buffers was higher than in the target area to begin with, so larger drops in crime were likely similar to or smaller than the drop in the target area percentage-wise.

The results also revealed that the target area had a significant effect on both buffer areas, and in fact, the significant and negative coefficient for the target area term indicates that the target area had a negative effect on the 1000' buffer: when crime went down in the target area, it went up in the 1000' buffer. The effect was very small, however (less than one crime), and the lagged target area terms were not significant. Therefore, while the significant negative coefficient could be a sign of displacement, the results also indicate

Table 6.10: Impact of Redevelopment of Capper/Carrollsburg, Washington, D.C.: Results of Structural VAR Model for All Crime

	Target Area		1000' Buffer		2000' Buffer	
	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err
Constant	6.16 **	1.80	16.15 **	4.76	28.29 **	5.85
Target area (no lag)	-	-	-0.29 **	0.06	0.38 **	0.20
AR Lag 1, Target area	0.13	0.09	0.21	0.24	-0.26 *	0.30
AR Lag 2, Target area	0.12	0.09	0.07	0.23	-0.15	0.29
1000' buffer (no lag)	-	-	-	-	-0.48	0.30
AR Lag 1, 1000' buffer	0.02	0.04	0.29 **	0.12	0.37	0.14
AR Lag 2, 1000' buffer	-0.10 **	0.04	0.05	0.12	0.15 **	0.14
AR Lag 1, 2000' buffer	0.09 **	0.04	0.04	0.10	0.24	0.12
AR Lag 2, 2000' buffer	-0.04	0.03	-0.04	0.09	-0.04 *	0.11
Move-out period	-3.24 **	0.95	-8.70 **	2.52	-8.91	3.10
Construction period	-3.98 **	1.13	-6.63 **	2.99	-12.03 **	3.68
Move-in period	-4.79 **	1.38	-7.04 *	3.64	-16.75 **	4.47
Stability period	-4.43 **	1.31	-9.13 **	3.47	-15.64 **	4.27
R-square	0.55		0.51		0.66	

N=115, *p<0.10, **p<0.05

that any displacement was short-term and small. The target area's effect on the 2000' buffer was the opposite—it was significant and positive, supporting the idea that diffusion of benefits took place. Again, though, the effect was very small and short-term.

Aside from these two significant coefficients, the models reveal that the target area did not have a strong effect on either buffer area—the three areas were relatively unconnected and their crime rates did not appear to co-vary. While this is an important finding, it should also be interpreted with caution. The Capper/Carrollsburg site was located in a larger area of investment and redevelopment, including new federal buildings and the new Nationals baseball stadium. Therefore, with the results of this modeling effort alone, it is difficult to attribute the direct effects found in the buffer areas to HOPE VI itself. Additional information on the timing of other redevelopment projects would be needed in order to account for their possible confounding effects in the buffers.

Overall, while the effects in the buffer area may not have been due to HOPE VI, the effects in the target area (discussed above in the ARIMA time series section) were at least partially driven by the redevelopment efforts on the site. In addition, the VAR results indicate that any displacement was unlikely, indicating that at least part of the drop in crime on site was a true drop in crime, and did not simply serve to move crime to another location.

6.2.4. Conclusion

The Capper/Carrollsburg site produced the most consistent results of all sites, and those results were fairly similar to the results from the Capitol Gateway analysis. The point pattern analysis did not reveal any changes in the pattern of crime, which was not surprising given the persistent hot spots outside the buffer areas throughout the study period, as identified in Figure 6.4. The WDQs were consistent, indicating a diffusion of benefits throughout the study period and for both the 1000' and 2000' buffers.

The time series analysis confirmed the noted drop in crime in the site, and the drop in crime over the study period was found to be large. This may have partially been a function of the long redevelopment timeline and extended period with few residents on site; that

period of lower resident numbers was longest in Capper/Carrollsburg of all three sites. The comparison area, however, did not experience a similar decline, and the comparison area was located just outside the 2000' buffer, in the area of additional redevelopment not associated with HOPE VI. This points to HOPE VI as a likely driver of the changes in crime levels observed in Capper/Carrollsburg.

