Mortgage Foreclosures and the Changing Mix of Crime in Micro-neighborhoods

Johanna Lacoe[1] and Ingrid Gould Ellen[2,3]

Abstract

Objectives: The main objectives of the study are to estimate the impact of mortgage foreclosures on the location of criminal activity within a blockface. Drawing on routine activity theory, disorder theory, and social disorganization theory, the study explores potential mechanisms that link foreclosures to crime. *Methods:* To estimate the relationship between foreclosures and localized crime, we use detailed foreclosure and crime data at the blockface level in Chicago and a difference-in-difference estimation strategy. *Results:* Overall, mortgage foreclosures increase crime on blockfaces. Foreclosures have a larger impact on crime that occurs inside residences than on crime in the street. The impact of foreclosures on crime location varies by crime type (violent, property, and public order crime). *Conclusions:* The evidence supports the three main theoretical mechanisms that link foreclosure activity to local crime. The investigation of the relationship by crime location suggests that foreclosures change the relative attractiveness of indoor and outdoor locations for crime commission on the blockface.

[1] Mathematica Policy Research, Inc., Oakland, CA, USA
[2] Robert F. Wagner Graduate School of Public Service, New York University, New York, NY, USA
[3] Furman Center for Real Estate and Urban Policy, New York University, New York, NY, USA

Corresponding Author:
Johanna Lacoe, Mathematica Policy Research, Inc., Oakland, CA, USA.
Email: lacoe@price.usc.edu

Introduction

In the wake of the housing crisis, there is growing concern that increased mortgage foreclosures may lead to physical deterioration of buildings and vacancy in neighborhoods, undermining neighborhood social controls, and increasing local crime. Recent research suggests that mortgage foreclosures in micro-neighborhoods cause modest increases in crime (Cui and Walsh Forthcoming; Ellen, Lacoe, and Sharygin 2013). In this article, we address the critical question of whether foreclosures generate spaces for criminal activity within micro-neighborhoods and therefore alter the spatial distribution of crimes. For instance, the presence of a vacant, foreclosed building may make it more likely that drugs will be sold inside the building rather than on the street. Using detailed foreclosure and crime data, we investigate whether foreclosures shift the location of criminal activity by changing the relative attractiveness to potential offenders of interior versus exterior locations.

This research focuses on Chicago, Illinois. In 2011, Chicago had the fourth highest violent crime rate among the nation's 20 largest cities[1] and the 11th highest foreclosure rate among the 100 largest metropolitan areas.[2] Media reports claim that foreclosed and abandoned buildings in Chicago have attracted criminal activity including gang activity, drug use, and burglaries, in addition to graffiti, and theft of copper pipes and radiators (Knight and O'Shea 2011). This study sheds new empirical light on the relationship between foreclosures and crime by examining how foreclosed buildings change the spatial distribution of crimes within micro-neighborhoods. Our measure of a micro-neighborhood is the blockface—a street segment in between the two closest cross streets.

Background: Theory and Literature Review

Existing Evidence

A growing literature has identified a cross-sectional correlation between mortgage foreclosure and crime at the county (Arnio, Baumer, and Wolff 2012; Baumer, Wolff, and Arnio 2012; Goodstein and Lee 2010) and neighborhood level (Immergluck and Smith 2006; Katz, Wallace, and Hedberg

2013; Payton, Stucky, and Ottensmann 2015; Stucky, Ottensmann, and Payton 2012; Teasdale, Clark, and Hinkle 2012). Providing compelling empirical evidence of a longitudinal association between foreclosures and neighborhood crime is more challenging. A few articles have used longitudinal data to try to identify a relationship. Two recent studies in Chicago come to different conclusions about the relationship between foreclosures and crime. Kirk and Hyra (2012) find no impact of foreclosures occurring between 2002 and 2009 on crime. Williams, Galster, and Verma (2014) find a short-term impact of foreclosures on property crime, but no association with violent crime. In both of these studies, the use of large units of geography—community areas that comprise approximately 10 Census tracts each—may mask significant micro-neighborhood level impacts.

Many past researchers have emphasized the empirical and theoretical significance of the choice of geographic unit of analysis (Braga and Weisburd 2010; Kirk and Laub 2010). The existing studies of foreclosures and crime rely on a range of units of analysis. Most authors make assumptions in their adoption of a particular geographic unit—for instance, that a county experiences uniform change in unemployment, foreclosures, and crime—that may not align with the theoretical mechanisms at play. Spatial heterogeneity within geographic units like counties or census tracts may mask significant findings on the micro level, leading researchers to promote the use of smaller geographies, such as the blockface (Smith, Frazee, and Davison 2000; Spelman, 1993; Taylor 1997). For example, recent research has identified significant variation in crime across street blocks in Seattle (Groff, Weisburd, and Yang 2010).

Several studies use smaller levels of geography. Stucky et al. (2012) investigate the relationship in Indianapolis, Indiana, using 1,000-foot square grid cells and annual measures of crime and foreclosure. They find that properties that are real estate owned (REO) or owned by the U.S. Department of Housing and Urban Development appear to increase some crime types but not others. In a second article, Payton et al. (2015) use 500-foot square grid cells and find significant associations between foreclosures and crime within 2,250 feet that fade with distance. In both articles, however, the grids may not reflect actual neighborhoods, and the use of annual data assumes that foreclosures have a one-year impact and does not account for the length of the foreclosure process or the timing of the effect on crime. Further, while the authors use a negative binomial fixed effects estimator, they only account for time-invariant characteristics of the grids and do not account for time-varying trends in the surrounding neighborhood that likely affect both foreclosures and crime.

Focusing on Glendale, Arizona, Katz et al. (2013) consider how monthly measures of REO properties affect crime at the census block level and find short-term increases in all types of crime following REO. Similarly, Cui and Walsh (Forthcoming) find that foreclosures that become vacant increase property and violent crime within 250-foot rings around the foreclosure in Pittsburg, Pennsylvania. Yet because these authors do not investigate the effects on crime prior to REO they might understate the relationship between foreclosures and crime. Finally, Ellen et al. (2013) analyze block-faces and find evidence that an increase in foreclosure notices on a block-face leads to additional crimes in New York City.

