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Social Disorganization and the Public Level of Crime Control: A Spatial Analysis of Ecological Predictors of Homicide Rates in Bogota, Colombia

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SOCIAL DISORGANIZATION AND THE PUBLIC LEVEL OF CRIME CONTROL: A
SPATIAL ANALYSIS OF ECOLOGICAL PREDICTORS OF HOMICIDE RATES IN
BOGOTA, COLOMBIA

by

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ABSTRACT

SOCIAL DISORGANIZATION AND THE PUBLIC LEVEL OF CRIME CONTROL: A
SPATIAL ANALYSIS OF ECOLOGICAL PREDICTORS OF HOMICIDE IN BOGOTA,
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Gipsy Escobar

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Research in the social disorganization tradition has found community disadvantage to be one of

the strongest and most consistent macro-level predictors of homicides in urban areas in the

United States (Pratt & Cullen 2005). This dissertation empirically tests the applicability of

ecological theories of crime to the spatial distribution of homicides in Bogota, Colombia, while

proposing alternative measures of social disorganization that are analogous to those used in the

American literature but that are more reflective of both social realities and data availability in

Colombia. The study used data from several sources including official homicide figures from the

National Institute of Forensic Medicine, socio-demographic characteristics from the 2005 census,

location of police stations from the Metropolitan Police of Bogota, and presence of criminal

groups and illegal markets from interviews with police precinct commanders. The research

employed Principal Components Factor Analysis (PCFA) to create ecological constructs, and

Exploratory Spatial Data Analysis (ESDA) and Spatial Regression Analysis (SRA) to examine

patterns of spatial dependence in the outcome and predictor variables. Results provide partial

support for social disorganization theory to the extent that concentrated disadvantage, social

isolation, and residential mobility positively predict homicide rates above and beyond the effect

of the presence of criminal groups and other controls. Only one proxy measure of the public

level of control (presence of police) was significant, but its effect was in the opposite direction to

what was hypothesized. However, this effect disappeared in the final model once the temporal lag of homicide rates was introduced. The study makes several contributions to the literature including testing the external and construct validity of social disorganization and systemic model of control measures, proposing a mixed-methods approach to get a more nuanced understanding of the spatial distribution of homicide rates, and suggesting policy implications to reduce the effects of disadvantage as potentially effective strategies in preventing violent crime at the neighborhood level. In sum, the study provides some evidence in favor of the usefulness of social disorganization theories to understand violent crime in Latin American cities. Replications in the region will be needed to assess the generalizability of these findings.

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CHAPTER 1. INTRODUCTION

This dissertation empirically tests the applicability of ecological theories of crime to the spatial distribution of homicides in Bogota, Colombia. The study proposes alternative measures of social disorganization that are analogous to those used in the American literature but that are more reflective of both social realities and data availability in Colombia. In this way, the monograph explores the effect of concentrated disadvantage, social isolation, residential mobility, ethnic and cultural heterogeneity, social disorder, and presence of voluntary associations on the 2003-2005 cumulative neighborhood homicide rate per 10,000 residents. In addition, the study investigates the potential effect of the public level of control—measured as the local availability of services related to quality of life and social control—on homicide victimization. The research also controls for factors related to Colombia's violence: criminal structures, organized crime, illegal markets, and forced displacement.

Data were collected from a variety of sources including: (1) all officially recorded homicide events for the period 2000-2005 collected by *Centro de Estudios sobre Desarrollo Económico* (Center of Economic Development Studies, CEDE for its acronym in Spanish) at *Universidad de Los Andes* in Bogota from records kept by the National Institute of Forensic Medicine; (2) socio-structural variables, social disorder indicators, local coverage of basic public services, land use, presence of voluntary associations, and persons displaced by the violence from the 2005 census; (3) information on the location of police stations and *Comandos de Atención Inmediata* (Immediate Response Police Commands, CAI for their acronym in Spanish) from the Metropolitan Police of Bogota; and (4) information on the presence of criminal structures, organized crime, and illegal markets from interviews with police officers conducted between 2003 and 2004 by CEDE researchers.

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The study employs Principal Components Factor Analysis to create measures of ecological concepts, and Exploratory Spatial Data Analysis (ESDA) to: (1) examine the spatial distribution of homicide rates and the main predictors; (2) identify the existence of spatial patterns, regimes, and atypical observations; (3) explore potential interactions among predictors; and (4) determine whether spatial dependence exists in the dependent variable. Finally, Spatial Regression Analysis (SRA) is utilized to estimate the effects of the predictors on homicide rates, controlling for any patterns of local and global spatial dependence. Both spatial lag (the values of the dependent variable in neighboring units are assumed to influence one another) and spatial error (the error terms are assumed to be spatially correlated due to unmeasured factors) models are tested in a comparative fashion (Ward & Gleditsch 2008).

1.1. Problem Statement

Research in the ecological tradition has established that differences in the socio-structural characteristics of communities produce variation in crime and delinquency rates. Shaw and McKay (2011[1942]) observed that Chicago neighborhoods with higher concentrations of poverty, residential mobility, and heterogeneity of values were more likely to have higher delinquency rates. They characterized these communities as socially disorganized, a condition that caused neighborhoods to be less efficient in exercising social control and, consequently, more criminogenic than more affluent, stable, and homogeneous communities.

Later research criticized this approach for focusing exclusively on the internal dynamics of communities, ignoring the external political and economic processes and decisions that shape them (Heitgerd & Bursik 1987). Bursik and Grasmick (1993a) proposed a systemic approach to social disorganization aimed at explaining the interactions that occur between a community's internal networks and the external world in the process of attempting to regulate behavior. The

Systemic Model of Crime Control puts forward the idea that social networks exercise social control at three separate, but interconnected levels. The first and most basic level of control takes place within private networks (i.e. families, friends, neighbors) where the expectations for acceptable behavior are transmitted and through which the behavior of children and adolescents is supervised. The next echelon of control, the parochial level, represents a community's ability to oversee the actions of residents and visitors, and it is exercised by broader interpersonal networks (i.e. neighborhood associations, tenant groups, parent-teacher associations, neighborhood watch groups) and through the participation in local institutions (i.e. churches, schools, voluntary organizations). Finally, the public level of control connects private and parochial ties to a larger system of networks embedded within the ecological structure of a city. Indeed, public control represents a community's ability to secure needed services and resources that are managed and distributed by external agencies. In general, these resources are limited and local communities must compete with other neighborhoods for their acquisition. Bursik and Grasmick (1995) suggest that the allocation of and competition for external resources may have an effect on the ability of a neighborhood to exercise social control.

Nonetheless, research on the ecology of crime in the United States has mainly focused on examining the effects of social cohesion and collective efficacy—embodied in private and parochial networks— on crime, with little emphasis on exploring the effects of the public level of control.

In addition, research on the ecology of crime has been largely conducted in the United States and the Anglophone world (Canada, England, and Australia). For instance, a search for the key terms "social disorganization," "ecology of crime," and "collective efficacy" in the National Criminal Justice Reference Service yielded almost 500 publications testing social disorganization

theory primarily in the United States. In recent years, however, there has been an increase in the interest to test ecological theories of crime in other latitudes such as China and Latin America. Indeed, an international conference on violence in Latin American neighborhoods convened in Santiago, Chile on October, 2011, showcased over forty studies analyzing various indicators of neighborhood violence in the region, about a third of which used an ecological approach. Despite this heightened interest in the ecology of crime in Latin America, there has been very little research using this conceptual framework to study violence in Colombia. Scholars in that country have mainly focused their attention on disentangling political violence from other types of violence at the national, regional, and local levels, and on evaluating the effects of local policies on violent crime rates. Moreover, with the exception of Cerdá, Morenoff, Duque and Buka (2008), studies that look at the potential effect of socio-structural variables on urban violence in that country have not relied on an ecological theoretical framework.

The paucity of social disorganization research outside of the Anglophone world brings to the forefront of the discussion the issue of measurement. It is unclear at this point whether measures of disorganization and disorder developed and tested in the United States are exportable to other cultural contexts, particularly in the developing world, or whether alternative measures are needed. This debate has been somewhat addressed in the literature when it comes to measuring disorganization in rural areas in the United States, but there is little in the way of discussing alternative measures in the international context.

Similarly, there is the issue of conceptualization. There is evidence in the literature that different groups within the same community may uphold divergent, even conflicting views of the kinds of behaviors that may signal disorder (Martinez 2010). If this is true within small-scale

communities, we cannot assume that standard definitions of disorganization necessarily apply across cultural contexts at the international level without some level of adaptation.

1.2. Purpose

The main purpose of this dissertation is to identify the ecological characteristics of communities that are associated with the spatial distribution of homicides in Bogota, Colombia, while controlling for the potentially confounding effect of the presence of criminal organizations and illegitimate agents of social control. Three specific aims are pursued:

1.2.1. <u>Explore the applicability of the social disorganization model to an urban setting in Latin America</u>

In their study on criminal victimization and fear of crime in Belo Horizonte, Brazil, Villareal and Silva (2006) found that neighborhood disadvantage was positively related to social disorder—as predicted by the social disorganization model—but it was also associated with higher levels of neighborhood social cohesion, countering the expectations of the ecological approach. Furthermore, social cohesion was not found to significantly predict criminal victimization, but social and physical disorder did predict higher levels of violent crime.

Likewise, in a study comparing the effects of collective efficacy on neighborhood violence in Chicago and Medellin (Colombia), Cerdá et al. (2008) found that in Medellin collective efficacy was positively associated with neighborhood disadvantage, perceived levels of violence, and homicide rates. On the other hand, neighborhood disadvantage was negatively associated with homicides, though the latter association disappeared once prior levels of homicide were controlled for.