The VAR model revealed some interesting results not observed in the other two sites: crime levels in any of the three areas (target area, 1000', and 2000' buffers) did not strongly co-vary. That is, the crime levels in each of the three areas appeared to operate independently of what was happening in the other two sites. The parameter estimates in the VAR were in the right direction, indicating that a positive relationship between crime levels in the three areas might have existed, but the estimates were small and for the most part, non-significant. The VAR also revealed that HOPE VI had apparent direct effects on all three areas; its effects did not simply work through the improvements observed in the target area. While counter-intuitive, these direct effects are best understood in the context of the larger, non-HOPE VI redevelopment projects taking place throughout the Near Southeast neighborhood, in which Capper/Carrollsbug was located. This supports the conclusions of Zielenbach and Voith (2010) in their study of HOPE VI in Boston and Washington, D.C.

Chapter 7

Discussion and Conclusions

7.1. RESULTS BY SITE

The results presented above provide mixed evidence as to whether crime was displaced from the HOPE VI sites included in this study and other similar large-scale public housing redevelopment efforts, and the three methodologies did not always agree. Overall, however, the results indicated very positive results in the target areas themselves, and some other positive changes in areas surrounding those sites, although those may have been delayed for several months to several years.

7.1.1. Milwaukee

The results from Milwaukee were the most mixed, with evidence of crime displacement provided by some of the WDQs. Table 7.1 provides a summary of the WDQ values for each site for each buffer (1000' and 2000'). This table is simply the count of all WDQs that fell into each range (less than -1, -1 to 1, and greater than 1). Numbers smaller than -1 indicate displacement, and numbers greater than 1 indicate diffusion of benefits. This table does not differentiate between different types of crime.

Only about half of the success measures for the different crime type/buffer/time period combinations studied in Milwaukee were negative and indicated that crime decreased in the target area (see Table 5.3). All of the success measures, however, were near zero, indicating that the effects—whether positive or negative—were minimal. The fact that the success measures were all positive for the 18-month pre/post-intervention WDQ is an indication that the redevelopment's reduction effects on crime grew with time and were stronger later in the study period. The WDQs provided evidence of some displacement of personal crimes—starting just after the intervention period ended—but that effect got smaller with increased time from the intervention period.

The time series analysis supported the finding that the effects of the intervention, while generally serving to decrease crime over the study period, were delayed. In fact, the time series suggested that a significant drop in crime at the site did not occur until after the intervention, during the move-in/stability period. It should be noted that the intervention period chosen for this research encompassed the construction of Highland Gardens only—because the construction period was so long, we decided to identify the construction for the first building as the "intervention," arguing that once major changes were made in one part of the site, changes would follow more quickly in other parts of the site. In other words, even though the other buildings (Cherry Court and the scattered sites) hadn't yet

Table 7.1: Summary of WDQ Results Across All Sites

	Buffer Distance	<-1	-1–1	>1
Milwaukee	1000'	0	7	0
	2000'	1	3	3
Capitol Gateway	1000'	1	4	6
	2000'	2	0	9
Capper/ Carrollsburg	1000'	0	2	10
	2000'	1	3	8
Total	1000'	1	13	16
	2000'	4	6	20
	All	5	19	36

been redeveloped, residents there were assumed to benefit from the changes at Highland Gardens before construction started in the rest of the site. The delayed effects of the intervention may in fact suggest that there were stronger effects from the redevelopment of Cherry Court and the scattered sites than from Highland Gardens. In addition, the fact that displacement effects seemed to lessen with time following the chosen intervention period suggests that had analysis been conducted on later periods, more diffusion of benefits effects might have been observed.

In addition, the comparison area trends were accounted for in the single series ARIMA model for the target area in Milwaukee by using as the dependent variable the difference between the target and the comparison area in each month instead of modeling each separately. This was done to account for the downward trend in crime in the comparison area over the study period. The drop in crime that was identified by the time series model, then, was over and above the citywide crime drop that happened late in the study period (which was captured by the comparison series). Thus the efforts were not without benefit greater than what would have occurred without the redevelopment.

The results of the VAR supported the results of the single series ARIMA model, finding that there were both direct and indirect effects of the redevelopment on the buffer areas. The indirect effects indicated that a diffusion of benefits, from the target area outward, occurred because crime dropped in the buffer areas when it dropped in the target area. One explanation for these effects is to consider them through a criminal opportunity framework. Under this framework, we assume that prior to redevelopment, offenders were likely attracted to the target site for potential criminal opportunities. The redevelopment efforts likely changed the criminal opportunity structure of the target area, for instance by changing the types of people who resided there (e.g., through stricter residency requirements) or even by changing the layout or design of the site itself. These changes could reduce the site's attractiveness to offenders. With fewer offenders either residing in or traveling to the target area, the surrounding areas—the buffers—would likely also experienced reduced crime, with fewer offenders in the area seeking opportunities to commit crimes. The effect of redevelopment, then, was felt in both the target area and in the buffer sites, and the effect was a decrease in overall criminal activity. The VAR, like the WDQ and the single series ARIMA models, indicated that those effects were stronger later in the study period.

