Effects of Multi-Family Housing on Property Values, Crime and Code Violations in Little Rock, 2000-2016

UALR Center for Public Collaboration

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Executive Summary

The study discussed herein analyzes the effect of new multi-family housing development in Little Rock on four neighborhood-level outcomes: sales prices of single-family houses; property crime; violent crime; and code violations. The analysis combines data on single family home sales from the Pulaski County Assessor's deed transfer file (January 2000 through May 2016) with building permit data for multi-family developments from the Little Rock Department of Planning and Development (2000 through 2016); crime reports from the Little Rock Police Department (2000-2014); and code violation reports from the Little Rock Department of Housing and Neighborhood Programs (2007-2015).

The results indicate that:

1) Subsidized multi-family housing has a positive effect on the sales prices of single-family within 1000 feet and reduces the vulnerability of properties within 2000 feet to property crime.

2) Most forms of non-subsidized market-rate housing, including condominiums, market-rate apartments, and senior and assisted-living facilities, have either no effect or a positive effect on the sales prices of single family homes within 2000 feet.

3) Small (fewer than 5 buildings) market-rate apartment complexes, subsidized apartment complexes, and dormitories have either no effect on the vulnerability of properties within 2000 feet or they reduce crime vulnerability.

4) Large (five or more) market-rate apartment complexes and condominiums appear to increase the vulnerability of properties within 1000 feet to violent crime. The causal mechanism for this finding remains unclear.

5) Senior and assisted living apartments appear to increase the vulnerability of properties within 1000 feet to property crime.

6) Insufficient evidence exists at this time to determine the effect of multi-family housing on the vulnerability of nearby properties to code violations.

Introduction and Background

At its February 16th, 2016 meeting, the Little Rock Board of Directors adopted a 12-month moratorium on new multi-family housing development along S. Bowman Road between 36th Street and Kanis Road (Resolution 14,289). As part of this moratorium, the Board requested an investigation into the potential effects of new housing development on S. Bowman Road on traffic, drainage, and other related items. As part of these other related items, the City's Department of Planning and Development was asked to provide an analysis of the effects of multi-family development on neighborhood quality of life across Little Rock.

The study discussed herein analyzes the effect of new multi-family housing development in Little Rock on four neighborhood-level outcomes: sales prices of single-family houses; property crime; violent crime; and code violations. The analysis combines data on single family home sales from the Pulaski County Assessor's deed transfer file (January 2000 through May 2016) with building permit data for multi-family developments from the Little Rock Department of Planning and Development (2000 through 2016); crime reports from the Little Rock Police Department (2000-2014); and code violation reports from the Little Rock Department of Housing and Neighborhood Programs (2007-2015). The University of Arkansas at Little Rock's Center for Public Collaboration (CPC) has geocoded this data, making it possible to estimate the level and trend in home prices, crime and code violations in neighborhoods before and after the construction of a new multi-family development. After controlling for other neighborhood effects, the differences in prices and in crime and code violation frequency before and after development can be interpreted as the effect of the development. This study, then, addresses the following questions:

1) What is the average effect of new multi-family housing development on sales prices of nearby single family homes?

2) What is the average effect of new multi-family housing development on frequency of violent and property crimes near the site?

3) What is the average effect of new multi-family housing development on frequency of code violations near the site?

Theories of Neighborhood Change and Multi-Family Housing

Skepticism of and opposition to multi-family housing development is a familiar feature of local politics in central Arkansas and across the country. Owners of single-family homes frequently cite concerns that such development will increase levels of neighborhood social disorder and crime, create added inconveniences and nuisances (such as more traffic), and reduce property values (Obrinsky and Stein 2006; Pendall 1999). Local public officials often raise additional concerns that multi-family housing development may have negative fiscal consequences for the community by increasing demand for local public services without a proportionate increase in tax revenues (Danielson 1976; Obrinsky and Stein 2006; Peterson 1981). At the same time, proponents of new multi-family housing point to the need for lower-cost housing to meet the demands of a growing population, equalize access to housing and promote better racial and income class integration. Consequently, multi-family housing is likely to continue to be an important part of Little Rock's housing and land use strategy.

Hence, the concerns of multi-family housing skeptics merit investigation. For many homeowners, the home does not just provide shelter, it represents their most important financial asset. Further, it is an asset that is vulnerable to changes in value that cannot be mitigated through insurance or diversification (Fischel 2001). Understandably, then, owners of single-family homes have serious concerns about protecting property values. Moreover, consistent with public perceptions, a series of studies by Brill and Associates for the U.S. Department of Housing and Urban Development in the 1970s documented significantly higher crime rates in and near high-rise public housing projects than in other neighborhoods in several major cities (1975, 1976, 1977a, 1977b, 1977c; see also Newman 1972 and Roncek, Bell and Francik 1981).

This suggests that the concerns of multi-family housing skeptics cannot be dismissed without closer examination.

Existing theories of neighborhood change and housing markets suggest a number of ways in which multi-family housing might affect property values, crime and other neighborhood quality-of-life factors. We can distinguish between three approaches to theorizing about the effects of multi-family housing, differing in the scope of multi-family housing types: i) effects of all types of multi-family housing, including condominiums, market rate and subsidized apartments, senior and special needs housing, and dormitories; ii) effects of multi-family market rate and subsidized rental property; and iii) particular effects of subsidized rental housing.

Broad multi-family housing concerns: Multi-family housing regardless of type tends to raise concerns about density. By design, multi-family housing concentrates population into a smaller area and at lower housing cost per person. Hence, it is reasonable to expect that such housing might generate additional traffic and demand for public services relative to the area that it occupies, and less tax property tax revenue per housing unit than a single-family house. At the same time, these density effects are likely to be offset, at least in part, by the smaller size of most multi-family households (generating fewer automobile trips per household and less demand for services per household) and by the difference in property tax rates for apartment complexes (taxed as commercial property) compared to single-family homes (Goodman 2006; Institute of Transportation Engineers 2003; Obrinsky and Stein 2006).

Concerns with multi-family rental housing: Multi-family rental housing, however, raises an additional concern not shared by condominium development: possible degradation of a neighborhood's social fabric. Mainstream theories of cooperative behavior hold that frequent interaction and expectations of frequent future interactions greatly facilitate the emergence of trust and cooperation, producing what many social scientists call "social capital" (i.e. a shared set of social rules for behavior and expectations for reciprocity) (Axelrod 1984; Kreps et al. 1982; Jacobs 1961; Putnam 2000). In other words, when a person cooperates in the implementation of a neighborhood watch program or attends a neighborhood meeting, it is with the expectation that her neighbors will do likewise, today and in the future. Homeownership might play a significant role, then, in generating neighborhood social capital by increasing the tenure or expected period of time an average person lives in the neighborhood (DiPasquale and Glaeser 1999; Rohe and Stewart 1996). Conversely, rental property reduces the number of people in the neighborhood expected to remain in the neighborhood over the long-run and might therefore reduce neighborhood social capital. Hence, it is possible that an increase in rental property brought about by multi-family rental development could reduce neighborhood social capital.

Moreover, it is possible that a decline in neighborhood social capital could, in turn, result in more neighborhood social disorder and crime and lower property values. Jacobs (1961), for instance, argues that neighborhoods with strong social capital form natural defense mechanisms against crime, what she refers to as "eyes on the street." That is, when neighbors know and trust each other, they are more inclined to watch out for each other and each other's property by reporting or intervening in suspicious activity and otherwise supervising the neighborhood while going about their daily lives. Similarly, neighborhood social capital may play an important role in forming and maintaining neighborhood organizations such as crime watches, neighborhood associations, and ad hoc groups seeking improvements from local government. Such organizations may play important roles in reducing crime, increasing social order, improving neighborhood quality of life and improving property values. A significant body of empirical evidence has emerged in recent years indicating that neighborhoods with more active and complex organizations and greater social capital tend to have lower crime and higher property values (Craw forthcoming; Sampson 2012).

At the same time, it is important to note that multi-family rental housing, in and of itself, need not necessarily result in lower social capital. What matters to the emergence of social capital is not homeownership, but tenure. To the extent apartment renters within a particular neighborhood remain as long as other neighborhood residents, one might expect little effect on neighborhood social capital. This is consistent with findings from DiPasquale and Glaeser (1999), who in an analysis of the General Social Survey find that while homeownership is significantly associated with a variety of civic and political activities, most of this effect is explained by tenure within the neighborhood rather than by homeownership per se.

Concerns with subsidized multi-family rental housing: Finally, subsidized rental housing raises yet other concerns that are not common to either condominium or market rate rental development. First, some forms of subsidized rental housing have physical characteristics that make them more vulnerable to crime. High-rise towers surrounded by large open lawns (inspired by the Swiss urban designer Le Corbusier) tend to reduce opportunities for social interaction and for casual observation and monitoring of events in the neighborhood, thus increasing the vulnerability of the community to crime (Jeffrey 1971; Lens 2013; Newman 1972). For instance, such developments frequently make it difficult to distinguish between private and public space, thus making it more difficult for residents to recognize spaces that are "theirs" and for which they are therefore responsible for monitoring (Rouse and Rubenstein 1978). In this way, some forms of subsidized housing may invite more crime than others.

Second, in some cases subsidized rental housing may "concentrate disadvantage", i.e. produce areas in which most residents are in poverty and vulnerable to economic shocks (Freeman and Botein 2002; Lens 2013). A significant body of research suggests that such concentration further reinforces the social and economic isolation of low-income households, making it more difficult to move out of poverty (Wilson 1987). Moreover, to the extent that subsidized housing residents differ in income and socio-economic status from neighbors in non-subsidized housing, it is possible that the presence of subsidized housing could reinforce a weakening of social ties and neighborhood social capital beyond what is expected with market-rate rental property (Morenoff, Sampson and Raudenbush 2001). This could occur because socio-economic differences make every-day social interactions even less frequent even between neighbors and because the needs and interests of those in different socioeconomic groups differ significantly (Heckathorn 1993). Social ties among residents of concentrated subsidized housing themselves may also be weaker than those in the surrounding neighborhood, possibly because longer work hours leave less time for social interaction; because of higher resident turnover and/or social heterogeneity within the housing project; or because of generalized feelings of disempowerment or hopelessness (Taylor 2001). Consequently, one might expect that neighborhoods with subsidized multi-family housing to be even more vulnerable to social disorganization and therefore crime and declining property values than neighborhoods with market-rate multi-family housing.

Concentrated disadvantage may also affect property values because of population effects. Higher socioeconomic status households may consider living near those of lower socioeconomic status (i.e. of a different race or income class) to be undesirable in and of itself (Di, Ma and Murdoch 2010; Ellen *et al.* 2007; Freeman and Botein 2002). Alternatively, potential neighborhood homeowner households may take the presence of lower status households as a signal for emerging neighborhood disorder, even in the absence of physical neighborhood decay. Potential homeowner households might also anticipate that landlords will have fewer incentives to adequately maintain subsidized housing units, resulting in future neighborhood blight. Hence, the mere introduction or announcement of subsidized housing, before any actual may prompt an expectation of neighborhood change that results in declining property values (Briggs, Darden and Aidala 1999; Schelling 1971).

