Violent Crime and The Spatial Dynamics of Neighborhood Transition: Chicago, 1970-1990*

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Abstract

Integrating ecological, demographic, and criminological theory, this article examines the role of violent crime and socioeconomic disadvantage in triggering population decline in Chicago neighborhoods from 1970 to 1990. The results show that high initial levels of homicide and increases over time in the spatial proximity to homicide were associated with large losses in total population across 826 census tracts. However, we also observe sharp group differences in patterns for blacks and whites. Although both black and white populations declined in response to high initial levels of homicide and socioeconomic disadvantage, increases *in neighborhood homicide, spatial proximity to homicide, and socioeconomic disadvantage were associated with black population* gain *and white population* loss. *In discussing these findings, we argue that taking violent crime and spatial processes into account resolves the apparent contradiction between Wilson's depopulation hypothesis and Massey's segregation hypothesis on the increasing concentration of urban poverty.*

Over the past 20 years, the social landscape of many American cities has been transformed by the growing concentration of poverty in segregated neighborhoods, many of which are losing population at a rapid pace. These changes in urban structure have generated intense interest among urban sociologists and demographers (e.g., Massey & Denton 1993; Wilson 1987). Surprisingly, however,

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the role played by predatory crime in the depopulation of urban neighborhoods has received little empirical attention. Although criminologists have noted the general effects of crime on migration patterns in selected neighborhoods and U.S. cities (e.g., Bursik 1986; Katzman 1980; Sampson & Wooldredge 1986), almost no empirical research exists on the relationship between crime and factors such as neighborhood population change, racial segregation, and rising poverty. Moreover, in what little research has been conducted, investigators have failed to separate the effects of crime and violence from the influence of other factors that may have contributed to urban change.

Demographers, of course, have conducted extensive research on racial differences in residential mobility (e.g., Frey 1979, 1980; Long 1988; South & Deane, 1993), and on how urban population shifts contribute to the geographical concentration of poverty (e.g., Coulton, Chow & Pandey 1990; Jargowsky & Bane 1991; Massey, Gross & Shibuya 1994). Yet they too have rarely considered the role that crime plays in demographic processes. Indeed, relatively little is known about the differential responses of black and white communities to the spread of crime, to the concentration of poverty and joblessness, and to changes in other aspects of neighborhood socioeconomic composition.[1] Despite its centrality to debates over the changing nature of urban poverty, the relationship between violent crime and the depopulation of segregated urban neighborhoods has thus not been resolved.

Addressing these limitations, we integrate criminological and demographic concerns by examining the effects of homicide and other ecological factors on changes over two decades in the neighborhood populations of a major American city, Chicago. We extend prior research by incorporating the spatial dynamics of urban processes into both theories of neighborhood change and the empirical estimation of causal models. In particular, a well-established body of criminological research suggests that population shifts in a given neighborhood may be affected not only by the level of violent crime in that neighborhood, but also by the degree to which fear of crime predominates among residents of that area (e.g., Anderson 1990; Rosenbaum 1991; Skogan 1986, 1991; Taub, Taylor & Dunham 1984). Fear of crime is not constrained to the boundaries of a single neighborhood, but is more broadly related to the geographic context of crime in the city. In other words, changing levels of violent crime in other parts of the city are likely to influence the way residents of a given neighborhood perceive the threat of crime, even if that particular neighborhood has not experienced similar changes. Consequently, trends in the geographic proximity of a neighborhood to crime elsewhere in the city may affect residents' decisions about whether to move to or from that neighborhood and thus, in the aggregate, contribute to changes in the neighborhood's population size and composition.

As an example, take the case of two hypothetical neighborhoods that share identical characteristics across social and economic dimensions, including the level of homicide, yet can be differentiated by their geographic locations — neighborhood

A is surrounded by other neighborhoods that have high levels of homicide, while neighborhood B is located in a low-crime area of the city. Although these two neighborhoods share the same level of homicide, they are still likely to have different profiles of population change because of the influence of spatial proximity to crime on residential mobility. All else being equal, neighborhood A would be more likely to lose population than neighborhood B if population change is affected not only by the immediacy of crime, but also by the threat (or perceived threat) represented by the spatial proximity to crime. This type of spatial explanation is closely related to diffusion perspectives that trace the spread of various social phenomena across and within societies (e.g., Gould 1991; Tolnay 1995). In this case, the process of spatial diffusion relates to the recognition of crime as a residential concern.

Such a framework is particularly appropriate for the study of city neighborhoods, where the urban ecological tradition has long emphasized the importance of spatial dynamics in shaping the patterns of population movement through urban communities. We analyze two contexts in which a neighborhood's geographic location may influence changes in its population: its proximity to crime elsewhere in the city, and its proximity to other neighborhoods that are also experiencing rapid changes in population. The former effect indicates the spatial diffusion of crime, while the latter measures the extent to which population change itself is a spatially contagious process. Using a multivariate model that incorporates the spatial dynamics of both homicide and population change, we assess the relationship between violent crime and population change by asking three critical questions: (1) What has been the contribution of homicide to the patterns of population change in Chicago's neighborhoods from 1970 to 1990; (2) What has been the independent effect of the spatial diffusion of homicide on population change; and (3) Do the determinants of population change vary systematically with the racial composition of neighborhoods, in accordance with the expectations generated by prior research on residential mobility and segregation?

Crime and Neighborhood Transition

Traditional ecological perspectives on crime, advanced by Shaw and McKay (1931, 1942, 1969), emphasized the role of neighborhood change in perpetuating social disorganization in ecologically disadvantaged areas. Building on the work of Park and Burgess (1925), Shaw and McKay (1931) showed that the highest delinquency rates in Chicago were located in low-income, deteriorated zones-in-transition next to the City's central business district and industrial areas. They related their observations to a spatial model of urban change, in which "the areas of decreasing and increasing populations show a configuration in many ways quite comparable to that . . . showing the location of industry" (Shaw et al. 1929:14). Thus, they found that the most severe population losses occurred in neighborhoods nearest to commercial and industrial centers. Neighborhoods located in zones farther away from the central business district and industrial areas increased in population, because they were "all residential and . . . marked by more stabilized populations and by the absence of the more severe forms of physical deterioration" (Shaw et al. 1929:17).[2]

The present study reformulates classical ecological theory on crime and urban dynamics in two important respects. First, like Shaw and his colleagues (1929:15), we argue that the distribution of neighborhood population change is conditioned by geographic factors. However, our perspective on neighborhood population change diverges from Shaw's analysis of Chicago circa 1910-20 (Shaw et al. 1929:14-17) in the underlying process that generates the spatial pattern. Namely, the inner ring of severe population loss is now located not around commercial and industrial areas, but in the core of the traditional black belt. Thus, whereas the traditional ecological model of neighborhood change was fueled by Chicago's commercial and industrial expansion, and the zonal pattern of land use it engendered, the contemporary pattern we observe is largely conditioned by the emptying out of core ghetto areas and the simultaneous population gains experienced by areas on the periphery of the ghetto.

Second, and perhaps more important, although Shaw and McKay based their explanation of neighborhood delinquency rates on an ecological model of urban change, they neglected to analyze the role that crime played as an engine of that change. As noted above, there are strong theoretical reasons to suspect that violent crime (homicide and robbery in particular) has had significant effects on contemporary urban dynamics. Crime and social disorder are especially salient and symbolic indicators of deterioration in the civility and inhabitability of urban areas. Yet unlike the vast research conducted on the causes of crime, there has been very little research testing the macrolevel effects of predatory crime on city change. Evidence from the relatively small number of empirical studies that do exist suggests that crime does in fact undermine the social and economic fabric of urban areas. One of the most important findings is that crime generates fear of strangers and a general alienation from participation in community life (Liska & Warner 1991; Rosenbaum 1991; Skogan 1986, 1991).

Besides weakening neighborhood social organization, high crime rates and concerns about safety may trigger population out-migration. For example, Bursik (1986) found that delinquency rates are not only one of the outcomes of urban change, they are an important part of the process of urban change. In an analysis of neighborhoods in eight U.S. cities, Skogan (1991) found that high rates of crime and disorder were associated with higher rates of fear, neighborhood dissatisfaction, and intentions to move out. In his research on Dallas neighborhoods, Katzman (1980) found that high rates of property crime were linked to out-migration. Furthermore, in a study of the fifty-five largest U.S. cities, Sampson and Wooldredge (1986) reported that crime rates were related to declining population from 1970 to 1980, especially nonwhite population loss. Crime rates had significant lagged effects on net migration patterns as well. More recently, Liska and Bellair (1995) documented reciprocal effects of violent crime and racial composition in a sample of U.S. cities spanning a 40-year time period. They found that while racial composition had a significant effect on crime only in the 1980s, the reverse causal path — i.e., violent crime's effect on racial composition — was significant over all four decades.

The picture painted by previous research on the relationship between crime and population change is still incomplete. Although both crime and fear of crime have been linked to individual out-migration and neighborhood depopulation, it is unclear whether this effect holds up in the presence of other changing conditions of inner-city neighborhoods with respect to poverty, public assistance, unemployment, family structure, racial composition, and age composition. Also, it has yet to be determined whether the association between crime and population change is driven primarily by the fear of crime, which may not have a direct relationship to the actual level of crime in a particular neighborhood, or whether the crime rates themselves remain a strong predictor of population change after considering other dynamics that may affect perceptions of crime. Although we do not present data on perceptions of crime *per se*, we explicitly take into account the spatial proximity of a neighborhood to homicide in the surrounding areas of the city.