Furthermore, although not directly testing social disorganization theory, Llorente, Escobedo, Echandia and Rubio (2001) found that in Bogota census tracts with a larger proportion of males in their population and with higher illiteracy and school dropout levels also presented higher homicide rates, suggesting a potential effect of disadvantage on violent crime. However, they also observed that poverty (measured using the Unsatisfied Basic Needs Index) had a negative effect on homicide rates.

These findings are counterintuitive and may suggest that, as Villareal and Silva (2006) put it, "[t]he organization of neighborhoods in large urban centers of the developing world presents a challenge to long-held assumptions regarding the effect of community characteristics on crime" (p.1744).

This dissertation explores the effect of social disorganization on the spatial distribution of homicides in Bogota, using alternative measures of commonly used disorganization indicators (i.e. concentrated disadvantage and social isolation, residential mobility, ethnic and cultural heterogeneity, and social disorder). It is hypothesized that all indicators have a direct positive effect on homicide, and that the parochial and public levels of control moderate the effects of disadvantage, isolation, and disorder on homicide rates.

1.2.2. Explore the role of the public level of control in facilitating social control at the neighborhood level

Most research on the ecology of crime has focused on studying the ability of private and parochial networks to exercise informal social control to prevent crime, delinquency, and victimization. The findings tend to agree that communities with strong private and parochial networks are more effective at preventing crime than neighborhoods with weak associations (Bellair 1997; Carr 2003; Lee & Bartkowski 2004; Rosenfeld, Messner & Baumer 2001;

Rosenfeld, Baumer & Messner 2007; Saegert & Winkel 2004; Saegert, Winkel & Swartz 2002; Sampson & Groves 1989; Sampson, Raudenbush & Earls 1997; Sampson & Raudenbush 1999; Simons, Simons, Burt, Brody & Cutrona 2005; Skogan 1986; Snell 2001; Taylor 2001b; Velez 2001).

However, it has also been observed that the socio-structural characteristics of communities have an effect above and beyond that of private and parochial networks whereby neighborhoods with higher levels of disadvantage and social isolation have higher crime rates regardless of social ties (Cerdá et al. 2008; Lee & Ousey 2005; Patillo 1998). In fact, recent studies have found that the existence of dense social networks is a necessary, but not a sufficient condition for the effective exercise of social control (Browining 2009; Bursik 1999; Elliot, Wilson, Huizinga, Sampson, Elliot & Rankin 1996; Kubrin & Weitzer 2003a; Sampson et al. 1997; Sampson 2002b; Stucky 2003; Warner & Rountree 1997), suggesting that vertical connections to the outside world—public control—are needed to successfully control crime at the local level.

Nonetheless, research about the effects of the public level of control on crime has been scarce in the United States, and practically inexistent in the international context. The limited evidence obtained in the American context, however, points to a negative effect of public control on crime rates that tends to moderate the effects of disadvantage and isolation (Belnar, Cerdá, Roberts & Buka 2008; Carr 2003; Lee & Ousey 2005; Stucky 2003; Taylor 2001a; Velez 2001).

The social isolation literature suggests that communities that lack connections to other communities and external institutions not only find their capacity to reproduce mainstream values and socio-economic opportunities hindered by this disconnect—thus promoting among their residents a higher tolerance for illegal activities that may require the use of violence to be

successful—but also lack the political power to influence decisions that may improve the neighborhood's quality of life (Shihadeh & Flynn 1996; Wilson 1987, 1991-1992). The physical and social isolation generated by a void in the public level of control may also produce, as Cohen and Tita (1999) suggest, a concentration of violence within these areas of the city (see also Fagan, Wilkinson & Davies 2007; Kubrin & Weitzer 2003b). This implies that variations in the ability to exercise public control across ecological units may help explain variations in crime and homicide rates as well. Furthermore, Sanchez, Espinosa & Rivas (2007) found that Bogota localities[1] with higher levels of public expenditure on the social sector had lower homicide rates, suggesting a potential effect of public control on violence in that city.

This study explores the role of the public level of control in facilitating social control at the neighborhood level in Bogota by introducing measures of the local distribution of public services related to quality of life and social control. It is hypothesized that the public level of control has a direct negative effect on homicide, but that this construct also moderates the effect of disadvantage, isolation, and disorder on the dependent variable.

1.2.3. Explore the effect of illegal groups on a neighborhood's capacity to exert social control

The ecological literature in the United States indicates that, in socially disorganized areas, criminal structures emerge as alternatives to declining legitimate work opportunities as sources of both income and social status and, thus, compete with mainstream social institutions in the exercise of social control at the local level (Fagan et al. 2007; Kornhauser 1978; Patillo 1998; Sampson & Wilson 1993).

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[1]The locality is the main political-administrative unit in Bogota. There is a total of 20 localities in the city, each clustering between seven and 51 official neighborhoods (30 on average).

A qualitative study of social networks and social control in three Brazilian *favelas* (shantytowns) conducted by Arias (2006) suggests that the presence of criminal structures may confound the relationship between public control and violent crime. According to this author, levels of homicide and violence declined in those communities that were effective at making contacts with outside agencies concerned with human rights; and remained high in those neighborhoods where criminal organizations controlled local politics through connections with community leaders and the police. It is possible that in communities where criminal structures have connections to local politicians and corrupt police, criminals, not the community, ultimately exercise public control. On the other hand, it is also possible that in those communities with a strong presence of criminal structures but where they do not control the local authorities, public control is hindered by threats of violence against those who attempt to connect with external agencies to improve neighborhood conditions.

Cerdá and colleagues (2008) hypothesized that the positive relationship between collective efficacy and perceived and actual violence in Medellin neighborhoods "may also reflect the insertion of criminal groups into the local social networks in low-income neighborhoods" (p. 28), particularly paramilitary groups known to control most of Medellin's slums at the time of the study (2003-2004). However, they did not control for the presence of these criminal groups in their models.

Similarly, Casas and Gonzalez (2005) argue that, although the impact was less dramatic than in cities like Medellin and Cali, the increase in violence in Bogota since the mid 1980s was very much related to the dynamics of the drug economy and the internal armed conflict. Researchers have also found that high homicide rates converge with the presence of criminal structures, and arms trafficking in the same areas of Bogota (Formisano 2002; Llorente et al.

2001). Therefore, not accounting for this potentially confounding effect could lead to a misspecification problem when applying ecological theories of crime to societies permeated by the presence of criminal organizations.

The present study explores this by introducing indicators of the presence of different types of criminal structures (i.e. gangs, contract killing *offices*, and social cleansing groups), organized crime (i.e. guerrilla militias and paramilitary cells), and illegal markets (i.e. drug distribution, arms trafficking, and chop shops) in Bogota neighborhoods. In addition, the study also controls for the presence of individuals displaced by the internal armed conflict. It is hypothesized that all of these indicators have a direct positive effect on homicide rates.

1.3.Summary

The present study contributes to the literature in several ways. First, it provides a test of the external validity of ecological theories of crime by assessing its applicability to the understanding of homicides in Bogota, Colombia. Second, it proposes alternative measures of social disorganization constructs that may be more reflective of the Latin American socio-cultural context. Third, it provides an empirical test of the public level of control, a largely under-tested concept within the ecological tradition, and proposes the use of the local availability of quality of life and social control public services as measures of this construct. Fourth, the study accounts for the potentially confounding role of the presence of organized groups that may compete with the legitimate authorities in the exercise of local social control by introducing measures of the presence of organized crime, criminal structures, and illegal markets. Finally, a large number of social disorganization studies have only placed attention to geography through the use of multilevel models controlling for the community context of individual behavior. However, these techniques do not account for the effect that neighboring communities might

have on one another. This dissertation uses spatial data analysis to focus explicitly on the geographic distribution of homicides across neighborhoods. In particular, Exploratory Spatial Data Analysis (ESDA) allows for the identification of spatial patterns of local autocorrelation, and Spatial Regression Analysis (SRA) enables the researcher to control for spatial dependence through the inclusion of a spatial weights matrix.

Figure 1 summarizes the hypothesized causal model. Blue boxes represent the independent variables of interest, green boxes represent the control variables, and the red box represents the dependent variable. In addition, solid lines represent main effects and dotted lines represent interaction effects. Finally, the horizontal position of the boxes represents the hypothesized causal ordering of the dimensions and effects being measured.

Chapter 2 delves deeper into the ecological literature and discusses the classic social disorganization as well as the systemic approach. In addition, the empirical evidence regarding the ecological variables that have been found to predict crime in the United States (i.e. concentrated disadvantage, residential mobility, social disorder) is reviewed. The chapter also examines the literature on the public level of control in the context of homicide, social isolation, criminal structures, and policing research. Finally, Chapter 2 further discusses the relevance of the study and its contributions to the field of criminology.

Chapter 3 presents an overview of the study site focusing on the characteristics of violence in Colombia and summarizing the literature on homicides in that country, with particular emphasis on research conducted in Bogota.

Chapter 4 provides a detailed account of the data used in the analyses, including their source and collection method, and discusses the data analysis techniques employed.

Chapter 5 discusses the results obtained in the Exploratory Spatial Data Analysis with emphasis on identifying spatial patterns on both the dependent and independent variables.

Chapters 6 presents the results of the spatial regression models predicting homicide rates, and Chapter 7 further discusses the theoretical, methodological, and policy implications of the findings, as well as the limitations of the study and recommendations for future research.