At the same time, it is important to note that the physical and social vulnerabilities of older forms of subsidized multi-family housing are not necessarily shared by new developments. A significant body of evidence has emerged suggesting that in neighborhoods where new subsidized housing replaces older and decayed housing stock, the new housing as an upgrading effect the boosts property values (Ellen *et al.* 2007; Freeman and Botein 2002; Nguyen 2005). Likewise, changes in neighborhood population may generate “market effects”, i.e. additional investment in the neighborhood that caters to the larger or changed population (Ellen *et al.* 2007). Moreover, new subsidized housing development is often based on crime prevention through environmental design (CPTED) principles that encourage greater interaction and more “eyes on the street”, e. g. low-rise buildings with greater walkability (Jeffery 1971; Newman 1972). Contemporary subsidized housing programs, such as those finances with the Low-Income Housing Tax Credit, also frequently incorporate elements to deconcentrate disadvantage through mixed-income development. It is reasonable to expect that such changes may reduce the effect of subsidized multi-family housing on crime and nearby property values.

Hence, a significant body of theory exists that implies that multi-family housing, at least in some contexts, may affect neighborhood crime, property values and other quality-of-life factors. At the same time, some of these factors may be mitigated in contemporary multi-family development through design or changes in demand for rental vs. owner-occupied housing. The next sections of this report, then, examine the empirical evidence on the relationship between multi-family housing, crime and property values.

Property Values and Multi-Family Housing

Most academic studies of the relationship between neighborhood property values and multi-family housing focus specifically on the effects of subsidized multi-family housing. Hence, it is important to be cautious in assuming that findings on the effects of subsidized housing can be generalized to market-rate housing, dormitories or condominiums. This is particularly the case for findings that suggest for findings of a negative effect on property values. As discussed above, market-rate rental housing is not likely to suffer from the same problems of concentrated disadvantage as subsidized housing, and condominium development is not likely to pose the same issues of resident tenure and social capital as rental housing.

That said, academic research on the effects of subsidized housing on the value of nearby market-rate housing has generally produced mixed results. Consistent with theories of concentrated disadvantage, a number of studies find evidence that proximity to subsidized housing reduces prices for nearby market rate housing, at least under some circumstances (see for example Cummings and Landis 1993; Ellen et el. 2007; Galster, Tatian and Smith 1999; Goetz, Lam and Heitlinger 1996; Lee *et al.* 1999). At the same time, other research finds evidence that subsidized housing has no effect (e.g. Briggs, Darden and Aidala 1999; Lyons and Loveridge 1993) or that it increases market-rate housing prices, at least under some conditions (e.g. Deng 2011; Di, Ma and Murdoch 2010; Ellen *et al.* 2007; Galster, Tatian and Smith 1999; Goetz, Lam and Heitlinger 1996; Lee, Culhane and Wachter 1999; Santiago, Galster and Tatian 2001; Schwartz *et al.* 2006). These findings suggest the possibility that upgrading effects and design elements that deconcentrate disadvantage may sometimes offset any negative effects.

A point on which there is agreement in the literature is that the magnitude of subsidized housing effects varies with distance and with the degree to which it is concentrated. For instance, in their study of the federally subsidized housing programs in Philadelphia, Lee, Culhane and Wachter (1999) find that the effects on property values are significantly larger within one-eighth of a mile than between one-eighth and one-quarter of a mile. Other researchers find similar declines in effect with distance from the subsidized housing site (Deng 2011; Goetz, Lam and Heitlinger 1996; Schwartz *et al.* 2006; Seo and Craw forthcoming). Moreover, the literature indicates that greater density of subsidized housing in a neighborhood generate negative externalities, while more dispersed units have a smaller negative, or even a positive, effect (Di, Ma and Murdoch 2010; Ellen *et al.* 2007; Galster, Tatian and Smith 1999). Consistent with this, studies focusing specifically on scattered site housing programs generally find no effect or a positive effect on nearby market-rate housing (Briggs, Darden and Aidala 1999; Santiago, Galster and Tatian 2001).

Moreover, the academic research on subsidized housing effects suggests that the direction and magnitude of these effects differ with characteristics of the subsidized units, including the program under which they are administered; the sort of entity managing the property (i.e. for-profit, non-profit or governmental); and the population served by the program. Programs that subsidize rental units in existing structures (e.g. public housing and section 8) and/or that are managed by governmental or for-profit entities tend to have negative effects on nearby property values (Ellen *et al.* 2007; Galster, Tatian and Smith 1999; Goetz, Lam and Heitlinger 1996; Lee *et al.* 1999). But programs that subsidize new or rehabilitated units for purchase by moderate income households and those that are managed by non-profit organizations tend to have a positive effect on property values (Deng 2011; Di, Ma and Murdoch 2010; Ding, Simon and

Baku 2000; Goetz, Lam and Heitlinger 1996; Lee, Culhane and Wachter 1999). Taken together, these results suggest that the effects of subsidized multi-family housing differ with the purposes and management of the development.

In addition, the characteristics of the neighborhood in which a subsidized housing development located, particularly its income and racial composition, may affect its impact on property values. Freeman and Botein (2002) argue that the most negative effects occur when subsidized multi-family housing is located in high income neighborhoods, while the effects in low-income neighborhoods may be positive. This is because subsidized units in high-income neighborhoods will tend to be of lower quality relative to other housing in the neighborhood and because its residents will tend to be of lower socio-economic status compared to the average neighborhood resident. Consistent with this, Deng (2011) finds that the property value effects of low-income housing tax credit projects in Santa Clara, CA are significantly more positive in low-income than middle and high income neighborhoods. Similarly, Seo and Craw (forthcoming) find that lease-purchase units in Cleveland more negatively affect property values in high income neighborhoods than middle and low income neighborhoods. But at the same time, Galster, Tatian and Smith (1999) and Santiago, Galster and Tatian (2001) find evidence that subsidized housing generates negative effects on property values in low-income neighborhoods and positive effects in higher-income neighborhoods. They argue that this may occur because subsidized housing reinforces a signal in low-income neighborhoods that poverty is becoming concentrated in the neighborhood, while higher income neighborhoods are more robust to change and thus can tolerate a subsidized development without consequence. Hence, while it seems likely that subsidized housing affects property values differently with neighborhood income, the direction and magnitude of these effects remains uncertain.

Research on the effects of condominiums and market-rate multi-family housing on property values is much sparser than for subsidized housing. From among those studies that do exist, however, the consensus is that condominiums and market-rate apartments have no negative effect on neighborhood property values. A recent study of Seattle compared home prices between 1987 and 1997 before and after development of both subsidized and market-rate apartments. The results found no effects from the market-rate units (and few to no effects for the subsidized units) (Koschinsky 2009). A 2004 study of lower-income Census tracts (those with between 60% and 100% of area median income) found that single-family home values were actually higher in tracts with concentrated multi-family housing than in tracts composed primarily of single family homes (Hoffman et al. 2004). Similarly, an unpublished study by the National Association of Home Builders in 2001 found that single-family homes in areas with more multi-family housing tended to appreciate in value more quickly than those in primarily single-family home neighborhoods.

Thus, the existing evidence on subsidized multi-family housing suggests that one should be cautious in generalizing about its effects on property values. The best available research suggests that the magnitude and direction of subsidized housing effects differ with proximity to the housing, with the characteristics of the subsidized housing and with neighborhood context. In some cases, for example, new multi-family subsidized housing may improve property values (such as when this housing replaces decayed housing stock in a lower-income neighborhood). In other cases, the effect may be negative (such as when it is sufficiently concentrated to produce concentrated disadvantage effects). Hence, housing advocates and policymakers should be careful about overgeneralizing about the effects of multi-family housing on property values.

Crime and Multi-Family Housing

As with studies of multi-family housing and property values, most academic studies of the effects of multi-family housing on crime focus specifically on the impact of subsidized multi-family housing. Hence, once again the reader should be cautious about generalizing from research about subsidized multi-family housing to market-rate multi-family housing and condominiums. As discussed above, a series of studies in the 1970s found evidence that some forms of subsidized housing in major cities, particularly high-rise public housing projects, significantly increased levels of crime in nearby neighborhoods (Brill and Associates 1975, 1976, 1977a, 1977b, 1977c; Jeffery 1971; Newman 1972). These results reinforced public perceptions linking subsidized housing to crime, but they also motivated changes in design and implementation of subsidized housing to mitigate their effects on crime. Hence, a substantial body of research has emerged over the years that more completely examines the relationship between subsidized multi-family housing and crime.

From the research conducted since the 1970s, a consensus appears to be emerging that subsidized multi-family housing does not generally increase crime in surrounding neighborhoods, and may sometimes reduce it (Freeman and Botein 2002; Kirk and Laub 2010; Lens 2013; Obrinsky and Stein 2006). Earlier studies in this vein challenged the Newman and the Brill and Associate findings using similar data and methods. For instance, Farley (1982) compares crime rates within each of eight blocks containing public housing projects to crime rates for the city of St. Louis as a whole in 1971, 1973 and 1976. He finds little evidence that crime rates are significantly higher in the public housing blocks than in other blocks. Such studies, though, suffer from an important drawback that limits what we can conclude from the results: they do not provide a way to control for the level of crime <u>before</u> the subsidized housing was constructed. It is possible, even likely, that public housing projects and other forms of subsidized housing are located in areas with more crime and with other less desirable features (Dreier, Mollenkopf and Swanstrom 2014; Judd and Swanstrom 2011). Consequently, higher crime rates near a public housing project might be a cause for the project's location rather than a consequence of it. To determine whether multi-family housing contributes to crime then, one needs data on crime both before and after the construction of multi-family housing.

A good early example of such an approach is the work of Goetz, Lam and Heitlinger (1996). Their study of fourteen multi-family housing rehabilitation projects in Minneapolis compared crime reports between 1986 and 1994 at the housing location before and after rehabilitation (an interrupted time series design). They found evidence that crime calls to police either remained unchanged or declined after rehabilitation.