Reconsidering Demographic Debates on Population Change

Urban poverty analysts have dealt extensively with the demographic mechanisms underlying the increasing concentration of poverty in inner-city neighborhoods, but few studies have examined the determinants of population change at the neighborhood level. Nonetheless, this line of research has important implications for the relationship between crime, socioeconomic disadvantage, and population change. Although Wilson (1987) recognized that a variety of mechanisms may operate simultaneously, Wilson maintained that "the significant increase in poverty concentration in these overwhelmingly black communities is related to the large out-migration of nonpoor blacks" (Wilson 1987:50). Because of the dearth of existing data sets with which researchers can examine class-selective patterns of migration through a large sample of urban neighborhoods, most of the evidence either for or against the selective out-migration thesis has been indirect. We too are subject to these same data limitations, and moreover, our outcome of interest is neighborhood population change and not changes in socioeconomic composition that result from selective migration. We thus extract from Wilson's theory the testable hypothesis that there should be a connection between the increasing concentration of socioeconomic disadvantage (and, by extension, homicide) and the depletion of urban neighborhood populations.

Although Wilson's thesis emphasizes the link between depopulation and the emergence of new poverty areas, Massey and Denton (1993), by contrast, argue that the forces of residential segregation ensure that shocks to the urban economy are confined to poor minority neighborhoods, a phenomenon which results in the geographic concentration of poverty, regardless of population change. Massey's more recent research on individual-level patterns of black and white residential mobility provides evidence of class-selective *in*-migration of poor blacks into emerging poverty areas and of the continuing abandonment of black neighborhoods by whites (Massey, Gross & Shibuya 1994). This perspective calls attention to segregated urban neighborhoods that become more impoverished through a combination of white flight and class-selective black migration.

These two viewpoints may appear to be mutually exclusive because one emphasizes the out-migration of blacks from poor neighborhoods, while the other highlights the forces that constrain middle- and upper-income blacks from moving very far away from those areas that have been overridden by poverty and crime. We argue, however, that the two perspectives can be reconciled by recognizing that both demographic mechanisms may be operating simultaneously, but in distinct spatial contexts. A critical dimension shaping these spatial dynamics relates to the geographical and historical distinction between neighborhoods located in older black settlements at the core of the ghetto and those that lie on the periphery of ghetto areas (Coulton, Chow & Pandey 1990; Jargowsky & Bane 1991; Morenoff 1994).[3] More specifically, the segregation argument suggests that as black residents flee core ghetto areas, many will relocate to nearby neighborhoods at the periphery of the ghetto, some of which are undergoing racial transition. As living conditions in core ghetto areas deteriorate, these neighborhoods should experience net population losses, which should further increase their poverty rates because those residents with the fewest resources are most likely to remain. Thus, we would expect crime and various dimensions of social and economic disadvantage to be associated with population loss in these core ghetto neighborhoods.

At the same time, however, neighborhoods along the periphery of the ghetto should be more likely than those at the core to experience gains in population, as a result of in-migration. In these neighborhoods we would expect crime and socioeconomic disadvantage to be related to population increases for a number of reasons. First, if more inner-city black families fell below the poverty line during the 1970s and the 1980s, as both Wilson and Massey and Denton have suggested, and at the same time if the spatial dynamics of segregation channel population flows into neighborhoods at the periphery of the ghetto, then it stands to reason that increases in disadvantage should be associated with population gains in this area of the city. Second, even though the in-migrants who move out of the core neighborhoods and into these periphery areas are likely to have more social and economic resources than those who remain behind, it is still probable that they will be of lower socioeconomic status than previous residents of the periphery neighborhoods, many of whom were middle-class whites (Massey, Gross & Shibuya 1994). In other words, the flow of in-migrants into these areas, along with the continuing exodus of middle-class whites, is likely to change the socioeconomic composition of the periphery neighborhoods, which also contributes to the positive relationship between increasing socioeconomic disadvantage and population.

The crucial point is that both the determinants and consequences of population change are likely to vary in a geographically systematic fashion. By emphasizing the spatial context of neighborhood change, this theoretical framework moves us towards reconciling the different perspectives in the debate over the dynamics of urban poverty. Chicago is a particularly important case study, in this regard, because of its central role in both Wilson (1987) and Massey and Denton's (1993) theories about the concentration of poverty. Although our argument about the spatial pattern of neighborhood change is based on this one case study, it may have broader implications for other older industrial cities with high levels of segregation, where Wilson and Massey and Denton's theories are most applicable.

The debate over the demographic mechanisms that lead to concentrated poverty has sparked a great deal of empirical research (e.g., Gramlich, Laren & Sealand 1992; Nelson 1991; Jargowsky & Bane 1991; Massey, Gross & Shibuya 1994; South and Deane 1993). Most of these studies have relied on microlevel data sets to analyze the predictors of individual residential moves, but few have examined the aggregate-level consequences of these decisions on trajectories of neighborhood change (for exceptions see Jargowsky & Bane 1991 and Nelson 1991). Although the current study is not intended to resolve these debates, it does break new ground by asking which *neighborhood*-level characteristics are associated with population gains and losses. By extending the logic of the competing theories on concentrated poverty and neighborhood change, we are able to construct empirical hypotheses that can be tested with the data at hand.

Research Hypothesis

Integrating our spatial perspective on urban ecological theory, Wilson's depopulation hypothesis, and Massey's segregation argument, we generate separate sets of research hypotheses concerning the dynamics of black and white population change. The dynamics of black neighborhood transition are likely to vary in a geographically systematic fashion in keeping with the core/periphery distinction. First, we suspect that Wilson's depopulation hypothesis — which suggests that the most economically deprived and crime-ridden areas of the city should experience selective out-migration of middle-income blacks — will be most applicable to core ghetto neighborhoods. For this reason, and because previous research shows that these neighborhoods are losing population at a rapid pace (Morenoff 1994), we expect that prior levels of homicide and socioeconomic disadvantage will be associated with black population loss. In other words, the most impoverished and highest crime areas of the city should experience black population losses over the succeeding decade.

However, the logic of the segregation argument dictates that blacks, who are able to flee the *immediacy* of crime in the most impoverished neighborhoods, will find it more difficult to escape the escalation of both levels of neighborhood crime and the geographic *proximity* of crime. Also, previous research shows that neighborhoods at the periphery of the ghetto are more likely to gain population at the same time that they experience some of the sharpest increases in disadvantage in the city (Coulton, Chow & Pandey 1990; Morenoff 1994). Hence, while higher initial levels of homicide and socioeconomic disadvantage should be consistently related to black population loss, we predict that neighborhoods experiencing the most growth in homicide, spatial proximity to homicide, and disadvantage will be more likely to experience black population gain. We caution that these inferences are indirect because our analysis is based on a racial disaggregation of population change and not a spatial disaggregation.[4]

In the case of white population change, our hypotheses are more straightforward. First, as was the case for black population change, we predict that higher levels of neighborhood homicide and socioeconomic disadvantage should serve as catalysts for white population loss. However, because the segregation literature shows that whites do not face the same sorts of housing and lending discrimination that restrict black residential mobility (e.g., Massey & Denton 1993), we predict that white population should also be more responsive to neighborhood *changes* in homicide and disadvantage. In other words, we expect that whites should not only be able to flee the most socially and economically deprived areas of the city, but that they should also be more able to avoid moving to areas of the city where these conditions are most rapidly spreading. Thus, we predict that increases in socioeconomic disadvantage, homicide, and the spatial proximity of homicide should be associated with white population loss.

Data and Methods

Our empirical analysis is conducted with both tract-level census data and geo-coded homicide data for Chicago, collected for the census years 1970, 1980, and 1990. The final data set contains 826 census tracts.[5] Our dependent variable is change in a tract's population over each intercensal period.[6] In addition to examining change in total population, we conducted separate analyses for change in the black and white populations of a given tract. In operationalizing the dependent variable we employ two common but distinct approaches to measuring change: raw change scores and residual change scores. The former approach is found frequently in the sociological literature, while the latter is more common in criminological research.

In the sociological literature, much of the debate over analyzing change as a dependent variable has focused on the merits of a differencing approach over the more conventional lagged-Y regressor model (Allison 1990; Firebaugh & Beck 1994). Under the differencing approach, the difference between two time period observations of the dependent variable (i.e., $Y_{i2} - Y_{i1}$), which we refer to as a "raw change" score, is regressed on the difference scores of the independent variables (i.e., $X_{i2} - X_{i1}$). In the lagged regressor model, the value of the dependent variable at time 2 (i.e., Y_{i2}) is regressed on Y at time 1 as well as values of the predictor variables at time 1. Essentially the debate concerns how to analyze panel data in a way that best controls for omitted variable bias. Although their formulations differ, both Allison (1990) and Firebaugh and Beck (1994) support the difference approach because it is mathematically formulated in a way that "differences out" unobserved, time-constant characteristics of the subjects, or "fixed effects."[7]

Firebaugh and Beck (1994) further distinguish a pure difference model from a so-called "semi-difference" model, in which the raw change score is regressed on the level of the predictor variables at time 1 (rather than on change scores of the predictor variables, as in the pure difference model). This model closely resembles the lagged-Y regressor model in that the dependent variable is regressed on prior levels of the causal variables, except that here the dependent variable is the raw change score (as in the pure difference model), and the prior level of Y at time 1 does not appear on the right hand side as a regressor; hence the term semi-difference model. Again, Firebaugh and Beck (1994) recommend the pure difference model over the semi-difference model because it alone differences out the fixed effects, thus controlling for unobserved heterogeneity.