The *direct* effects of redevelopment on the buffer areas can be understood if we consider the social benefits of HOPE VI on the area. The redevelopment efforts should act to improve

the behavior of residents and other individuals on site, reducing their criminal activity. HOPE VI efforts include the provision of additional social services, and are intended not only to improve the physical conditions of the site itself but to assist residents in improving the quality of their lives through job skills training, educational opportunities, substance abuse and mental health treatments, and other needed services. Through these services, the redevelopment efforts should be expected to reduce the criminal activity of residents who live on site, making them less likely to commit crimes both in the target area and in nearby areas. In addition, with stricter criteria for residents who live in HOPE VI units, individuals on site are expected to be more responsible and less likely to commit crimes, regardless of whether they were previously residents of the site and accessed extensive service through HOPE VI or were simply new residents who met the more stringent criteria. In either case, the individuals in the target site would be less likely to commit crimes, and would be less likely to commit crimes in nearby areas, reducing the levels of crime in the buffer areas.

The delay in effects suggested by both the WDQ and the time series models should not be seen as a negative result of the redevelopment efforts. Instead, the Milwaukee site provided the purest assessment of the effects of the physical site changes on crime because the residents on site were largely the same before and after the intervention. The delay in the crime decrease identified supports the idea that it takes time for the physical changes to manifest themselves as changes in the quality of life in the area, here measured via crime levels. And when those changes started to take place, the effects got stronger and stronger—crime in the redevelopment site continued to drop at a faster pace to the end of the study period (see Figure 5.3). This is an important finding that helps to highlight the success of physical redevelopment alone.

7.1.2. Capitol Gateway

The results from Capitol Gateway were much more consistent than those from Milwaukee in that the different methods employed produced similar results. The initial descriptive analysis of crime in the site showed an obvious drop in crime starting at the beginning of redevelopment; a concurrent drop did not occur in the comparison area and it appeared that the buffers experienced smaller drops that occurred later in the study period. The point pattern analysis did not reveal any changes in the pattern of crimes from the period prior to redevelopment to the period following redevelopment. Table 7.1 indicates that the Capitol Gateway site had more large and positive WDQs than neutral or negative WDQs, providing evidence that diffusion of benefits took place. The WDQs indicated that the results varied with type of crime but the success measures were all negative, indicating a drop in crime in the target area. Property crimes in particular showed evidence of displacement early in the redevelopment period, but after the redevelopment period, showed strong evidence of diffusion of benefits. The initial displacement may have been an immediate reaction to the redevelopment activities that dissipated after all residents moved out and the site was empty. The success of the redevelopment efforts is found more in the consideration of crime at the site when residents move back in, and during that period, the WDQs all pointed to a diffusion of benefits. Results for personal crime and "all crime" also showed evidence of a diffusion of benefits, and that diffusion started immediately after redevelopment.

In Washington, D.C., more so than in Milwaukee, the residents of the redeveloped site were likely different than those who moved out prior to redevelopment. In all sites, and in HOPE VI in general, criteria to move into a redeveloped or new unit are much stricter than

for other public housing. This results in residents who are more likely to be "successful"—at maintaining a housing unit, finding and maintaining employment, or participating in governance of the development (as is required in Milwaukee). While we were not able to collect any data on residents' characteristics, we assume that with these kinds of stricter resident criteria in all three sites came less criminally inclined residents, and residents who had higher stakes in maintaining the safety and quality of their housing. The results observed in the Capitol Gateway site, then, where diffusion of benefits increased after residents moved back in, is likely one manifestation of the stricter resident criteria.

The time series analyses supported the WDQ findings; the models showed a significant and large drop in crime in the target area that was not experienced in the comparison area. The success of HOPE VI in reducing crime on site is even more remarkable when the increase in crime that the comparison area experienced over the same time period is considered; the drop in crime at the HOPE VI site occurred despite an increase in crime in similar sites elsewhere in the city. This is an indication that our findings quantifying the drop in crime are likely on the conservative side for Capitol Gateway.