More recent studies that seek to measure neighborhood outcomes both before and after the construction of a multi-family housing development) use a "difference-in-differences" approach (Galster, Tatian and Smith 1999). This approach calls for measuring crime both within and outside of a defined neighborhood (typical values might be 500, 1000, or 2000 feet) around a subsidized housing development for a number of years both before and after construction. This approach can be generalized to include multiple developments within a given city, with more developments providing better estimates. The effect of development on crime, then, can be assessed by using multiple regression analysis to estimate the effect of location within a subsidized housing neighborhood on the crime rate before construction and the effect after construction. A significant difference between the two rates implies an effect of the housing development on crime. Two studies in recent years have used this approach to analyze the effect of subsidized housing on crime. Santiago, Galster and Pettit (2003) evaluate the effect of new public housing developments in Denver between 1990 and 1997, finding that the new developments did not increase crime relative to the pre-crime period. Woo and Joh (2015) evaluate the effect of new low-income housing tax credit projects on crime in Austin. They find that crime rates tended to be significantly higher in the pre-development period of neighborhoods around future public housing sites than in the city of Austin as a whole, indicating that development occurred in higher crime parts of the city. They also found evidence that crime rates declined in these neighborhoods post development to a rate near the average for the city as a whole. In short, the two most rigorous studies of subsidized multi-family housing and crime to date found no evidence that they increased crime, and in fact may reduce crime.

In addition to these studies, a recent analysis by Freedman and Owens (2011) also failed to find evidence that subsidized housing affects crime rates. Rather than use a difference-in-differences analysis, Freeman and Owens analyze the relationship between county crime rates and number of low-income housing tax credit units from 2000-2007 for the U.S as a whole. The results suggest, then, that the results of the Denver and Austin difference-in-differences analyses may generalize to other cities as well.

It is important to note, however, that not every study since 2000 has failed to find a relationship between subsidized housing and crime. Two of these studies are particularly worth noting. In a study of crime rates across 400 neighborhoods in Atlanta, McNulty and Holloway (2000) found that crime rates are higher in block groups that are closer to block groups that contain public housing projects. The method this study uses, however, does not control for crime rates prior to the construction of public housing, making it impossible to determine whether a causal relationship exists. Second, in a study of crime near fourteen group homes and other supportive and assisted housing in Denver between 1990 and 1997, Galster et al (2002) find that crime rates were significantly higher within 500 feet and between 500 and 1000 feet of each site compared to rates prior to development. They found that there was no effect on crime between 1000 and 2000 feet away from the site. It is important to recognize that the focus of this study was specifically on supportive housing, with thirteen of the sites being assisted living or hospice care, one a substance rehabilitation center and one a parolee halfway house). The authors conclude that the likely explanation for their finding is that residents of these facilities are more easily victimized and more likely to report crime.

Consequently, the empirical evidence on the effects of subsidized multi-family housing on crime tend to contradict theories of concentrated disadvantage. Research using the best available methods have thus far failed to find convincing evidence for a significant relationship. Even so, the number of studies on this subject are limited and focus on particular cities. It is not entirely clear if they generalize to other U.S. cities. Moreover, nearly all the research on the topic focuses on subsidized housing. Little has been done to see if these findings generalize to market rate and owner-occupied multi-family housing. The next sections of this report, then, analyze the effect of multi-family housing on property values, crime, and physical blight in Little Rock, using a difference-in-differences methodology. The analysis addresses itself to three main questions:

1) What is the average effect of new multi-family housing development on sales prices of nearby single family homes?

2) What is the average effect of new multi-family housing development on frequency of violent and property crimes near the site?

3) What is the average effect of new multi-family housing development on frequency of code violations near the site?

Data and Methods of Analysis

To answer these questions, I estimated four sets of difference-in-differences regression models, each corresponding to one of four outcomes concerning Little Rock neighborhoods: sales prices for single family homes; incidents of violent crime; incidents of property crime; and code violations. The analysis includes code violations in addition to property values and crime because they serve as an indicator of neighborhood blight or physical deterioration. Some theories of neighborhood change argue that such blight (referred to sometimes as "broken windows") is a precursor to a breakdown in social relationships, crime and declines in property values (Wilson and Kelling 1982). Each of these outcomes affects particular parcels in particular neighborhoods over time, and so parcels serve as the unit of analysis.

The main variables of interest in each of these models is a set of indicators for the proximity of each parcel to a multi-family housing project that was developed between 2000 and 2016 (a total of 78 projects, as indicated by city building permit records). Each of these indicators also indicates whether in a given year the project was pre-development (prior to building permit being issued) or post-development (after the building permit was issued). The pre indicator variables then provide a way to measure the effect of being in a given location when the development is NOT present, providing a basis for comparison for the effect of development on the outcome once it is built (measured by the post indicator variables). Each model also includes an appropriate set of control variables to help screen out the effect of parcel and neighborhood factors and time-specific effects, other than proximity to new multi-family housing development, on property values, crime and code violations. I describe the data and analysis for each neighborhood outcome in more detail below.

Analyzing Little Rock single-family home sales

To determine the extent to which new multi-family housing development affects property values, I put together a data set of sales for single family homes in Little Rock from January 2000 through May 2016. The sales data come from the Pulaski County Assessor's deed transfer database. This dataset was filtered to exclude transactions outside the city of Little Rock; transactions on non-residential, multifamily, mobile home, or attached structures (e.g. townhouses, duplexes, etc.); and transactions that were not arms-length, leaving a total of 46,903 sales in the model. Home prices are typically skewed and so the analysis log-transforms the selling price to better fit a normal distribution, offsetting a potential source of bias in the results.

To identify the locations and construction dates of new multi-family housing units in Little Rock, I used the City of Little Rock Planning Department's building permit file. This data set identifies each new structure built in the city between 2000 and 2016, categorizing each by its intended use (including whether or not it is a multi-family structure) and whether it is new construction, a renovation or addition. From this data, I identified 480 permits for new multi-family buildings, covering 78 unique projects: 14 condominium projects, 15 large (consisting of five or more buildings) market-rate apartment projects, 16 small market rate apartment projects, 8 subsidized apartment projects, 16 senior or assisted care facility projects, and 9 other multifamily projects (primarily dormitories). A list of these projects is found in Appendix A.

Using its address or longitude/latitude coordinates, I was able to geocode each building permit for new multi-family construction over this time period. In addition, I geocoded the location of each single-family home sale from 2000 through 2016 using the Pulaski County Assessor's parcel map, downloaded from the Arkansas GIS Office's GEOStor data base (https://gis.arkansas.gov/). This made it possible to determine whether each transaction was near an existing or future site for one of the 78 new multi-family projects. Moreover, the sales date for each transaction made it possible to determine whether each sale occurred before or after each building permit was issued. This makes it possible to estimate a set of indicators for each transaction that categorize it in terms of:

1) Whether the sale occurred before or after construction of a new multi-family housing development

2) The type of multi-family project

3) How close the parcel was to the site

These indicators make it possible to carry out a difference-in-differences analysis to measure the effect of new development on sales prices. To understand how this works, it is helpful to imagine a ring of a given radius (say 1000 feet) around each single-family home parcel at the time it sold. A “pre” indicator variable takes on a value of one if a future multi-family housing site is within that radius at the time of the sale, and zero otherwise. A “post” indicator takes on a value of one if an existing multi-family housing site (constructed since the year 2000) is within that radius at the time of the sale, and zero otherwise. Both indicator variables take on a value of zero if no multi-family housing site constructed between 2000 and 2016 was within the radius.

The single-family home sales analysis includes pre and post indicators for six types of multi-family housing built between 2000 and 2016:

Condominiums
Large market-rate apartments (those projects with 5 or more buildings)
Small market-rate apartments (those projects with fewer than 5 buildings)
Subsidized apartments
Senior or assisted living apartments

Other multi-family housing (primarily dormitories and student apartments for universities)

These indicators allow the analysis to differentiate between the effects of owner-occupied multi-family housing, market-rate housing, and subsidized housing on property values. In addition, some researchers have argued that larger multi-family developments have larger spillover effects on single-family homes that smaller complexes. Hence this approach differentiates between larger and smaller market-rate developments.

In addition, some researchers have argued that new multi-family development might begin to affect property values before construction begins. This would be the case if the announcement of the multi-family housing causes prompts some households to leave the neighborhood or reduces demand for housing in the neighborhood in anticipation of the coming development (Ellen *et al.* 2007). In addition, others have argued that the effect of multi-family housing on property values might be delayed. This would be the case if the main impact of multi-family housing comes from a lack of adequate maintenance, a problem that would not occur until some years after its construction. Consequently, I have included two pre and two post indicator variables for each type of multi-family development, indicating whether the home sold more than 2 years before the construction of a multi-family project, 2 or fewer years before construction, within 2 years of completing construction, or more than 2 years after construction. This makes it possible to distinguish between short-run and long-run effects of multi-family housing on property values.

Moreover, as noted in the literature review, the effect of multi-family housing is expected to be larger on single-family homes that are closer to the development. Much of the existing research suggests that the effects are most noticeable at distances up to about 2000 feet (around a third of a mile) (Ellen *et al*. 2007). Consequently, the statistical model includes pre and post indicators for each type of multi-family housing at two sets of distances from each sale: multi-family units within 1000 feet, and multi-family units between 1000 and 2000 feet away.

In addition to multi-family housing, single family home prices are affected the characteristics of the neighborhood in which it exists, the home itself, and the time period in which the home is sold. To obtain an estimate of the effect of proximity to multi-family housing on sales prices, the effect of these factors must be subtracted out. In order to control for the influence of these factors, the statistical model includes a set of variables collected by the Pulaski County assessor that measure the characteristics of the housing unit itself, including its age, total square footage, lot size, style, housing quality grade, type of heating and ventilation system, number of bathrooms, whether the house has a fireplace and a basement, and its distance from Little Rock's downtown. In addition, the statistical analysis uses data from the Census Bureau's American Community Survey to control for a set of four neighborhood characteristics (measured at the Census block group): median household income, percentage of population that is nonwhite, the average age of housing stock in the neighborhood, and the neighborhood's population density.

Further, the statistical model controls for each home sale's proximity to multi-family housing constructed before 2000. These units were identified using the Pulaski Area GIS (PAGIS) Consortium's building outline file, which identifies each structure in Pulaski County and categorizes them according to land use. Using this data set, I calculated the number of pre-2000 multifamily housing structures within 1000 feet and between 1000 feet and 2000 feet of each home sale. While this data cannot be used to draw inferences about the impact of pre-2000 multi-family housing on home sales (since there is no pre-construction estimate for nearby home values to compare to), it can be used to control for their effect on home sales prices.

In addition, to these variables, the statistical model includes two sets of so-called "fixed effects" variables. The first set of fixed effects represent each of the city's neighborhoods (represented by the Census block groups). These variables control for any characteristics of the neighborhood that are fixed in time and not otherwise measured by the neighborhood variables described above (such as its general character; historical development; land use characteristics; and location within the metropolitan region). The second set represent each quarter from 2000 through 2016. These variables control for characteristics of a particular time period that are not otherwise measured and controlled (such as general level of housing prices in the city as a whole; economic conditions in the city; and migration to and from the city).

Finally, the statistical analysis controls for the level of housing prices in the immediate vicinity of each home sale with an average of the sales price of the six closest sales in the year preceding the home sale. This controls for the practice common in real estate of using "comparables" to set a price for a given home. It also corrects for a form of bias called spatial autocorrelation that is common in the analysis of geographic data (Ward and Gleditsch 2008).