Based on theoretical concerns, we employ an augmented version of the difference approach. In our model the left-hand side is raw change in population (just as it is in a difference model), but the right-hand side is a hybrid of the pure difference model and the lagged-Y regressor model in that the set of regressors includes prior levels of both population and the causal variables (as in the lagged regressor model), and change scores for the causal variables (as in the pure difference model). Our model is expressed in the following equation:

$$Y_{i2} - Y_{i1} = \alpha + \delta Y_{i1} + X_{i1}\beta + (X_{i2} - X_{i1})\gamma + \epsilon_{i2} \quad (1)$$

where Y refers to the population of a given census tract, observed at two time periods, X is a vector of causal variables, and δ, β, and γ are vectors of parameters. This model is particularly appropriate given our theoretical interests in determining the effect of both the prior *level* of crime and the interdecade *change* in crime and disadvantage on change in population.[8] Moreover, by including lagged population on the right-hand side we can directly observe the dependence of population change on the prior level of population.

Another approach to studying change, which is more prevalent in the criminological literature, is to use residual change scores as the dependent variable (see Bursik & Webb 1982). Residual change in population reflects the amount of change in a given tract's population that is unaccounted for or unexplained by its initial level of population. Specifically, it is defined as *observed* population at time 2 minus the *predicted* population at time 2, where the latter is derived from a regression equation in which population at time 1 is used to explain levels at time 2 for all tracts in the city [e.g., $\Delta\ Pop80 = Pop80 - (\alpha + \beta * Pop70)$]. Thus, population residual change scores have the advantage over raw change scores of being statistically independent of initial levels of population. In addition, since all tracts in Chicago are used to estimate the regression equation upon which the residuals are computed, these change scores incorporate the dynamics of the ecological system under study. In other words, residual change reflects the population change that a neighborhood experiences above and beyond the city-wide pattern of population change.

We computed residual change scores not only for population, but also for all of our independent variables, yielding the following model:

$$\Delta Y_{i(1,2)} = \alpha + X_{i1}\beta + (\Delta X_{i(1,2)})\gamma + \epsilon_{i2} \qquad (2)$$

where $\Delta Y_{i(1,2)}$ represents residual change in population between times 1 and 2, X is a vector of causal variables, $\Delta X_{i(1,2)}$ represents a vector of residual change in the causal variables, and β and γ are vectors of parameters. In substantive terms, equations 1 and 2 are similar in that they each capture the change in population that is predicted by both level and change in the independent variables, controlling for initial levels of population. As a check on the robustness of our findings we estimated both models and found similar results. For reasons of parsimony, we report only the results of the models estimated from equation 1, which allows us to directly observe the dependence of population change on prior level of population.

INDEPENDENT VARIABLES AND PRINCIPAL COMPONENTS

Our independent variables include a set of 13 census indicators as well as tract-level homicide counts. Our homicide measures come from the Chicago Homicide Data Set (Illinois Criminal Justice Department Information Authority 1994), which is geo-coded to match census geography. We computed aggregate tract-level homicide counts for the three year period leading up to and including each census year. For example, our 1980 homicide count includes the number of homicides occurring in a given tract from 1978 to 1980.[9]

We are well aware that not all homicides provoke fear (e.g., homicide among friends), and that other crimes such as robbery and burglary may generate even more concerns about neighborhood change (Liska & Bellair 1995). However, homicide is sufficiently rare that we are unable to reliably examine victim-offender relationships, and crimes other than homicides are not measured at the tract level for our time periods (1970, 1980, and 1990). These limitations are offset by the generally large positive correlations among census tracts between homicides and other serious crimes.[10] In other words, where homicide rates are high, so too are rates of other predatory crimes. Although our empirical data refer to homicide, we believe the results have import for understanding the general effect of violent crime on population change.

To avoid problems of multicollinearity that stem from including too many correlated ecological variables in a regression analysis, we conducted principal components analysis on a set of 13 census variables, representing a range of sociodemographic characteristics of neighborhoods. Initially we ran separate analyses for each of the three census years under study, but after finding that the factor solution was relatively stable across time, we pooled all of the time-period observations together and reestimated the principal components model.[11] By using the pooled data to construct the latent factors to be used in the multivariate analysis, we constrain the model so that the variables' factor loadings do not change over time, thus ensuring the compatibility of the factor variables across time periods. Moreover, because the distributions of factor scores are standardized relative to the pooled data set, and not with regard to separate census years, the factor scores for a given census tracts do change over time. Changes in the distribution of factor scores over time are evident from the descriptive statistics displayed in Appendix A.

We found that Chicago was characterized by a stable ecological structure consisting of four latent dimensions: socioeconomic disadvantage, ethnicity/immigration, age composition, and residential stability.[12] The resulting factor pattern is displayed in Table 1. The first factor, which we call "socioeconomic disadvantage," captures the entanglement of poverty, racial composition, and other social dislocations in Chicago neighborhoods (Wilson 1987). More specifically, this factor is characterized by high positive loadings for the percentage of families in a given tract on public assistance and in poverty, the percentage of unemployed individuals in the civilian labor force (i.e., the unemployment rate), the percentage of families headed by females, and the percentage of non-Hispanic blacks in the total population; and a high negative loading for the percentage of non-Hispanic whites in the total population. Appendix A shows that the mean level of the socioeconomic disadvantage factor for Chicago census tracts increased over time, with most of that change taking place between 1970 and 1980 (when the mean score rose from -.58 to .12).

The "ethnicity/immigration" factor is positively associated with the percentage of the population that is Hispanic and foreign born, and negatively related to the percent black. The mean value of this factor's distribution also increased over time (from -.51 to .23 between 1970 and 1980), as more Hispanic immigrants settled in Chicago neighborhoods. Our third factor, age composition, has higher scores for those tracts with greater percentages of elderly (those of ages 75 and older) and lower scores for tracts with greater percentages of youth (those of ages 17 and under). Appendix A shows that the mean score for this factor also increased with time, meaning that the average city neighborhood experienced growth in its proportion of elderly residents. Finally, the "residential stability" factor is positively related to the percentage of the population that has lived in the same house for more than five years, and the percentage of houses in a tract that are owner occupied. Note that the same house indicator is problematic to interpret by itself because a highly "unstable" neighborhood undergoing severe population loss can score very high on this item if the remaining residents had all lived in the area for at least five years. Nevertheless, the latent factor for residential stability captures the shared variation in both the same house variable and the rate of owner occupancy, providing a more robust indicator of residential stability than does either of the two components on its own.

The set of predictors to be used in the multivariate analysis includes the homicide counts, the scores for each of these four factors, and the decade-to-decade change in these variables. Our final model includes two additional terms that capture the spatial dynamics affecting the process of population change. These are discussed below.

SPATIAL EFFECTS AND HOMICIDE DIFFUSION

One of the critical methodological issues facing ecological research is how to control for spatial effects in both the dependent variable (also known as the problem of spatial autocorrelation) and theoretically important independent variables (e.g., homicide). The issue of spatial autocorrelation in the *dependent* variable arises when data have been aggregated to represent areal units (in this case census tracts), and theory suggests that some spatial process is influencing the social process under study (Doreian 1981). In our case, the theoretical motivation for suspecting spatial effects is twofold. First, we have general reasons to expect that neighborhood population change is a contagious process, which, once underway in a given area, is likely to affect other neighborhoods in close geographic proximity. This argument applies both to the case of population loss, which has disruptive effects on the social organization of a geographical area that extend beyond the arbitrary boundaries of a census tract; and to the case of population gain, as in the case of immigration, where the geographical proximity of a tract to an area serving as a "port of entry" for a particular group increases the likelihood that this tract will experience a similar population increase (Massey 1985). Second, the literature on segregation suggests that black population change, in particular, is constrained geographically due to discrimination in both housing and lending markets. Again, the spatial contagion of population change could be a cause of both population loss, in areas at the core of the ghetto that are being overrun by poverty and crime, or of population gain, at the periphery of the ghetto in neighborhoods that have more recently been abandoned by whites.

Methods for incorporating spatial interaction terms into a regression framework first reached a wide sociological audience with Doreian's (1980, 1981) modifications of Ord's (1975) maximum likelihood estimation procedures. Later work by two criminologists, Roncek and Montgomery (1984, 1993), pointed out that Ord's method was particularly impractical for use on large data sets (i.e., over 500 cases), which are often encountered in ecological research that relies on census tracts or city blocks as units of analysis. The problem relates to the unwieldy nature of the operations that must be performed on an *n*-by-*n* spatial proximity matrix. Instead, Roncek and Montgomery adapted a concept originally introduced by Duncan, Cuzzort, and Duncan (1963) to study migration and other spatial processes — population potential. For a particular census tract, this variable measures the cumulative population of all other tracts in the city, where the population of each surrounding tract is weighted by its geographical proximity to the reference tract. Formally, the population potential for a given areal unit i, PP_i, is defined by

$$PP_i = \Sigma\,(P_j/D_{ij}) \quad j \neq i \tag{3}$$

where P_j is the population of the jth areal unit, D_{ij} is the distance of unit j from unit i, and the summation is taken over all units in the city other than i.[13] Roncek and Montgomery (1984) extended the potential concept to what they called "generalized potentials" which can be applied to the study of any spatial phenomenon, such as the diffusion of crime.

A shortcoming of Roncek and Montgomery's approach, which was recognized by Land and Deane (1992), is that when the generalized potential variable is inserted as a regressor in a conventional linear model, it becomes correlated with the error term, resulting in statistically inconsistent parameter estimates. As a corrective method, Land and Deane (1992) propose a two-stage least squares (2SLS) technique to derive consistent estimators in spatial-effects models with potential variables. We apply Land and Deane's two-stage least squares technique to create a measures of "population change potential."[14] These variables capture the spatial dependence of population change in a given census tract on population change in the surrounding area, and the significance of their coefficients provide a test for spatial autocorrelation.