Although these studies collectively show that foreclosures can invite crime, they provide little insight into possible mechanisms and do not distinguish (either theoretically or empirically) between crimes that occur inside homes versus those that take place outside. Indeed, this distinction has only been made by a limited number of researchers. In their seminal work on routine activity theory, Cohen and Felson (1979) find differences between victimization at home, on the street, and elsewhere when calculating risk rates of victimization based on the number of hours spent in those locations. Research on spatial displacement investigates whether police interventions lower crime or just push it to nearby streets, but do not specify whether these interventions displace crime indoors (Weisburd et al. 2006). In a study of violence among women in indoor and outdoor prostitution venues in Chicago, Raphael and Shapiro (2004) find different types of crime victimization by indoor and outdoor location. Still, as Eck and Weisburd (1995:9) point out, existing studies "do not differentiate between offenses at the facility and those in the surrounding block," nor can they determine whether crime was committed inside a residence, or on the street.

In the case of foreclosures, distinguishing between interior and exterior crimes is critical, as one reason foreclosures may increase crime is through the increased presence of vacant buildings that may invite criminal activity (Kingsley, Smith, and Price 2009). For example, Spelman (1993) compares blocks with abandoned, unsecured buildings to similar blocks without abandoned buildings within one neighborhood in Austin, Texas. He finds evidence of illegal activity such as prostitution and drug deals, inside over 80 percent of the abandoned buildings surveyed. Further, blocks with unsecured vacant buildings experience twice the number of police calls for service as similar blocks with no unsecured buildings. Most research is limited by the inability to identify when properties in the foreclosure process become vacant. We too face this limitation, but unlike previous work, we are able to identify crimes that occur specifically within vacant or abandoned buildings.

Theory and Mechanisms

The three most prominent theories of criminal behavior that seek to explain where and when crime occurs are routine activity theory, disorder theory, and social disorganization theory. Routine activity theory suggests that crime occurs when the following three factors come together at a particular time and place: likely offenders, suitable targets, and the absence of capable guardians (Cohen and Felson 1979). The theory asserts that physical characteristics of buildings, streets, and neighborhoods, paired with the patterns of use of these places, affect whether and where crime will occur. A body of research addresses how the built environment, including nonresidential land uses such as schools, businesses, and parks, affects disorder and crime in neighborhoods (Bernasco and Block 2009; Booth 1981; Eck and Weisburd 1995; Kurtz, Koons, and Taylor 1998; McCord et al. 2007; Stucky and Ottensmann 2009; Wilcox et al. 2004). Although not specifically situated within the routine activity literature, empirical evidence on how land use affects crime provides additional insight into how the design and use of physical space contributes to the presence of likely offenders and suitable targets (i.e., commercial business areas with access to public transit have higher daytime foot traffic, increasing the pool of potential victims and offenders; summarized by Eck and Weisburd 1995).

By contrast, disorder theory and the incivilities thesis highlight the relationship between physical disorder and crime (Sampson and Raudenbush 1999; Taylor 1999; Wilson and Kelling 1982). According to these theories, the presence of physical disorder such as unmaintained yards, graffiti, and vacant buildings increases both crime rates and perceptions of crime and safety as problems among neighborhood residents (Taylor 2009). In particular, the "broken windows" theory suggests that neighborhood disorder begets more serious criminal activity (Wilson and Kelling 1982). However, several studies seeking to find empirical support for broken windows theory have failed to do so (Harcourt 2001; Harcourt and Ludwig 2006; Sampson and Raudenbush 1999), and some have asserted that disorder does not cause crime, but rather that both are generated by the same underlying processes (Taylor 2009).

Although routine activity theory and disorder theory mostly focus on how the physical environment shapes social interactions, social disorganization theory emphasizes how neighborhood social and demographic characteristics, in particular, residential instability, low socioeconomic status, and ethnic heterogeneity, challenge the ability of neighborhood residents to organize themselves successfully against disorder, contributing to higher

crime rates (Shaw and McKay 1969 [1942]). Several related concepts have been developed and applied to further test how neighborhood factors affect crime, including informal social control, social interaction/social ties, and collective efficacy (summarized by Sampson, Morenoff, and Gannon-Rowley 2002). Further, several studies identify a reciprocal effect of social control and disorder, in which neighborhoods lacking strong social cohesion and informal social control experience greater disorder, which causes residents to move, further degrading the ability of the remaining community to protect against crime (Dugan 1999; Steenbeek and Hipp 2011; Xie and McDowall 2008).

Mortgage foreclosures have the potential to change both the physical space and the social dynamics of a neighborhood. A foreclosed property may increase crime by providing a new target for crime. The property, particularly if left vacant, may be a primary target for the theft of copper piping and vandalism or a haven for other types of crimes that might otherwise occur on the street, such as prostitution or drug use. In this way, crime may be displaced from the street inside foreclosed buildings. Foreclosures can also increase vacancy rates as lenders take over properties from delinquent borrowers. These changes may make the foreclosed building or the street itself a more "suitable" target for crime and may also send a signal to offenders that residents are not closely monitoring their communities. Further, properties in foreclosure are often spatially clustered (i.e., Kaplan and Sommers 2009), and the concentration of foreclosures may aggravate neighborhood crime dynamics. For instance, the presence of multiple "target" homes for crime may increase the value of committing crime on the block, relative to blocks with fewer foreclosed homes (Taylor 2009).

Foreclosures may also increase overall crime by weakening social control among neighborhood residents and decreasing the community's ability to defend against crime. When owners know they are likely to lose their home, they may be become less invested in the community and less engaged in social activities. Further, the number of capable guardians on the street is reduced when residents move because of a foreclosure and homes sit vacant. Therefore, disengagement and heightened turnover due to foreclosure may reduce social cohesion in a neighborhood. Unmaintained lawns, broken windows, and other signs of disrepair and disorder can signal to offenders that the likelihood of getting caught committing a crime in the neighborhood is lower on this block, compared to nearby blocks. This externality effect of foreclosure can extend beyond the foreclosed building itself and increase crime

along the entire block, both inside and outside. In fact, one study finds that foreclosures increase social disorder in the short term in block groups prior to the housing crisis (Wallace, Hedberg, and Katz 2012).

There are theoretical reasons to expect the impact of foreclosure to vary by crime type. Foreclosures may invite more public order and violent crimes, but may not change property crime levels. When homes are vacant and abandoned through foreclosures, they may become less attractive targets for theft because they contain fewer items of value. On the other hand, they may become a more attractive space for public order crimes such as trespassing, prostitution, drug crimes, and vandalism. Further, fewer people on the street and in homes watching the neighborhood may result in more robberies or assaults. For these reasons, we expect foreclosures to increase both violent and public order crime, but the predicted relationship between foreclosures and property crime is unclear. The growing body of literature on foreclosures and crime finds variation in the relationship by crime type, with some articles finding effects for violent crime but not property crime (Ellen et al. 2013; Immergluck and Smith 2006), others finding effects only on property crime (Arnio et al. 2012; Goodstein and Lee 2010; Williams et al. 2014), and others finding effects on both types of crime (Cui and Walsh Forthcoming; Payton et al. 2015). The variation in results is likely driven by differences in the geographic unit of analysis and the econometric methods employed.