The analysis uses regression analysis to combine this data to estimate the effect of each variable on single-family home prices in Little Rock. This method estimates a set of coefficients corresponding to each variable in the analysis. Each coefficient measures the average percentage increase in home sales price from a one-unit increase in the corresponding variable. Hence, each of the post indicator variables represents the average percentage increase in home sales price resulting from proximity to a particular type of multi-family housing. One can then compute the average net effect of the construction of a particular type of multi-family unit by subtracting the "pre" indicator coefficient from the post indicator coefficient.

Analyzing Little Rock crime and code violations

The Little Rock Police Department provided a data set consisting of all reported Part I crimes from 2000 through 2014. These crimes are tracked for reporting for the FBI's Uniform Crime Report, and consist of violent crimes (homicide, sexual assault, robbery, and aggravated assault) and serious property crimes (e.g. e.g. arson, breaking and entering, burglary, larceny, purse-snatching, shoplifting, auto theft). Note that the available property crime data begins in 2003 rather than 2000. Each crime report indicates the address where the incident was reported, which I used to geocode the location of each crime. I used a similar process to geocode the locations of code violations. The Little Rock Department of Housing and Neighborhood Programs provided a data set consisting of all cases of code violations from 2007 through 2015. These violations primarily consist of instances of physical disorder: abandoned vehicles, graffiti, high grass and weeds, housing and rental code violations, trash and illegal dumping, and cars parked in the yard. Each incident includes the address for the violation, which I used to geocode its location.

Most difference-in-differences analyses of crime and multi-family housing focus on differences in neighborhood crime rates. A typical approach is to define one set of neighborhoods consisting of those areas within a certain radius (say 2000 feet) of an existing or future multi-family housing development and another set of neighborhoods consisting of Census block groups and portions thereof that are more than 2000 feet from an existing or future multi-family project (Santiago, Galster and Pettit 2003; Woo and Joh 2015). This approach, however, poses difficulties in estimating population and crime rates within the neighborhoods defined by proximity to a multi-family housing development. This is because population data is generally reported by block and block group, units that do not necessarily correspond to the area within a 2000-foot radius of a housing site.

Consequently, I instead estimated the likelihood that a given parcel would experience a crime incident each year from 2000 through 2014. Using the crime and code violation data, I identified whether each parcel was the site of at least one incident of violent crime each year. I developed similar measures for property crime incidents and code violation incidents. The result is a data set consisting of each parcel in Little Rock for each year from 2000 through 2014 for the violent crime analysis, from 2003-2014 for the property crime analysis, and from 2007 through 2015 for the code violation analysis.

As in the sales price analysis, the main variables of interest are a set of variables indicating whether a given parcel is located within 1000 feet or 1000-2000 feet of an existing or future multi-family housing project built between 2000 and 2016. These are computed in the same way as in the sales price analysis. Since there is no theoretical reason to believe that crime rates near a multi-family unit will differ with respect to the length of time before or after construction, I use a simpler set of pre and post indicators that merely indicate whether each parcel in a given year existed before or after the completion of a multi-family housing development.

Since I include both residential and nonresidential parcels, the crime and code violation analyses control for four characteristics of parcels that may affect their vulnerability: their size, distance from downtown, assessed value (logged to ease interpretation), and land use. The analysis also controls for the number of crimes or code violations within 500 feet of the parcel in each year and for pre-existing multi-family units.

Because the outcome variable is binary (whether a crime occurred or not) rather than continuous, the data analysis uses a somewhat different version of regression analysis, known as logistic regression. The coefficient estimates from these models have a somewhat different interpretation from the sales model (discussed in the technical appendix), but nevertheless also provide a measure of the effect of each variable on the likelihood of a crime occurring in a given parcel. Hence, the coefficients on the pre and post multi-family housing indicators can again be used to estimate the effect of multi-housing development on vulnerability to crime and/or code violations.

Results

Effect on single family home prices

The analysis of single-family home prices generally indicates that, over the long run, most forms of multi-family housing in Little Rock have either no effect or a modest positive effect on price. Table 1 reports the estimated price premium (as a percentage of sale price) for a single family home within 1000 feet and between 1000 and 2000 feet of a multi-family housing development, both 2 or more years before the development is built and 2 or more years after it is built. These results, then, compare average single-family housing prices well before multi-family construction began and well after this housing has been established. Hence, the difference between these two estimate indicates the estimated long-run effect of constructing the multi-family development on single-family home prices. For example, the estimates suggest that on average a single-family home located within 1000 feet of a future subsidized housing complex sold for 16% less than what we would otherwise expect for that neighborhood, year and type of home and it sold for 0.8% more than what we would otherwise expect for that neighborhood, year and type of home after the housing complex was built. This suggests that single-family home prices gained 16.8 percentage points in price that is attributable to the subsidized housing development. Moreover, this result is statistically significant. That is, the likelihood of obtaining this result owing to random sampling error is less than five percent. These estimates are made based on the results of the statistical model for single-family home prices discussed above (and reported in Appendix B).

Table 1

Estimated Long Run Effect of Multi-Family Housing Development on Single-Family Home Prices in Little Rock, 2000-2016 (by Type of Multi-Family Development)

	Average price premium/discount 2 or more years after MF development (as % of sale price)		**Average price premium/discount 2 or more years prior to MF development (as % of sale price)**		**Average long-run price premium/discount attributable to MF development (as % of sale price)**	
Condominium						
Within 1000 feet	0.6%		-6.4%	*	7.0%	*
Between 1000 and 2000 feet	1.0%		-4.2%	*	5.1%	*
Large market-rate apartment complex						
Within 1000 feet	2.4%		5.2%		-2.9%	
Between 1000 and 2000 feet	4.0%	*	2.5%	*	1.5%	
Small market-rate apartment complex						
Within 1000 feet	0.6%		-9.6%	*	10.2%	*
Between 1000 and 2000 feet	4.3%	*	-4.1%	*	8.4%	*
Subsidized apartment complex						
Within 1000 feet	0.8%		-16.0%	*	16.8%	*
Between 1000 and 2000 feet	5.4%		12.7%	*	-7.3%	
Senior housing						
Within 1000 feet	-2.6%		-8.8%		6.2%	
Between 1000 and 2000 feet	-3.2%		-6.7%	*	3.5%	
Other multi-family housing						
Within 1000 feet	2.3%		36.9%	*	-34.7%	*
Between 1000 and 2000 feet	9.6%		0.9%		8.6%	

* Statistically significant at the 5% level of confidence

In addition to subsidized housing, the results suggest that the construction of condominiums and small market rate apartment complexes (those with fewer than 5 buildings) may have modest positive effects on single-family home prices. On average, single family homes gained 7 percentage points in premium within 1000 feet of a new condominium complex, and 5.1 percentage points for those between 1000 and 2000 feet away. Similarly, single-family homes within 1000 feet of a new small market rate apartment complex gained an average of 10.2 percentage points in value relative to similar homes for the neighborhood and year, and those between 1000 and 2000 feet away gained an average of 8.4%. Proximity to new large market rate apartment complexes and to new senior and assisted living housing appear to have neither a positive nor a negative effect on single-family home prices, as suggested by the statistical insignificance of the difference in single-family prices before and after construction of those sorts of development.

The results also indicate that some forms of multi-family development tend to locate in areas where property values are on average lower for the neighborhood and time period. Hence, the gain in single-family home prices resulting from the development is attributable to an increase to prices closer to the average for the neighborhood and year. This is consistent with what we expect from the literature. Multi-family housing developers have an incentive to purchase property that is undervalued. Gains in nearby single-family homes may occur, then, through an upgrading effect brought about when new housing replaces blighted properties or other less desirable land uses (Ellen *et al.* 2007).

A notable exception to these results is the effect of other multi-family housing. This category primarily consists of new dormitories and homeless and transitional multi-family housing (see appendix A). The estimates in table 1 indicate that, prior to construction, single-family homes within 1000 feet tended to sell on average for a 37% premium compared to similar homes for the neighborhood and year in which they were located. After construction, however, these homes sold for prices that were comparable to similar homes in the neighborhood. First, this indicates a tendency for price to be less of a consideration to builders in the location of dormitories compared to other multi-family housing. Second, it suggests that nearly all this price premium tends to go away after construction, indicating that this sort of housing may have more significant externalities than other multi-family housing. Finally, it is worth noting that these effects appear to be localized to an area of 1000 feet (about one-fifth of a mile or 3 blocks) from the multi-family site. The average effect of such housing beyond 1000 feet is modestly positive, though statistically insignificant.

The result concerning dormitory and other multi-family housing is a bit puzzling. As discussed above, most of the theory on the effects of multi-family housing on property values suggests that the most negative consequences are likely to be associated with subsidized housing, rather than dormitories. Possibly this should be a topic for further academic research.

In addition to providing a measure for the long-term effects of multi-family housing on single-family home values, the regression analysis also provides a measure for the short-run or temporary effects. As discussed in the review above, the announcement of a multi-family project could reduce property values before development because of fears such development may have undesirable spillover effects or reduce property values (Ellen *et al.* 2007). In addition, it is possible that new multi-family housing might have a larger positive effect on property values in its first years after development when it is least susceptible to blight or maintenance issues. To assess this, table 2 provides estimates for the premium to single-family home prices in the two years immediately before construction of a multi-family development and in the two years

Table 2

Estimated Short-Run Effect of Multi-Family Housing Development on Single-Family Home Prices in Little Rock, 2000-2016 (by Type of Multi-Family Development)

	Average price premium/discount within 2 years after MF development (as % of sale price)		**Average price premium/discount within 2 years prior to MF development (as % of sale price)**		**Average short-run price premium/discount attributable to MF development (as % of sale price)**
Condominium					
Within 1000 feet	6.0%	*	0.4%		5.6%
Between 1000 and 2000 feet	0.8%		-2.0%		2.7%
Large market-rate apartment complex					
Within 1000 feet	-25.0%	*	-17.1%	*	-7.8%
Between 1000 and 2000 feet	0.8%		-2.0%		2.7%
Small market-rate apartment complex					
Within 1000 feet	-4.5%		-0.6%		-4.9%
Between 1000 and 2000 feet	-4.0%		0.4%		-4.4%
Subsidized apartment complex					
Within 1000 feet	5.8%		-4.7%		10.5%
Between 1000 and 2000 feet	-0.5%		-9.3%	*	8.8%
Senior housing					
Within 1000 feet	-17.9%	*	-4.0%		-13.9%
Between 1000 and 2000 feet	5.8%	*	1.7%		4.1%
Other multi-family housing					
Within 1000 feet	22.7%	*	11.8%		10.8%
Between 1000 and 2000 feet	0.0%		10.8%		-10.8%

* Statistically significant at the 5% level of confidence

immediately after construction. The difference between these two provides a measure of the temporary or short-run effect of construction of multi-family housing. By this measure, it appears that location within 1000 feet of a large market rate apartment complex or senior and assisted living may reduce property values temporarily, while location near new subsidized multi-family housing may raise them. However, none of these estimated short-run effects are statistically significant (that is, one would obtain these estimates more than one time out of twenty as a result of the random chance associated with sampling). This suggests that we have insufficient data to say whether multi-family housing in Little Rock has a short-run effect on single-family home prices that is different from its long-run effect.