Figure 1. Hypothesized Causal Model
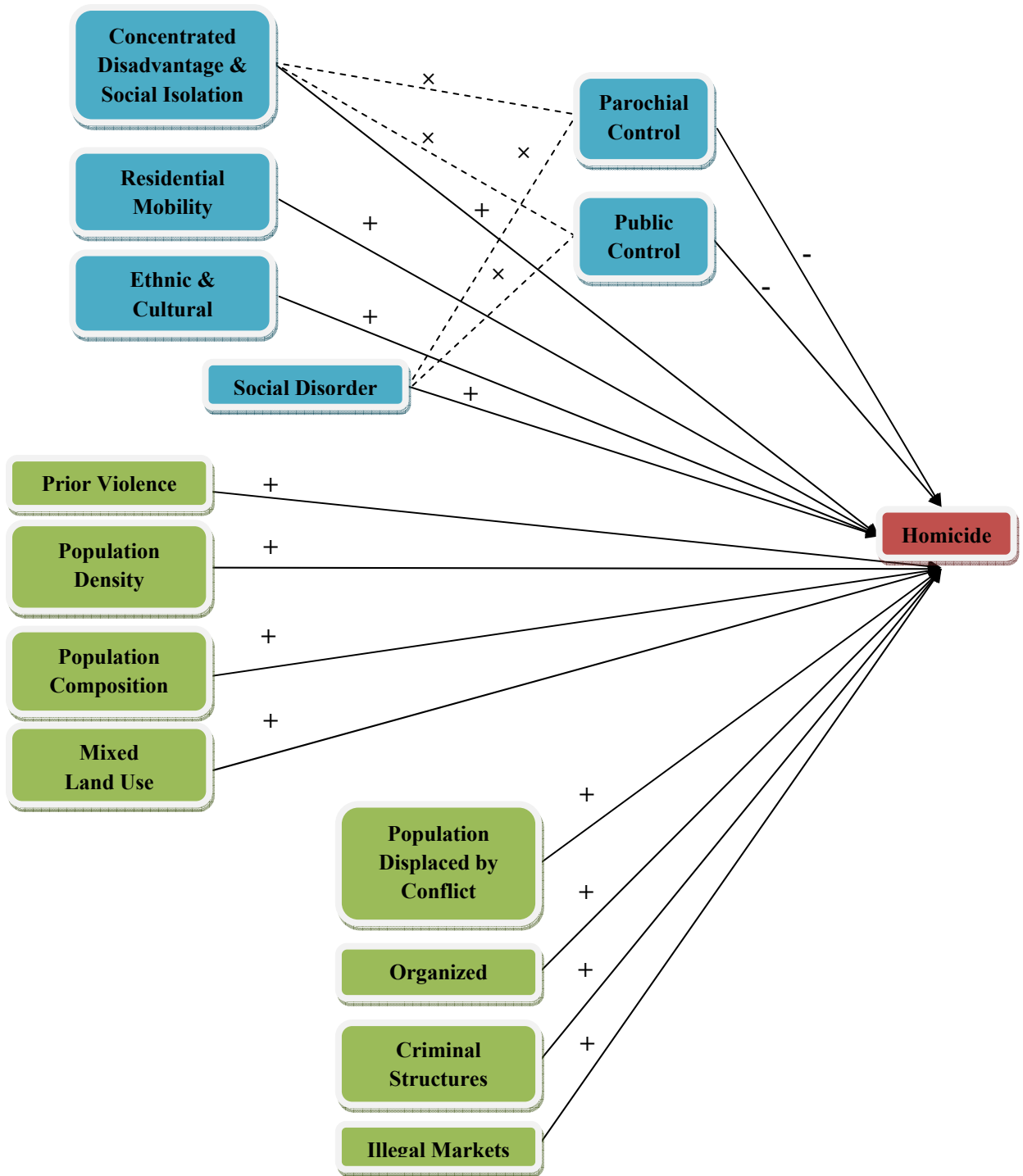
CHAPTER 2. BACKGROUND AND RELEVANCE

2.1.Social Disorganization: The Classic Approach

At the turn of the 20th century, the field of criminology was dominated by theories that placed the source of crime within the individual and encouraged the incapacitation of criminals as the only way to guarantee public safety. These theories were influenced by 19th century thinkers such as the Italian physician Lombroso who argued that criminals were different from normal people in their biological make up. In other words, contrary to what Beccaria and the Classical School had proposed a century earlier, criminals could not make a rational decision to engage in crime simply because they were born deviants and did not have a choice in the matter.

Simultaneously, large cities in the United States were experiencing massive transformations caused by the industrialization process, and the ensuing transition from an agriculture-based to a manufacturing-centered economy. Most notably, millions of people from depressed rural areas all over the country and the world migrated into industrial cities like Chicago and New York attracted by the possibility of finding work and a better quality of life. In fact, Cullen and Agnew (2011) note that when Chicago was incorporated into the United States in 1837 it had a population of just over 4,000, and less than a century later the city had grown to have two million residents. Cities were fundamentally unprepared to deal with this rapid population growth, and could not offer suitable housing options to the constant influx of new immigrants that arrived every year. In view of this, immigrant workers and their families tended to settle in rundown tenements in the downtown areas of the cities were factories concentrated.

During the 1920s, urban sociologists from the University of Chicago noticed that the very poor social conditions that characterized these neighborhoods seemed to be connected to the crime rate upsurge experienced in that city since the late 1800s. Community attributes, they

hypothesized, not individual traits must be responsible for delinquent and criminal behaviors. This basic hypothesis opened the door to the notion of studying human behavior as a process of adaptation to the environment (McKenzie 1967[1925]), thus giving birth to the human ecology school. Park (1967[1925]) argued that urban crowding, the division of labor, and residential mobility undermined the ability of families, neighborhoods, and local communities to exercise social control over children and teenagers. In a similar vein, Burgess (1984[1925]) agreed that residential mobility and rapid population growth, caused by the influx of people from different backgrounds, made it difficult for residents of decaying areas to agree and organize around the same values and goals. As a consequence, these communities experienced a number of social maladies including disease, vice, crime, mental health problems, and immorality, which Burgess (1984[1925]) considered to be rough indicators of social disorganization.

A decade later, Burgess' student Clifford R. Shaw and his colleague Henry D. McKay conducted a seminal ecological study of delinquency in Chicago. Shaw and McKay (2011[1942]) mapped the addresses of delinquents referred to juvenile court between 1900 and 1933 and then computed delinquency rates by census tracts and city zones. They found that the juvenile delinquency rates in Chicago's neighborhoods varied from one zone to the next, but, at the same time, they were quite stable over time. Based on their research, they concluded that the differences in delinquency rates were related to the stability and affluence of a neighborhood. In this way, neighborhoods with high concentrations of poverty, where neighbors did not share the same set of values (heterogeneity), and where the residents tended to be residentially transient (mobility) were characterized by Shaw and McKay (2011[1942]) as socially disorganized. According to these authors, socially disorganized communities suffer from a breakdown in their social institutions (e.g., families, churches, schools), which in turn hinders their ability to

exercise informal social control over youth and prevent the emergence of moral values that compete with traditional norms with regards to child rearing and law abiding behavior. They argue that, even though mainstream values may still be endorsed by most members in these communities, the conditions of poverty drive them to be more tolerant of illegal behaviors, especially when the fruits of crime help sustain their families, eliciting a culture attenuation process (Kornhauser 1978).

In these environments, children are exposed to criminal role models who are appealing to them because they seem to have become more successful financially than traditional non-deviant models. This exposure increases the chances of children learning the know-how of crime and engaging in delinquent behaviors at an early age. Children in affluent, low-crime communities, on the other hand, may know of the existence of these criminal subcultures but since they are not in direct contact with criminal role models, they do not fall prey to their deviant values. Finally, Shaw and McKay (2011[1942]) argue that the very presence of conflicting systems of values and high residential mobility, as Burgess (1984[1925]) suggested, thwarts the ability of residents of socially disorganized neighborhoods to form a uniform opinion about problems of common interest and reach agreements about possible collective solutions.

Shaw and McKay were criticized for not clearly elaborating the process by which social disorganization develops and for failing to define the mediating elements between the proximate causes of disorganization and delinquency. In other words, Shaw and McKay assumed that the mere presence of poverty, mobility, and heterogeneity indicated that a community was disorganized but they did not directly measure community organization (Kornhauser 1978; Kubrin, Stucky & Krohn 2009). In addition, the early tests of the theory tended to confound the causes of social disorganization with its effects by proposing that high delinquency rates were an

indicator of disorganization, and then employing disorganization to predict delinquency rates (Cullen & Agnew 2011; Kornhauser 1978; Kubrin et al. 2009).

Furthermore, as it will be discussed later, the classic social disorganization approach focused only on the internal dynamics of communities, ignoring larger political and economic processes that influence neighborhood life (Heitgerd & Bursik 1987; Kubrin et al. 2009). Finally, critics also felt uncomfortable with the suggestion that slum life equated disorganization. Indeed, Shaw and McKay were accused by liberal academics of middle-class moralizing, and by conservative scholars of being willfully blind to the inherently vicious characteristics of slum dwellers (Kornhauser 1978).

