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Commercial Density, Residential Concentration, and Crime: Land Use Patterns and Violence in Neighborhood Context

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Abstract

Drawing on Jacobs's (1961) and Taylor's (1988) discussions of the social control implications of mixed land use, the authors explore the link

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between commercial and residential density and violent crime in urban neighborhoods. Using crime, census, and tax parcel data for Columbus, Ohio, the authors find evidence of a curvilinear association between commercial and residential density and both homicide and aggravated assault, consistent with Jacobs's expectations. At low levels, increasing commercial and residential density is positively associated with homicide and aggravated assault. Beyond a threshold, however, increasing commercial and residential density serves to reduce the likelihood of both outcomes. In contrast, the association between commercial and residential density and robbery rates is positive and linear. The implications of these findings for understanding the sources of informal social control in urban neighborhoods are discussed.

Keywords
density, violence, mixed land use

Although combining residential and commercial land use was common in early industrialized cities, the emergence of modern urban planning theory in the late nineteenth and early twentieth centuries brought increasing opposition to the mixing of residential and commercial activity within urban neighborhoods. Commerce was thought to interfere with residential neighborhood dynamics, fostering disorder and anonymity. The publication of Jane Jacobs's (1961) classic book, *The Death and Life of Great American Cities*, forcefully challenged this current of Modernist-inspired architectural and urban planning theory. Jacobs emphasized the positive aspects of organically developing neighborhoods, focusing on the role of concentrated residential population and commercial establishments ("mixed use" neighborhoods) in generating conventional street activity, with the associated social control benefits of "eyes on the street" (Jacobs 1961).

Jacobs's focus on the social control benefits of concentrated, diverse neighborhoods has remained influential, spawning new developments in research and advocacy rooted in a positive evaluation of "mixed use" neighborhoods. Proponents of the "New Urbanism," for instance, encourage design of densely settled, walkable communities that intersperse residences and businesses. In turn, increased street activity is presumed to enhance neighborhood cohesion and reduce the likelihood of crime (Calthorpe and Fulton 2001; Duany, Plater-Zyberk, and Speck 2001). Nevertheless, debate continues regarding the relative advantages of mixed land use for the safety and well-being of communities. Taylor and colleagues

(Taylor 1988; Taylor et al. 1995), for instance, have offered a "territorial" model of community control that points to the tension between residents' informal social control efforts and the street dynamics induced by extensive commerce. In this view, as local business activity increases in residential areas, informal social control capacity is likely to diminish, with consequences for the prevalence of crime.

We test alternative approaches to the link between concentrated, mixed use neighborhoods and crime using data from the National Neighborhood Crime Study (NNCS) for Columbus, Ohio. The NNCS includes 1999-2001 crime data and sociodemographic information from the 2000 census for all tracts within a representative sample of large U.S. cities, including Columbus. We merge violent crime and 2000 census data from the NNCS with detailed tax parcel information describing land use characteristics. These data are analyzed using a number of statistical techniques, including spatial regression models that account for potential dependencies among proximate neighborhoods. The research design and analytic strategy offer a fruitful opportunity to examine the influence of land use on urban crime.

Background

Urban neighborhoods combining high residential and small retail densities became widely prevalent in the late nineteenth and early twentieth centuries. The historical convergence of fixed path transportation (railroads) and industrialization led to the concentration of manufacturing near central city rail hubs. Large-scale immigration brought enormous increases in urban population to central city neighborhoods in close proximity to low-skill manufacturing jobs. Although wages for low-skill manufacturing work were by no means extravagant, they generated enough income to support (at high population densities) a considerable number of small retail establishments. Consequently, commercial and residential densities during this period of urban growth were especially high, much higher than those found in contemporary cities (Rae 2003).

The development of the automobile in the early twentieth century was perhaps the critical factor in reversing the several decade-long period of "convergent" or central-city–concentrated urban growth (Felson 2002). As manufacturers shifted location to exploit cheaper suburban real estate and increasingly relied on trucking for transportation, central cities suffered from the decline in the availability of opportunities for low-skill wage labor. Competition from national chains further contributed to the diminishing

prevalence of smaller scale retail establishments within urban neighborhoods.

More recent urban history has been marked by substantial spatial heterogeneity in trajectories of population and commercial change. Of particular concern has been significant decline in both population and commerce in economically disadvantaged areas. Wilson (1987, 1996) has forcefully argued that the upheaval of Urban Renewal, the shift from a manufacturing to a service-based economy, and the flight of middle-class residents from declining urban neighborhoods resulted in an unprecedented concentration of poverty within some inner-city communities. The institutional and population depletion of emerging high poverty neighborhoods resulted in spatial inequality in the distribution of residential concentration and retail establishments across urban communities. Although evidence of population decline in poor and African American neighborhoods is widely acknowledged (Kingsley and Pettit 2002), recent evidence has challenged aspects of Wilson's "deinstitutionalization" hypothesis. For instance Small and McDermott's (2006) analysis of 365 U.S. cities demonstrates that economically disadvantaged neighborhoods actually exhibit *higher* commercial densities than their more advantaged counterparts. In contrast, neighborhoods with higher proportions of African Americans have lower concentrations of businesses, pointing to the potential role of segregation in commercial depletion.

Despite considerable discussion and debate about the association between neighborhood economic decline and the extent and distribution of residential and commercial density, relatively few studies have examined the consequences of neighborhood densities for urban populations—particularly, for the prevalence of violent crime. This, despite the fact that extant theory addressing the impact of commercial activity on crime has yielded clear, but opposing claims regarding the role of high density, mixed use neighborhoods in generating effective informal social control of crime.