It follows that the relationship between foreclosures and crime location may also differ by crime type. If foreclosures do not change the overall attractiveness of a blockface for the commission of property crime (i.e., overall property crime does not change), the presence of foreclosed buildings may still influence where property crimes occur *within* the blockface. The effect may work in either direction—foreclosures may increase property crimes that occur inside versus on the street (because of the safe haven provided by the foreclosed property), or increase property crimes on the street and decrease those occurring indoors (due to a decrease in ''eyes on the street'' to discourage crime). We build from this theoretical foundation to shed light on the dynamic relationship between foreclosures and crime in micro-neighborhoods.

Research Design

This article addresses two central research questions. First, do foreclosures change micro-neighborhood crime patterns in Chicago? Second, do

foreclosures change the spaces in which crimes occur within micro-neighborhoods? Our main models of the relationship between foreclosures and crime use a negative binomial estimator. We use a quarterly model of the impact of foreclosure starts on crime, instead of an annual model, which allows us to closely observe the timing of the foreclosure notice and changes in crimes that occur during the foreclosure process (which takes an average of one year to complete in Chicago). Intuitively, the approach compares changes in crime counts on a blockface that experiences an increase in foreclosure activity, to changes in crime counts on other block-faces in the same quarter that did not experience the same jump in foreclosure activity. Specifically, we estimate the following baseline negative binomial regression model:

$$y_{bnt} = \alpha + \beta_1 X_{1bt} + \beta_2 X_{2nt} + T_t + B_b + \varepsilon_{bnt}, \tag{1}$$

where y_{bnt} is the count of crime (by crime type) on the blockface, b, in a given quarter, t. The variable of interest is X_{1bt}, the number of foreclosures starts on the blockface in past four quarters. Blockface fixed effects, B_b, control for time-invariant characteristics of blockfaces. In addition, we control for the quarterly census tract population, extrapolated from the U.S. Census in 2000 and 2010, to control for neighborhood-level (n) population changes (X_{2nt}).[3] Finally, the models include quarter fixed effects to capture city-level factors that might be changing over time, such as policing strategy or reporting of crime statistics. Separate models are estimated by crime type, namely, total, violent, property, and public order crime, and standard errors are clustered at the census tract level. We also estimate models by crime location (street, residence, abandoned/vacant building, and other locations) to investigate whether foreclosures shift the location of crime on the blockface.

At very small levels of geography, it can be a challenge to control for characteristics of the area that may contribute to foreclosure activity and crime. As a robustness test, we use fine spatial and temporal fixed effects to control for micro-neighborhood characteristics and localized time trends that may confound the relationship between foreclosures and crime on the blockface. We estimate the following ordinary least squares (OLS) model:

$$y_{bdnt} = \alpha + \beta_1 X_{1bdnt} + \beta_2 X_{2nt} + T_{dt} + B_b + \varepsilon_{bdnt}, \tag{2}$$

where y_{bdnt} is the count of crime (by crime type) on the blockface, b, within neighborhood, n, and police district, d, in a given quarter, t. The variable of interest remains X_{1bdnt}, the number of foreclosures starts on the blockface in

past four quarters. The models include blockface fixed effects, B_b, and quarterly neighborhood population at the census tract level (X_{2nt}). The OLS models also include quarterly time trends at the level of the police district (T_{dt}) to control for factors that are changing over time which may affect both foreclosures and crime, such as changes in employment, policing strategy, or population demographics.[4] The inclusion of these controls allows us to compare changes in crime on a blockface to changes in crime on the blockfaces that are within the same police district, in a given quarter.

As an additional robustness test, we estimate models of the relationship between foreclosures and crime by crime location, relative to all other crime activity on the blockface. These models, which build on the baseline OLS model in equation (2), are estimated for crimes occurring on the street, inside residences, in vacant buildings, and in other locations, and include a measure of total crime as a control. Therefore, they provide insight into whether foreclosures are related to overall increases in crimes in certain locations on a blockface or changes relative to crimes occurring in other locations on a blockface.[5] We also estimate these models by crime type and location.

Data and Measures

We use point-specific data on foreclosures and crime to create a blockface-level data set with quarterly observations from 2007 through 2011.

Crime Measures

The crime data come from the Chicago Police Department and include geographic coordinates, date and time, crime descriptions, and information about the location where the offense occurred. We use records from 2007 through 2011 to construct quarterly counts of total, violent, property, and public order crime at the level of the blockface. Violent crimes include homicide/murder, assault, battery, robbery, felony weapons violations, and criminal sexual assault. Property crimes include burglary, theft, motor vehicle theft, criminal damage, and arson. Foreclosure activity may also affect less serious criminal behavior, such as graffiti, drug use and sales, and prostitution. These lower-level offenses are grouped into a "public order" category that includes criminal trespass, liquor law violation, narcotics, obscenity, offenses involving children, prostitution, public peace violations, indecent exposure, and weapons violations. All remaining crimes are categorized as "other."[6]

The specific location of a crime—whether it occurs indoors or out-doors—may have implications for the neighborhood and for policing strategy. The location of each reported crime is included in the crime data. We estimate the impact of foreclosures on crimes that occur in four mutually exclusive locations, namely, in the street or on a side-walk, inside residences, inside vacant or abandoned buildings, and in all other locations.[7] Patterns of crime location do not vary much by crime type: Street crimes are comprised of 28 percent violent crimes, 47 percent property crimes, and 21 percent public order crimes. For crimes occurring inside residences, the shares of crimes by type are similar— 28 percent are violent crimes, 45 percent are property crimes, and 23 percent are public order crimes. However, of crimes occurring in vacant buildings, a smaller share are property crimes (35 percent, compared to 47 percent on the street and 45 percent inside), and a larger share are public order crimes (34 percent, compared to 21 percent on the street and 23 percent inside).