Shaw and McKay's social disorganization theory is considered to be one of the most influential criminological theories in the history of the field (Kubrin et al. 2009). Indeed, the theory informed public programs aimed at preventing delinquency by improving neighborhood conditions and offering options to disadvantaged youth (e.g., the Chicago Area Projects), and it also influenced the development of two other prominent criminological schools (i.e. social learning and social control). Nonetheless, the theory fell out favor by the mid 1950s due largely to the little support found for the effect of socio-economic status on delinquency by several studies fraught with methodological problems. Indeed, Kornhauser (1978) criticizes these studies in several dimensions: (1) inclusion of highly correlated and redundant predictors in the models causing multicollinearity and singularity issues that made the estimates unreliable; (2) poorly defined independent variables—in particular SES—and dependent variables—in particular when delinquency was measured through self-report; (3) use of small study sites with very low variability in terms of SES and delinquency; (4) high reliance on school samples, which were not representative of dropout and truant populations usually more likely to engage in delinquency;

(5) high reliance on White samples thus excluding minorities who suffered of the most extreme levels of poverty; and (6) disregard of the ecological fallacy by assigning community income characteristics to individuals, thus reducing individual level variability.

In this way, ecological theories of crime did not receive much attention between the 1950s and 1980s, while the focus of the field turned to micro-level explanations, most prominently social learning and social control. The 1970s, however, saw a revival in the interest to understand social networks, which in turn influenced a number of criminologists to revisit and revise social disorganization theory in the 1980s.

2.2. The Ecology of Crime: The Systemic Approach

The notion of a systemic approach was first put forward by Kasarda and Janowitz (1974) who proposed that local communities are complex systems of "friendship and kinship networks and formal and informal associational ties rooted in family life and on-going socialization processes. At the same time [they are] fashioned by the large scale institution of mass society" (p. 329). Using a survey from the Royal Commission on Local Government in England, these authors found that residents' engagement in community affairs increased with their social status, and with length of residence (Kasarda & Janowitz 1974; see also Berry & Kasarda 1977). This study granted renewed support for Shaw and McKay's hypothesis regarding the importance of residential stability in the generation of social organization.

Furthermore, Granovetter's (1973) social networks research concluded that social ties that are peripheral to the core of the network (also described as weak ties) are extremely important because it is through these links that communities can gain access to needed resources that would not be available otherwise. In other words, weak ties connect a social network to the outside world and allow it to become an integral part of the more complex urban system.

These studies helped spur a revival of the ecological approach to community organization and crime, emphasizing that it is through complex networks of association that a neighborhood's ability to regulate behavior becomes a reality (Bursik & Grasmick 1995).

Nonetheless, the social networks research of the 1970s prompted a slow reaction from the criminological community. In 1982 two pieces encouraged the final step towards the development of the new ecological theories of crime. On the one hand, Bursik and Webb (1982) published an article reporting the results of a study employing the concept of human ecology to look at the effect of community changes on delinquency in Chicago[2]. They found that rapid social change affects a community's social networks and institutions in such a way that their ability to exercise control over youth may be impaired and, therefore, make delinquency more likely. The second influential publication presented the results of a study assessing the effects of inequality on violent crime in large metropolitan areas of the United States (Blau & Blau 1982). The Blaus found general (including income) and racial inequalities to be positively related to violent crime, even after controlling for poverty. According to these authors, relative deprivation produces "social disorganization and discontent which find expression in frequent nonrealistic conflict and criminal violence" (Blau & Blau, 1982:122).

The findings from these two studies inspired a new generation of criminologists to focus on the macro-level predictors of crime. In 1986 Albert Reiss Jr. and Michael Tonry published the volume *Communities and Crime* compiling several studies espousing this new ecological approach. Moreover, Sampson and Groves (1989) conducted a study using the British Crime Survey that tested for the first time the dimensions that mediate social structure and social organization. Indeed, these authors conceptualized social organization using direct measures of

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[2] In fact, Bursik and Webb used Shaw and McKay's data and complemented it with data from the 1950s, 1960s, and 1970s.

local friendship networks, local participation in formal and voluntary organizations, and the ability to supervise and control groups of teenagers, thus proposing an empirical solution to one of the main criticisms of Shaw and McKay's theory. Their results showed that these three dimensions mediated over half of the effects of socio-structural factors (socio-economic status, mobility, and heterogeneity) on criminal victimization.

Taylor (1997) summarizes the ecological approach in five principles: (1) Neighborhoods are human habitats different from one another in their physical and socio-structural characteristics; (2) residents are attached to and dependent on their neighborhoods, this attachment is influenced by and in turn shapes local behavioral patterns, social dynamics, and cognitive mapping strategies; (3) communities are interdependent and are influenced by events occurring in adjoining neighborhoods; (4) communities compete with one another for access to resources and services, and their socio-structural characteristics may determine whether they receive more public services than do others; and (5) populations in a location can change over time in invasion-succession processes by which new occupants replace long-term residents, tipping the internal balance of social control towards a lowered ability to regulate behavior.

In this way, the ecological framework focuses on the characteristics of communities, not individuals, or what Bursik and Grasmick (1993a) call emergent properties:

> The relational networks associated with the control of crime within a
> neighborhood, the viability of local neighborhood organizations as agencies of
> formal and informal social control, the linkages between these organizations, the
> political power base of the neighborhood, and the relationship of the local
> community to the wider urban context are all prime examples of emergent
> properties (p. 27).

In sum, ecological theories propose that neighborhoods are dynamic entities that change over time; that these changes may affect their social control capabilities; and that associational networks, internal and external institutions, and surrounding communities all affect a neighborhood's ability to regulate behavior and control crime within its borders. In other words, as suggested by Sampson and Wilson (1993), communities are cognitive landscapes where standards and expectations of behavior are developed and transmitted. Thus, in communities where socio-structural conditions of disadvantage prevail, alternative value systems emerge "in which crime, disorder, and drug use are less than fervently condemned and hence expected as part of everyday life. These ecologically social perceptions and tolerances in turn appear to influence the probability of criminal outcomes and harmful deviant behavior" (Sampson & Wilson, 1993:50).

2.3. Socio-structural Predictors of Crime: What is the Evidence?

The ecological literature hypothesizes that socio-structural factors such as concentrated disadvantage, residential mobility, ethnic and cultural heterogeneity, institutional weakness, mutual distrust, civic engagement, social support, population structure (size and density), population composition (age and gender), and culture (location in Southern state), affect crime rates at different levels of analysis in the United States.

In a comprehensive meta-analysis of 214 quantitative studies reviewing macro-level predictors of crime, Pratt and Cullen (2005) observed that the effect size and direction of many of the socio-structural predictors listed above were not consistent across studies. Controlling for units of analysis, model specification, research design, sample size, and dependent variable, Pratt and Cullen (2005) found that percent nonwhite, incarceration rate, percent black, family disruption, and poverty are the strongest and most stable macro-level predictors of crime, and

warn that studies failing to control for their effects run a high risk of misspecification. This section summarizes the research on socio-structural predictors of crime focusing on those that have received the most support in the literature and that will be central to this study's exploration of the relationship between social disorganization and homicide in a Latin American context.

2.3.1. Concentrated Disadvantage

Concentrated disadvantage has generally been defined as the spatial concentration of poverty and other disadvantages, such as unemployment and family disruption, in a confined number of neighborhoods within a city (Krivo, Peterson, Rizzo & Reynolds 1998). Furthermore, given that, as argued by Wilson (1987, 1991-1992), the structural changes resulting from the urban policies implemented after World War II led to a higher concentration of negative outcomes in African American communities, most scholars have also included a measure of racial heterogeneity in their concentrated disadvantage indexes.

Concentrated disadvantage has been hypothesized to foster social disorganization and the consequent likelihood of crime. Indeed, the high concentration of unemployment in the inner-city reduces the amount of positive adult models, and diminishes the availability of potential links to employment for youth. Thus, the intergenerational flow of mainstream values is obstructed in these neighborhoods, whose residents end up putting "a premium on male aggressiveness as a means of dealing with limited opportunity and of providing a social identity" (McGahey 1986:252).

Additionally, the concentration of female-headed households with children and high divorce rates also reduces a community's ability to supervise its young primarily because the ratio of children in need of supervision to supervising adults is much higher than in more privileged communities (Krivo et al. 1998). Moreover, the compounded effect of disadvantage

and high crime and delinquency rates further promotes instability and decay in these neighborhoods (Reiss 1986). This process ultimately undermines the strength of the neighborhood's social ties and institutions, harming their political base and their ability to converse with local bureaucracies to guarantee a fair distribution of resources and public services (Tripplet, Gainey & Sun 2003).

Ecological studies have provided evidence that economic deprivation has a direct positive effect on delinquency rates (Bursik & Grasmick 1993b), and that family disruption is a strong predictor of juvenile group offending (Sampson 1986). In fact, as mentioned earlier, Pratt and Cullen (2005) found that concentrated disadvantage indicators (racial heterogeneity, poverty, and family disruption) are among the strongest and most stable macro-level predictors of crime. In general, the concentrated disadvantage index has been found to (1) increase the likelihood of neighborhood delinquency and violence rates (Fagan & Davies 2004; Kane 2005); (2) decrease positive perceptions of the quality of police services, perceptions of residents willingness to cooperate with the police, and general satisfaction with the police (Reisig & Park 2000; Triplett, Sun & Gainey 2005); and (3) increase the likelihood of police misconduct (Kane 2005), in urban settings in the United States.

However, recent studies (see Cerdá et al. 2008; Villareal & Silva 2006) suggest that the effects of disadvantage on crime may be different in Latin America's urban centers because of the way low-income settlements developed in those cities. Indeed, since the 1930s a succession of economic crises affecting the agricultural sector, and the advent in some Latin American countries, such as Colombia, of conflicts between state and irregular forces produced several migration waves from rural areas into the major cities of those countries. Unlike in the United States where immigrants settled in the industrial heart of large cities, in Latin America rural

migrants tended to settle in the outskirts of urban areas. Villareal and Silva (2006) argue that the residents of these improvised settlements—many of which still do not receive basic public services such as potable water, electricity, and sewerage today—were highly dependent on each other to survive, generating dense social networks in these disadvantaged neighborhoods.