Jacobs's Street Control Model

In contrast to the tenets of what she labeled "orthodox planning theory," Jacobs (1961) offered an optimistic assessment of the traditional urban street and its diverse uses. In her view, densely populated, mixed use neighborhoods draw pedestrians onto the street. Neighborhoods with residential density and diverse, evenly distributed commerce will tend to draw foot traffic across a large proportion of neighborhood streets. Throughout the day, such neighborhoods will be more likely to experience pedestrians

traversing city streets on the way to work, running errands, and going to restaurants or other entertainment venues. The ecological dynamics generated by concentrated, mixed use neighborhoods provide a foundation for effective informal social control of public space through encouraging a steady stream of "eyes on the street." The most effective monitoring of street space comes from what Jacobs calls the "natural proprietors" of neighborhoods—residents and local business owners. Regardless of who is on the street, residents and business owners will take an interest in active streets, with increased monitoring as a byproduct.

In Jacobs's view, the social ecologies engendered by mixed use neighborhoods foster public interactions that are crucial for the emergence of neighborhood-based trust. Active streets that draw the participation of residents in neighborhood public life result in casual but consequential acquaintanceship networks among neighbors, business owners, and regular users of the streets. The contacts that feed such networks are exemplified by the largely trivial but routine interactions associated with errand running, dog walking, passing children using a regular play space, and other activities of daily urban living. The result of ongoing public contact is "a web of public respect and trust" and an "almost unconscious assumption of general street support when the chips are down" (Jacobs 1961:56). Jacobs's emphasis on the role of mutual trust and shared expectations regarding the control of public space can be seen as a forerunner of Sampson's concept of collective efficacy (Sampson and Raudenbush 1999; Sampson, Raudenbush, and Earls 1997). For Jacobs, then, street activity provides both immediate street monitoring and the social conditions for the emergence of effective informal social control norms, reducing the prevalence of crime.

Jacobs's argument emphasizes the importance of widely distributed commercial and residential concentration. Mixed use neighborhoods with dispersed commercial and other destinations will avoid "grey area" streets with minimal traffic. In contrast, street activity that is unevenly distributed or concentrated on only a small proportion of a neighborhood's streets may have adverse implications for overall levels of crime. Dense pedestrian traffic in areas characterized by highly concentrated commercial activity, for instance, may provide social control benefits but lead to a thinning out of activity on peripheral streets. These marginal streets may have insufficient pedestrian presence to promote effective monitoring. Indeed, a minimal street presence (e.g., the occasional lone pedestrian) may offer little more than opportunities for victimization, potentially offsetting the social control benefits experienced on active streets. At the neighborhood level, then, the net effect of a small proportion of active streets may actually be to increase

crime levels. Jacobs's model thus offers a curvilinear expectation regarding the effect of commercial and residential density on crime—at very low levels, increasing commercial and residential density contributes to crime by drawing a predominately sparsely distributed pool of potential victims onto the street; beyond a threshold, however, the more widespread street activity produced by a sufficient concentration of commerce and population exerts a regulatory effect on crime.

An important feature of Jacobs's model is her expectations regarding the role of strangers in street control. In Jacobs's view, strangers are an inevitable feature of street life. Although much street activity will be comprised of neighborhood residents, many residents may be unfamiliar to one another due to the difficulty of knowing or recognizing large numbers of people in highly dense urban environments. Moreover, outsiders may also be drawn to businesses within urban neighborhoods or traverse streets on their way to nearby destinations. The objective, according to Jacobs, is not to reduce the presence of strangers (a goal inspired by an outdated and romanticized notion of the insular, small-town reproduction), but to accommodate or even leverage their presence in an effective system of street control. Residential and commercial concentration is a key component of this system; neighborhood streets with a sufficient number of functional destinations that draw pedestrian traffic (residents or strangers) attract the interest and eyes of local residents and business owners. Ongoing activity thus brings, as a byproduct, consistent monitoring of streets with associated social control benefits. Indeed, individuals on the street may be unknown to one another but nevertheless provide the activity necessary to spur monitoring from those who maintain a natural interest in street safety.[1] Thus diverse, mixed use neighborhoods generate the conditions that produce effectively monitored streets, even when these contexts draw significant numbers of strangers.

Taylor's Territoriality Model

Taylor and colleagues have advanced an alternative perspective on the role of mixed land use in the regulation of crime. Taylor's "territorial" model focuses on the radius of responsibility local residents extend around their homes and the aggregate impact of this subjectively claimed space on the effectiveness of neighborhood informal social control. As the circles of space that residents tend to and monitor begin to overlap with those of their neighbors, public space is increasingly subject to local informal control, reducing the prevalence of crime.

Taylor's model hypothesizes that street activity increases as a function of residential and commercial density. Dense, mixed use neighborhoods tend to increase pedestrian traffic while decreasing the likelihood that street occupants will know one another. Thus, both Jacobs and Taylor describe the relationships between patterns of land use and pedestrian activity in a similar manner. However, Taylor's model differs from Jacobs in how it views the roles of "outsiders" versus "regulars." For Taylor, as the prevalence of unfamiliar faces increases, the sense of anonymity becomes more pervasive. Anonymity, in turn, induces withdrawal among those who live in the neighborhood, shrinking the radius of responsibility maintained by residents and diminishing social control inclinations and effectiveness. Even if anonymous pedestrian traffic is perceived to be "legitimate," it fosters a sense of insecurity and reduces resident's willingness to use public space. The weakening of social control inclinations among neighborhood residents is accompanied by enhanced opportunity for victimization. More street activity brings potential offenders and victims together in a context of increasingly absent guardianship (Felson 2002; Felson and Cohen 1979), escalating the risk of crime.