Foreclosure Measure

The foreclosure data include all notices of foreclosure filed between 2006 and 2011 in Chicago from Record Information Services. Illinois is a judicial foreclosure state, and the foreclosure process takes a min-imum of nine months from filing to eviction, unless the borrower pro-tests the foreclosure in court, extending the process. For properties entering foreclosure in Chicago between 2006 and 2011, the average time to reach the conclusion of the foreclosure process, be it a short sale, sale at auction to a third party, or bank ownership (REO), is just over one year (376 days). Based on this average, the primary indepen-dent variable used in the analysis is the number of foreclosure starts in the past four quarters. This measure captures the stock of properties in the foreclosure process in a given quarter.

Geographic Unit of Analysis

Although crime declined in Chicago between 2007 and 2011, the city-wide crime rate masks considerable variation in crime patterns at lower levels of geography. For instance, during this period, 20 percent of the blockfaces in Chicago experienced increases in crime, 31 percent expe-rienced decreases in crime, and 49 percent experienced no change at all. To investigate changes in crime at the subneighborhood level, we create

Table 1. Mean Foreclosures and Crimes by Year.

Blockface-quarter Average	Year					Total
	2007	2008	2009	2010	2011	
Foreclosure measure						
Foreclosure starts	0.10	0.14	0.15	0.15	0.13	0.13
Crime measures						
Total crime	0.95	0.93	0.86	0.81	0.76	0.86
Crime type						
Violent crime	0.28	0.27	0.25	0.24	0.22	0.25
Property crime	0.40	0.41	0.37	0.35	0.34	0.37
Public order crime	0.24	0.21	0.20	0.19	0.17	0.20
Other crime type	0.04	0.04	0.03	0.03	0.03	0.03
Crime location						
Street	0.40	0.39	0.35	0.34	0.32	0.36
Residence	0.29	0.29	0.27	0.25	0.24	0.27
Vacant building	0.004	0.004	0.005	0.006	0.002	0.004
Other location	0.26	0.25	0.23	0.21	0.20	0.23

a map of 118,276 blockfaces in Chicago based on street files and geo-code each foreclosed property and crime to a blockface. For intersection crimes, we draw 40-foot buffers around each intersection and assign the crimes that fall within the buffer to each blockface that touches the intersection. We do this because a crime occurring in an intersection could legitimately be affected by a foreclosure on any of the adjoining blockfaces. The resulting "double-counting" of crimes in the data is not a concern because crimes near foreclosures should not be more likely to be in intersections than crimes that are not near foreclosures. After geo-coding, we aggregate the crime and foreclosure counts to the blockface by quarter. On average, there are 0.86 crimes and 0.13 fore-closure starts (in the past four quarters) on blockfaces in a given quarter (Table 1).

Results

Our regression analyses confirm that foreclosures are related to increases in total crime on blockfaces in Chicago. Further, we uncover significant variation in the impact of foreclosures on crime location.

Table 2. Impact of Foreclosure Starts on Total Crime, Negative Binomial (2007–2011).

DV: Total Crime Variables	(1) Raw	(2) Quarter FE	(3) + Blockface FE
(a) Model parameters			
Foreclosure starts	0.590***	0.591***	0.0114***
	(0.013)	(0.013)	(0.001)
Tract population	−1.29e−05	−1.33e−05	4.11e−05***
	(0.000)	(0.000)	(0.000)
Constant	0.0159	0.0506	1.792***
	(0.0390)	(0.0406)	(0.0123)
(b) Estimated incident rate ratio			
IRR for one additional foreclosure (99% CI)	1.803	1.806	1.011
Observations	1,755,260	1,755,260	1,636,360
Log likelihood	−2.359e+06	−2.356e+06	−1.445e+06
χ^2	2,039	5,718	18,008
Quarter FE	No	Yes	Yes
Blockface FE	No	No	Yes
Number of blockfaces	N/A	N/A	81,818

Note: DV = dependent variable; FE = fixed effect; N/A = not applicable; IRR = incident rate ratio.
***$p < .01$. **$p < .05$. *$p < .1$.

Negative Binomial Results

The first set of results in Table 2 present coefficients from the baseline negative binomial model. The coefficients on the foreclosure starts measure are positive and significant, and robust to the addition of blockface fixed effects and controls for citywide time trends. The first specification presents the raw relationship between foreclosure starts and total crime. The model is strengthened by the addition of quarter fixed effects to control for citywide time changes in the housing market and in crime patterns (column 2), and blockface fixed effects to control for time-invariant characteristics of the blockface (column 3). The estimated incident rate ratios for the coefficient on foreclosures are presented below the point estimates (row b) in each table. In the preferred model, specification 3, an additional foreclosure increases total crime on the blockface by a factor of 1.011.

Foreclosures in Chicago are associated with increases violent, property, and public order crime on the blockface. Table 3 shows results by crime

Table 3. Impact of Foreclosures Starts on Crime, by Crime Type, Negative Binomial (2007–2011).

Variables	(1) Total Crime	(2) Violent Crime	(3) Property Crime	(4) Public Order Crime	(5) Other Crime Type
(a) Model parameters					
Foreclosure starts	0.0114***	0.00903***	0.00761***	0.0155***	0.000989
	(0.001)	(0.00188)	(0.00172)	(0.00230)	(0.00624)
Tract population	4.11e−05***	2.49e−05***	8.12e−06**	4.91e−05***	2.08e−05**
	(0.000)	(4.78e−06)	(3.36e−06)	(3.58e−06)	(8.42e−06)
Constant	1.792***	1.693***	1.686***	0.980***	0.735***
	(0.0123)	(0.0241)	(0.0191)	(0.0183)	(0.0479)
(b) Estimated incident rate ratio					
IRR for one additional foreclosure	1.011	1.009	1.008	1.016	NS
Observations	1,636,360	1,156,760	1,393,280	1,112,340	509,060
Log likelihood	−1.445e+06	−685,244	−954,515	−594,183	−153,385
χ^2	18,008	9,035	9,691	5,113	1,050
Quarter FE	Yes	Yes	Yes	Yes	Yes
Blockface FE	Yes	Yes	Yes	Yes	Yes
Number of blockfaces	81,818	57,838	69,664	55,617	25,453

Note: Standard errors in parentheses. FE = fixed effect; NS = not significant; IRR = incident rate ratio.
***$p < .01$. **$p < .05$. *$p < .1$.