In a similar vein, Cerdá et al. (2008) contend that these processes "combined with the subsequent need to fight for possession of illegally occupied lands and to get access to water, meant that many poor neighborhoods in Medellin became highly socially organized" (p. 8). Nonetheless, these neighborhoods still tend to have relatively high rates of violent crime. In fact, Villareal and Silva (2006) and Cerdá et al. (2008) found social cohesion and collective efficacy respectively to be positively associated with disadvantage, disorder, and violence.

In sum, communities in differing social and cultural contexts may resort to different strategies to cope with conditions of concentrated disadvantage. However, neighborhood disadvantage does seem to increase the chances that a community will experience higher levels of crime and disorder than its wealthier counterparts, regardless of the cultural context.

2.3.2. Residential Mobility

Burgess (1984[1925]) hypothesized that cities grow in a series of concentric circles around the industrial district, or loop, where the jobs that unskilled immigrants could perform were located. The second circle represented the transition zone where newcomers settled due to its proximity to factory jobs and cheap housing. The following three circles: the zone of workingmen's homes, the residential zone, and the commuter's zone, were inhabited by people who had adjusted to city life. Burgess (1984[1925]) argued that the zone in transition was the most problematic in terms of disease, disorder, immorality, and crime precisely because its

residents did not feel attached to their neighborhoods and lived in terms of achieving the ultimate place of residence outside of it.

Shaw and McKay (2011[1942]) further developed the idea that residential mobility was an indicator of social disorganization because it was a sign that people were not content with the conditions in their neighborhood. Furthermore, residential mobility increases the likelihood of delinquency and crime because it takes time to establish the social ties needed to exercise social control within a community. Thus, when people are constantly moving in and out of a neighborhood, residents do not have the time to build meaningful and trustful relationships. The inverse of residential mobility, residential stability, allows the neighborhood as a social system to reproduce itself (Skogan 1986). In other words, residential stability facilitates the intergenerational transmission of mainstream values and the consequent creation of social networks that provide the new generations with opportunities to maintain or improve their social status. In addition, residential stability increases residents' stake in the community, thus promoting their participation in the establishment of common goals and the solution of collective problems. In fact, Kasarda and Janowitz (1974) found that residential stability was a stronger predictor of community participation than population structure (size and density).

The literature shows that residential mobility, generally measured as the percent of people—five-years old and older—who have changed residence in the prior five years, is negatively related to social cohesion and community satisfaction (Sampson 1991); and positively related to disadvantage (Taylor 2001a), delinquency rates (Bursik 1986; Bursik & Webb 1982), and violent crime (Kane 2005).

2.3.3. Social Disorder

Skogan (1999) defines disorder as a violation of tacitly agreed upon norms of public behavior. According to this author, the concept of disorder serves to classify a wide range of neighborhood problems into two broad categories: (1) physical disorder is evidenced by the presence of junk and trash, decaying and boarded-up buildings, vandalism and graffiti, and stripped and abandoned cars in the streets and alleys; and (2) social disorder which is indicated by the presence of bands of teenagers congregating on street corners, prostitutes and panhandlers, public drinking, verbal harassment of women on the street, and open gambling and drug use. In this way, visible social disorder is an indicator of community disorganization because it shows the residents' lack of commitment to collectively work on the solution of common problems (Skogan 1990). In addition, Bursik and Grasmick (1995) add that, insofar as social disorder affects collective action, it reduces a community's regulatory capacities and it also decreases its ability to bring in external resources to prevent further deterioration. Furthermore, Wilson and Kelling (1982) argue that untended signs of disorder lead a community into a spiral-down of decay, atomizing residents who start refraining from engaging in collective activities for fear of crime and "inviting" criminals to take over control of the neighborhood.

Social disorder has been shown to (1) mediate the effect of socio-structural factors on crime (Taylor 2001a); and (2) indirectly affect crime rates by decreasing the levels of neighborhood interaction and mutual trust (Snell 2001) in the United States. Sampson and Raudenbush (2001), on the other hand, consider that disorder, as much as crime, is an effect of social disorganization rather than an indicator, and that the only difference lies in the levels of perceived seriousness (see also Sampson 2002a).

2.4. Ecological Predictors of Homicides: Evidence from Previous Research

The foregoing discussion suggests that ecological attributes of communities have consistently proven useful in understanding and predicting disorder, delinquency and crime. Moreover, a great deal of research on the ecology of crime has used homicide as the dependent variable because of its rather high reliability and low levels of under-reporting. Additionally, it has been observed that the distribution of homicides presents spatial patterns of concentration and diffusion that seem to make it amenable to the ecological approach (Cohen & Tita 1999; Fagan & Davies 2004; Fagan, Wilkinson & Davies 2007; Kubrin & Weitzer 2003b; Mears & Bhati 2006; Sampson 2003).

In their review of the homicide literature, Land, McCall and Cohen (1990) found inconsistencies across studies in the effects of known covariates of crime on homicide rates. These authors estimated a model controlling for time period, unit of analysis, sample size, and model specification, and found that three structural indexes—population structure, concentrated disadvantage, and percentage of the male population divorced—consistently predicted homicide rates in the expected positive direction. Indeed, these findings suggest that homicides present spatial patterns that overlap with those of socio-structural characteristics of geographic areas. This section summarizes previous research findings regarding the effect of ecological factors on homicide.

2.4.1. Concentrated Disadvantage and Homicide

The homicide literature shows that the concentrated disadvantage index—and the indicators that compose it—is one of the most consistent predictors of violence and homicides. Indeed, as first established by Land and colleagues (1990), research on homicide in the United States continues to find that population structure, divorce rates, income and racial inequality,

poverty, and concentrated disadvantage positively predict higher levels of homicide (Baller, Anselin, Messner, Deane & Hawkins 2001; Kubrin & Weitzer 2003b; Lee & Bartkowski 2004; Pridemore 2002; Rosenfeld et al. 2001; Sampson 1986; Stretesky, Schuck & Hogan 2007).

Cross-national studies of homicide rates, on the other hand, have found that high levels of income inequality, unemployment, and poverty; and low rates of Gross Domestic Product growth and development predict higher levels of homicides at the national level as well (Fajnzylber, Lederman & Loayza 2002; Messner, Raffalovich & Shrock 2002; Pratt & Godsey 2003; Pridemore 2008). These findings indicate that some concentrated disadvantage factors may be associated to homicide in other countries as well. However, cross-national studies do not allow making conclusions about the ecological dynamics of homicide in other nations, basically because the high level of aggregation employed precludes an examination of the internal variation of these phenomena.

How does concentrated disadvantage increase the likelihood of homicides? As noted earlier, concentrated disadvantage minimizes social advancement opportunities, cutting the links to mainstream society, and hindering the generational transmission of mainstream values. In addition, families and other social institutions see their ability to regulate the behavior of children reduced by the constant demand to provide for their wellbeing with very scarce social and economic resources. Under these conditions, residents of disadvantaged neighborhoods resort to alternative solutions to the social advancement problem, some of which involve engaging in illegal activities.

Furthermore, the illegal nature of these alternatives implies that those who engage in them must compete among themselves to gain the control of markets and places. This competition tends not to occur in amicable conditions, normalizing the use of violence to secure

a more or less stable position within these systems. Fagan and Davies (2004), for instance, found that the likelihood of violence and homicides in New York City was higher in "ecological context[s] of weak social control, poorly supervised adolescent networks, active illegal markets where violence is the primary regulatory device, widespread perceptions of danger and the demand for lethal weapons, and the attenuation of outlets to resolve disputes without violence" (p. 132). Even more, Lee and Bartkowski (2004) found that concentrated disadvantage has a stronger effect on juvenile than on adult homicide rates; and Kubrin and Weitzer's (2003b) results show "that neighborhoods with higher levels of concentrated disadvantage are *especially* likely to experience greater numbers of retaliatory than non-retaliatory killings" (p. 169 – emphasis in original).

These findings support the idea that concentrated disadvantage promotes a normalization of violent responses to daily problems among youth in deprived communities. In addition, the detrimental effects of concentrated disadvantage may also spread to neighboring areas by increasing their incidence of violent events, independent of their own socio-structural conditions (Mears & Bhati 2006).

In sum, perhaps the most deleterious byproduct of concentrated levels of economic, social, and cultural disadvantage in urban areas is the attenuation of mainstream cultural values (Kornhauser 1978; Warner 2003) that protect a community from the spread of deviance and violence.

2.4.2. Parochial Control and Homicide

Parochial control (also found in the literature as civic engagement) primarily represents the extent to which a community gets involved in public affairs of interest to its membership. Community members can either get involved directly through participation in voluntary

organizations, or indirectly through the exercise of their democratic rights (i.e. electoral participation and attendance to public meetings).

The available research offers mixed results in terms of the effects of parochial control on homicide. Most of the studies reviewed did not find a significant effect of civic engagement on homicide (Galea, Karpati & Kennedy 2002; Kennedy, Kawachi, Prothrow-Stith, Lochner & Gupta 1998; Lederman, Loayza & Menendez 2002; Messner, Baumer & Rosenfeld 2004; Rosenfeld et al. 2001; Rosenfeld et al. 2007; Sampson et al. 1997). However, Lee and Bartkowski (2004) found that religious civic engagement decreased juvenile homicide rates, while secular civic participation (electoral participation, and membership in social and civic organizations) reduced the likelihood of adult homicides. In addition, Lee and Ousey (2005) found that parochial control is of particular importance for African American communities. Indeed, their results show that "in urban areas where Blacks have greater access to social and civic organizations, Black homicide rates are lower" (p. 42).