Moreover, in Taylor's view, the mix of business with residential space generates gaps in the spatial distribution of territoriality. Owners will be less effective in monitoring the public space surrounding their establishments when their businesses are closed. Unoccupied commercial establishments produce interstices in the overlapping radii of responsibility maintained by residents. In turn, these weakly regulated spaces may be exploited by potential offenders. Thus, at higher levels, increases in residential and commercial concentration are hypothesized to be criminogenic for Taylor—an expectation in opposition to that of Jacobs.[2]

Contingencies in the Impact of Mixed Land Use

Jacobs's expectations regarding the role of mixed land use and the street activity it engenders are contingent upon social organizational features of urban communities. Although Jacobs argues that on average, higher levels of street activity contribute to the emergence of acquaintanceship networks and informal social control norms, she also highlights the interdependency of street activity and informal social control orientations in the supervision of public space. Without the expectation that others will back one up in an intervention effort, the monitoring benefits of "eyes on the street" are unlikely to translate into effective social control. Similarly, shared expectations are likely to have less impact on street crime without the benefit of

street activity and associated monitoring. Thus, lower levels of anonymity, more prevalent informal exchange networks, and widely shared norms regarding the control of public space are likely to amplify the benefits of street activity for the control of crime. In contrast, increasing street activity in neighborhoods characterized by minimal social control and streets dominated by strangers may experience more widespread crime.

Research has demonstrated strong links between neighborhood socioeconomic disadvantage and levels of social organization, including informal social control norms, intergenerational ties and support, and viable exchange networks (Sampson et al. 1997; Sampson, Morenoff, and Earls 1999). Given the lower average levels of social organization in socioeconomically disadvantaged communities, Jacobs's model leads to the expectation of less pronounced beneficial effects of mixed land use in these neighborhoods. Accordingly, an important goal of the current analysis will be to examine this potential contingency in the impact of commercial and residential density by level of structural disadvantage.

Despite its enormous influence,[3] tests of Jacobs's theoretical approach have been relatively limited. Studies have demonstrated that greater residential and commercial density is associated with more pedestrian traffic (Frank and Pivo 1995; Kitamura, Mokhtarian, and Laidet 1997; Lund 2003; Shriver 1996). However, evidence regarding the implications of these factors for crime is incipient and mixed. Fowler (1987) examined the association between neighborhood structure and physical design characteristics identified by Jacobs as preconditions for street control, neighboring, and crime: population concentration, mixed primary uses, short streets, and a mix of old and new structures. The findings indicate that "physical diversity"—a measure combining these characteristics—is positively related to neighboring and negatively related to crime, consistent with Jacobs's expectations (although neighboring is not related to crime). Sampson and Raudenbush (1999) found a negative association between a tract-level measure of the proportion of face blocks with both residential and commercial activity and violent victimization (based on survey data). No relationship was observed, however, between mixed land use and homicide, robbery, or burglary (from incidents reported to the police).

Beyond these studies, scholars are left to draw conclusions from research on noncriminal outcomes. Taylor and colleagues found that mixed land use is positively associated with physical deterioration (Taylor et al. 1995) and negatively associated with residents' willingness to manage nearby outdoor space (Kurtz, Koons, and Taylor 1998; see also Wikstrom 1991).[4] Finally, Szapocznik et al. (2006) found positive associations between diversity of

land use and teacher's reports of children's grades in a predominately Hispanic and high poverty neighborhood. In brief, findings to date have been based on disparate settings (e.g., neighborhoods, schools, outdoor space) and outcomes and are ambiguous with respect to the impact of mixed land use. Moreover, no published study has examined the nonlinear association between mixed land use and violent crime.

Here, we test expectations regarding the relationship between the concentration of commercial and residential activity and violent crime drawn from Jacobs's and Taylor's approaches. Clarifying the relationship between land use characteristics of urban neighborhoods and patterns of crime is particularly important given ongoing efforts at urban redevelopment and debates regarding the impact of land use and zoning practices for community outcomes.

Data and Method

Sample

We use data from Columbus, Ohio, a large, Midwestern city with a 2000 population of over 700,000. The data used in our analyses mainly come from the National Neighborhood Crime Study (NNCS), which includes reported crime counts from the Columbus Division of Police and sociodemographic information from the 2000 census for all tracts that are wholly or partly within the city and have a population of at least 300. Additional crime data for the 1990 period were obtained directly from the police department. Land use information for 2000 comes from the Franklin County Auditor's Office (the county in which Columbus is located). There are a total of 198 census tracts in the city of Columbus that meet the aforementioned criteria.[5] Because our analysis includes a control for prior rates of crime (see the following), the sample is reduced somewhat due to changes in tract boundaries and some missing information in the 1990 data provided by the police department. Thus, the final sample for the analyses includes 184 census tracts.

As with any study of a single city, we must be cautious in generalizing findings to other localities. However, Columbus, Ohio, is a large city (15th largest in the United States in 2000) that is diverse in population composition (26 percent African American, 4 percent Asian, and 4 percent Latino; U.S. Bureau of the Census 2009) and economic functions. It is a state capital, home of a major university, and the headquarters of numerous corporations including large national insurance companies, fast food industries, and major banks and retailers. Although it is different from either New York

City, which was studied by Jacobs, or Philadelphia, which was examined by Taylor, it has characteristics that reflect a wide range of places in the United States. Nonetheless, additional research should collect data on land use patterns across a broader range of cities and metropolitan areas to validate the results reported in the following.

Measures

Three dependent variables are used in the analysis: three-year (1999-2001) average homicide counts, aggravated assault rates, and robbery rates (per 1,000 population). We focus on violent crime as it is typically more overt, and observable, than property crime. In addition, the particular violent crimes we consider are more likely to occur in or near public spaces (e.g., by comparison with rape).[6] As noted, we use three-year counts for each crime in order to minimize the influence of measurement error and volatility in the year-to-year occurrence of violent crime.