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Table 4. Impact of Foreclosures Starts on Total Crime, by Crime Location, Negative Binomial (2007–2011).

| | (1) | (2) | (3) | (4) |
| | | | | Other |
	Street	Residence	Vacant	Location
(a) Model parameters				
Foreclosure starts	0.00552***	0.0120***	0.0111	0.00613
	(0.00169)	(0.00165)	(0.00976)	(0.00378)
Tract population	1.76e−05***	1.25e−05***	−6.96e−05**	5.38e−05***
	(3.76e−06)	(4.43e−06)	(3.21e−05)	(3.56e−06)
Constant	1.681***	1.705***	−0.172	1.299***
	(0.0198)	(0.0245)	(0.159)	(0.0186)
(b) Estimated incident rate ratio				
IRR for one additional foreclosure	1.006	1.012	NS	NS
Observations	1,495,260	977,260	109,720	896,340
Log likelihood	−960,551	−672,462	−24,508	−491,500
χ^2	16,005	4,017	1,020	3,603
Quarter FE	Yes	Yes	Yes	Yes
Blockface FE	Yes	Yes	Yes	Yes
Number of blockfaces	74,763	48,863	5,486	44,817

Note: Standard errors in parentheses. FE = fixed effect; NS = not significant; IRR = incident rate ratio.
***$p < .01$. **$p < .05$. *$p < .1$.

type using the blockface fixed effects specification that controls for city-wide time trends. The association with foreclosures is largest for public order crime (an additional foreclosure increases the rate of public order crime on the blockface by a factor of 1.016), compared to increases in the rate of violent and property crime (factors of 1.009 and 1.008, respectively).

Foreclosures also appear to influence where crimes occur. If a property going through foreclosure becomes a more attractive or suitable target for crime, we expect to see more crimes occur inside buildings on blockfaces with foreclosures. The results in Table 4 show that the largest increase in total crime occurs inside residences (an increase by a factor of 1.012), compared to the increase in crime on the street that occurs following an additional foreclosure start (an increase of a factor of 1.006). These models show no statistically significant increase in crimes within vacant buildings or other locations.

When crime type and location are considered together, three primary patterns emerge. First, the primary increases in crime occur inside residences. As shown in Table 5, foreclosures are related to increases in violent, property, and public order crimes that occur indoors. Further, while foreclosures are associated with increases in violent and public order crime on the street, the association is stronger for crimes that occur indoors. This may reflect a change in the opportunity presented by the foreclosure for the commission of these crimes, shifting them inside residences and away from the street or other locations.

Second, the only link between foreclosure and property crime is for property crimes inside residences, with no association between foreclosure and property crimes on the street or in any other location. Property crime indoors increases by a factor of 1.011 following an additional foreclosure start. In other words, foreclosures appear to increase property crime that occurs indoors, such as stolen copper piping or other goods from inside the home, but do not change the level of property crime occurring elsewhere (such as motor vehicle theft).

Third, when we consider public order crimes, we see increases in almost every location. Consistent with our theory, the physical and social disorder that may accompany a building in foreclosure and the surrounding properties is related to the largest, most consistent increases in public order crime regardless of location.

Finally, in both Tables 4 and 5, we find consistent positive coefficients on foreclosures in the models of crime in vacant and abandoned buildings that do not reach statistical significance. This may be due to the low frequency of reported crimes within vacant buildings (the average blockface-quarter crime level in vacant buildings is 0.004), as we will discuss in detail in the Discussion section. The negative binomial models do not tell us whether the level of crime in vacant buildings has changed relative to overall crime levels on the blockface. We address this issue in the OLS models presented next.

OLS Results

As discussed in Guimarães and Portugal (2009), there is no simple solution to estimating nonlinear models with two high-dimensional fixed effects. We recognize that appropriately modeling the large number of blockfaces with zero crimes is a significant benefit of using the negative binomial estimator. Since we are not able to estimate negative binomial models with two high-dimensional fixed effects, we present OLS models with both blockface

Table 5. Impact of Foreclosure Starts on Crime, by Type and Location, Negative Binomial (2007–2011).

	(1)	(2)	(3)	(4)
	Street	Residence	Vacant	Other Location
A. Violent crime				
(a) Model parameters				
Foreclosure starts	0.00684**	0.00970***	0.0313	−0.0169**
	(0.00270)	(0.00255)	(0.0292)	(0.00718)
Tract population	4.88e−06	1.75e−05**	−0.000145	1.37e−05*
	(9.54e−06)	(8.33e−06)	(0.000207)	(7.40e−06)
(b) Estimated incident rate ratio	1.007	1.010	NS	0.983
Observations	972,380	625,880	21,780	440,820
Log likelihood	−413,736	−313,333	−3,534	−176,299
χ^2	11,494	1,861	236.0	1,172
Number of blockfaces	48,619	31,294	1,089	22,041
B. Property crime				
(a) Model parameters				
Foreclosure starts	0.00144	0.0113***	0.0129	0.00841
	(0.00258)	(0.00240)	(0.0137)	(0.00532)
Tract population	−1.77e−05***	8.84e−06	−7.71e−05*	1.60e−05***
	(5.73e−06)	(6.13e−06)	(4.65e−05)	(4.90e−06)
(b) Estimated incident rate ratio	NS	1.011	NS	NS
Observations	1,187,300	807,180	72,380	711,920
Log likelihood	−559,884	−415,447	−13,360	−324,965
χ^2	6,540	2,233	737.3	2,566
Number of blockfaces	59,365	40,359	3,619	35,596
C. Public order crime				
(a) Model parameters				
Foreclosure starts	0.0104***	0.0134***	0.0119	0.0157**
	(0.00306)	(0.00344)	(0.0158)	(0.00755)
Tract population	3.58e−05***	1.64e−05**	−2.35e−05	5.96e−05***
	(5.05e−06)	(7.31e−06)	(4.31e−05)	(6.57e−06)
(b) Estimated incident rate ratio	1.010	1.013	NS	1.016
Observations	875,460	576,260	42,480	408,240
Log likelihood	−368,730	−230,322	−8,895	−144,173
χ^2	3,568	1,617	288.8	823.3
Number of blockfaces	43,773	28,813	2,124	20,412

(continued)

Table 5. (continued)

	(1)	(2)	(3)	(4)
	Street	Residence	Vacant	Other Location
D. Other crime type				
(a) Model parameters				
Foreclosure starts	−0.00306	−0.000969	−0.0206	0.00956
	(0.0112)	(0.00847)	(0.0731)	(0.0162)
Tract population	9.29e−05***	4.50e−05*	−0.00137	−9.44e−07
	(3.08e−05)	(2.62e−05)	(0.00114)	(9.29e−06)
(b) Estimated incident rate ratio	NS	NS	NS	NS
Observations	180,960	280,420	2,680	219,480
Log likelihood	−36,511	−61,323	−405.0	−69,571
χ^2	1,165	237.4	21.82	390.8
Quarter FE	Yes	Yes	Yes	Yes
Blockface FE	Yes	Yes	Yes	Yes
Number of blockfaces	9,048	14,021	134	10,974