The VAR results pointed to a diffusion of benefits from the target area to the buffer areas. The strongest effects were found in the 1000' buffer, and the 2000' buffer experienced small but significant drops in crime later in the study period. Because the time series models used "all crimes" as the dependent variable, no displacement of crime was identified early in the period (as was the case for property crimes according to the WDQs). The use of all crimes as the dependent variable may have served to mask the effects for property crime alone. As in Milwaukee, the HOPE VI efforts at the Capitol Gateway site were found to have both indirect and direct effects on the buffer areas, and the same arguments made above regarding both the criminal opportunity structure of the site before and after redevelopment and the criminal behavior of residents and other individuals on site before and after redevelopment both apply to Capitol Gateway as well.

Overall, the results found very positive effects in and around Capitol Gateway from the HOPE VI efforts. With more family units occupied each month, and additional redevelopment starting to take place in other areas surrounding the site, the benefits can be expected to continue for some time.

7.1.3. Capper/Carrollsburg

Like those from Capitol Gateway, the results from Capper/Carrollsburg were very similar across methods, and the results were similar to the findings from Capitol Gateway as well. All of the success measures calculated as part of the WDQ analysis were negative, indicating that crime did drop in the site during and after redevelopment. Nearly all of the WDQs themselves were positive, indicating that a diffusion of benefits took place from the target area to the buffers. Many of those WDQs were also larger than one, pointing to a large positive effect in the buffer areas (see Table 7.1).

The time series analysis confirmed the drop in crime identified through descriptive techniques and the WDQ. Similar to Capitol Gateway, crime at Capper/Carrollsburg dropped significantly and by a large amount each month, starting in the resident move-out period. The largest average monthly drops in crime occurred during the resident move-in period, with the second largest drops occurring in the stability period. In addition, the VAR revealed that the buffer areas experienced crime drops over the study period but that those did not appear to be associated with drops in the target area. Instead, the model indicated that the intervention itself affected crime in the buffers. These results are likely a result

of the larger, non-HOPE VI redevelopment projects taking place in the neighborhood of Capper/Carrollsburg.

Two important details of the Capper/Carrollsburg site should be kept in mind in interpreting the results. First, the timeline for both of the Washington, D.C., sites was much longer than for the Milwaukee site, meaning those sites had a longer time period with fewer residents on site. Given the lack of residents on site, combined with the construction efforts at each site—making the site unattractive in terms of criminal opportunity—it is not surprising that crime dropped earlier at the Washington, D.C., sites than in Milwaukee, where residents on site throughout redevelopment.

A second important feature of the Capper/Carrollsburg site, mentioned above, was the large amount of redevelopment not associated with HOPE VI that was going on in the area immediately surrounding the site. These efforts should have served to decrease criminal opportunity there, as well, preventing much displacement from taking place to the buffer zones surrounding the Capper/Carrollsburg site. Moreover, the redevelopment taking place in addition to HOPE VI can help to explain the interesting finding of a direct intervention effect on the buffers; it is more likely that the effect was the result of the *other* redevelopment, not the effect of HOPE VI itself. Therefore the VAR results should be interpreted with caution.

7.1.4. Summary of Results

The first two research questions, then, were answered through the analytic methods presented above. The first question, "Does the closing of a large high-poverty public housing development under HOPE VI influence patterns of crime in and around that development, and if so, how?" can be answered in the affirmative. We found a clear indication in all three sites that crime dropped at some point during redevelopment and that redevelopment affected crime in surrounding areas in some way—usually by decreasing it. The effects in the buffers varied, but for the most part, we observed a diffusion of benefits from the target sites outward. Additional investigation into subtypes of crime would help to bring more specificity to the results (e.g., whether any crime prevention methods implemented during redevelopment should target specific types of crimes that are more vulnerable to displacement).