Our key independent variable combines standardized logged measures of the percentage of the tract area allotted to (1) commercial parcels (see Appendix A for a list of the types of properties included) and (2) multifamily dwellings (rental apartments and condominiums) based on 2000 tax parcel data. This measure includes multifamily dwellings in order to capture residential concentrations that are likely to lead to the kinds of street dynamics highlighted in Jacobs's and Taylor's approaches. The physical concentration of residents in apartments and condominiums may produce correspondingly more concentrated street activity. The correlation between multifamily dwellings and commercial density is .40

A number of control variables are included in the models based on prior theory and research on the structural antecedents of violent crime (Land, McCall, and Cohen 1990; Morenoff, Sampson, and Raudenbush 2001). Disadvantage combines measures of the percent of the population age 16 to 64 who are unemployed or out of the labor force (joblessness), percentage of employed persons age 16 and older who are working in professional or managerial occupations (reverse coded), percentage of the population age 25 and older who are college graduates (reverse coded), percentage of households who are female-headed families, percentage of the employed civilian population age 16 and older who work in the six occupations with the lowest average incomes (secondary sector workers), and percentage of the population below the poverty line ($\alpha = .93$). Residential instability combines measures of the percentage of occupied housing units that are renter occupied and the percentage of residents age 5 or older who lived in a

different dwelling in 1995 ($\alpha = .69$). Immigrant concentration is a three-item index that combines the percentage foreign born, the percentage Hispanic, and the percentage of linguistically isolated households (percentage of households in which no one age 14 and older speaks English very well). This measure is included due to increasing evidence that immigrant concentration may have protective effects on the occurrence of crime (Lee and Martinez 2002; Martinez and Nielsen 2006; Sampson, Morenoff, and Raudenbush 2005). Scale scores for disadvantage, instability, and immigrant concentration are the standardized average z scores of the component items. We also include the natural log of the percentage African American, a measure of the percentage young men (percentage of the population that is male and between ages 15 and 24), and the natural log of the population density per square mile. Finally, we include the three year (1989-91) average violent crime rate (murder, rape, robbery, and aggravated assault) to address possible endogeneity in the relationship between residential/commercial density and violence.[7]

Analytic Strategy. We use negative binomial models with robust standard errors to analyze 1999-2001 homicide counts and ordinary least squares (OLS) regression models with robust standard errors to analyze aggravated assault and robbery rates. Negative binomial models of homicide counts use the tract population (in thousands) as an exposure variable. Thus the outcome is the log homicide rate per 1,000 population. We also employ spatial modeling techniques, where appropriate, to account for potential spatial dependencies in violent crime outcomes. Spatial dependency may occur when the boundaries of areal units are incorrectly specified or when spillover effects ("spatial externalities") are operating between jurisdictions (Anselin 1988). The data used in the current analyses are drawn from contiguous census tracts based on administratively defined boundaries. Moreover, Columbus neighborhoods with similar characteristics tend to cluster together spatially—a common phenomenon that may indicate spatially based dependencies. Indeed, prior research on violent crime has offered evidence of spatial dependencies (Baller et al. 2001; Morenoff et al. 2001). Accordingly, we incorporate the potential for spatial effects into our statistical strategy.

To test for the presence of residual spatial autocorrelation, we calculated robust Lagrange Multiplier (LM) statistics for nonspatial OLS regressions[8] of violent crime outcomes using a first-order contiguity weight matrix. The LM tests revealed little evidence of spatial autocorrelation for homicide. In the case of assault, spatial diagnostic tests revealed only a marginally

Table 1. Descriptive Statistics for Variables Used in the Analysis

Independent Variables	*M*	*SD*
Homicide	1.152	1.532
Aggravated assault (log)	0.717	1.25
Robbery (log)	1.101	1.242
Disadvantage	0.000	1.000
Residential instability	0.000	1.000
Immigrant concentration	0.000	1.000
Percent African American (log)	2.674	1.419
Population density (log)	8.424	0.676
Percent young males	8.263	6.549
Comm/residential density (log)	0.000	1.000
1989-1991 Violent crime rate	1.720	1.212

significant ($p < .10$) robust LM statistic indicating spatial error dependence. Spatial error models produced results only nominally different from OLS regression models. The latter are reported in the following. For robbery, strong evidence of spatial lag dependence emerged (robust LM test was significant [$p < .001$]). Accordingly, models for robbery presented in the following are estimated using a mixed regressive-spatial autoregressive specification, given by:

$$\mathbf{y} = \rho \mathbf{W} \mathbf{y} + \beta \mathbf{X} + \epsilon \sim \mathrm{N}(0, \sigma^2)$$

where y is an N × 1 vector of observations on the outcome measure, W is a first order contiguity weight matrix, X is an N × K matrix of independent variables, β is a K × 1 vector of regression coefficients, ρ is the spatial lag operator, and ε is a vector of independent and identically distributed error terms with 0 means and constant variances. Bivariate correlations among variables used in the analysis are reported in Appendix B.