Effect on violent and property crime

The analysis of crime in Little Rock generally indicates that some forms of multi-family housing may be associated with an increase in violent or property crime while other forms of multi-family housing may be associated with a decrease in property crime. Table 3 reports the estimated probability of an occurrence of at least one violent crime in a given year for any given parcel located near a multi-family housing development, both before and after the development's construction.[1] These probabilities are estimated from the statistical model for violent crime discussed above and reported in Appendix B. Table 3 also reports the change in this average crime risk after completion of a multi-family development. This change can be taken as a measure of the effect of multi-family housing development on violent crime risk. Based on this measure, we can conclude that on average violent crime risk is significantly higher after

[1] Specifically, the estimate reported is for a commercial parcel of average size, assessed value and distance from downtown in the year 2000. The average violent crime risk per year for such a parcel that is also more than 2000 feet away from a new multi-family development is reported in table 3 as 0.6%. The estimated difference in the crime risk, however, is the same regardless of the year or characteristics and location of the parcel.

Table 3

Estimated Effect of Multi-Family Housing Development on Probabilty of Violent Crime, Per Parcel Per Year, Little Rock, 2000-2014 (by Type of Multi-Family Development)

	Average probability of violent crime after MF development	**Average probability of violent crime prior to MF development**	**Expected increase(+)/decrease(-) in probability of violent crime from MF development**	
Condominium				
Within 1000 feet	0.89%	0.61%	0.28%	*
Between 1000 and 2000 feet	0.60%	0.50%	0.10%	
Large market-rate apartment complex				
Within 1000 feet	1.22%	0.49%	0.74%	*
Between 1000 and 2000 feet	0.78%	0.72%	0.06%	
Small market-rate apartment complex				
Within 1000 feet	0.50%	0.66%	-0.16%	
Between 1000 and 2000 feet	0.54%	0.62%	-0.08%	
Subsidized apartment complex				
Within 1000 feet	0.70%	0.72%	-0.02%	
Between 1000 and 2000 feet	0.56%	0.72%	-0.17%	*
Senior housing				
Within 1000 feet	0.60%	0.44%	0.16%	
Between 1000 and 2000 feet	0.76%	0.59%	0.17%	*
Other multi-family housing				
Within 1000 feet	0.66%	0.80%	-0.14%	
Between 1000 and 2000 feet	0.56%	0.70%	-0.13%	*
More than 2000 ft from any MF	0.60%			

* Statistically significant at the 5% level of confidence

completion of a condominium project or a large (more than 5 buildings) market rate apartment project. Crime risk increased by an average of 0.28 percentage points within 1000 feet of a new condominium development, and by 0.74 percentage points within 1000 feet of a large market rate apartment complex. These results are statistically significant, meaning that the probability of obtaining these results because of random sampling error is less than 5 percent.

In addition, the results show three other statistically significant increases or decreases in average violent crime risk: an increase of 0.17% in risk for proximity to senior or assisted living housing, and a decrease of 0.17% and 0.13% in risk for subsidized housing and other multi-family housing, respectively. These differences, however, are found only at a distance of 1000 to 2000 feet from the complex and no statistically significant differences are found for these types of housing within 1000 feet. Since there is not a strong theoretical reason to expect that crime would increase or decrease 1000 to 2000 feet away but not within 1000 feet, it is likely that these results are a statistical artifact rather than indicating a significant relationship.

Table 4 reports the estimated probability of an occurrence of at least one property crime for any given parcel located near a multi-family housing development, both before and after the development's construction. These probabilities are estimated from the statistical model for property crime discussed above and reported in Appendix B. As with the violent crime analysis, the difference in these two levels of risk indicates the effect of multi-family housing development on property crime risk. Based on this measure, we can conclude that property crime risk was significantly higher for parcels within 1000 feet of a new senior multi-family housing development than it was before the development was built. On average, property crime risk was 6.9% per year for a given parcel prior to development and 9.1% per year after, an

Table 4

Estimated Effect of Multi-Family Housing Development on Probabilty of Property Crime, Per Parcel Per Year, Little Rock, 2003-2014 (by Type of Multi-Family Development)

	Average probability of property crime after MF development	**Average probability of property crime prior to MF development**	**Expected increase(+)/decrease(-) in probability of property crime from MF development**	
Condominium				
Within 1000 feet	10.3%	9.8%	0.50%	
Between 1000 and 2000 feet	9.8%	8.7%	1.11%	*
Large market-rate apartment complex				
Within 1000 feet	12.7%	10.5%	2.14%	
Between 1000 and 2000 feet	9.0%	9.5%	-0.53%	
Small market-rate apartment complex				
Within 1000 feet	9.6%	8.7%	0.93%	
Between 1000 and 2000 feet	8.5%	9.3%	-0.77%	
Subsidized apartment complex				
Within 1000 feet	8.0%	9.7%	-1.70%	*
Between 1000 and 2000 feet	6.9%	8.6%	-1.75%	*
Senior housing				
Within 1000 feet	9.1%	6.9%	2.21%	*
Between 1000 and 2000 feet	9.3%	9.0%	0.35%	
Other multi-family housing				
Within 1000 feet	9.4%	11.6%	-2.21%	*
Between 1000 and 2000 feet	8.5%	10.4%	-1.91%	*
More than 2000 ft from any MF	9.1%			

* Statistically significant at the 5% level of confidence

increase of 2.2 percentage points in property crime risk. This result is statistically significant; the probability of obtaining this result from random sampling error is less than one in twenty.

At the same time, the results suggest that risk for property crime declined significantly after subsidized multi-family housing development or other multi-family housing development (i.e. dormitories) within 2000 feet. Property crime risk on average was 1.7% lower for those parcels within 2000 feet of a subsidized development after it was completed compared to before, and 2.2% lower for those parcels within 1000 feet (and 1.9% for those between 1000 and 2000 feet) of other multi-family housing development. Proximity to new market-rate multifamily housing did not significantly change risk for property crime. Proximity to new condominium development is significantly associated with greater risk for property crime at distances between 1000 feet and 2000 feet, but not within 1000 feet. But since there is no plausible explanation at hand for why a development would affect crime at 2000 feet, but not 1000 feet, it is more likely that this result is a statistical artifact rather than indicating a relationship.

In some important respects, these results seem to contradict what we would expect from the concentrated disadvantage theory discussed earlier. Based on that body of theory, one would expect proximity to subsidized housing to generate the most additional vulnerability to crime of any of category of multi-family housing. The findings here, however, indicate that proximity to subsidized housing either has no effect on crime, or perhaps even lowers risk of crime, particularly property crime. A possible explanation perhaps lies in more widespread adoption of crime prevention through environmental design (CPTED) principles. Since all the housing developments under consideration here occurred in the year 2000 or later, it could be the case that newer subsidized housing stock is replacing older housing stock built under design principles that make them more vulnerable to crime. At the same time, it is surprising that condominiums, large apartment complexes and senior housing increases vulnerability to crime. Galster *et al.* (2002) provide a possible explanation for increased crime vulnerability near new senior housing: the senior population may in general be more vulnerable to crime victimization regardless of location. Even to the extent this is the case, however, these results suggest a need to revisit some of the existing theory on the relationship between housing and crime.

Effect on code violations

The code violation analysis generally suggests that proximity to multi-family housing has little significant effect on the vulnerability of a neighborhood to blight. Table 5 reports the estimated probability for the occurrence of at least one property crime in a given year for any given parcel located near a multi-family housing development, both before and after the development's construction. These probabilities are estimated from the statistical model for code violations discussed above and reported in Appendix B. As with the crime analyses, the difference in these two levels of risk indicates the effect of multi-family housing development on vulnerability to code violations. Based on this measure, however, we can draw no conclusions about the effect of multi-housing development on code violations. Some of the estimates suggest a substantive effect on risk for code violations. For instance, the average risk of a given parcel within 1000 feet of a subsidized housing development increases from 0.9% per year before construction to 1.3% per year after construction. However, there is a more than 5 percent chance that this estimate would occur as the result of random sampling error. Indeed, this is true for each of the difference-in-differences estimates of code violation risk reported in table 5. Consequently, we must conclude here that we do not yet have sufficient data to draw conclusions about the effect of multi-family housing on blight (as measured by code violations) in Little Rock.

Table 5

Estimated Effect of Multi-Family Housing Development on Probabilty of Code Violation, Per Parcel Per Year, Little Rock, 2007-2015 (by Type of Multi-Family Development)

	Average probability of code violation after MF development	Average probability of code violation prior to MF development	Expected increase(+)/decrease(-) in probability of code violation from MF development
Condominium			
Within 1000 feet	1.3%	1.1%	0.13%
Between 1000 and 2000 feet	1.1%	0.8%	0.28%
Large market-rate apartment complex			
Within 1000 feet	1.2%	1.4%	-0.18%
Between 1000 and 2000 feet	1.1%	1.0%	0.16%
Small market-rate apartment complex			
Within 1000 feet	1.5%	1.3%	0.23%
Between 1000 and 2000 feet	1.3%	1.1%	0.19%
Subsidized apartment complex			
Within 1000 feet	1.3%	0.9%	0.39%
Between 1000 and 2000 feet	1.0%	1.2%	-0.18%
Senior housing			
Within 1000 feet	1.2%	1.0%	0.24%
Between 1000 and 2000 feet	1.0%	1.1%	-0.12%
Other multi-family housing			
Within 1000 feet	1.1%	1.2%	-0.12%
Between 1000 and 2000 feet	1.1%	1.2%	-0.16%
More than 2000 ft from any MF	1.1%		

* Statistically significant at the 5% level of confidence

Discussion and Conclusions

The results of the analysis, then, generally indicate that the effects of multi-family housing are more nuanced and complex than proponents and opponents of multi-family housing, and even academic researchers, typically suppose. Contrary to the concerns of some multi-family housing skeptics, it does not appear to be the case that subsidized multi-family housing development reduces property values for nearby single-family homes or that it facilitates violent or property crime. Indeed, the analysis in this report suggests that sales prices for single-family homes within 1000 feet of a subsidized multi-family development tend to be higher following construction of the development than before the development occurred. They also suggest that the vulnerability of properties within 2000 feet of a subsidized multi-family development is significantly smaller following completion of the project than was the case before the project began. These results hold even after we control for the characteristics of the housing unit or parcel, the surrounding neighborhood, the time period, and nearby home prices and levels of violent and property crime.