Controlling for spatial autocorrelation eliminates the methodological problems caused by ignoring the spatial dependence of the dependent variable, but it still does not elucidate how spatial location conditions the association between population change and theoretically important *independent* variables, such as homicide.[15] However, the spatial dynamics of these relations can also be addressed with the generalized potential method. Drawing on our theoretical discussion of diffusion and the fear of crime, we construct an additional "homicide potential" variable to reflect the geographical proximity of a given neighborhood to homicide in the surrounding area. This term measures how close a neighborhood is to homicide levels in other city neighborhoods (i.e., the higher its value the more

FIGURE 1: Socioeconomic Disadvantage Factor, 1970

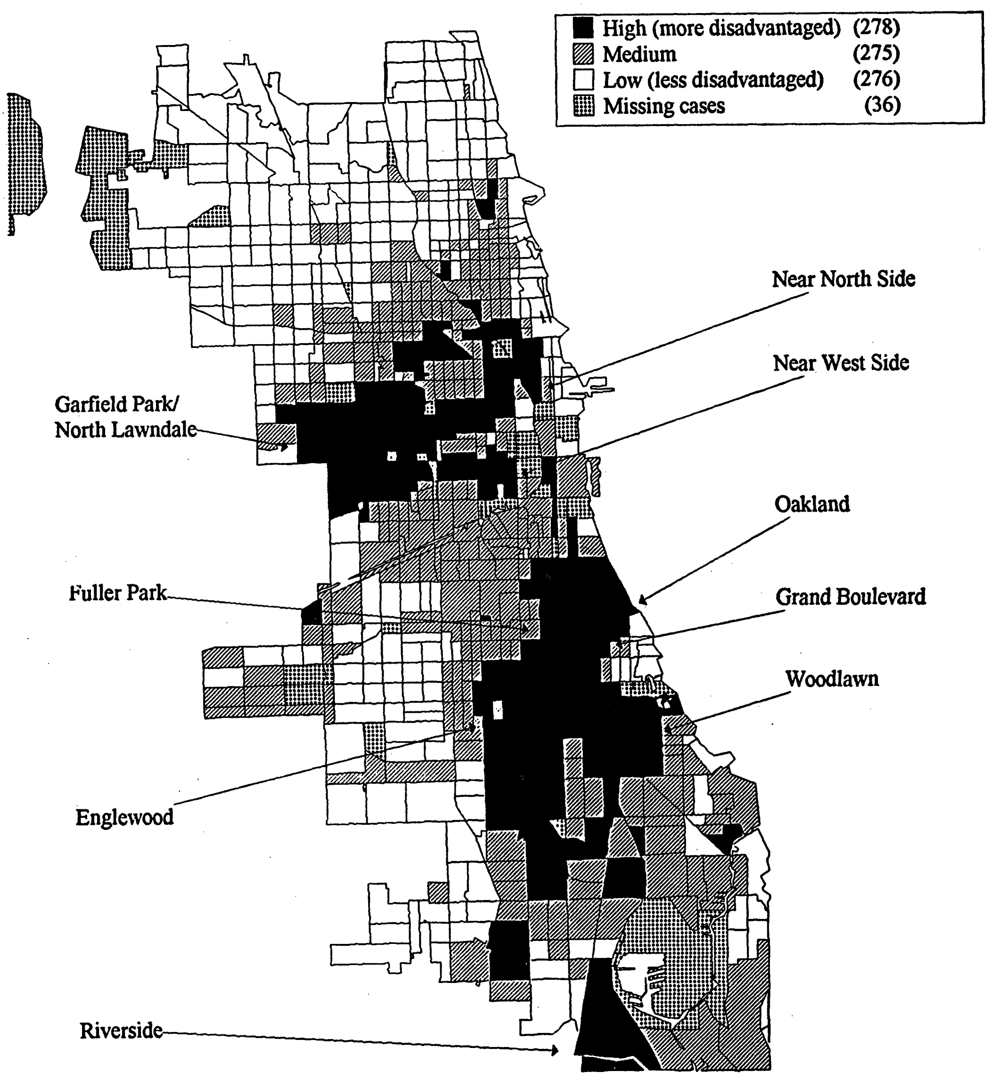


FIGURE 2: Residual Change in Socioeconomic Disadvantage, 1970-1980

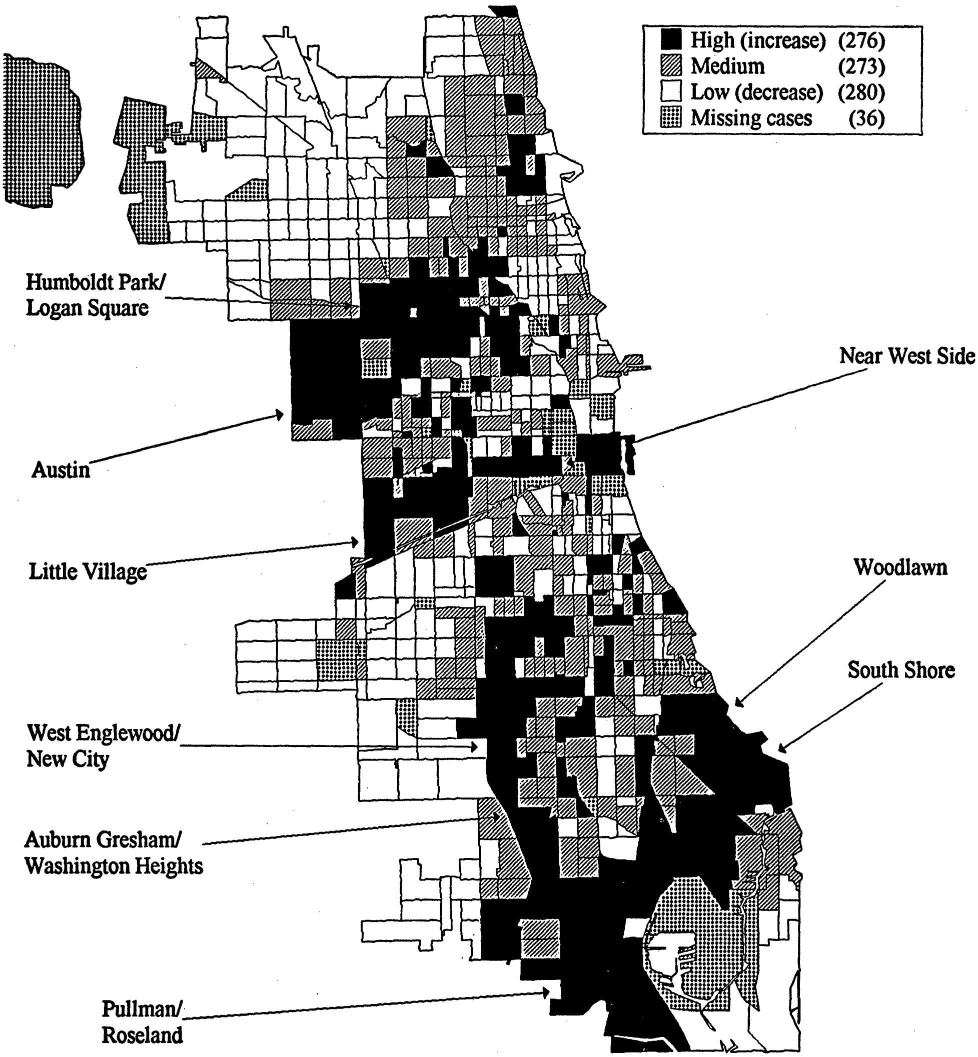


FIGURE 3: Homicide Potential, 1970

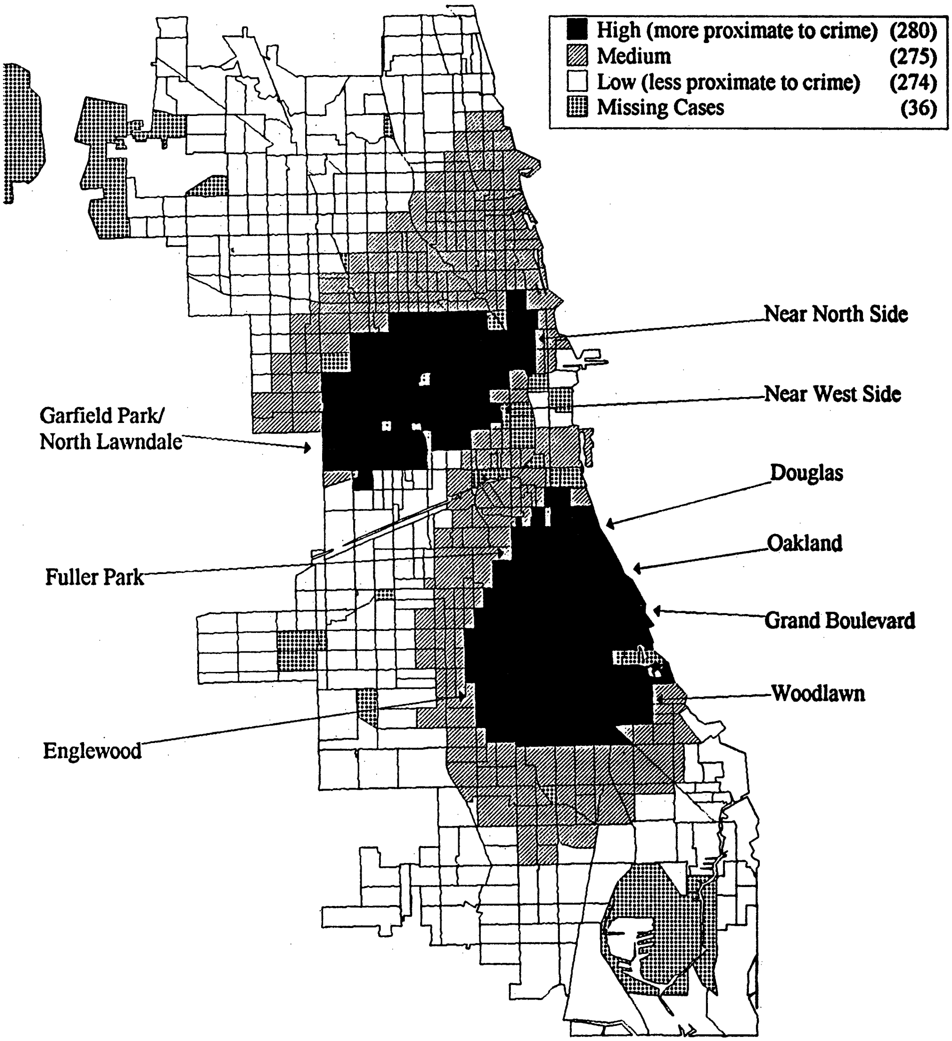


FIGURE 4: Residual Change in Homicide Potential, 1970-1980

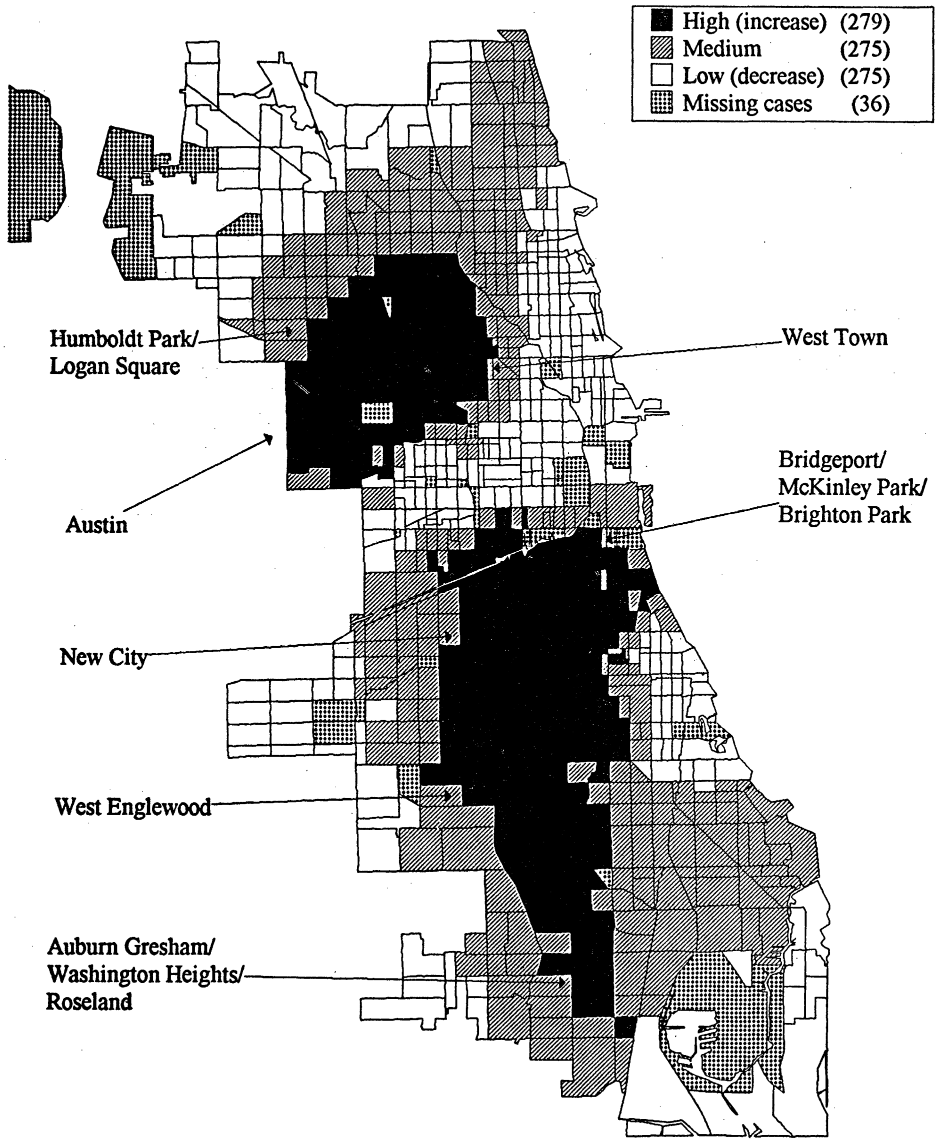
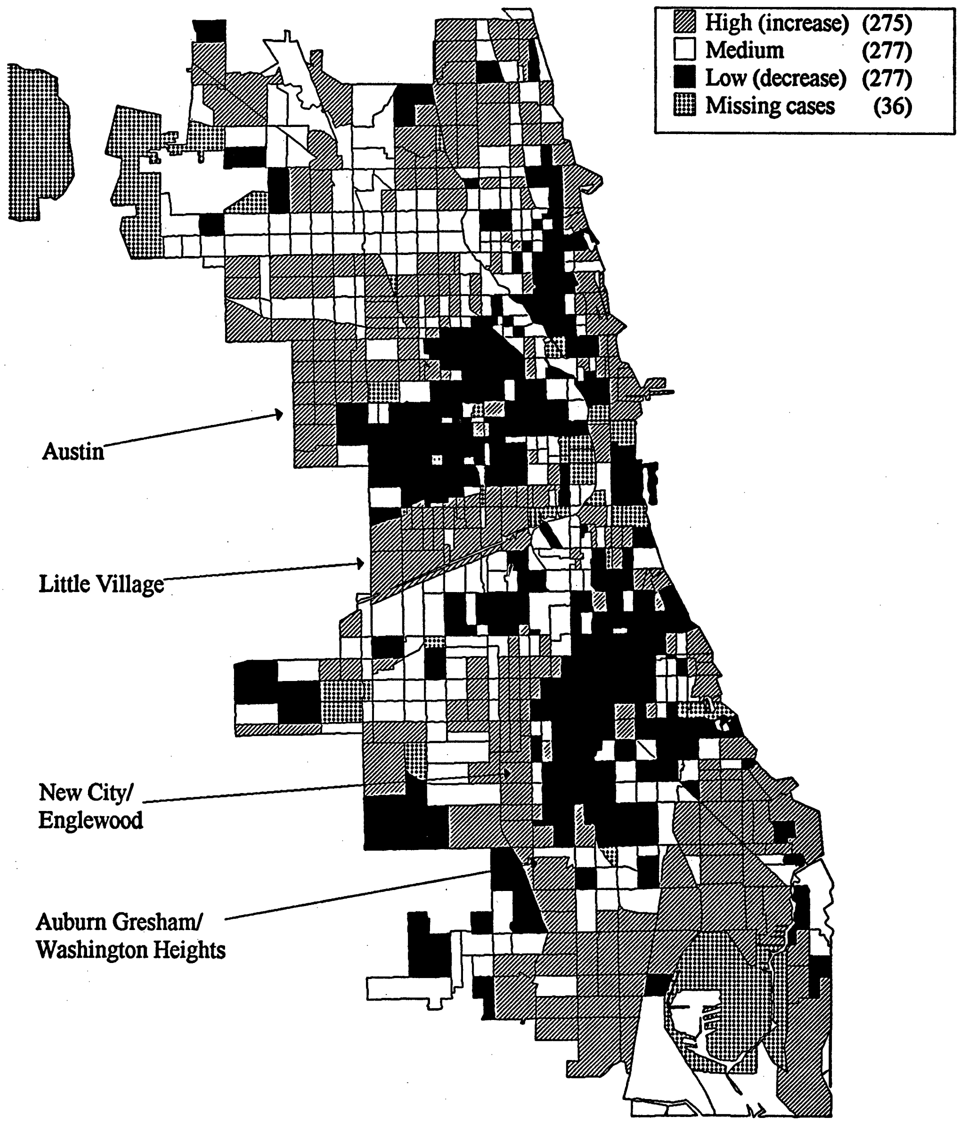


FIGURE 5: Residual Change in Population, 1970-1980



proximate the neighborhood is to high crime), and thus it provides yet another independent assessment of the effect of neighborhood spatial location on population change. As with other independent variables, we use both the lagged level of homicide potential and change in homicide potential in our model.[16] Thus, our model allows homicide to affect population change in any of four ways: (1) through the lagged level of homicide in a given tract, (2) through the lagged level of a tract's proximity to homicide (which we call the spatial diffusion of homicide) (3) through change in the level of homicide in a given tract, and (4) through change in a tract's geographical proximity to homicide.

Geographic Evidence

Because many of our hypotheses highlight the spatial processes involved in neighborhood transition, we first analyze the geographic patterns of some of its key dimensions. We present three series of maps in order to display changes over time in socioeconomic disadvantage, the spatial diffusion of homicide, and population change. Here we rely on residual change scores rather than raw change scores because they provide a visual representation of the neighborhood change that occurs above and beyond citywide trends. To facilitate the identification of geographical areas, we refer to the names of Chicago's local community areas in which individual census tracts are embedded (Chicago Fact Book Consortium 1984).