Messner and colleagues (2004), on the other hand, found that neighborhoods with higher levels of community and political activism tend to present higher levels of homicide. In fact, Latorre (2004) found a similar association between social capital (measured as participation in voluntary organizations and support for community participation as a strategy to reduce crime) and violence in Colombia. These results counter the expectations of both social capital and ecological theories. The interpretation provided by these authors posits the possibility of a reciprocal relationship by which high homicide rates prompt residents to increase their participation in community and political affairs, in search of a solution to the violence levels they are experiencing.

On the whole, though, despite theoretically identifying civic engagement or parochial control as a community attribute with potentially important effects in preventing homicide, the literature is not conclusive about this matter. These findings somewhat undermine the support for ecological theories of homicide insofar as participation in local affairs is considered to be a measure of social organization and assumed to moderate the relationship between disadvantage and homicide.

2.4.3. Illegal Markets and Homicide

Finally, the homicide literature finds a clear relationship between illegal markets and homicide at the neighborhood level. Although both illegal markets and homicide are in fact outcomes of social disorganization, it is important to account for the role of illegal markets in the geographic escalation and diffusion of violence and homicide.

As mentioned earlier, conditions of disorganization and disadvantage foster an attenuation of mainstream values and increase the likelihood of community members to engage in illegal activities, among which drug dealing is usually the most prominently preferred. Success in these extremely competitive markets is dependent upon its agents' ability to effectively use the threat of violence as a means to gain monopolistic control over both suppliers and consumers. Fagan, Wilkinson and Davies (2007) summarize the complex processes by which illegal markets escalate neighborhood violence as follows:

> Several processes have contributed to the epidemic of lethal violence. The growth in illegal markets heightens the demand for guns as basic tools that are associated with routine business activity in illegal markets. In turn, the increased presence of weapons and their diffusion into the general population change normative perceptions of the danger and lethality associated with everyday interpersonal disputes, giving rise to an "ecology of danger". Thus, we

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hypothesize that guns were initially an exogenous factor in launching an epidemic of gun violence, but became endogenous to socially isolated neighborhoods and came to dominate social interactions. Everyday disputes, whether personal insults or retributional violence, in turn are more likely to be settled with potentially lethal violence (p. 692).

In a similar vein, in a longitudinal study of homicide rates and drug markets in 132 U.S. cities, Ousey and Lee (2007) found that drug markets were positively related to within-city changes (1984-2000) in the homicide rates, a relationship that remained significant even after introducing formal social control variables. Moreover, these authors found a significant interaction effect of structural disadvantage and drug markets by which the former increases the positive effect of the latter on homicide rates.

2.5. The Systemic Model of Crime Control

The classic social disorganization approach focused primarily on the socio-structural characteristics of neighborhoods, and assumed they had a specific effect on the ability of residents to build internal systems of informal social control. Furthermore, modern revisions of the theory propose that the ability of a community to exercise social control depends primarily on their levels of mutual trust and solidarity, and on their willingness to intervene in community affairs for the collective good (Sampson et al. 1997). However, one of the shortcomings of this collective efficacy approach is that it ignores the external political and economic processes and decisions that affect a neighborhood's actual ability to intervene (Heitgerd & Bursik 1987). As a matter of fact, Bursik and Grasmick (1993a, 1995) criticized Shaw and McKay's model because it failed to explain the existence of neighborhoods with dense internal networks that have persistently high rates of delinquency nonetheless (see also Browning 2009; Patillo 1998). They

argue that a neighborhood's capacity to regulate the nature of activities that take place within its borders also depends on effectively generating ties with external entities that can bind them into the broader ecological structure of the city. In other words, Bursik and Grasmick (1993a) propose that a neighborhood's capacity to exercise social control depends on the structure of *both* informal *and* formal associational networks that connect residents together as a community.

Drawing on Hunter's (1985) work, Bursik and Grasmick (1993a, 1993b, 1995) propose a systemic approach to crime control that provides an understanding of the complex role that associational networks play in regulating behavior at the neighborhood level. This Systemic Model sets forth three interconnected types of community social control. *Private* social control is that which is expressed in intimate social groups (i.e. family, friends, and neighbors), is exercised through social approval or disapproval, and tends to be more effective with adolescents than with adults. *Parochial* social control involves broader local interpersonal networks and institutions such as parent-teacher associations, churches, voluntary organizations, and stores. However, control at this level is mediated by external contingencies. Those externalities are administered at the *public* level of control, which represents a community's ability to secure resources that are managed and distributed by external agencies such as policing, health, education, infrastructure, garbage collection, and other public services and private businesses.

There is a plethora of research within the ecological tradition that focuses on the effects of informal social control—embedded in private and parochial social networks—on crime, delinquency, victimization, fear of crime, and social disorder. There is in fact widespread agreement that dense private ties produce higher levels of social cohesion (Gibson, Zhao, Lovrich & Gaffney 2002; Sampson 1991; Sampson, Morenoff & Earls 1999), and that higher levels of social cohesion in turn predict higher levels of community involvement and lower

levels of deviant behaviors (Bellair 1997; Carr 2003; Lee & Bartkowski 2004; Pattavina, Byrne & Garcia 2006; Rosenfeld et al. 2001; Rosenfeld et al. 2007; Saegert et al. 2002; Saegert & Winkel 2004; Sampson & Groves 1989; Sampson et al. 1997; Sampson & Raudenbush 1999; Simonset al. 2005; Skogan 1986; Snell 2001; Taylor 2001b; Velez 2001).

Nevertheless, current social disorganization researchers emphasize that the existence of dense social networks is a necessary, but not a sufficient condition for the exercise of effective systemic social control, and that ties to external entities are needed to achieve that end (Browning 2009; Bursik 1999; Kubrin & Weitzer 2003a; Lee & Ousey 2005; Sampson et al. 1997; Sampson 2002b; Stucky 2003).

Even though it has been recognized that linking private and parochial networks to the public level is essential to achieving effective social control, there has been only a handful of studies in the United States, and practically none in the international context, that examine the effects of the public level of control on crime rates. The limited evidence from the United States, however, suggests that those communities that are not effective in reaching out to external agencies and thus fail to acquire needed services and resources are more likely to have higher rates of crime, delinquency, and victimization than those that are successful in doing so (Belnar et al. 2008; Carr 2003; Pattavina et al. 2006; Stucky 2003; Taylor 2001a; Velez 2001). In addition, the available research suggests that the negative effect of public control (Velez 2001) and access to social institutions (Lee & Ousey 2005) on crime varies across ecological units and moderates the effect of disadvantage and social isolation.

2.5.1. The Public Level of Control

> People know if a city cares for them or not. A playground is a lot more than a playground. A little vest-pocket park is a little more than a little bit of green: it's a sign that the city cares, that it's willing to devote something to your neighborhood.
>
> Robert A. Caro
> *New York: A Documentary Film, Episode Six: City of Tomorrow* (Burns 2001)

Insofar as it reflects a neighborhood's ability to influence decision-making processes about political and economic issues that may affect local quality of life and its capacity to acquire resources and services allocated by external entities, the public level of control determines the degree to which a community is capable of effectively exercising social control (Bursik & Grasmick 1993a). Moreover, public resources are often limited and, given that communities within large urban areas depend greatly on external means to deal with crime (Reiss 1986), neighborhoods must compete with each other to secure public services. In fact, as suggested by Sampson (2002b), even culturally diverse communities can agree on common goals such as public safety. What provokes conflict and undermines social control, then, is not necessarily cultural diversity but the unequal distribution of resources across communities. In this way, the systemic model assumes that crime will be more likely in those areas where "the networks of public control cannot effectively provide services to the neighborhood" (Bursik & Grasmick, 1993b:279).

Furthermore, Velez (2001) found that the effect of neighborhood disadvantage on personal victimization was moderated by public control. In other words, through strong connections to city officials and the police, neighborhoods can secure the appropriate resources to reduce the risk of victimization, even in conditions of concentrated disadvantage. In fact, Velez (2001) observed that the effect of public control on victimization was more pronounced in highly and extremely disadvantaged neighborhoods and less effective in reducing victimization

in neighborhoods with lower levels of disadvantage. This finding suggests that public control may have an empowering effect in disadvantaged communities. Similarly, Stucky (2003) found that city public spending per resident had a negative effect on violent crime rates. In addition, he also observed that the number of representation-enhancing local political structures—arguably a proxy for public control—weakened the effects of poverty, unemployment, marital disruption, and homeownership on violent crime. In addition, Belnar and colleagues (2008) found that the availability of organizations and services at the neighborhood level reduced aggressive behavior among youth, and it reinforced the positive effects of pro-social peers.

In sum, the scant research shows support for a negative effect of the public level of control on violent behavior. Not only that, the literature also suggests that residents of urban areas are in fact more likely to call the police to solve community problems than to directly intervene. In other words, there is some evidence that contemporary city dwellers in the United States prefer to activate the public level of control when the public peace is disturbed than to directly exercise informal social control and intervene to restore it (see Carr 2003; Pattavina et al. 2006; Warner 2007).

2.5.2. Public Control and Police-Community Partnerships

Bursik and Grasmick (1995) propose that police-community partnerships represent the most obvious dimension of public control. As a matter of fact, they argue, even the most basic of interactions between the community and the police—calls for service—seems to be associated to the development of neighborhood links to the political structure of the city. Indeed, urban policing is also contingent upon the ecological structure of a city, and there are in fact marked differences in the way neighborhoods are policed across and within cities (Sherman 1986). For instance, research has shown that police departments are more inclined to make certain police

resources more readily available in affluent neighborhoods than in underprivileged areas, primarily because these communities tend to have a stronger power base and can therefore influence local politicians with more ease than their more disadvantaged counterparts (Sherman 1986).