Moreover, it seems clear that most non-subsidized forms of multi-family housing do not negatively affect nearby single-family home values, and that the effects of multi-family housing on crime differ significantly from one type of housing to the next. Over the long-run, condominium development, market rate apartment complexes, and senior and assisted living housing appear to either have no effect or a positive effect on the sales prices of nearby single-family homes. In addition, the results show no evidence that market rate apartment complexes of fewer than 5 buildings, subsidized housing, or dormitory housing make nearby properties more vulnerable to violent or property crime. Consequently, it would be inappropriate to suppose that all forms of multi-family housing have the same effects on home prices or crime. Instead, the evidence suggests that the effects differ significantly with the type of multi-family housing.

At the same time, the statistical results suggest that some forms of non-subsidized multi-family housing may have a negative effect on single-family home values or may increase the vulnerability of a neighborhood to violent or property crime. In particular, the results suggest that sales prices for single-family homes are significantly lower following the completion of a dormitory or similar sort of multi-family housing compared to what they were before the project began. Moreover, condominium and large market-rate apartment complexes appear to make a neighborhood somewhat more vulnerable to violent crime. And the construction of senior housing seems to increase the vulnerability of the surrounding area to property crime. Once again it is difficult to attribute these findings to characteristics of the neighborhood, parcel, housing unit, or time period or to the characteristics of the location where the multi-family housing unit was built.

Moreover, it is difficult to interpret such findings since they run contrary to expectations from existing research and theory. For instance, while it appears that other multi-family housing (i.e. dormitories) may reduce single family home values, it is clear that this cannot be attributed to any affect such housing may have on crime. Possibly such housing creates additional nuisances of the sort that may reduce nearby single family housing demand. Moreover, the causal mechanism for a relationship between condominium and large market-rate apartment development and violent crime is unclear. It is difficult to attribute this to the social capital effects discussed earlier because these findings do not hold in the case of other forms of multi-family housing, particularly subsidized housing, that are thought to possibly reduce social capital. Such findings, then, call for further investigation.

Indeed, these findings reveal an important limitation in academic research on multi-family housing. By far, most research gives attention to subsidized multi-family housing. In part, this reflects the needs of local policymakers and land use planners, since the most vocal criticism of multi-family housing concerns subsidized development. But multi-family housing is much more diverse than this, and the effects of various forms of non-subsidized housing are much less well understood. The findings here suggest, though, that these effects are much more complex than is commonly assumed. It oversimplifies matters greatly to assume that subsidized housing is destined to have the largest and most negative spillover effects. Hence, a significant need exists for a more robust theory of multi-family housing and thus to further investigate multi-family housing beyond subsidized housing.

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Appendix A: Multi-family Housing Developments Included in Analysis

project name	project type	subsidized	senior/assisted
Palisades at Chenal Valley	apt	no	no
Stonebridge Apartments	apt	no	no
Chenal Pointe Apartments	apt	no	no
Highland Pointe Apartments of West Little Rock	apt	no	no
Cedars at Wellington Lake	apt	no	no
4211 A Street	apt	no	no
Rowan Park Apartments	apt	no	no
The Pointe at Brodie Creek	apt	no	no
Chenal Woods	apt	no	no
Ridge at Chenal Valley	apt	no	no
Links at Eagle Hill	apt	no	no
8700 White Rock Lane	apt	no	no
Residences at Riverdale	apt	no	no
Pinnacle Valley View Drive	apt	no	no
Eagle Hill	apt	no	no
5307 Lee Avenue	apt	no	no
Parham Pointe	apt	no	no
1615 Aldersgate Road	apt	no	no
South Village Apartments	apt	no	no
The Row at Legion Village	apt	no	no
Bowman Pointe Apartments	apt	no	no
McKenzie Park Apartments	apt	no	no
Park Avenue Apartments	apt	no	no
421 S. Bowman Road	apt	no	no
MacArthur Commons	apt	no	no
1001 McMath	apt	no	no
Scott Street Flats	apt	no	no
Riverhouse Apartments	apt	no	no
Renaissance Point	apt	no	no
Rushmore Apartments	apt	no	no
Capitol Hill Apartments	apt	no	no
Woodland Heights	apt	no	yes
Fox Ridge Living Center	apt	no	yes
Villas of Chenal	apt	no	yes

project name	project type	subsidized	senior/assisted
The Cottages at Otter Creek	apt	no	yes
Clarity Pointe	apt	no	yes
Memory Care of Good Shepherd	apt	no	yes
Stonewood Apartments	apt	yes	no
Wimbledon Green Apartments	apt	yes	no
LRHA --- Granite Mountain	apt	yes	no
Metropolitan Village and Cumberland Manor Apartments	apt	yes	no
Chapel Ridge at Stagecoach	apt	yes	no
Valley Estates at Mabelvale	apt	yes	no
Madison Heights II	apt	yes	no
Osmundsen Court	apt	yes	no
Wilson Court	apt	yes	yes
Cloverdale Estates	apt	yes	yes
Armistead Village	apt	yes	yes
Wilson Court II	apt	yes	yes
Orchards of Mabelvale	apt	yes	yes
Christopher Homes --- Little Rock	apt	yes	yes
Cottages at Good Shepherd	apt	yes	yes
Orchards at Mabelvale II	apt	yes	yes
The Manor Assisted Living	apt	yes	yes
Harold Court	apt	yes	yes
220 Gamble Road	condo	no	no
220 River Market	condo	no	no
7100 Ohio Street	condo	no	no
Pinnacle View Cove	condo	no	no
Stagecoach Village	condo	no	no
12401 Kanis Road	condo	no	no
River Market Tower	condo	no	no
300 Third Tower	condo	no	no
Timberidge Condominiums	condo	no	no
Rainwater Flats	condo	no	no
5217 J Street	condo	no	no
The Vallon	condo	no	no
Barrister Court Apartments	other	no	no
Coleman Place Apartments	other	no	no
Philander Smith College Dormitory	other	no	no
Philander Smith College temporary dormitory	other	no	no

project name	project type	subsidized	senior/assisted
Philander Smith College Dormitory	other	no	no
Dormitory, Arkansas Baptist College	other	no	no
Arkansas Baptist College, Dormitory	other	no	no
Our House Shelter	other	yes	no
Theressa Hoover United Methodist Church, dormitory	other	yes	no

Appendix B --- Statistical Methods

Single-family home sales price analysis

To obtain the estimated long-run and short-run effects of multi-family housing on nearby single-family sales prices reported in tables 1 and 2, this analysis used parameter estimates from the following regression model:

(1) $lnP_{ijt} = \beta_0 + \lambda WlnP_{ijt} + \beta_1 T_t + \beta_2 G_j + \beta_3 H_{ij} + \beta_4 N_{jt} + \beta_5 X_{ij} + \beta_6 B_{ijt} + \beta_7 A_{ijt} + \varepsilon_{ijt}$

Where:

lnP_{ijt} = Natural log of the sales price of single family home i in neighborhood j in quarter t

W = spatial weight matrix identifying the 6 nearest sales within the year prior to each sale

T_t = set of dummy variables indicating the quarter t in which the sale occurred

G_j = set of dummy variables indicating the Census block group j in which the sale occurred

H_{ij} = set of variables indicating housing unit characteristics (e.g. lot size, quality grade, distance to downtown)

N_{jt} = set of variables indicating characteristics of the Census block group in each time period (Source: 2000 Census of Population for years 2000-2005; the 2006-2010 American Community Survey estimates years for 2006-2010; the 2010-2014 American Community Survey estimates for years 2011-2016).

X_{ij} = set of variables indicating the number of buildings of each type of multi-family housing constructed before 2000 that are within 1000 feet and between 1000 and 2000 feet away from the sale.

B_{ijt} = set of dummy variables indicating whether or not the sale is within 1000 feet, 1000-2000 feet, or neither of a future unit of each type of multi-family housing.

A_{ijt} = set of dummy variables indicating whether or not the sale is within 1000 feet, 1000-2000 feet, or neither of each type of multi-family housing constructed after 2000.

ε_{ijt} = independent and identically distributed random error term

This sort of model is often referred to as a "difference-in-differences" model. From such a model, we can infer the effect of multi-family development from the difference in the post-construction coefficients (β7) from each corresponding pre-construction coefficient (β6). The set of post-construction coefficients represent the effect of multi-family development on sales prices, while the set of pre-construction coefficients represent the effect of any unmeasured characteristics of the location at which the multi-family development will be constructed. The pre-construction coefficients, then, play a role similar to that effect of an experimental control group; hence the term “difference-in-differences” regression (referring to the computing of an experimental effect as the difference between experimental and control groups in their respective post and pre-test measurements).

The parameter estimates for this model were estimated using ordinary least squares in Stata 14. Table A1 reports the coefficient and other parameter estimates for this model. The reported p-values are those associated with a t-test on each corresponding coefficient estimate. Statistical significance is indicated by a p-value of less than 0.05 (5%). Since sales prices are logged, statistically significant coefficient estimates can be interpreted as approximately the average expected percentage increase in sales price with a one-unit increase in the corresponding independent variable. The estimates in table 1 use the pre (2 years or more) and post (2 years or more) coefficient estimates to estimate a long-run effect on sales prices, and the estimates in table 2 use the pre (0-2 years) and post (0-2 years) coefficient estimates to estimate a short-run or temporary effect on sales prices attributable to new multi-family development. The statistical significance of these differences is determined by means of an F test on the hypothesis that the difference is zero.

Violent, property crime and code violation analysis

To obtain the estimated effect of multi-family housing on the likelihood of a given parcel experiencing at least one violent crime reported in table 3, this analysis used parameter estimates from the following regression model:

(2) $V_{ijt} = \beta_0 + \beta_1 C_{ijt} + \beta_2 T_t + \beta_3 G_j + \beta_4 P_{ij} + \beta_5 X_{ij} + \beta_6 B_{ijt} + \beta_7 A_{ijt} + \nu_i + \varepsilon_{ijt}$

Where:

V_{ijt} = Whether or not a violent crime was reported at parcel i in neighborhood j in year t (0 no, 1 yes).

C_{ijt} = number of violent crimes occurring within 500 feet of parcel i in year t.

T_t = set of dummy variables indicating year t

G_j = set of dummy variables indicating the Census block group j in which parcel i is located.

P_{ij} = set of variables indicating parcel characteristics (i.e. land use, lot size, log of assessed value and distance from downtown Little Rock)

X_{ij} = set of variables indicating the number of buildings of each type of multi-family housing constructed before 2000 that are within 1000 feet and between 1000 and 2000 feet away from the sale.

B_{ijt} = set of dummy variables indicating whether or not the sale is within 1000 feet, 1000-2000 feet, or neither of a future unit of each type of multi-family housing.

A_{ijt} = set of dummy variables indicating whether or not the sale is within 1000 feet, 1000-2000 feet, or neither of each type of multi-family housing constructed after 2000.