The second question, "Does crime displacement or diffusion of benefits result during the time that the development is closed for rebuilding, and does crime return to previous levels when the development reopens?" was also answered fairly consistently across all three sites. As just stated, we found a consistent pattern of diffusion of benefits from such large-scale public housing redevelopment efforts. In addition, in no site did we find any return to pre-intervention crime levels following the intervention period. This indicates that the positive effects—the drops in crime—lasted at least as long as the study period, which was generally one to two years beyond the end of the intervention period in each site. It should be noted that with a small "post" period in each site, this study may have captured only the initial positive benefits of redevelopment. If those results were not maintained or did not last past the initial first wave of residents, that degradation of benefits was not captured. In other words, it may be that the first wave of residents who move into a new site are successful, but that once resident turnover begins—which is common in public housing units—the second wave of residents may not be as successful or the criteria may not be enforced as strictly, leading to conditions on the site slowly regressing to their initial state. While we have no evidence that this happened in any of the sites, this represents a

note of caution in interpreting the results based on the short post-intervention length.

7.1.5. Challenges

This research has highlighted many of the difficulties associated with the study of displacement in this context—from large-scale public housing redevelopment sites. Most previous displacement studies have focused on interventions associated with problem-oriented policing strategies, such as enhanced enforcement in a hot spot, or a small geographic area. Those types of interventions are usually short-term in nature, have clear start and end dates, and target clearly defined, small sites. The difficulties with applying the techniques and theories from that type of study to one like this where the intervention is long-term and takes place over a large geographic area should not be ignored. First, identifying the specific period of intervention is difficult—here, in each site we did our best to use the redevelopment timeline to make educated decisions about when the most intense changes on site occurred, and used that period as our intervention. In Milwaukee, where residents were on site while redevelopment took place, this was difficult, and we chose construction of the first new building as our intervention period. In Washington, D.C., where residents were not on site during redevelopment, we chose the period when residents were not on site as our intervention period.

Second, choosing the boundaries of the sites proved difficult, especially in Milwaukee, where one redevelopment project bled into another, and the process of redevelopment for each building or unit was intertwined with the others. We necessarily chose a large target site to encompass all redevelopment activities in Milwaukee, but the results indicated that there may have been differential effects from the redevelopment of each portion of the larger site (e.g., the effects of changes to Cherry Court may have been different from the effects of changes at Highland Gardens; see Section 7.1.1). In Washington, D.C., public housing site definition was more straightforward, but for Capper/Carrollsburg, nearby redevelopment efforts made the actual boundaries of redevelopment efforts difficult to identify.

Finally, identifying areas of possible displacement was also difficult. Resident data are notoriously hard to collect from housing authorities, and, while the two housing authorities consulted for this research were extremely helpful, we did not get any information on specific residents, including demographics or where residents moved when they were relocated from the site pre-redevelopment. This limited our ability to include any demographic data in the statistical models and to identify possible locations of crime displacement other than the buffer zones.

Nonetheless, studying displacement from public housing is an important undertaking, and the possibility of displacement should be considered by housing authorities either already undertaking such efforts or considering whether to start large-scale redevelopment. While this research showed that diffusion of benefits is likely from redeveloped public housing, more work of this type—exploring different options for target area boundaries, intervention periods, and displacement areas—can provide more evidence of the best approaches to this type of effort and inform housing authorities of the most efficient ways to include studies of displacement and diffusion in their redevelopment efforts.

7.2. COMPARISON OF METHODS

The third question is addressed here: "Do different methodologies for examining crime displacement and diffusion of benefits from public housing developments yield similar

results, and which is most appropriate for studying displacement in this context?" In addition to assessing the levels of displacement or diffusion of benefits that took place at the selected study sites, this research aimed to evaluate the methods employed to determine, first, the comparability of the results they produced and second, whether any one method was better for a specific context than another.

After using descriptive methods to determine that crime had indeed dropped in each site during the intervention period, we first employed a point pattern analysis to determine whether the pattern of crimes in each site had changed from before the intervention to during or after the intervention. If displacement had occurred, we expected the point pattern to reveal a change in the geographic pattern of crimes. In each site, we tested a number of different parameters for this method, including varying the number of random points used in each iteration and comparing different years for changes. For all three sites, the basic result was the same: we found no change in the pattern of crimes between any time points tested. The method was also time-consuming and the process was somewhat complicated to follow; while the actual calculations required were quite simple, the number of steps involved was extensive. In addition, depending on the number of crime points in the two time periods under comparison and the number of random points chosen for each iteration, the computational requirements could get quite heavy and could be a limiting factor for some researchers or practitioners.