Note: Standard errors in parentheses. NS = not significant; FE = fixed effect.
***$p < .01$. **$p < .05$. *$p < .1$.

fixed effects and Police District × Year × Quarter Fixed Effects as a point of comparison.[8] These models also include tract-level population, extrapolated to the quarter. An additional feature of the OLS models is the ability to estimate the relationship between foreclosures and crime in a particular location, such as the street, relative to crimes occurring in other locations on the blockface. To do this, we include a measure of the crime in all locations by type as a control in these models. For example, in the model of foreclosures and street crimes, we control for total crime on the blockface as an independent variable. By including this variable, the coefficient on foreclosure starts can be interpreted as an increase in crime at a particular location (i.e., in the street) relative to the overall change in crime—or in other words, a shift in the location of crime.

Table 6 adds some nuance to the story told by the negative binomial results, by highlighting the relative changes in different locations. First, foreclosures are primarily associated with increases in indoor crime. In fact, as panel A shows, there is no association between foreclosures and total crime in the street or inside vacant buildings.

Table 6. Impact of Foreclosure Starts on Crime, by Type and Location, OLS (2007–2011).

	(1) Street	(2) Residence	(3) Vacant	(4) Other Location
A. Total crime				
Foreclosure starts	0.00231	0.00680*	0.000670	−0.00978*
	(0.00230)	(0.00337)	(0.000394)	(0.00410)
Total crime	0.326***	0.289***	0.00533***	0.380***
	(0.0217)	(0.0392)	(0.000719)	(0.0570)
Tract population	−0.0000177	−0.0000173	−0.00000229	0.0000374
	(0.0000155)	(0.0000202)	(0.00000120)	(0.0000327)
Observations	1,754,940	1,754,940	1,754,940	1,754,940
R^2	.845	.855	.188	.888
B. Violent Crime				
Foreclosure starts	0.000961	0.00260	0.000286*	−0.00385***
	(0.00124)	(0.00144)	(0.000120)	(0.000979)
Total violent	0.383***	0.334***	0.00291***	0.280***
	(0.00461)	(0.00802)	(0.000515)	(0.0119)
Tract population	−162,597.0	−210,064.7	−2,593.5	282,530.5
	(177,282.1)	(281,129.2)	(2,870.4)	(222,067.6)
Observations	1,755,260	1,755,260	1,755,260	1,755,260
R^2	.744	.739	.088	.754
C. Property Crime				
Foreclosure starts	−0.00311**	0.00359*	0.000397	−0.000876
	(0.00118)	(0.00142)	(0.000279)	(0.00110)
Total property	0.311***	0.316***	0.00600***	0.367***
	(0.0113)	(0.0330)	(0.000648)	(0.0418)
Tract population	−29,386.5	−59,824.7	2,565.1	46,952.2
	(43,457.1)	(39,942.7)	(8,395.6)	(45,518.8)
Observations	1,755,260	1,755,260	1,755,260	1,755,260
R^2	.732	.788	.126	.886
D. Public order Crime				
Foreclosure starts	0.00284	0.00151	0.0000201	−0.00437*
	(0.00166)	(0.00123)	(0.000282)	(0.00175)
Total public order	0.379***	0.173***	0.00577***	0.442***
	(0.0423)	(0.0388)	(0.000686)	(0.0697)
Tract population	−398,491.6	−349,560.9	−2,341.6	1,434,914.1
	(362,022.3)	(360,843.1)	(2,213.7)	(1,418,090.1)
Observations	1,755,260	1,755,260	1,755,260	1,755,260
R^2	.761	.634	.164	.804
District × Quarter FE	Yes	Yes	Yes	Yes
Blockface FE	Yes	Yes	Yes	Yes

Note: Clustered standard errors in parentheses. FE = fixed effect; OLS = ordinary least squares.
***$p < .01$. **$p < .05$. *$p < .1$.

Second, there is one key point of divergence between the OLS and the negative binomial results. When we consider the impact of foreclosures on the location of violent crime relative to all other crimes of that type (panel B), we find that the only increase in violent crime occurs within vacant or abandoned buildings (a 53.2 percent increase from the blockface mean). Because buildings in foreclosure are more likely to be vacant than buildings that are not in foreclosure, this suggests that foreclosed and vacant buildings present attractive locations for the commission of violent crimes, relative to other locations on a blockface, or other blockfaces within a police district.

Third, although there is a small overall association between foreclosures and property crime (an increase of 4.1 percent from the blockface mean),[9] foreclosures also appear to shape where property crimes occur (panel C). Following an additional foreclosure start, we estimate a relative increase in property crimes occurring indoors (consistent with the negative binomial results), and a concurrent decrease in property crimes that occur on the street (relative to property crimes occurring elsewhere). These results suggest that foreclosures shift the location of property crimes from the street to indoor locations.

Finally, although Table 5 revealed that foreclosures are most strongly associated with public order crime (an increase of 6.4 percent from the blockface mean), there is no effect of foreclosures on the relative location of public order crimes. In other words, following a foreclosure, public order crime increases in all locations within the blockface.

In a final set of robustness tests, we take several approaches to controlling for the dynamic relationship between foreclosures and crime across space using an OLS estimator.[10] To address the concern that foreclosures on nearby blockfaces may influence crime on the central blockface, we estimate the relationship between foreclosures that occur on surrounding blockfaces and crime on the central blockface, and find no statistically significant association. Next, because the processes that generate crime may operate on a scale larger than a single blockface, we control for the number of crimes on nearby blockfaces in the baseline models presented previously, and find that the main result is unchanged by the inclusion of controls for concurrent nearby crime. Finally, to address another element of the spatial relationship between foreclosures and crime, we explore whether foreclosures are related to increases in crime on nearby blockfaces, and we find no evidence of crime spillovers. These analyses bolster our use of the blockface as the primary unit of analysis by providing evidence of the localized association between foreclosures on crime.

Discussion

Increasingly, researchers are exploring the ways in which routine activity, disorder, and social disorganization theories complement one another and enrich our understanding of where crime occurs (Rice and Smith 2002). In this article, we extend these theoretical perspectives to investigate the mechanisms that may link foreclosure activity to local crime. We find support for the primary theories of crime location.