Results

Table 1 reports univariate descriptive statistics for variables used in the analysis. Table 2 reports the results of negative binomial, OLS, and spatial regressions of 1999-2001 homicide counts, log aggravated assault rates, and log robbery rates, respectively. Beginning with homicide, model 1 of Table 2 shows coefficients for a baseline model including only structural covariates drawn from the 2000 census. Disadvantage, residential instability, and the logged percentage African American are positively associated with

Table 2. Negative Binomial, Ordinary Least Squares (OLS), and Spatial Regression Models of 1999-2001 Violent Crime Outcomes (N = 184)

		1999-2001 Homicide[a]			Assault Rate (log)[b]			Robbery Rate (log)[c]	
Independent Variables	1	2	3	4	5	6	7	8	9
Disadvantage	.309***	.136	−.073	.307***	.300***	.038	.106	.213***	.012
	(.112)	(.126)	(.093)	(.088)	(.109)	(.079)	(.078)	(.079)	(.066)
Residential instability	.267**	.467***	.260	.353***	.359***	.200*	.356***	.136	−.009
	(.106)	(.127)	(.118)	(.075)	(.122)	(.104)	(.072)	(.088)	(.072)
Immigrant concentration	−.114	−.011	.048	−.262***	−.237***	−.134**	−.080	−.141**	−.069
	(.094)	(.066)	(.078)	(.049)	(.058)	(.055)	(.060)	(.060)	(.049)
Percentage African American (log)	.374***	.426***	.194**	.382***	.368***	.188***	.140***	.115**	.030
	(.095)	(.102)	(.096)	(.064)	(.067)	(.068)	(.051)	(.049)	(.041)
Population density (log)	.117	.242	.098	.138	.154	.011	.067	−.040	−.074
	(.150)	(.155)	(.124)	(.113)	(.126)	(.094)	(.090	(.091)	(.074)
Percentage young males	−.012	−.006	.004	−.014	−.012	.001	−.010	−.006	.008
	(.015)	(.014)	(.013)	(.010)	(.010)	(.007)	(.010)	(.010)	(.008)
Commercial/residential density (log)	—	−.373**	−.383***	—	−.061	−.041	—	.405***	.362***
		(.173)	(.144)		(.163)	(.126)		(.109)	(.088)
Commercial/residential density squared	—	−.377**	−.288*	—	−.162***	−.107**	—	−.007	−.019
		(.157)	(.152)		(.052)	(.044)		(.056)	(.046)
1989-1991 violent crime rate	—	—	.659***	—	—	.618***	—	—	.657***
			(.114)			(.075)			(.063)
Intercept	−3.262*	−4.312**	−3.798**	−1.369	−1.380	−.883	−.408	.494	.183
	(1.322)	(1.389)	(1.118	1.011)	(1.131)	(.822)	(.758)	(.760)	(.617)

(continued)

Table 2. (Continued)

		1999-2001 Homicide[a]			Assault Rate (log)[b]			Robbery Rate (log)[c]	
Independent Variables	1	2	3	4	5	6	7	8	9
R-squared	—	—	—	.557	.574	.745	—	—	—
Rho	—	—	—	—	—	—	.565***	.577***	.231***
							(.064)	(.063)	(.071)
Variance ratio	—	—	—	—	—	—	.556	.592	.775

Note: Standard errors in parentheses.
[a] Negative binomial models with robust standard errors.
[b] OLS models with robust standard errors.
[c] Spatial lag models.
* $p < .10$.
** $p < .05$.
*** $p < .01$. (two-tailed tests)

homicide. Immigrant concentration, population density, and the tract proportion young male, however, are not significantly associated with this outcome.

Model 2 adds the linear and quadratic commercial/residential density variables to the baseline model. Both effects are statistically significant and negative, offering evidence of a curvilinear association between commercial/residential density and homicide in Columbus neighborhoods. At low levels, increases in commercial/residential density lead to a corresponding increase in the homicide rate. Beyond a threshold (below the mean, as indicated by the negative and significant linear effect), commercial/residential density begins to exert a negative effect on the homicide rate. Note also that the effect of disadvantage in model 2 is reduced substantially in magnitude and rendered insignificant at the .10 level, suggesting that the effects of disadvantage on homicide may operate, in part, through commercial/residential density. In contrast, the effect of residential instability increases in magnitude. The linear and quadratic effects of commercial/residential density remain statistically significant in model 3 (although the quadratic effect is modestly reduced in magnitude and significance) with the inclusion of the 1989-91 violent crime rate, which is powerfully positively associated with 1999-2001 homicide.

Models 4 to 6 report findings from OLS models (with robust standard errors) of the tract logged aggravated assault rate. The effect of structural covariates in model 4 parallel findings for homicide in model 1, with the exception of immigrant concentration, which exerts a statistically significant negative effect on assault rates. Model 5 adds the linear and quadratic effects of commercial/residential density. Again, the quadratic effect is significant and negative, offering evidence of similar curvilinearity to that observed for homicide in the relationship between commercial/residential density and assault. The linear effect is not significant, but negative, indicating that the inflection point is below the mean commercial/residential density. The effects of structural covariates in model 5 change minimally by comparison with model 4. Finally, model 6 adds prior violent crime, which is, again, a significant positive predictor of 1999-2001 aggravated assault. Although the quadratic effect is reduced somewhat in magnitude and significance in model 6, the effect remains significant and nontrivial.

Finally, models 7 to 9 report the results of comparable models of the logged robbery rate for Columbus census tracts. Only residential instability and the logged percentage African American achieve significance in the baseline model (both positive in their association with robbery). Model 8 adds commercial/residential density. Although the linear effect of commercial/

residential density is positive and significant in model 8, the quadratic effect is not a significant predictor of robbery. Thus, in contrast to homicide and aggravated assault, increasing commercial/residential density positively predicts robbery across the range of the density scale. In addition, disadvantage and immigrant concentration become statistically significant positive and negative predictors, respectively, of robbery in model 8. Finally, model 9 adds prior violent crime, reducing all covariates to insignificance, with the exception of commercial/residential density, which remains a significant positive predictor of robbery.