One suggestion on implementation of the point pattern analysis may assist future users of the method. Ratcliffe's point pattern analysis seems best suited for small sets of crime points; the example offered in his presentation of the method considered only burglaries, and only covering a brief period of time. The resulting number of crime points was relatively small compared with those considered here. In addition, here, the points were contained in a much smaller area (Ratcliffe's work looked at burglaries over a whole city), meaning that there were more crimes in a smaller area—the patterns compared for this work were denser. With such a dense arrangement of crime points, any change in their pattern would be hard to detect statistically. This method thus seems best suited for looking at the distributions of single crime types of interest—aggravated assault, drug crimes, burglary—than at classes of crimes.

While the point pattern analysis is intended to provide evidence to researchers regarding whether or not a search for displacement effects should continue, we employed two additional methods despite the indication from the point pattern work that displacement had not occurred. We did this for comparison's sake, calculating multiple WDQs for each and developing ARIMA and VAR models for each site. The WDQ was found to be very simple to implement, and one big attraction was the ease in changing the parameters used in calculating the quotient, allowing a researcher to compare results for different areas and across different time periods in short order. The WDQ is very accessible, even to those without a statistics background, as it only employs simple arithmetic calculations. Interpretation of the results is straightforward as well. The WDQ results did differ from the point pattern results and indicated either a displacement or diffusion effect in all sites. One limitation of the WDQ is the relativity of the quotients; they cannot be used to quantify displacement or diffusion except in relation to changes in the target area. In addition, the quotient lacks statistical significance tests, limiting the ability of researchers to assess the accuracy of the results. The WDQ should be attractive to practitioners who are studying the effects of this type of redevelopment in their cities, as long as the method is used with the understanding that the results are descriptive.

The most statistically rigorous method was conducted last: time series analysis. Two

types of time series analysis were implemented here: a single series ARIMA model developed for both the target and comparison areas in both sites and a structural VAR, simultaneously solved for the target and two buffer areas. The single series ARIMA modeling efforts allowed us to confirm and quantify the drops in crime experienced in each site. The time series results confirmed what was found via the WDQ effort in most cases; the dependent variable used in the ARIMA modeling was "all crime" while the WDQ was calculated separately for the personal and property crime categories, to which most of the difference (where there was any) between the time series and WDQ results can be attributed. In all three sites, the ARIMA modeling efforts revealed drops in crime in the target area in different time periods of redevelopment in each site. The results pointed to the overall success of HOPE VI in the target areas themselves in terms of reducing crime levels there.

The VAR models were used to identify any displacement or diffusion that might have been taking place at each site. While most previous work on displacement employed simple before-and-after comparison methods, some researchers have used sophisticated regression techniques to study displacement. Lawton et al. (2005), for example, used ARIMA models to compare changes over time in a target and comparison area. The limitation of that approach, however, is that each series (target area and comparison area) is modeled separately, and the models do not explicitly account for what is happening in the other study area. VAR methods address that shortcoming, simultaneously solving equations for all three areas. The efforts result in estimates of the direct effects of the intervention on each area and the indirect effects of the target area on the buffers. This is a more satisfying method for studying displacement because it allows all the study areas to be connected, and allows a closer examination of the relationships between the areas under study. The methods, however, require skilled analysts familiar with both the redevelopment timelines at the site under study and the specific techniques required to implement a VAR model. This may be difficult for nonstatisticians to implement, despite the obvious benefits of its results.

For practitioners especially, we suggest that the WDQ is the most accessible and appropriate method for studying displacement. While the method is descriptive and lacks any tests of statistical significance, it is could easily be implemented by a housing authority or other practitioner looking to better understand displacement from public housing in his/her city. The level of resource commitment required by the WDQ is low; different parameters can easily be tested by anyone with a basic arithmetic aptitude, and extensive data holdings over several years are not necessary. Much as Ratcliffe suggests that the point pattern analysis be used as a descriptive, intermediate step in the study of displacement, we also suggest that the WDQ be used as a useful but descriptive and intermediate tool in studying displacement. The results of the WDQ can be used to inform expectations of more rigorous statistical testing but cannot be relied upon solely for quantifying displacement or diffusion.

Based on their associated statistical significance tests, we find the ARIMA and VAR models to be the most rigorous methods for examining possible displacement. If statistical analysts and extensive data covering a long time period are available, then, we suggest the combined use of single series ARIMA models and VARs in order to better quantify the size and timing of any displacement or diffusion effects that might have occurred. The VAR models were particularly well suited to the study of displacement, as they allowed consideration of crime in all three study areas at once. Future researchers should consider use of these models in order to better understand potential displacement or diffusion effects from a variety of different interventions.