Figures 1 and 2 display the spatial distribution of the socioeconomic disadvantage factor scores for 1970 and their change scores over the succeeding decade. With its distinction as being the most racially segregated city in America (Massey & Denton 1993), it comes as no surprise that the initial concentrations of disadvantage — displayed in the 1970 map (Figure 1) — were geographically clustered at the core of Chicago's black belt, in community areas such as Grand Boulevard, Oakland, Woodlawn, and Englewood to the south; and Garfield Park and North Lawndale along the western corridor. Figure 2 shows that over the decade that followed, the most severe increases in disadvantage were found not at the core of Chicago's black ghetto, but in neighborhoods along the periphery, which pushed further outward with each succeeding decade. Figure 2 reveals two clear outer rings of tracts experiencing acute onsets of disadvantage: one along the edges of the southern black belt, in community areas such as West Englewood, Auburn Gresham, Roseland, and South Shore on the south side; and another on the west side in the predominantly black community of Austin, but also in the Puerto Rican community areas such as Humboldt Park and Logan Square, and in parts of Little Village, which is mostly Mexican. Changes from 1980-90 (not shown) reveal a continuation of this same spatial pattern as well as the outward expansion of the periphery, with tracts as far west as Chicago Lawn on the south side, and as far north as parts of Lincoln Square and Rogers Park on the north side, all witnessing sharp declines in their socioeconomic profiles. In sum, over each decade the most dramatic increases in disadvantage occurred at the periphery of the traditional black ghetto, and the periphery itself was pushed further outward away from the core of the ghetto.

The second series of maps provide a visual account of how the spatial dynamics of homicide follow a pattern very similar to that of socioeconomic disadvantage. To be parsimonious in our presentation of geographic data, we display only the maps for our indicator of homicide diffusion, (i.e., the homicide potential variable). Again, this variable measures the spatial proximity of a given tract to levels of homicide in the surrounding area. We present these maps, instead of those for the homicide count variable, in order to provide an intuitive glimpse of what this construct measures, and because of the theoretical significance of its association with population change. Figure 3 shows that in 1970 the distribution of homicide potential parallels that of socioeconomic disadvantage in Figure 1.

Figure 4 reveals that the most intense change in proximity to homicide occurred in many of the same periphery neighborhoods as did change in disadvantage, with some exceptions. In comparing this map to Figure 2, we can see that proximity to homicide increased dramatically in neighborhoods of some north side community areas, primarily West Town and Uptown, which did not experience similar sharp increases in disadvantage. In the 1980s change in homicide potential (not shown) did not parallel that of socioeconomic disadvantage as closely. Our analysis revealed that the most intense change in proximity to homicide occurred in south side areas on the periphery of the traditional black belt, including some black middle-class community areas such as Avalon Park, Pullman, Roseland, Morgan Park, and Chatham. Thus, despite their high socioeconomic status relative to other black communities, black middle-class neighborhoods were not immune to the spread of homicide diffusion.

The final map portrays the spatial pattern of our dependent variable, population *change*. Figure 5 shows that as expected, the most severe population loss occurred in core ghetto neighborhoods, which also had high initial levels of disadvantage and proximity to homicide (compare to Figures 1 and 3), located in such community areas as Woodlawn, Englewood, and North Lawndale. Conversely, population gains were recorded in many of the same periphery neighborhoods that experienced marked increases in disadvantage and homicide potential (compare to Figures 2 and 4), in community areas such as West Englewood, New City, and Austin. It is also worth noting that growing Hispanic communities, such as Little Village, tended to experience increases in both population and disadvantage, but not proximity to crime. In the 1980s (not shown), core neighborhoods continued to lose population at a rapid pace, as the band of periphery neighborhoods gaining population expanded outward.

In sum, these maps present initial geographic evidence that the relationship between population change, disadvantage, and homicide is spatially conditioned by the process of ghetto expansion, and that the core/periphery distinction appears to be salient across multiple dimensions of neighborhood transition. Also, the maps indicate that the spatial dynamics of homicide do differ in important ways from those of socioeconomic disadvantage, and that remnants of both these patterns can be found in the maps displaying the ecological dynamics of population change. The geographic evidence thus suggests that a significant part of the variation in population change is likely to be independently related to homicide diffusion. To more thoroughly assess the contribution of homicide to population change, we now turn to the multivariate analysis.

Multivariate Results

We first present results from our analysis of total population change and then from separate analyses on racially disaggregated population change scores for blacks and whites. In each case, we present separate models for each decade under study.[17] To compare coefficients in different models, we conducted *t* tests for the equality of coefficients across (1) time period equations and (2) equations for black and white population change.[18] Our discussion of the findings is limited to variables of theoretical interest. We caution against making strong causal inferences, recognizing the possibility that population change may have reverse causal effects on some of our independent change variables, particularly homicide and disadvantage. Although these paths of reverse causation are not relevant to the lagged models analyzing prior levels of homicide and disadvantage, we intend to pursue them in future studies.

The results from our models of total population change are presented in Table 2.[19] Prior level of homicide is associated with population loss in each decade. This coefficient also maintains a consistent effect across time periods ($t = -1.09$). However, the relationship between interdecade change in neighborhood homicide levels and population change is more difficult to interpret because the direction of the coefficient is different in each time period, and this difference is statistically significant ($t = 4.19$). This inconsistency is probably due to the disparate effects that change in homicide has on white and black population change, as we will see below. Neighborhoods where homicide became more spatially proximate over time tended to lose population, but during the 1980s this relationship was insignificant. There is no evidence in these models, however, that population change itself was a spatially contagious process. In short, these initial results suggest that homicide exerts an independent effect on population change, and that it appears to operate in two theoretically distinct contexts: the immediacy of crime, as represented by prior level, and the potential threat posed by the spatial diffusion of crime.

The results for socioeconomic disadvantage are somewhat ambiguous in these models. Prior level of disadvantage is associated with population loss, but its effect is insignificant in both decades.[20] The direction of the coefficients is consistent

TABLE 1: Principal Components Analysis

Indicator	Factor Loadings
Socioeconomic Disadvantage	
Indicator	Factor Loadings
Percent public assistance	.922
Unemployment rate	.900
Percent below poverty	.897
Percent families headed by female	.864
Percent black	.673
Percent white	-.743
Eigenvalue	5.412
Ethnicity/Immigration	
Indicator	Factor Loadings
Percent Hispanic	.912
Percent foreign born	.912
Percent black	-.56
Eigenvalue	2.235
Age Composition	
Indicator	Factor Loadings
Percent ages 75 and older	.907
Percent ages 17 and under	-.766
Eigenvalue	1.339
Residential Stability	
Indicator	Factor Loadings
Percent in same house 5 years	.900
Percent owner occupancy	.794
Eigenvalue	1.078

with our theoretical prediction, based on Wilson's depopulation hypothesis, that the most disadvantaged neighborhoods located in the core ghetto area would lose population over the succeeding decade. Change in disadvantage is more difficult to interpret in these models because our theoretical predictions lead us to expect that it would have opposite effects on change in black and white populations. We find that increasing levels of disadvantage are generally associated with population gains, but again, this relationship is statistically significant only during the 1970s.[21]

In order to address our principal research hypotheses, we now examine the results from models of racially disaggregated population change. Table 3 presents the results for our model of black population change. As expected, the lagged

TABLE 2: OLS Prediction of Change in Total Population, by Decade: Chicago Census Tracts

	Dependent Variable: Change in Total Population					
	1970-80			1980-90		
Independent Variables	Coef.	Std. Error	Beta	Coef.	Std. Error	Beta
10-Year Lagged Variables						
Socioeconomic disadvantage	-138.63	92.72	-.09	-69.42	48.65	-.09
Ethnicity/immigration	-24.51	51.36	-.02	134.08**	22.29	.21
Age composition	106.51**	31.00	.12	61.71**	21.55	.09
Residential mobility	25.39	44.14	.03	-118.71**	25.29	-.17
Homicide	-83.11**	8.65	-.41	-70.44**	7.83	-.40
Logged total population	-248.10**	35.98	-.21	-103.78**	30.06	-.12
Interdecade Difference Scores						
Change in disadvantage	225.66**	53.03	.14	36.54	44.91	.03
Change in ethnicity/ immigration	-12.56	38.21	-.01	68.8	42.62	.05
Change in age composition	-352.23**	31.93	-.34	-203.81**	32.43	-.22
Change in residential mobility	36.85	47.21	.03	-85.36*	36.85	-.07
Change in homicide	22.02**	8.24	.09	-24.73**	7.53	-.11
Change in homicide potential[a]	-18.22*	7.60	-.09	6.95	13.50	.04
Spatial autocorrelation						
Total population change potential[a]	0.00	.06	0.00	.06	.05	.12
Intercept	1,794.48**	417.83	0.00	1,002.5**	339.56	0.00
Adjusted R^2	.54			.51		

[a] Coefficients and standard errors have been multiplied by 1,000.

* p < .05 ** p < .01

homicide count has a negative effect on black population trends, meaning that high-crime areas of the city lost black population in the succeeding decade. This relationship is consistently negative, with no significant time-period differences ($t = .47$). However, interdecade *change* in neighborhood homicide and spatial *proximity* to homicide have the opposite effect on black population change. Those neighborhoods that experienced increases in either homicide or homicide potential actually gained population. Change in homicide potential exerts a significant positive effect in each time-period equation, with no period differences ($t = .79$). Increases in homicide are a significant contributor to black population gain, but only during the 1970s, and here period differences are present ($t = 6.24$). These results generally confirm our hypothesis that while blacks may have been able to flee the immediacy of crime, they were not able to escape the spatial encroachment of crime. When considered with the geographic evidence, this finding indicates that as population flowed toward the periphery of high-crime ghetto neighborhoods, the periphery areas also became higher in crime and increasingly proximate to high rates of violent crime.