ν_i = random error term (parcel level)

ε_{ijt} = independent and identically distributed random error term

As with the sales price analysis, this model is a "difference-in-differences" model. Hence we can infer the effect of multi-family development from the difference in the post-construction coefficients ($\beta 7$) from each corresponding pre-construction coefficient ($\beta 6$). The set of post-construction coefficients represent the effect of multi-family development on sales prices, while the set of pre-construction coefficients represent the effect of any unmeasured characteristics of the location at which the multi-family development will be constructed. The pre-construction coefficients, then, play a role similar to that effect of an experimental control group; hence the term "difference-in-differences" regression (referring to the computing of an experimental effect as the difference between experimental and control groups in their respective post and pre-test measurements).

Given that the data in this case constitute a balanced panel data set and given that the dependent variable (whether a violent crime occurred in a given year at a given location) is dichotomous, the parameter estimates were obtained from a random-effects logistic regression analysis of equation 2. A random effects approach is used rather than a fixed effects approach because of the computation limits of available computer hardware. To help offset this limitation, the model includes fixed effects for Census block groups and for year and it includes control variables for the characteristics of each parcel. In addition, variation across parcels is in part controlled for by the inclusion of a random effect at the parcel level. However, it remains possible for some portion of the estimated relationship between proximity to multi-family housing to be the result of unmeasured parcel-level characteristics that change between the pre and post construction periods.

Since this is a logistic model, the coefficient estimates in Table A2 are expressed in terms of logged odds ratios. That is, each coefficient represents the average change in the logged odds associated with a one- unit increase in the corresponding independent variable. To obtain the estimated probabilities of violent crime before and after multi-family development, then, I calculated predicted probabilities using the parameter estimates in Table A2 (Long 1997). The predicted probabilities assume mean values for the model's numeric variables and assume a parcel that is a commercial parcel in the year 2000 located east of Little Rock's downtown. The estimated difference in predicted probabilities, however, is the same regardless of location, year or parcel type.

The property crime analysis is based on a similar analysis, based on the following regression equation:

(3) $Y_{ijt} = \beta_0 + \beta_1 C_{ijt} + \beta_2 T_t + \beta_3 G_j + \beta_4 P_{ij} + \beta_5 X_{ij} + \beta_6 B_{ijt} + \beta_7 A_{ijt} + \nu_i + \varepsilon_{ijt}$

Where:

Y_{ijt} = Whether or not a property crime was reported at parcel i in neighborhood j in year t (0 no, 1 yes).

C_{ijt} = number of property crimes occurring within 500 feet of parcel i in year t.

The coefficient estimates for the likelihood of a given parcel experiencing a property crime in a given year, reported in Table A3, are the product of a random effects logistic regression analysis and thus hold a similar interpretation. These estimates are used to produce the predicted probabilities reported in table 4.

Similarly, the code violation analysis is based on the following regression equation:

(4) $Z_{ijt} = \beta_0 + \beta_1 C_{ijt} + \beta_2 T_t + \beta_3 G_j + \beta_4 P_{ij} + \beta_5 X_{ij} + \beta_6 B_{ijt} + \beta_7 A_{ijt} + \nu_i + \varepsilon_{ijt}$

Where:

Z_{ijt} = Whether or not a code violation was reported at parcel i in neighborhood j in year t (0 no, 1 yes)

C_{ijt} = number of code violations reported within 500 feet of parcel i in year t.

The coefficient estimates for the likelihood of a given parcel experiencing a code violation in a given year, reported in Table A4, are the product of a random effects logistic regression analysis and thus hold a similar interpretation. These estimates are used to produce the predicted probabilities reported in table 5.

Table A1
Parameter Estimate for Regression Model of Logged Single-Family Home Sales Prices, Little Rock, 2000-2016 (N=46,903)

Variable	**Coefficient**	**Standard error (robust)**	**P-value**
Time fixed effects by quarter	Included^		0.000
Block group fixed effects	Included^		0.000
Spatial lag of logged price	0.415	0.014	0.000
Housing unit characteristics			
Age	-0.004	0.000	0.000
Lot size (acres)	0.082	0.012	0.000
Living area (sq. ft)	0.000	0.000	0.000
Condition	Included^		0.000
Style	Included^		0.000
Wall type	Included^		0.000
Heating type	Included^		0.000
Bathrooms	0.042	0.004	0.000
Fireplace	0.079	0.006	0.000
Basement	-0.018	0.023	0.432
Distance to downtown	-0.021	0.005	0.000
Neighborhood characteristics			
Neighborhood age	-3.08E-04	8.76E-04	0.725
% nonwhite	-7.88E-04	3.20E-04	0.014
Population density	9.62E-07	4.69E-06	0.837
Median household income	6.90E-08	2.06E-07	0.738
Pre-existing multi-family structures			
Number condos, 0-1000 feet	6.90E-05	2.11E-04	0.744
Number market-rate apartments, 0-1000 feet	-4.25E-04	1.49E-04	0.004
Number subsidized apartments, 0-1000 feet	-1.36E-03	7.41E-04	0.066
Number senior apartments, 0-1000 feet	-1.26E-03	1.73E-03	0.469
Number uncategorized MF, 0-1000 feet	2.57E-03	5.80E-04	0.000
Number condos, 1000-2000 feet	3.15E-04	1.24E-04	0.011
Number market-rate apartments, 1000-2000 feet	-1.02E-04	7.57E-05	0.179
Number subsidized apartments, 1000-2000 feet	-7.73E-04	3.64E-04	0.034
Number senior apartments, 1000-2000 feet	3.43E-04	3.46E-04	0.321
Number uncategorized MF, 1000-2000 feet	2.21E-03	3.39E-04	0.000

Pre and post MF construction rings			
Pre (2 or more years) condominiums, 0-1000 feet	-0.064	0.027	0.017
Pre (0-2 years) condominiums, 0-1000 feet	0.004	0.028	0.880
Post (2 or more years) condominiums, 0-1000 feet	0.006	0.017	0.708
Post (0-2 years) condominiums, 0-1000 feet	0.060	0.026	0.023
Pre (2 or more years) large market rate apartments, 0-1000 feet	0.052	0.032	0.100
Pre (0-2 years) large market rate apartments, 0-1000 feet	-0.171	0.050	0.001
Post (2 or more years) large market rate apartments, 0-1000 feet	0.024	0.035	0.498
Post (0-2 years) large market rate apartments, 0-1000 feet	-0.250	0.075	0.001
Pre (2 or more years) small market rate apartments, 0-1000 feet	-0.096	0.040	0.017
Pre (0-2 years) small market rate apartments, 0-1000 feet	-0.006	0.032	0.850
Post (2 or more years) small market rate apartments, 0-1000 feet	0.006	0.021	0.774
Post (0-2 years) small market rate apartments, 0-1000 feet	-0.045	0.030	0.129
Pre (2 or more years) subsidized apartments, 0-1000 feet	-0.160	0.074	0.032
Pre (0-2 years) subsidized apartments, 0-1000 feet	-0.047	0.059	0.428
Post (2 or more years) subsidized apartments, 0-1000 feet	0.008	0.037	0.823
Post (0-2 years) subsidized apartments, 0-1000 feet	0.058	0.048	0.229
Pre (2 or more years) senior apartments, 0-1000 feet	-0.088	0.064	0.172
Pre (0-2 years) senior apartments, 0-1000 feet	-0.040	0.079	0.614
Post (2 or more years) senior apartments, 0-1000 feet	-0.026	0.049	0.592
Post (0-2 years) senior apartments, 0-1000 feet	-0.179	0.067	0.007
Pre (2 or more years) other multi-family, 0-1000 feet	0.369	0.122	0.003
Pre (0-2 years) other multi-family, 0-1000 feet	0.118	0.136	0.386
Post (2 or more years) other multi-family, 0-1000 feet	0.023	0.097	0.814
Post (0-2 years) other multi-family, 0-1000 feet	0.227	0.113	0.045
Pre (2 or more years) condominiums, 1000-2000 feet	-0.042	0.016	0.008
Pre (0-2 years) condominiums, 1000-2000 feet	-0.020	0.017	0.244
Post (2 or more years) condominiums, 1000-2000 feet	0.010	0.011	0.359
Post (0-2 years) condominiums, 1000-2000 feet	0.008	0.017	0.651

Pre (2 or more years) large market rate apartments, 1000-2000 feet	0.025	0.012	0.042
Pre (0-2 years) large market rate apartments, 1000-2000 feet	0.003	0.025	0.914
Post (2 or more years) large market rate apartments, 1000-2000 feet	0.040	0.016	0.015
Post (0-2 years) large market rate apartments, 1000-2000 feet	-0.003	0.027	0.916
Pre (2 or more years) small market rate apartments, 1000-2000 feet	-0.041	0.020	0.042
Pre (0-2 years) small market rate apartments, 1000-2000 feet	0.004	0.030	0.901
Post (2 or more years) small market rate apartments, 1000-2000 feet	0.043	0.015	0.004
Post (0-2 years) small market rate apartments, 1000-2000 feet	-0.040	0.026	0.127
Pre (2 or more years) subsidized apartments, 1000-2000 feet	0.127	0.039	0.001
Pre (0-2 years) subsidized apartments, 1000-2000 feet	-0.093	0.041	0.023
Post (2 or more years) subsidized apartments, 1000-2000 feet	0.054	0.028	0.053
Post (0-2 years) subsidized apartments, 1000-2000 feet	-0.005	0.037	0.887
Pre (2 or more years) senior apartments, 1000-2000 feet	-0.067	0.026	0.011
Pre (0-2 years) senior apartments, 1000-2000 feet	0.017	0.032	0.596
Post (2 or more years) senior apartments, 1000-2000 feet	-0.032	0.019	0.091
Post (0-2 years) senior apartments, 1000-2000 feet	0.058	0.030	0.050
Pre (2 or more years) other multi-family, 1000-2000 feet	0.009	0.064	0.884
Pre (0-2 years) other multi-family, 1000-2000 feet	0.108	0.082	0.191
Post (2 or more years) other multi-family, 1000-2000 feet	0.096	0.064	0.135
Post (0-2 years) other multi-family, 1000-2000 feet	-4.22E-05	0.093	1.000
Constant	7.361	0.258	0.000
^ *Statistical significance determined by joint Wald test*			

Table A2
Parameter Estimates for Random-Effects Logistic Regression Model of Violent Crime Incidence by Parcel and Year, 2000-2014 (N = 1,183,170)