Tests of the impact of commercial/residential density on homicide and aggravated assault reveal findings consistent with Jacobs approach. However, the average effect of commercial/residential density on violent crime may mask differences in the impact of this covariate by level of economic disadvantage. As noted, to the extent that commercial/residential density is only effective when social organization (strongly predicted by economic disadvantage) is high, the beneficial effect of commercial/residential density may not be observed for more disadvantaged neighborhoods. Accordingly, Table 3 reports the results of analyses that reproduce models 3 and 6 for neighborhoods above the 50th percentile on the disadvantage scale.[9] Despite incorporating all controls, including prior 1989-91 violent crime, and a reduced sample size, both the linear and quadratic effects of commercial/residential density are statistically significant and negative. Thus the curvilinear pattern observed for homicide and aggravated assault in Table 2 is reproduced for more disadvantaged neighborhoods. Indeed, comparable models (not reported) of low disadvantaged neighborhoods yielded negative, but insignificant quadratic effects of commercial/residential density for both homicide and aggravated assault. Although the coefficients for commercial/residential density were not significantly different from one another across models for low and high disadvantage census tracts, these findings nevertheless offer stronger evidence in favor of the curvilinearity of commercial/ residential density in more disadvantaged neighborhoods.[10]

Figures 1 and 2 chart predictions for the relationship between commercial/residential density and both homicide and aggravated assault for the pooled sample and higher disadvantaged census tracts. The effects of commercial/residential density on log homicide rates per 1,000 population are comparable for the pooled and high disadvantage samples. For aggravated assault, the negative and curvilinear effects of commercial/residential density are somewhat more pronounced—although, again, these effects are not statistically different from those observed in the pooled model.

Table 3. Negative Binomial and Ordinary Least Squares (OLS) Regression Models of 1999-2001 Homicide and Aggravated Assault, for Higher Disadvantage Tracts ($N = 92$)

	Models for Tracts > 50th Percentile on Disadvantage	
Independent Variables	Homicide Count[a]	Assault Rate (log)[b]
Residential instability	.462***	.319***
	(.112)	(.101)
Immigrant concentration	.061	−.127**
	(.082)	(.060)
Percentage African American (log)	.318*	.189**
	(.154)	(.078)
Population density (log)	.198*	.056
	(.114)	(.078)
Percentage young males	−.005	−.009
	(.014)	(.006)
Commercial/residential density	−.453**	−.224**
	(.194)	(.100)
Commercial/residential density squared	−.360**	−.136***
	(.174)	(.042)
1989-1991 violent crime rate	.525***	.539***
	(.134)	(.102)
Intercept	−4.659***	−.844
	(1.148)	(.687)
R-squared	—	.833

Note: Standard errors in parentheses.
[a] Negative binomial models with robust standard errors.
[b] OLS models with robust standard errors.
* $p < .10$.
** $p < .05$.
*** $p < .01$. (two-tailed tests)

Conclusions

Few works of urban sociology have achieved the breadth of impact that *The Death and Life of Great American Cities* has seen since its 1961 publication. Jacobs laid the groundwork for the emergence of a whole current of research exploring the link between physical features of communities and their functioning. Fundamentally contesting the claims of mainstream mid-century Modernist urban planners, Jacobs argued that the seemingly

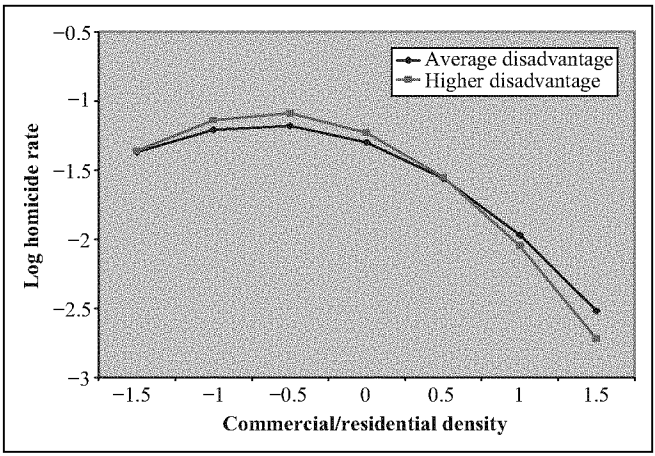

Figure 1. Predicted log homicide rate per 1,000 population (average and higher disadvantage census tracts)

chaotic, organically developing, mixed use urban neighborhoods frequently slated for demolition under Urban Renewal actually fostered effective systems of street monitoring and control. Despite the prominence of Jacobs's theoretical contributions, empirical investigation into the tenability of her model has remained relatively scant.

Taylor and colleagues (Taylor 1988; Taylor et al. 1995) have offered a theoretical challenge to Jacobs's expectations regarding the role of mixed land use on crime and neighborhood disorder. Although both Jacobs and Taylor expect the concentrated mix of residential and commercial uses to bring pedestrians onto neighborhood streets, they differ in their claims regarding the impact of such street activity. For Jacobs, street life is a source of interest, bringing the eyes of a neighborhood's "natural proprietors"—residents and business owners—onto the street, with the byproduct of monitoring and more effective informal social control. An important subsidiary claim of Jacobs's model, however, is that the concentration of people and commerce must be sufficiently high to engender the volume of street activity necessary to achieve effective streets. Increases in commercial and residential density at very low levels may only increase the prevalence of crime, as the additional, but potentially sparsely distributed, pedestrian traffic provides more opportunities for victimization. In contrast, Taylor views pedestrian activity rooted in mixed land use as a source of anonymity on city streets. Commercial activity in the context of residential neighborhoods draws strangers or "outsiders"