7.3. CONCLUSION

This research sought to answer three main research questions about crime in an around public housing redeveloped under HOPE VI: did crime patterns change throughout the redevelopment period, did crime return to pre-redevelopment levels after residents moved back in, and how did the methods compare and which were best for different contexts? The results of the research provided solid answers to all three questions: the patterns of crime did indeed change, and while some limited indications of displacement were found for certain crimes and certain time periods in the sites, the overall effect was overwhelmingly one of a diffusion of benefits from the target area outward. We found no evidence that crime returned to pre-redevelopment levels, indicating that HOPE VI, at least in these three sites, had a positive effect on crime.

While the HOPE VI effort was certainly shown in this research to have significantly positive effects on crime, especially in the target sites themselves, not all credit for the changes in the surrounding areas can be directly attributed to HOPE VI. Statistically, we were unable to control for all other redevelopment efforts that were taking place in the areas surrounding the target sites: in Milwaukee, for instance, the city assembled non-HOPE VI funding for the redevelopment of Cherry Court, which was in the neighborhood of the two HOPE VI sites (Highland Gardens/Homes and the scattered sites), and in Washington, D.C., the area surrounding the Capper/Carrollsburg site concurrently underwent significant redevelopment with non-HOPE VI funds. We did not quantify these other efforts, and thus can only suggest that HOPE VI appeared to have a positive effect in the buffer areas. In these cases, however, the HOPE VI efforts can be seen as a catalyst or an early element of larger redevelopment plans for a neighborhood. The federal HOPE VI funds can be leveraged to draw funds from other sources to the neighborhood, allowing a greater level of redevelopment to take place. Thus, in the traditional sense of diffusion of crime reduction benefits from a site, HOPE VI cannot be given direct credit. But in the sense that HOPE VI funds allow a city to target the greater neighborhood for additional redevelopment, HOPE VI can be credited with a diffusion of benefits to areas outside the site.

While it cannot replace more rigorous statistical analyses and testing, the typical constraints felt by most practitioners on time and resources make the WDQ best suited for their context. The WDQ is intuitive, easy to calculate, and does not require a long series of data. It is appropriate for use in exploring the possible effects of an intervention to determine whether more sophisticated analyses are worthwhile. While there are drawbacks to the use of the WDQ—it is only descriptive, it can only indicate relative (not absolute) effect sizes, and it is dependent on the parameters selected (time periods and displacement areas selected)—it is nonetheless a useful intermediate tool in the study of displacement.

Where skilled statisticians are available and a quantification of the changes in crime levels is desired, the time series analyses methods presented here produce more rigorous results. Our results also demonstrated the desirability of the structural VAR over the traditional time series method typically used in displacement research—single series ARIMA modeling. The VAR was preferable based on the simultaneous modeling of the three study areas, as opposed to modeling each area individually.

The point pattern analysis had limited use in the present context, but we concluded that it would have more utility if a specific crime, such as homicide, robbery, or burglary, were studied as opposed to studying a class of crimes such as personal or property crimes. The method is also quite involved, but efficiencies are gained once analyses are set up for one context, making it easier to apply the method in additional contexts (e.g., for additional

time period comparisons, different areas/site boundaries, or types of crime).

Finally, a note about generalizability: to the extent that the three HOPE VI sites in two cities are representative of other actual and possible HOPE VI sites, the results are applicable to other public housing sites undergoing this type of large-scale redevelopment, especially given the comparability of results we found across sites *and* methods. The consistency with which we found evidence of diffusion from the sites is an indication that redevelopment under HOPE VI does indeed lead to diffusion of crime reduction, whether via changes directly attributable to HOPE VI in the target area or indirectly by encouraging additional investment in the larger neighborhood, leading to additional redevelopment efforts in areas surrounding the HOPE VI site itself. In addition, the sites studied presented a variety of characteristics: inclusion of the Milwaukee sites allowed a more pure test of the physical site designs because residents were largely the same before and after redevelopment, the Capitol Gateway site allowed an examination of changes in a site where there was actually little other redevelopment outside the site concurrently taking place, and Capper/Carrollsburg allowed an examination of effects where a massive amount of additional development was taking place. In all, the variety presented by the sites makes the results applicable to a number of other, similar sites. Additional research in this vein that confirms the results here would add to the case presented here for the positive effects of HOPE VI on target sites and on surrounding neighborhoods.

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