On the other hand, Smith (1986) argues that police also make resource allocation and patrol decisions based on their ecological understanding of the city. In their daily patrols, police officers may assign their perceptions of the ecological characteristics of a location (dangerous and crime-ridden or quiet and safe) to all the persons encountered in those areas, which will ultimately affect their interactions with citizens accordingly. Extrapolating this dynamic to the allocation of police services, police departments may over- or under-estimate (depending on the case) the real needs for services in a neighborhood.

The processes noted by Sherman (1986) and Smith (1986) are crucial to understanding the public level of control as they might influence the way by which a community is policed and the types of resources allocated by police departments, on the one hand, and the willingness of residents to work in tandem with the police in the control of crime, on the other.

Now, the willingness of residents to engage in joint actions with the police to control crime in their neighborhoods is extremely reliant on conditions of mutual trust. In other words, successful police-community partnerships require that police officers and residents perceive each other as trustworthy and fair. Triplett, Sun, and Gainey (2005) found that willingness to cooperate with the police was increased by neighborhood perceived levels of (1) police legitimacy; (2) quantity of police services; and (3) quality of police services. Residents of disadvantaged minority neighborhoods have been found to have lower levels of trust in the police (MacDonald & Stokes 2006) and to be more likely to have negative dispositions toward

them (Carr, Napolitano & Keating 2007). In fact, Carr and his colleagues observed an overlap between those who had a negative disposition toward the police and those who had had a direct interaction with law enforcement. This finding suggests that disadvantaged communities, which tend to be over-policed due to a heightened perception of them as being crime prone and dangerous (low-quality policing), are less likely to consider the police as allies in the exercise of systemic social control. Police-community partnerships, and by extension public control, are extremely hard, but not impossible, to achieve under these conditions.

Likewise, Warner (2007) hypothesized that when residents perceive the police as ineffective and unresponsive they may be less likely to intervene in any way to control inappropriate neighborhood behaviors. On the one hand, neighbors may feel that calling the police will serve no purpose and will not solve the problem, and, on the other, they may feel too vulnerable to intervene directly. Warner's (2007) actual findings showed that neighborhood disadvantage negatively predicted faith in the police, but faith in the police did not significantly predict the likelihood of intervening directly or calling the police to solve neighborhood disputes. Carr et al.'s (2007) additional findings may help explain these results. They observed that even when their respondents had negative dispositions toward the police, when asked what they would do to reduce crime and disorder the answer was, almost invariably, to improve law enforcement presence.

In short, even when negative attitudes toward the police are prevalent in disadvantaged neighborhoods, residents still consider police intervention as the best way of controlling crime and, thus, public control is still possible. In other words, communities notice and are sensitive to differences in the quality and quantity of police services across areas, which in turn affects their

perceptions of and willingness to cooperate with the police (Reisig & Park 2000; Triplett et al. 2005).

The police are thus not seen by disadvantaged communities as enemies per se but as potential allies were they willing to improve the quality of services provided in these neighborhoods. Thus public control through police-community partnerships may still be possible even under conditions of extreme disadvantage, but it will take more effort than in more stable communities. As a matter of fact, Velez (2001) found that increases in public control had a stronger negative effect over victimization in disadvantaged communities than in more affluent neighborhoods. In this sense, public control becomes an empowering force in these locations.

2.5.3. Public Control, Social Isolation, and Homicide

The social isolation literature provides an explanation of the process by which public control affects homicide at the neighborhood level. In his seminal work *The Truly Disadvantaged*, William Julius Wilson (1987) established the detrimental impact that post-World War II public policies had on urban minority communities, particularly African Americans, in the United States. Indeed, the combined effect of the relocation of the manufacturing industry to the suburbs, the building of expressways across neighborhoods, the redlining of minority neighborhoods by urban planners and bankers, and the relocation of minority communities into overcrowded, physically isolated housing projects disrupted community life drastically by undermining social ties and segregating these communities to areas with low or no opportunities for upward social and economic mobility. These political decisions, made in the name of progress and urban development, led to the social isolation of communities that lacked the political clout to stop these processes from threatening their stability.

Moreover, Wilson (1991-1992) argues that social isolation further deprives communities of links to the social networks, institutions and resources that facilitate the reproduction of mainstream values and socio-economic opportunities, thus promoting a higher tolerance of illegal activities among their residents. In fact, Cohen and Tita (1999) suggest that social and spatial isolation facilitated the explosion of violent crack markets in Black neighborhoods in urban areas of the United States during the late 1980s and early 1990s. Similarly, Shihadeh and Flynn (1996) found that in cities with high levels of Black isolation, "the rates of serious black violence are exceedingly high" (p. 1345).

Stated somewhat differently, social isolation unleashes a number of detrimental processes for communities, leading to their destabilization, fomenting social disorganization, and, consequently, weakening their ability to exercise social control at all levels, but especially at the public level. Indeed, social isolation produces a breakdown of the links that connect communities to sources of mainstream values (schools, churches, community organizations), of upward mobility opportunities (job markets), and of investment in the quality of life and safety of the neighborhood (public agencies, private businesses). Faced with extremely limited legitimate opportunities of gainful employment, and a sense that governments and mainstream society do not care for their fates, some residents in these areas will resort to illegal activities that may require the use of violence to be successful and profitable. In turn, in absence of the protective shield provided by the contact with mainstream values, other community members, particularly relatives who depend on the profits of crime for their daily survival, will be more tolerant of crime and violence in their neighborhoods.

Additionally, there is evidence that, under conditions of concentrated disadvantage and social isolation, neighborhood residents are less likely to belong to organizations, to participate

in politics, and to have contacts with public officials, while at the same time being more likely to be victims of a crime (Cohen & Dawson 1993; Shihadeh & Flynn 1996). In sum, as expressed by Fagan and Davies (2004), "social isolation suggests an ecological dynamic where the components of poverty, joblessness, and structural disadvantage are interconnected with the dynamics of social control and opportunity structures" (p. 132).

2.5.4. Public Control and Illegal Sources of Social Control

The review of the literature provided thus far in this chapter strongly supports the notion that the compounded effect of ecological factors such as concentrated disadvantage, social isolation, and social disorder increases the likelihood of a neighborhood having a higher incidence of crime and homicide. It has been argued that this occurs because the aforementioned conditions facilitate the attenuation of mainstream cultural values (Kornhauser 1978; Warner 2003) and increase the tolerance of residents toward illegal behavior. Cultural attenuation in turn makes the appearance and further consolidation of criminal groups, not just individual criminals, possible in these areas. The literature suggests that criminal groups may hinder social control and escalate violence in a neighborhood through at least two interconnected processes. The first process implies the infiltration and cooptation of local social networks to ensure control of the local illegal market. The second process involves criminal groups usurping some state functions aimed at (1) gaining the favor, support and tolerance of local residents; and (2) facilitating dealings with and reducing attacks from the state. In extreme cases, particularly when state presence is very weak, the second process may lead to a total impersonation of the state in these areas. This section will offer some evidence from the literature in regards to both social network infiltration and state functions usurpation.

2.5.4.1. Infiltration and Cooptation of Local Social Networks

As it was mentioned earlier, the classic social disorganization approach failed to explain the existence of places with dense social ties that nevertheless presented high rates of delinquency and crime. Recently, scholars have found that social networks are very complex and that strong ties may, in some cases, also lead to negative outcomes. In fact, Kubrin and Weitzer (2003a) explain that the consequences of social ties are actually dependent on the type of actors involved and their interests. For instance, Rubio (1997) argues that the strong networks of trust that have traditionally existed in the Antioquia region of Colombia, facilitated the consolidation of the Medellin drug cartel during the 1970s and 1980s. This infamous criminal organization took advantage of kin and friend networks to promote the criminal enterprise that would later permeate the whole of Colombian society. As a matter of fact, the initial exports of cocaine from Colombia to the United States were made using trust as currency instead of actual money.

Furthermore, several other criminal organizations in that country have employed this kinship and friendship structural scheme. To mention only a few: the Cali drug cartel—masterminded by the Rodriguez-Orejuela brothers—; the Ochoa family's drug trafficking clan; and the paramilitary militia (*Autodefensas Campesinas de Córdoba y Urabá*) created in the 1990s in the northwest of the country by the Castaño brothers—which would later become a national organization—all began as a family enterprise.

Thus, it can be argued that the first point of entry of criminal organizations into local social networks is through the cooptation of family and friends. According to Browning, Feinberg and Dietz (2004), dense ties and frequent contact among neighbors result "in more extensive integration of residents who participate in crime into existing community-based social networks" (p. 510). Hence, dense social ties may also lead to higher crime rates. In her

groundbreaking qualitative study of crime in a Black middle-class neighborhood in Chicago, Patillo (1998) found that deviant and non-deviant residents are bound to each other in a "system of interlocking networks … that sometimes paradoxically, and always precariously, keeps the peace" (p.748). Indeed, Patillo's (1998) findings concur with the attenuated culture argument (Kornhauser 1978) whereby criminals and responsible residents may agree on the goals, but differ in the strategies. She observed that neighborhood networks do not forbid residents from engaging in illegal behavior, but they do monitor gang activities and demand that they do not break tacitly agreed upon neighborhood norms of order. In turn, gangs and drug dealers may also become agents of social control in the neighborhood, by threatening physical punishment for those actions that may harm the success of their businesses or break neighborhood rules. When these two goals contradict each other, fragile coexistence agreements may break and conflict and violence are likely to escalate.