Our results suggest that foreclosures change the relative attractiveness of indoor and outdoor locations for crime commission on the blockface, consistent with routine activity theory. Increases in crime indoors suggest that foreclosures on a blockface make indoor locations more attractive locations for public order and property crimes relative to all other locations. The estimated decrease in property crimes on the street suggests that offenders are selecting to commit these types of crimes indoors in the presence of a foreclosure, instead of on the street.

The relative increase in violent crime within vacant buildings in the OLS models provides suggestive evidence of a mechanism through which foreclosures might invite crime, if one believes that foreclosed properties are the most likely to be vacant. The overall increases in public order crime on blockfaces that experience foreclosure, but no significant effect on the location of public order crimes within blockfaces are consistent with social disorganization theory. Social disorganization and disorder theories might predict foreclosures to increase crime in all locations due to changes in the social makeup of the neighborhood that allow disorder to accumulate. The presence of disorder can foster the perception that the space is unguarded making it an attractive target for crime. If foreclosures increase disorder, when coupled with residential turnover and periods of vacancy it may further weaken social controls and contribute to the increases in public order crime that we observe. Although these analyses are not meant to be definitive theoretical tests, each theory illuminates aspects of the relationship between foreclosures and crime in micro-neighborhoods.

Reporting

The primary limitation posed by this study is potential bias in reported crime. Many fewer crimes are reported to police than occur according to victimization surveys (Hart and Rennison 2003). However, residential turnover due to foreclosure may result in vacant buildings and fewer

residents to report local crime. If crimes are more likely to go unreported in areas with foreclosures, the increases in crime found here are likely underestimates of the true impact of foreclosure.

Second, patterns of crime reporting may also differ by crime location—crimes occurring inside residences may be less likely to be reported to police than crimes that occur on the street. It is more difficult to observe and police crimes that occur indoors, and police rely more heavily on citizen reports which are fewer where foreclosures are abundant and many homes go to auction, revert to bank-ownership status, and sit vacant. Therefore, estimates of the impact of foreclosure on crimes inside residences are also likely to be underestimates.

Third, crimes in vacant buildings may be the least likely to be reported. Since we do not know for certain which foreclosures result in vacancy, we cannot pinpoint whether foreclosure leads to an increase in crime in the foreclosed building itself. Although our use of data that reflects crimes reported in vacant buildings is an advance over previous work, we expect that the impacts of foreclosures on crime in vacant buildings are understated.

Fourth, criminological research has long identified issues with reporting lower-level offenses, such as public order crime. Patterns of crime reporting are known to differ by crime type, with more accurate reporting of crimes that have clear victims (i.e., homicides) or incentives for reporting (i.e., motor vehicle theft for insurance purposes; Skogan 1974, 1975), and less reliable reporting for lower-level crimes that may go unobserved or do not have clear victims (such as drug crimes or prostitution; Hart and Rennison 2003). For instance, Hart and Rennison (2003) use the National Crime Victimization Survey and find that the reporting rate for serious violent crime is 57 percent, compared to burglary (53 percent), and motor vehicle theft (81 percent), with the lowest rates for the least serious crimes, such as pickpocketing (28 percent). Due to the high frequency of occurrence of public order crimes and the lack of incentive for reporting, public order crimes may be more likely to be underreported. Alternatively, police may target neighborhoods for raids of drug sales, prostitution, or gambling, and these "proactive" crime reports may inflate the number of public order crimes during specific quarters or in certain neighborhoods. However, we are not concerned with bias generated by public order crime reporting because we have no reason to believe that such under- or overreporting would be systematically different on blockfaces with high levels of foreclosure.

Although there is little that can be done empirically to adjust for the reliability of the crime data, we make some assumptions about how much crime reporting varies *within* a blockface over time. If blockfaces that experience foreclosure actually have a concurrent decrease in crime reporting (because of residential turnover), any increases in crime found here are likely underestimates of the full influence of foreclosure on crime. Further, we control for quarterly time effects at the city and police district level to capture reporting issues.

Finally, as detailed in the Data and Measures section, we categorize crimes by type using broad categories for violent, property, and public order crime. Although the crimes categorized as ''violent'' include a range of different offenses—homicide, robbery, rape, and assault—we are unable to look at these crimes separately because of the relative infrequency with which they occur at the blockface level. We recognize that isolating results for specific crime types below these categorizations could provide additional insight into the relationship between foreclosures and crime, but we believe that the greater contribution of the analysis is explaining how these dynamics work at very localized levels of geography where we can most confidently control for time-invariant characteristics of the blockface and other potential confounding factors in the surrounding area.

Despite these limitations, this article offers insight into how foreclosure activity shapes and changes the composition and location of criminal activity within micro-neighborhoods. The identification strategy compares blockfaces over time, isolating the influence of a change in foreclosure activity on crime on a single blockface while controlling for other time varying factors in the area that may generate increases in both foreclosures and crime. We estimate that foreclosures are associated with increases in micro-neighborhood crime of a nontrivial magnitude. Our findings lend support for several hypothesized mechanisms and suggest that foreclosures affect both the physical and the social aspects of the blockface in ways that may attract crime.

Policy Implications

As we have shown in Chicago, increased foreclosure activity on a blockface changes the perceived costs and benefits of committing crimes on that blockface, relative to other blockfaces. As a result, violent, property, and public order crime increase, and the locations in which crime is committed shift, with a greater increase in crime inside residences, as opposed to on

the street. These findings contribute to the growing evidence of neighborhood spillover effects of mortgage foreclosures. In addition to detrimental effects on property values (Ihlanfeldt and Mayock 2014; Lin, Rosenblatt, and Yao 2009; Schuetz, Been, and Ellen 2008), housing formation (Molloy and Shan 2010), and educational outcomes for children (Been et al. 2011; Kingsley et al. 2009), heightened foreclosure activity increases crime in micro-neighborhoods.

These patterns have real implications for policing and housing policy. Crimes committed on the street are more likely to be witnessed by passerby, to be known to the public, and to affect the feelings of safety and security of residents in the neighborhood. Foreclosures increase crime inside residences even though crimes occurring inside may be less likely to be reported, and as a result, offenders are less likely to be apprehended. Foreclosures are associated with relative increases in violent crime in vacant buildings (in the OLS models), suggesting that long-term vacancy poses a threat to neighborhood safety.