The patterns for socioeconomic disadvantage add more support to this interpretation. As predicted, higher prior levels of disadvantage are associated with black population loss, in keeping with the depopulation hypothesis. Comparisons reveal that this effect is statistically larger during 1970 to 1980 ($t = -.23$), when the most rapid changes in poverty concentration were occurring in Chicago (Morenoff 1994). In addition, based on the geographical dynamics of segregation, we hypothesized that change in disadvantage would have a positive effect on black population change. This result in fact obtains, and dovetails with the geographical evidence, showing that neighborhoods at the periphery of the ghetto that became more impoverished also tended to gain population. As was the case with lagged socioeconomic disadvantage, this association is statistically stronger during the 1970s ($t = 5.97$). Our results thus provide indirect support for *both* the depopulation and segregation arguments. On the one hand, neighborhoods with higher prior levels of homicide and disadvantage did experience losses of black population. However, we also find support for the segregation argument because increases in neighborhood levels of homicide, homicide potential, and disadvantage are all associated with black population gains, indicating that black population movements are constrained in such a way that areas experiencing the most growth in these pernicious conditions also gained population.

The logic of our spatial argument suggests that the social processes conditioning black population change should stand in stark contrast to those observed in the case of white population change. The results in Table 4 generally support this conclusion. Although they are not consistently significant, the effects of lagged homicide support the hypothesis that white population declined in response to high prior levels of homicide. Here again, we found time-period differences ($t = -1.83$), as the relationship was significant only during the 1970s. Also as predicted, neighborhoods experiencing increases in either homicide or homicide potential tended to lose white population.[22] Both of these effects are statistically significant in each time period but stronger during the 1970s (for change in homicide, $t = -1.88$; and for change in homicide potential, $t = -8.54$).[23] The patterns for socioeconomic disadvantage add further support to the hypotheses on white population change. Namely, white populations declined both in neighborhoods that were initially impoverished and in those that became more so over the successive decade. These effects are also significant in both time periods but stronger during the 1970s (for lagged disadvantage, $t = -3.59$; and for change in disadvantage, $t = -8.94$). In sum, the key point is that in almost all the contexts we examine, higher levels of socio-

TABLE 3: OLS Prediction of Change in Black Population, by Decade — Chicago Census Tracts

Dependent Variable: Change in Black Population

Independent Variables	1970-80 Coef.	1970-80 Std. Error	1970-80 Beta	1980-90 Coef.	1980-90 Std. Error	1980-90 Beta
10-Year Lagged Variables						
Socioeconomic disadvantage	-554.51**	115.83	-.21	-163.1**	35.27	-.20
Ethnicity/immigration	247.33**	73.27	.09	175.61**	27.99	.25
Age composition	267.35**	47.88	.17	90.79**	24.67	.12
Residential mobility	174.09**	51.95	.11	-31.59	26.06	-.04
Homicide	-61.84**	12.23	-.17	-68.52**	7.29	-.35
Logged black population	55.63**	20.52	.12	25.53*	10.61	.11
Interdecade Difference Scores						
Change in disadvantage	880.91**	81.21	.31	334.58**	42.23	.24
Change in ethnicity/ immigration	-869.67**	65.43	-.40	-475.27**	46.46	-.30
Change in age composition	-766.85**	57.02	-.42	-270.38**	34.35	-.27
Change in residential mobility	-.50	65.34	0.00	-6.31	39.53	0.00
Change in homicide	75.36**	11.93	.18	-13.26	7.70	-.05
Change in homicide potential[a]	43.94**	11.52	.13	33.49**	6.37	.17
Spatial autocorrelation						
Black population change potential[a]	.02	.05	.02	.07**	.03	.10
Intercept	240.88	136.10	0.00	61.17	69.68	0.00
Adjusted R^2	.63			.53		

[a] Coefficients and standard errors have been multiplied by 1,000.

* $p < .05$ ** $p < .01$

economic disadvantage, homicide, and geographic proximity to homicide are associated with white population loss.

Our theory predicts that changes in socioeconomic disadvantage, homicide, and homicide potential, should have opposite effects on black and white population change. The appropriate comparisons support this conclusion, showing statistically significant differences across race-specific models for the following coefficients: change in disadvantage (for 1970-80, $t = 17.35$; for 1980-90, $t = 12.02$), change in homicide (for 1970-80, $t = 7.23$), and change in homicide potential (for 1970-80, $t = 10.34$; for 1980-90, $t = 7.51$). The only exception was change in homicide from 1980 to 1990, where we did not find a significant race difference ($t = .41$). In addition, in the cases of lagged socioeconomic disadvantage and homicide, where our theory predicts similar effects on black and white population change, comparisons still revealed interesting race differences. We found significant race differences in the effect of lagged homicide (for 1970-80, t = -2.38; for 1980-90, t = -7.29), such that in each decade it was a stronger contributor to white depopulation than to black depopulation. This finding adds further support to Massey's segregation argument, by showing that white population was more responsive to problems of neighborhood crime than was black population. There are no significant race differences in the case of lagged socioeconomic disadvantage (for 1970-80, t = -.48; for 1980-90, t = -.73).

Discussion and Conclusion

The preceding analysis has demonstrated that homicide is a significant predictor of population change even after taking into account numerous aspects of socioeconomic disadvantage and other ecological factors related to neighborhood transition. High levels of neighborhood homicide were consistently associated with total population loss in the subsequent decade. However, the effect of violent crime on population change was also transmitted through the *spatial diffusion* of homicide. All else being equal, the more that crime in the area surrounding a given neighborhood increased, the greater its total population loss over a decade. This result corresponds with the geographic analysis of city maps, which reveal a clear pattern of association between the diffusion of homicide and population change. In addition, the significant role that spatial proximity to homicide plays in population dynamics supports a strong theoretical tradition in criminology, which emphasizes the roles of both crime and the fear of crime in undermining neighborhood social organization and triggering out-migration (e.g., Anderson 1990; Liska & Bellair 1995; Skogan 1986; Taub, Taylor & Dunham 1984).

Most important, we believe, our multivariate analysis uncovered sharp group differences that add to our understanding of how neighborhood populations differ in their demographic response to detrimental social conditions. Those neighborhoods with the highest levels of homicide and socioeconomic disadvantage at the beginning of a decade tended to lose both white and black population over the succeeding decade. In other words, neighborhoods that were already beset by violent crime and high concentrations of socioeconomic disadvantage experienced depopulation of all groups, although the population decline in response to violent crime was sharper among whites. On the other hand, *change* in a neighborhood's homicide level, its spatial proximity to homicide, and its level of disadvantage, all had divergent demographic outcomes for black and white populations. Whereas white population *declined* in response to increases in homicide, the diffusion of homicide, and socioeconomic disadvantage, black population *grew* precisely in the same areas that experienced the largest increases in these characteristics.

These findings, along with the consistent picture painted by geographic evidence (see Figures 1-5), suggest that black population declined most dramatically in

TABLE 4: OLS Prediction of Change in White Population, by Decade: Chicago Census Tracts

	Dependent Variable: Change in White Population					
	1970-80			1980-90		
Independent Variables	Coef.	Std. Error	Beta	Coef.	Std. Error	Beta
10-Year Lagged Variables						
Socioeconomic disadvantage	-482.87**	93.41	-.23	-128.32**	32.28	-.22
Ethnicity/immigration	603.00**	76.71	.28	-36.43	19.67	-.07
Age composition	202.30**	41.57	.16	10.28	18.86	.02
Residential mobility	170.77**	45.49	.14	-53.59**	19.11	-.10
Homicide	-23.24*	10.66	-.08	-1.07	5.70	-.01
Logged white population	-332.60**	27.93	-.56	-124.90**	11.64	-.59
Interdecade Difference Scores						
Change in disadvantage	-1,095.75**	79.87	-.48	-318.77**	34.23	-.31
Change in ethnicity/immigration	-6.94	54.02	.00	-24.65	33.05	-.02
Change in age composition	877.01**	49.57	.59	169.29**	27.31	.23
Change in residential mobility	397.13**	60.46	.22	-4.54	30.17	.00
Change in homicide	-40.02**	10.60	-.12	-17.21**	5.88	-.10
Change in homicide potential[a]	-267.79**	27.84	-.96	-26.44**	4.8	-.19
Spatial autocorrelation						
White population change potential[a]	-.71**	.07	-.99	.07**	.03	.10
Intercept	-1,844.30**	411.08	.00	598.98**	82.73	.00
Adjusted R^2	.59			.46		

[a] Coefficients and standard errors have been multiplied by 1,000

* $p < .05$ ** $p < .01$

neighborhoods located at the core of the ghetto, which had the highest initial levels of homicide and disadvantage. At the same time, the results imply that blacks could not escape from the proximity to homicide, as the highest black population increases were recorded at the periphery of the ghetto where both violent crime and the proximity to crime increased over time.

Ultimately, then, the apparent contradiction between Wilson's depopulation hypothesis and Massey's segregation argument may be reconciled by (1) taking violent crime into account as well as the concentration of disadvantage, and (2) recognizing that both dynamics can coexist in a geographically systematic fashion based around the core/periphery distinction. Whether these particular spatial dynamics are unique to Chicago is a question that must be left to future research, but similar spatial patterns have already been observed with regard to the growth of concentrated poverty in other older industrial cities such as Cleveland (Coulton, Chow & Pandey 1990), Philadelphia, Memphis, and Milwaukee (Jargowsky & Bane

1991). We thus strongly suspect that the spatial context of violent crime has played an important role in conditioning the dynamic processes of neighborhood change in many older industrial cities with traditionally high levels of residential segregation over the past several decades. It remains to be seen whether similar spatial patterns have emerged in newer American cities with lower levels of segregation and different ecological structures, such as many of those in the South and West.