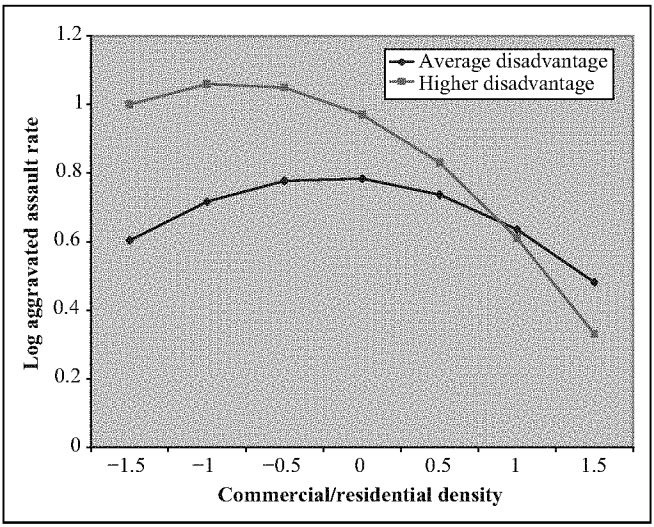

Figure 2. Predicted log aggravated assault rate by commercial/residential density (average and higher disadvantage census tracts)

into urban neighborhoods, leading residents to withdraw from the responsibilities of managing public spaces around their homes. In turn, opportunities for victimization increase as potential victims and offenders are brought together in settings of diminished informal social control.

We tested these alternative perspectives on the role of mixed land use using data on violent crime, community structure, and land use in Columbus, Ohio, neighborhoods. Three violent crime outcomes were considered: homicide, aggravated assault, and robbery. We expected overt violent crimes to be more readily deterred by the presence of mixed land use in contrast to more covert property crimes that may actually be facilitated by pedestrian concentrations in which perpetrators can disappear rapidly. This is because violent interactions, such as assaults in public places, are likely to unfold over a period of time in which they are difficult to conceal from the view of passersby.

Findings from models examining the linear and quadratic effects of a measure of mixed land use revealed evidence consistent with Jacobs's expectations for both homicide and aggravated assault. At low levels, increases in commercial/residential density led to corresponding increases in these violent crimes. However, beyond a threshold, mixed land use led

to nontrivial decreases in the prevalence of homicide and aggravated assault. Jacobs's often overlooked hypothesis of nonlinearity in the impact of commercial/residential density has, to date, not been subject to empirical investigation. These findings offer initial evidence in support of Jacobs's claims, in the context of models that control a range of additional structural covariates as well as prior violent crime.

In contrast, the expectations of Taylor's territoriality model were supported in the case of robbery. Only the linear effect of commercial/residential density achieved significance in analyses of this outcome: The effect was consistently positive across models, suggesting that mixed land use is criminogenic with respect to the prevalence of robbery. Differences in the impact of commercial/residential density across homicide/aggravated assault and robbery may be due to distinctions in the nature of these crimes. As noted, homicide and aggravated assault may typically involve escalating disputes that draw the attention of proximate individuals. In contrast, robbery may have a more strategic component, unfold over a shorter period of time, and be more easily (or intentionally) hidden from the view of potential bystanders or witnesses. Extensive commercial activity may also attract potential offenders seeking opportunities for robbery (Bernasco and Block 2009). In this case, the clustering of potential victims and offenders brought about by concentrated, mixed land use may outweigh the benefit of increased guardianship due to pedestrian traffic. A possible test of this notion would involve separating out commercial robberies from street robberies. Unfortunately, our data do not include information that would allow for such a comparison.

Understanding the impact of land use patterns on crime is an important research goal in the context of increasing debate over the direction of urban regeneration and the role of developers and municipalities in shaping the urban landscape (Calthorpe and Fulton 2001). The findings of this study suggest, for instance, that communities that have suffered depopulation and deinstitutionalization over the past several decades may experience counterintuitive negative effects from initial efforts at redevelopment. Increases in commercial and residential density at low levels may actually lead to higher crime as streets become marginally active but do not yet benefit from the social control effects of more widespread pedestrian traffic. Yet, sustained residential influx and commercial development will likely reverse initial increases in crime, ultimately leading to the emergence of more viable streets and public spaces.

An additional component of the analysis examined the conditional effects of commercial/residential density in the context of neighborhoods

characterized by high poverty and disadvantage. Research has demonstrated strong associations between neighborhood socioeconomic disadvantage and consequential dimensions of social organization (e.g., collective efficacy; Sampson et al. 1997). Thus, examining the impact of commercial/residential density in disadvantaged and (on average) less socially organized communities may offer insight into whether the beneficial effect of mixed land use is contingent upon social characteristics of communities such as reciprocated exchange, trust, and informal social control norms. Findings offered stronger evidence of a curvilinear effect of commercial/residential density on homicide and aggravated assault in communities characterized by *higher* levels of disadvantage, suggesting that the beneficial effects of commercial/residential density may not be contingent upon robust neighborhood social organization. Indeed, street activity may operate autonomously to regulate the prevalence of crime. Street collectivities, even if dominated by strangers, hold the potential to intercede in criminogenic situations. Even the perception, among potential offenders, that active streets may harbor bystanders capable of witnessing or intervening may provide a deterrent effect. These results also highlight the relevance of mixed land use in those communities that are likely to benefit more from conditions that regulate the prevalence of crime.

Although this research has underscored the varying impact of mixed land use on different types of violent crime, additional research is needed to further explicate the scope and application of Jacobs's and Taylor's perspectives. Both theories are articulated with regard to the role of mixed land use for crimes that are likely to occur in public rather than private space. For example, high levels of commercial/residential density and the associated street traffic may be effective in curtailing would-be homicides and assaults that occur in confrontations in public settings. However, they are unlikely to influence domestic assaults and killings that are more hidden from public view or that are considered "private affairs" even if they occur in public. The homicide or assault data used in the current analysis cannot be disaggregated by relationship or public versus private location to explore this possibility. Future more refined tests of the land use models should examine different types of crime disaggregated according to meaningful characteristics such as the degree to which they are "private" versus "public," the extent to which they involve strangers versus people who know one another, or the extent to which they are instrumental versus expressive.