Successful policy solutions will take into account the multiple ways foreclosures change the physical form and social cohesion of neighborhoods. Specifically, policies combating the negative impacts of foreclosure might focus on limiting periods of vacancy within neighborhoods, either by supporting homeowners in foreclosure with options to stay in their home and maintain an ownership stake in the property or by quickly turning the home over to new residents. This research also suggests that lengths should be taken to secure buildings that are currently in the foreclosure process, to make them less attractive targets for violent crime. This might mean physically securing entrances, windows, and yards, or by maintaining the property so it becomes a less visible target. Reaching out to residents in surrounding buildings and encouraging them to report any and all criminal activity in the area of the foreclosure may help stimulate neighborhood social control networks, and also improve reporting in areas that have experienced residential turnover and vacancy. Finally, increasing police presence in areas where foreclosure activity is concentrated may change the impression that areas hard hit by foreclosures are more lenient and accepting of criminal behavior.

Appendix

Table A1. Crime Categories.

Primary Crime Type	Frequency	Percentage of Category Total
Violent crime		
Battery	532,776	61.24
Assault	173,855	19.98
Robbery	114,668	13.18
Weapons violation	27,841	3.20
Criminal sexual assault	10,162	1.17
Sex offense[a]	5,942	0.68
Homicide	3,305	0.38
Offense involving children	1,445	0.17
Violent crime total	869,994	
Property crime		
Theft	598,611	46.76
Criminal damage	353,643	27.63
Burglary	183,417	14.33
Motor vehicle theft	139,947	10.93
Arson	4,501	0.35
Property crime total	1,280,119	
Public order crime		
Narcotics	350,818	48.88
Other offense	180,775	25.19
Criminal trespass	89,640	12.49
Prostitution	36,346	5.06
Public peace violation	22,757	3.17
Offense involving children	16,557	2.31
Liquor law violation	6,648	0.93
Interference with public officer	5,265	4.66
Sex offense[b]	3,114	0.43
Offenses involving children	259	0.04
Obscenity	156	0.02
Other narcotic violation	60	0.01
Public indecency	54	0.01
Public order total	717,714	
Other crime type		
Deceptive practice	98,952	87.53
Gambling	7,824	6.92
Kidnapping	2,388	2.11
Intimidation	1,716	1.52
Stalking	1,364	1.21
Sex offense[c]	792	0.70
Ritualism	10	0.01
Other crime type total	113,046	

[a]Aggravated criminal sexual abuse (and attempted) and criminal sexual abuse (and attempted). [b]Indecent exposure. [c]Adultery, bigamy, marrying a bigamist, criminal transmission of HIV, fornication, indecent solicitation of an adult or child, sex relation in the family, sexual exploitation of a child, and other sex offenses.

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Declaration of Conflicting Interests

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Notes

1. The Uniform Crime Report Violent Crime Rate per 100,000 in 2011 for Chicago was 991 (omitting sexual assault), compared to other cities in which sexual assaults/rapes are included (*Source:* U.S. Department of Justice, Federal Bureau of Investigation 2012).
2. *Source*: Analysis of LPS Applied Analytics data by Local Support Initiatives Corporation (LISC). Percentage of all mortgages in the foreclosure inventory in September 2011. Mortgages in the foreclosure inventory include those in foreclosure and bankruptcy foreclosures prior to auction or trustee sale.
3. Census tract–level data are linearly interpolated by quarter between 2000 and 2010, using U.S. Census data. The Census Bureau estimated that Chicago's population grew 0.5 percent between 2010 and 2011; therefore, the 2010 population figures are inflated by 0.5 percent over the four quarters of 2011.
4. The primary difference between the fixed effect models we employ and a hierarchical model (or multilevel random effects model) is that we constrain the variance on the intercept and slopes to be zero. This is appropriate because we believe that controlling for the unobserved characteristics of blockfaces (such as the type of buildings or uses, the proximity to transit, etc.) is preferable to letting the effects vary. Fixed-effect models also generally produce smaller standard errors.
5. It is not possible to estimate these models using a negative binomial regression.
6. See Appendix Table A1 for a full list of crime types by category.

7. Street crimes include those occurring in the following locations: street, side-walk, parking lot/garage (nonresidential), alley, park property, Chicago Housing Authority parking lot/ground, residential yard, residential driveway, vacant lot/land, cemetery, porch, yard, parking lot, vacant lot, Chicago Housing Authority parking lot, driveway, and school yard. Crimes inside residences include those occurring in the following locations: apartment, basement, residence, residence porch/hallway, or residence garage. "Other locations" where crimes take place include other (3.6 percent of the total crimes), parking lot/garage (nonresidential; 2.8 percent of the total crimes), and school public building (2.2 percent of the total crimes). The following places represent less than 2 percent of the total each, including vehicle noncommercial, small retail store, restaurant, department store, grocery food store, gas station, Chicago Transit Authority platform/train, commercial/business office, Chicago Housing Authority parking lot/apartment/property, bar/tavern, public school grounds, bank, drug store, hospital, construction site, place of worship, hotel/motel, government building, convenience store, private school, nursing home, and so on.

8. An alternative approach to addressing the large number of observations with zero crimes is to transform the dependent variable (DV) using logarithms. In these models, the observations with zero values for the DV were transformed using DV + 0.1, before taking the log. The results differ slightly when we use the transformed variables. We find that foreclosures only significantly increase violent crime, and crime in vacant buildings relative to other locations. When we consider the effects by both crime type and location simultaneously, we find that foreclosures lead to significant increases in violent crime inside residences, and decreases in property crimes on the street. However, the large number of zeroes causes concern for this method. When the zero values are transformed, we create a large number of outliers that will have disproportionate effects on the results. For instance, when we transform the DVs using DV + 0.01, instead of the (arbitrary) DV + 0.1, the magnitude of the results change substantially.

9. Table available from author upon request. Effect sizes are calculated as a percentage change from the blockface mean for the entire study period.

10. We utilize an additional geographic measure—the "h-block"—that contains each of the blockfaces that share an intersection with the central blockface. Because central blockfaces vary in the number of contiguous blockfaces that they touch, we estimate the following models using counts at the h-block level as well as averages per blockface within the h-block. Contact author for tables.

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Author Biographies

Johanna Lacoe, PhD, is a researcher at Mathematica Policy Research. Her research focuses on crime, housing, and education policy. Email: jlacoe@mathematica-mpr.com.

Ingrid Gould Ellen is a Paulette Goddard professor of urban policy and planning at New York University's Wagner Graduate School of Public Service and faculty director of the Furman Center for Real Estate and Urban Policy.