Notes

1. Recent research by Alba et al. (1994) uncovers substantial racial differences in exposure to crime in the suburbs of New York which are not explained by individual-level factors such as household income and home ownership. By contrast, community-level factors such as racial composition and poverty rates provide a more powerful explanation. Alba et al. conclude that "even the most affluent blacks are not able to escape from crime, for they reside in communities as crime-prone as those housing the poorest whites" (427).

2. Shaw and McKay (1942, 1969) also argued that three structural factors — low economic status, ethnic heterogeneity, and residential mobility — led to the disruption of neighborhood social organization, which in turn accounted for higher crime and delinquency rates (see also Kornhauser 1978). This cross-sectional hypothesis has generated a long line of empirical research (see Bursik & Grasmick 1993).

3. The term *ghetto* here specifically refers to "a set of neighborhoods that are exclusively inhabited by members of one group (in this case blacks), within which virtually all of the members of that group live" (Massey & Denton 1993:18-19).

4. In other words, we conduct separate analyses for black and white population change, but we do not perform separate analyses on different geographical subsets of neighborhoods. We opted for the former strategy over the latter because it allows us to use information from our full range of cases (i.e., census tracts), and because the latter approach would involve arbitrary decisions on where to set racial composition thresholds in order to classify tracts as being either black or white.

5. Tracts were deleted from our final data set if they had population sizes of 100 or less during any one of the three time periods.

6. It is important to note that in measuring population change, we are not isolating the change due to net migration. This is a constraint posed by census data, which does not provide us with the vital statistics necessary to estimate net migration.

7. In this case, fixed effects refer to characteristics of neighborhoods that do not change over time. Thus, the effects of omitted ecological characteristics associated with traditional models of neighborhood change, such as distance from the central business district, quality of the housing stock (although the latter does change somewhat with time), and the presence of other ecological characteristics that can either add or detract from the quality of residential life (e.g., parks, industrial land use, and rail yards), but cannot be measured with census data, are controlled for in this pure difference model. Although we do not present the results of these models, we estimate them to confirm that our findings were not unduly influenced by omitted variable bias.

8. We include only 10-year lagged variables in our model. We did not consider 20-year lagged effects due to the considerable length of the time interval, and because such a model would require data from another time period, 1960.

9. Two aspects of our homicide measure merit additional explanation: (1) our decision to use the number of homicides committed rather than a rate, and (2) our procedure for aggregating these counts across three year time intervals. First, we chose to use counts instead of rates because of the presence of outliers, primarily tracts with very small population sizes (the denominator of the homicide rate). However, as Roncek (1981) notes, using the number of homicides rather than rates also avoids the problem presented by some tracts with many crimes having low homicide rates because they have many residents. Thus, following Roncek, we chose to employ homicide counts and, in our analysis of population change, to include the lagged level of population as an independent variable to control for the opportunity to commit crime, as represented by the number of residents. Second, we chose to construct three-year counts in order to increase the variation among census tracts in each time period. Simply using one-year counts would result in many tracts having no recorded homicides in a given year, thus skewing the distribution towards zero. We tried using both two-year and three-year counts in our multivariate analysis, and the results were identical in terms of the direction and significance of the parameters.

10. Using cross-sectional census tract-level data on crime available only for 1993, we calculated the bivariate correlations between homicide and a number of other crimes. We found particularly high correlations of homicide with robbery (.60), other assaults (0.66), drug crimes (0.59), and weapons crimes (.68); while homicide had somewhat lower correlations with burglary (.48), auto theft (.41), and various other crimes. Liska and Bellair (1995), who argue that violent property crimes are particularly salient in determining residential moves, found that of all violent and nonviolent crimes, robbery had the strongest effect on racial composition. The high correlations between homicide and both robbery and other types of assaults in Chicago census tracts thus suggests that homicide is a fairly good indicator of violent crime in general.

11. When we conducted separate principal components analyses on the variable set in each of the three census years, we found that the identical factor structure emerged in each time period, with one exception in the ordering of the latent factors: in 1980, the residential stability component emerged as the third factor and age as the fourth (where the rankings refer to the strength of the overall factor, as indicated by their eigenvalues). However, the factor loadings revealed that there was no change in the substantive interpretation of either factor.

12. Our decision to analyze four factors is based on the conventional criterion of interpreting only those factors with eigenvalues of at least 1.0.

13. To operationalize the distance measure in the denominator, we measure the Euclidean (or straight-line) distance between census tracts, based on latitude and longitude.

14. In the first stage, predicted values of the potential variable are obtained by regressing the generalized potential on the set of predictors used in equation 1 as well as a set of instrumental variables, which in this case are dichotomous variables representing police districts. These police district variables essentially capture regional variation in the city

which is assumed to affect the dynamics of population change in the city, but not in the reference census tract. The idea of using regional dummy variables as instruments is suggested by Land and Deane (1992). The predicted values for the generalized potential variable are then used as a regressor in the second stage, where population change is the dependent variable.

15. This point was clarified to us by a reviewer, who noted that although it does not directly illustrate the pattern of spatial effects among the independent variables, the control for spatial autocorrelation does take into account the spatial effects of all causes of the dependent variable (i.e., the independent variables), even without the introduction of additional spatial terms into the model.

16. Because this potential variable is not constructed from our dependent variable, it is not correlated with the error term of the model, and hence we do not use Land and Deane's (1992) 2SLS technique. Instead, we construct the variable directly from equation 3.

17. We examined diagnostics for both influential observations and multicollinearity, and generally found neither to be a problem in the models reported in Tables 2-4. To detect influential observations, we computed Cook's D, and found no values of one and above in any of the models. Although it did not greatly affect our estimates, we did detect some multicollinearity in models for change in total population (i.e., Table 2) and change in white population (i.e., Table 4), as evidenced by high variance inflation statistics related to the spatial autocorrelation variables (VIF = 13.21 for total population change potential in 1970-80 model and 19.50 for 1980-90 model; while VIF = 20.47 for white population change potential in 1970-80 model). In these instances, we reestimated the models without the spatial autocorrelation term and reported any differences in the results.

18. We applied the following computational formula (Kleinbaum & Kupper 1978:99-102):

$$t = (b_1 - b_2)/[SE_1^2 (n_1 - k - 1) + SE_2^2 (n_2 - k - 1)]^{1/2}$$

where: b_1 = unstandardized coefficient in equation 1

b_2 = unstandardized coefficient in equation 2

SE_1 = standard error in equation 1

SE_2 = standard error in equation 2

n_1 = sample size in equation 1 (i.e., 826)

n_2 = sample size in equation 2 (i.e., 826)

N = combined sample size (i.e., 826)

k = number of predictors (i.e., 13)

19. The lagged homicide potential variable was dropped from the final model due to multicollinearity. As a result, population change is now predicted by the prior level of homicide at the start of the decade, and the interdecade change in both homicide and homicide diffusion.

20. Due to the high correlations in the 1970-80 model between total population change potential and both lagged socioeconomic disadvantage (-.78) and change in

socioeconomic disadvantage (-.71), and in the 1980-1990 model between total population change potential and change in homicide potential (.77), we reestimated these models without the spatial autocorrelation terms. In the new 1970-80 model, lagged socioeconomic disadvantage (b = -141.86)) becomes significant, but no other coefficients are affected. In the new 1980-90 model, lagged socioeconomic disadvantage (b = -114.85) again becomes significant, but no other coefficients change.

21. Again, when the model is respecified without the spatial autocorrelation term, this relationship becomes significant for the 1970-80 period.

22. Due to the high correlation in the 1970-80 period between white population change potential and change in homicide potential (-.88), we reestimated this model without the spatial autocorrelation term. The new results show that change in homicide potential becomes insignificant from 1970-80 (b = -.03).

23. The time-period difference for change in homicide potential becomes insignificant when the model is respecified without the spatial autocorrelation term (see 22).

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APPENDIX: Descriptive Statistics

Variable	Mean	Std. Dev.
Dependent		
Total population change 1970-80	-431.82	876.27
Total population change 1980-90	-267.27	689.92
Black population change 1970-80	124.00	1,510.05
Black population change 1980-90	-133.86	754.83
White population change 1970-80	-838.13	1,238.86
White population change 1980-90	-300.23	538.48
Independent		
Socioeconomic disadvantage 1970	-.58	.58
Socioeconomic disadvantage. 1980	.12	.91
Socioeconomic disadvantage 1990	.45	1.13
Socioeconomic disadvantage change 1970-80	.71	.54
Socioeconomic disadvantage change 1980-90	.33	.53
Homicides 1970	2.55	4.27
Homicides 1980	2.97	3.89
Homicides 1990	2.69	3.59
Homicide potential 1970	21,843.52	9,812.80
Homicide potential 1980	24,739.15	8,536.46
Homicide potential 1990	21,705.05	7,179.93
Homicide potential change 1970-80	2,895.63	4,388.78
Homicide potential change 1980-90	-3,034.09	3,840.94
Total population change potential 1970-80	-3,824,666.06	1,322,686.56
Total population change potential 1980-90	-3,822,670.40	1,438,890.98
Black population change potential 1970-80	216,117.10	1,462,454.23
Black population change potential 1980-90	-1,162,878.98	1,182,444.61
White population change potential 1970-80	-6,251,207.48	1,711,691.01
White population change potential 1980-90	-2,152,493.03	722,005.64