Variable	**Coefficient**	**Standard error**	**P-Value**
Time fixed effects by year	Included^		0.000
Block group fixed effects	Included^		0.000
Number of violent crimes --- 500 feet	0.057	0.003	0.000
Parcel characteristics			
Land use ---HPR	2.500	0.516	0.000
Land use --- Industrial	-2.166	0.202	0.000
Land use --- INF	-1.106	0.128	0.000
Land use --- Public	0.433	0.713	0.544
Land use --- Residential	-1.543	0.039	0.000
Lot size (acres)	0.008	0.001	0.000
Log of assessed value	0.279	0.010	0.000
Distance to downtown (miles)	-0.394	0.045	0.000
Pre-existing multi-family structures			
Number condos, 0-1000 feet	0.019	0.006	0.002
Number market-rate apartments, 0-1000 feet	0.028	0.003	0.000
Number subsidized apartments, 0-1000 feet	0.041	0.005	0.000
Number senior apartments, 0-1000 feet	0.064	0.012	0.000
Number uncategorized MF, 0-1000 feet	-0.009	0.006	0.129
Number condos, 1000-2000 feet	-0.004	0.004	0.376
Number market-rate apartments, 1000-2000 feet	-0.001	0.002	0.598
Number subsidized apartments, 1000-2000 feet	0.002	0.004	0.708
Number senior apartments, 1000-2000 feet	-0.012	0.008	0.113
Number uncategorized MF, 1000-2000 feet	-0.014	0.005	0.003
Pre and post MF construction rings			
Pre-construction condominiums, 0-1000 feet	0.066	0.114	0.565
Post-construction condominiums, 0-1000 feet	0.403	0.101	0.000
Pre-construction large market rate apartments, 0-1000 feet	-0.206	0.259	0.427
Post-construction large market rate apartments, 0-1000 feet	0.720	0.191	0.000

Pre-construction small market rate apartments, 0-1000 feet	0.090	0.116	0.436
Post-construction small market rate apartments, 0-1000 feet	-0.188	0.158	0.236
Pre-construction subsidized apartments, 0-1000 feet	0.178	0.142	0.211
Post-construction subsidized apartments, 0-1000 feet	0.149	0.126	0.237
Pre-construction senior apartments, 0-1000 feet	-0.305	0.146	0.036
Post-construction senior apartments, 0-1000 feet	0.004	0.131	0.976
Pre-construction other multi-family, 0-1000 feet	0.284	0.093	0.002
Post-construction other multi-family, 0-1000 feet	0.091	0.085	0.286
Pre-construction condominiums, 1000-2000 feet	-0.189	0.092	0.040
Post-construction condominiums, 1000-2000 feet	-0.002	0.082	0.979
Pre-construction large market rate apartments, 1000-2000 feet	0.186	0.160	0.247
Post-construction large market rate apartments, 1000-2000 feet	0.260	0.149	0.081
Pre-construction small market rate apartments, 1000-2000 feet	0.034	0.083	0.684
Post-construction small market rate apartments, 1000-2000 feet	-0.103	0.107	0.334
Pre-construction subsidized apartments, 1000-2000 feet	0.185	0.098	0.058
Post-construction subsidized apartments, 1000-2000 feet	-0.078	0.095	0.415
Pre-construction senior apartments, 1000-2000 feet	-0.016	0.088	0.852
Post-construction senior apartments, 1000-2000 feet	0.232	0.081	0.004
Pre-construction other multi-family, 1000-2000 feet	0.153	0.062	0.013
Post-construction other multi-family, 1000-2000 feet	-0.063	0.058	0.277
Constant	-6.103	0.220	0.000
Standard deviation of parcel-level variance	1.603	0.016	
^ *Statistical significance determined by joint Wald test*			

Table A3
Parameter Estimates for Random-Effects Logistic Regression Model of Property Crime Incidence by Parcel and Year, 2003-2014 (N = 946,536)

Variable	**Coefficient**	**Standard error**	**P-Value**
Time fixed effects by year	Included^		0.000
Block group fixed effects	Included^		0.000
Number of property crimes --- 500 ft	0.016	0.000	0.000
Parcel characteristics			
Land use ---HPR	4.223	0.301	0.000
Land use --- Industrial	-1.159	0.102	0.000
Land use --- INF	-0.832	0.069	0.000
Land use --- Public	1.909	0.341	0.000
Land use --- Residential	-1.132	0.023	0.000
Lot size	0.009	0.001	0.000
Log of assessed value	0.323	0.005	0.000
Distance to downtown (miles)	-0.246	0.020	0.000
Pre-existing multi-family structures			
Number condos, 0-1000 feet	0.014	0.003	0.000
Number market-rate apartments, 0-1000 feet	0.012	0.001	0.000
Number subsidized apartments, 0-1000 feet	0.024	0.003	0.000
Number senior apartments, 0-1000 feet	0.034	0.007	0.000
Number uncategorized MF, 0-1000 feet	0.005	0.003	0.117
Number condos, 1000-2000 feet	1.64E-04	1.76E-03	0.926
Number market-rate apartments, 1000-2000 feet	-5.94E-04	8.34E-04	0.476
Number subsidized apartments, 1000-2000 feet	7.77E-05	2.15E-03	0.971
Number senior apartments, 1000-2000 feet	-2.90E-03	3.05E-03	0.342
Number uncategorized MF, 1000-2000 feet	-2.31E-03	2.52E-03	0.361
Pre and post MF construction rings			
Pre-construction condominiums, 0-1000 feet	0.077	0.070	0.271
Post-construction condominiums, 0-1000 feet	0.133	0.050	0.009
Pre-construction large market rate apartments, 0-1000 feet	0.163	0.101	0.107
Post-construction large market rate apartments, 0-1000 feet	0.372	0.082	0.000
Pre-construction small market rate apartments, 0-1000 feet	-0.052	0.064	0.417
Post-construction small market rate apartments, 0-1000 feet	0.060	0.071	0.396

Pre-construction subsidized apartments, 0-1000 feet	0.073	0.091	0.425
Post-construction subsidized apartments, 0-1000 feet	-0.138	0.070	0.048
Pre-construction senior apartments, 0-1000 feet	-0.306	0.082	0.000
Post-construction senior apartments, 0-1000 feet	-0.003	0.074	0.964
Pre-construction other multi-family, 0-1000 feet	0.270	0.065	0.000
Post-construction other multi-family, 0-1000 feet	0.035	0.054	0.521
Pre-construction condominiums, 1000-2000 feet	-0.050	0.049	0.306
Post-construction condominiums, 1000-2000 feet	0.082	0.036	0.024
Pre-construction large market rate apartments, 1000-2000 feet	0.053	0.061	0.385
Post-construction large market rate apartments, 1000-2000 feet	-0.010	0.058	0.857
Pre-construction small market rate apartments, 1000-2000 feet	0.026	0.042	0.547
Post-construction small market rate apartments, 1000-2000 feet	-0.069	0.047	0.139
Pre-construction subsidized apartments, 1000-2000 feet	-0.056	0.061	0.359
Post-construction subsidized apartments, 1000-2000 feet	-0.301	0.052	0.000
Pre-construction senior apartments, 1000-2000 feet	-0.013	0.049	0.784
Post-construction senior apartments, 1000-2000 feet	0.028	0.043	0.516
Pre-construction other multi-family, 1000-2000 feet	0.144	0.041	0.000
Post-construction other multi-family, 1000-2000 feet	-0.080	0.034	0.020
Constant	-4.687	0.118	0.000
Standard deviation of parcel-level variance	1.167	0.007	
^ *Statistical significance determined by joint Wald test*			

Table A4
Parameter Estimates for Random-Effects Logistic Regression Model of Code Violation Incidence by Parcel and Year, 2007-2015 (N = 708,444)

Variable	Coefficient	Standard error	P-Value
Time fixed effects by year	Included^		0.000
Block group fixed effects	Included^		0.000
Number of code violations--- 500 feet	0.049	0.001	0.000
Parcel characteristics			
Land use ---HPR	2.769	0.401	0.000
Land use --- Industrial	-0.567	0.159	0.000
Land use --- INF	-0.723	0.115	0.000
Land use --- Public	0.188	0.633	0.767
Land use --- Residential	0.124	0.035	0.000
Lot size	0.002	0.001	0.104
Log of assessed value	0.149	0.007	0.000
Distance to downtown (miles)	-0.194	0.031	0.000
Pre-existing multi-family structures			
Number condos, 0-1000 feet	0.015	0.004	0.000
Number market-rate apartments, 0-1000 feet	0.013	0.002	0.000
Number subsidized apartments, 0-1000 feet	0.027	0.004	0.000
Number senior apartments, 0-1000 feet	0.038	0.010	0.000
Number uncategorized MF, 0-1000 feet	-0.004	0.005	0.432
Number condos, 1000-2000 feet	-2.36E-04	2.59E-03	9.27E-01
Number market-rate apartments, 1000-2000 feet	-6.16E-04	1.18E-03	6.01E-01
Number subsidized apartments, 1000-2000 feet	-0.007	0.003	0.028
Number senior apartments, 1000-2000 feet	0.012	0.004	0.004
Number uncategorized MF, 1000-2000 feet	-0.013	0.004	0.000
Pre and post MF construction rings			
Pre-construction condominiums, 0-1000 feet	0.252	0.253	0.320
Post-construction condominiums, 0-1000 feet	0.122	0.075	0.106
Pre-construction large market rate apartments, 0-1000 feet	0.210	0.217	0.333
Post-construction large market rate apartments, 0-1000 feet	0.066	0.128	0.604

Pre-construction small market rate apartments, 0-1000 feet	0.146	0.104	0.160
Post-construction small market rate apartments, 0-1000 feet	0.313	0.092	0.001
Pre-construction subsidized apartments, 0-1000 feet	-0.215	0.212	0.311
Post-construction subsidized apartments, 0-1000 feet	0.147	0.088	0.096
Pre-construction senior apartments, 0-1000 feet	-0.160	0.132	0.228
Post-construction senior apartments, 0-1000 feet	0.066	0.102	0.522
Pre-construction other multi-family, 0-1000 feet	0.104	0.105	0.322
Post-construction other multi-family, 0-1000 feet	-4.65E-04	7.10E-02	0.995
Pre-construction condominiums, 1000-2000 feet	-0.293	0.213	0.170
Post-construction condominiums, 1000-2000 feet	-0.004	0.057	0.940
Pre-construction large market rate apartments, 1000-2000 feet	-0.146	0.133	0.271
Post-construction large market rate apartments, 1000-2000 feet	0.008	0.087	0.923
Pre-construction small market rate apartments, 1000-2000 feet	-0.022	0.069	0.748
Post-construction small market rate apartments, 1000-2000 feet	0.138	0.061	0.024
Pre-construction subsidized apartments, 1000-2000 feet	0.029	0.120	0.809
Post-construction subsidized apartments, 1000-2000 feet	-0.143	0.066	0.030
Pre-construction senior apartments, 1000-2000 feet	-0.026	0.075	0.733
Post-construction senior apartments, 1000-2000 feet	0.015	0.061	0.801
Pre-construction other multi-family, 1000-2000 feet	0.097	0.070	0.168
Post-construction other multi-family, 1000-2000 feet	-0.040	0.047	0.401
Constant	-5.308	0.170	0.000
Standard deviation of parcel-level variance	1.354	0.011	
^ *Statistical significance determined by joint Wald test*			