Additionally, we have not explored how variation in commercial/residential density is related to the presence of formal social control through policing in ways that might affect levels of violent crime. As more

businesses come into an area, neighborhoods likely have an increase not only in pedestrian traffic and potential informal social control but also in the presence of police. Thus, some of the downturn in homicide and aggravated assaults observed at high levels of commercial and residential density may be a function of increased policing. Studies that incorporate information on the amount and type of police surveillance would be useful in evaluating this contention. It would also be helpful to include measures of police-community relations in models as these may determine whether police gain assistance from the community in their efforts to control crime.

Longitudinal data on neighborhood change, allowing for tests of Jacobs's nonlinearity hypothesis over time would be beneficial for research. With such over time data, analysts could also explore whether and how commercial development and violent crime may have reciprocal effects on one another. More detailed ecological data on patterns of street use will provide an opportunity to examine the key mediating dynamic specified by Jacobs. Although land use patterns have received some attention in the research literature, the actual social ecologies of urban streets have been almost completely neglected. Standardized data on land use patterns across a range of urban settings will also offer insight into the conditions under which Jacobs's and Taylor's models hold; for example, mixed land use may have distinct effects in more recently developed, automobile-oriented cities. Finally, multilevel data on both neighborhoods and residents will likely illuminate the complexities of individuals' interactions with land use patterns in their communities.

Notes

1. The street monitoring and intervention of neighborhood residents is offered as a principal source of social control engendered by dynamic streets. Jacobs does not, however, hold to the pessimistic image of the apathetic stranger. In contexts where streets are effectively monitored and trust is high, strangers may contribute to street control.
2. Stark (1987) also points to residential density and mixed land use as criminogenic features of urban neighborhoods. Density increases exposure of youth to one another and to the inevitable subpopulation of deviant actors (leading to peer reinforcement of deviant acts). Density also contributes to "moral cynicism" by complicating the process of concealing deviance from other neighborhood residents (which is less problematic in more private suburban settings).
3. See, for instance, the extensive literature on "defensible space" (Newman 1973) and environmental design and crime (Brantingham and Brantingham 1981).

4. Some studies have examined specific land uses thought to be crime-generating or -attracting, such as bars (Peterson, Krivo, and Harris 2000).
5. Two additional census tracts are in Columbus but outside of Franklin County and are not included due to the lack of availability of land use data.
6. We recognize that many violent crimes do not occur in public and would likely not be responsive to any deterrent influence of mixed land use. Although we cannot isolate more public crimes, we assume that the inclusion of all cases for each crime would likely mute the impact of mixed land use on violence, resulting in a more conservative test of the hypotheses considered.
7. The prior total violent crime rate was considered rather than crime specific prior rates as it was as, or more powerfully associated with the outcomes for each crime (particularly in the case of homicide).
8. For the purposes of diagnostic analysis of spatial dependency, we ran ordinary least squares (OLS) models of homicide using empirical Bayes (EB) estimates of neighborhood log homicide rates per 100,000 population. These estimates were generated from a Poisson model of the three-year homicide count. The EB estimate adjusts log homicide rates for skewness and is appropriate for spatial regression techniques (Morenoff, Sampson, and Raudenbush 2001; Raudenbush and Bryk 2002).
9. Models in Table 3 also include the continuous predictor of disadvantage (omitted). Separate models that do not include disadvantage yield comparable results.
10. In comparable models for robbery, the effect of commercial/residential density achieves significance in the model for *lower* disadvantage, but not for higher disadvantage communities. Again, however, the effects of the coefficients for commercial/residential density do not vary significantly across the two types of communities.

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Declaration of Conflicting Interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Appendix A. Commercial Tax Parcel Codes

Commercial lawn/garden
Hotels
Nursing homes and private hospitals
Nursing home–custodial
Day care/preschool
Discount/junior department stores
Supermarkets
Neighborhood shopping center
Community shopping center
Other retail structures
Restaurant/cafe/bar
Supper club/night club
Drive-in restaurant/food service
Family restaurant/dining rooms, café
Other food service structure
Medical clinics and offices
Full service banks
Savings and loans
Auto service station
Car washes
Auto car sales/services
Parking garage, lots
Gas station/convenient food stores
Gas station/car wash
Theaters
Drive-in theaters
Bowling alleys
Dog/cat kennels
Other commercial structures
Apartments over retail (WALKUP)
Office over retail (WALKUP)
Storage over retail (WALKUP)

Appendix B. Correlations Among Variables in the Analysis

	1	2	3	4	5	6	7	8	9	10	11
1. 1999-2001 homicide count	1.00										
2. 1999-2001 aggravated assault rate (log)	.56	1.00									
3. 1999-2001 robbery rate (log)	.49	.84	1.00								
4. 1989-1991 total violent crime rate	.53	.83	.85	1.00							
5. Disadvantage	.48	.55	.51	.58	1.00						
6. Residential instability	.33	.44	.45	.41	.53	1.00					
7. Immigrant concentration	−.02	−.09	.00	−.04	.20	.33	1.00				
8. Percentage African American (log)	.39	.63	.54	.58	.47	.26	.00	1.00			
9. Percentage young men ages 15 to 24	.05	.05	.11	.05	.32	.45	.33	−.07	1.00		
10. Population density (log)	.18	.15	.21	.20	.22	.24	.16	.04	.30	1.00	
11. Commercial/residential density	.07	.21	.34	.18	.14	.62	.38	.12	.25	.33	1.00
12. Commercial/residential density squared	−.15	−.25	−.26	−.18	−.04	−.08	.09	−.16	.10	.02	−.32

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