In addition, Browning et al. (2004) found that networks binding criminals and law-abiding residents together interact with collective efficacy in affecting victimization and homicide rates. In fact, these networks of interaction and exchange between criminals and non-criminals significantly reduce the negative effect of collective efficacy on violence.

Finally, Taylor (2001a) found that residents of Baltimore neighborhoods were so concerned about potential retaliatory acts by local drug dealers "that not only were they unwilling to supply information [to the police], they were reluctant to serve on local community organization boards" (p. 64) as well.

In sum, these findings suggest that when criminal structures infiltrate and co-opt local social networks, neighborhood residents may enter in tacit or even explicit agreements with criminals in order to keep a modicum of peace and order within the community. These

agreements undermine the regulatory capacities of a neighborhood and its ability to prevent crime and violence because (1) law-abiding resident networks become embedded with criminal networks, fostering acquiescence with illegal behavior, or as Browning (2009) conceptualizes it, engaging in "negotiated coexistence;" (2) criminal structures normalize the use of violence as a legitimate way to regulate behavior; and (3) law-abiding residents will be persuaded from contacting outsiders, including city authorities, to solve communal problems because such behavior may be considered a breach of contract and may lead to violent retaliation. The end result is the disempowerment of communities, the weakening of their ability to exert systemic social control, particularly at the public level, and the escalation of violence in these areas.

2.5.4.2. Usurpation of State Functions and Public Control

The police department is the state representative with the most access to local communities in urban contexts. It was discussed earlier in this chapter that when neighborhoods perceive the police as inefficient, unresponsive or unfair they are less willing to get involved in social control at any level (private, parochial or public). The presence of criminal structures in some of these neighborhoods complicates this scenario. Indeed, Kubrin and Weitzer (2003a) suggest that when neighborhoods experience vacuums in formal control (perceived or real), local offenders will take advantage of these voids and impose their own forms of informal control, often involving the threat of physical violence, to others in the community. In fact, the same authors found that, in Saint Louis, retaliatory homicides are more likely in disadvantaged neighborhoods than in any other type of neighborhood, partially because residents perceive the police as unwilling or unable to deal with community problems, leading some residents to take the law into their own hands (Kubrin & Weitzer 2003b).

However, not all residents will resort to this strategy. Those with more access to firearms and some level of organization would probably be more likely to engage in vigilante operations. As mentioned above, tacit and explicit agreements may be reached by non-criminal residents and criminal elements in a neighborhood whereby criminal groups are expected to exercise some of the social control activities that the police would if they had a legitimate and effective presence in these areas. For instance, Patillo (1998) found that organized gangs helped maintain order in the neighborhood (see also Taylor 2001a). Arias (2006), on the other hand, found that organized crime groups in a Rio de Janeiro shantytown "provide services to residents to maintain their support in the face of the violence provoked by drug trafficking. These efforts include providing funds to individuals in need, maintaining some degree of order by preventing assault and theft, and supporting large-scale festivities for residents" (p. 303). In addition, drug gangs in Rio were able to strike deals with state officials and civic leaders to guarantee the success of their criminal enterprise (Arias 2006). Furthermore, according to Casas and Gonzalez (2005), gangs and irregular groups in Bogota have also been known for engaging in "social cleansing" operations aimed at physically eliminating social "undesirables" such as prostitutes, street criminals, drug addicts, homeless people, and community activists in the areas they control.

In conclusion, the presence of illegal sources of social control at the neighborhood level not only undermines the capacity of local networks to exercise legitimate systemic social control, but it also challenges the monopoly of violence that in modern democracies should be concentrated in the State. Indeed, under the conditions described here, it is never clear who is in control at any given time, leading to more conflict among community members (both law-abiding and criminal residents) and the resulting escalation and concentration of violence in

these places. These dynamics get entwined with and further foster disadvantage, isolation, and disorganization.

2.6. Relevance and Contributions to the Field

The study of social disorganization and the public level of control and their effects on crime rates in an international setting is of central importance for the advancement of criminological theory and public policy. Thirty years of research within the modern ecological tradition have emphasized the importance of the types of social control that are embedded within private and parochial networks, taking for granted the role that the interactions between endogenous networks and exogenous institutions play in the regulation of behavior at the neighborhood level. Only recently have we begun to unpack the ways by which public control is exercised, and we do not yet clearly understand its role in facilitating social control within neighborhoods. Furthermore, the great bulk of research on social disorganization and the ecology of crime has been conducted within the United States, and we know very little about the power of this approach to explain crime in other countries or whether measures developed in the United States translate to other cultural contexts. In addition, the literature provides strong evidence that criminal structures complicate the local exercise of systemic social control. This potentially confounding effect has not been systematically explored in models testing the Systemic Model of Crime Control.

This dissertation advances our understanding of the ecology of crime in several ways. First, the research tests the external validity of ecological theories of crime by applying the systemic social disorganization model to a city outside the United States. Indeed, the development of scientific knowledge depends greatly upon our ability to replicate and validate theories, measurements, methodologies, and findings in different contexts. This study provides a

test of social disorganization theory in an urban setting within a developing country, thus furthering the evidence about the explanatory power of the ecological approach in the study of violent crime.

Second, the study proposes alternative measures of social disorganization that might better reflect the socio-cultural context in Latin America. The few studies applying the ecological approach to the study of crime in that region suggest that disorganization may have different outcomes there than in the United States. Indeed, disadvantage in Latin American urban centers has been found to be positively associated to social cohesion, collective efficacy, and violent victimization (Cerdá et al. 2008; Villareal & Silva 2006). It is not clear as of now whether traditional measures of disorganization and disorder used in the United States can be directly exported to socio-cultural contexts in the developing world or if the measurement of social disorganization is specific to place. This study contributes to the literature by proposing and testing alternative measures of social disorganization that, though being analogous to those used in the United States, may be more representative of social processes in Latin America.

Third, the dissertation empirically tests the public level of control, a largely under-tested concept within the ecological tradition. Two limitations in the ecology of crime literature in regards to the public level of control have been identified here. The first shortcoming refers to the scarcity of empirical studies testing this level of systemic social control. The second limitation is related to the lack of agreement around the measurement of this concept. The reviewed studies have measured public control as (1) residents' perceptions and satisfaction with the local government's involvement with the neighborhood (Velez 2001); (2) residents' willingness to cooperate with the police and the existence of active police-community partnerships (Taylor 2001a); (3) overall city expenditure per capita (Stucky 2003); (4) residents'

connections to city bureaucracies (Carr 2003); and (5) the availability of general services such as parks and playgrounds, neighborhood watch programs, health services, block group and tenant associations, among others (Belnar et al. 2008). This study contributes to the literature by providing additional evidence about the effects of the public level of control on violent crime, and it joins the discussion about the appropriate measures that should be used to assess this model, by proposing the availability of quality of life (basic public services) and crime control (police) services as indicators of the public level of control.

Fourth, the presence of criminal structures that may co-opt local networks and usurp state functions is introduced in the model to account for its potentially confounding role in the exercise of local public control. In this way, the study may reduce the chance of model misspecification.

Fifth, the study makes methodological contributions by employing a spatial approach that allows accounting for the influence that communities exercise on one another's structural processes. In particular, the study utilizes methods to identify patterns of spatial dependence and spatial heterogeneity, and it compares a number of multivariate spatial models employing different perspectives (i.e. spatial lag models, where spatial dependence is understood as part of the structural process; and spatial error models, where spatial dependence is basically treated as a nuisance).

Finally, since this study explores the connotations of public service allocation on violent crime at the neighborhood level, the findings have important policy implications for the control of crime in urban areas, particularly in, but not limited to, developing countries.

CHAPTER 3. STUDY SITE[3]

3.1. The Context of Crime and Violence in Colombia

During the past four decades, Colombia has faced a number of challenges that have had detrimental consequences for the quality of life and safety of its citizens. Indeed, since the mid-1960s the country has been engaged in an internal conflict involving the government, left-wing guerrillas, and right-wing paramilitary groups that has caused the deaths of thousands and the forced displacement of millions of civilians. Furthermore, the emergence of violent drug cartels in the 1970s, and their consolidation in the 1980s, added an extra layer of complexity to the conflict, as drug lords got involved in the financing of paramilitary groups and engaged in a terrorist campaign against the government and society at large. In addition, by the 1990s the criminal techniques and technologies used by these organized groups had permeated some sections of Colombian society, increasing the levels of criminal activity in the streets and the levels of corruption inside government agencies.

Different strategies to fight organized and street crime have been implemented by central and local governments in Colombia with varying levels of success. The first decade of the 21st century has seen a reduction in the violence related to the conflict, particularly in the main urban centers. However, crime rates are still high and organized crime remains a problem.

Figure 2 presents the trend of crimes reported to the police between 1970 and 2007 in Colombia. According to the official statistics, during this period an average of 678 crimes (per 100,000 population) were reported to the police each year, with the lowest rate reported in 1993 (521) and the highest in 2006 (890).

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[3] Sections of this chapter have been published in Escobar, G. (2011).

On the surface, this trend seems to suggest that crime rates were high in the 1970s, went down in the 1980s and 1990s, and increased again in the 2000s. However, this picture is deceiving as reforms to the Penal Code implemented in 1980 and 2000 changed the definitions of punishable conducts. Indeed, the Penal Code of 1980 redefined some criminal offenses as violations, accounting for the apparent drop in crime rates in the 1980s, while the Penal Code of 2000 created new criminal offenses, giving the impression of a steep increase in the crime rate in the 2000s.

Figure 2. Crime Rate per 100,000 in Colombia (1970-2007)
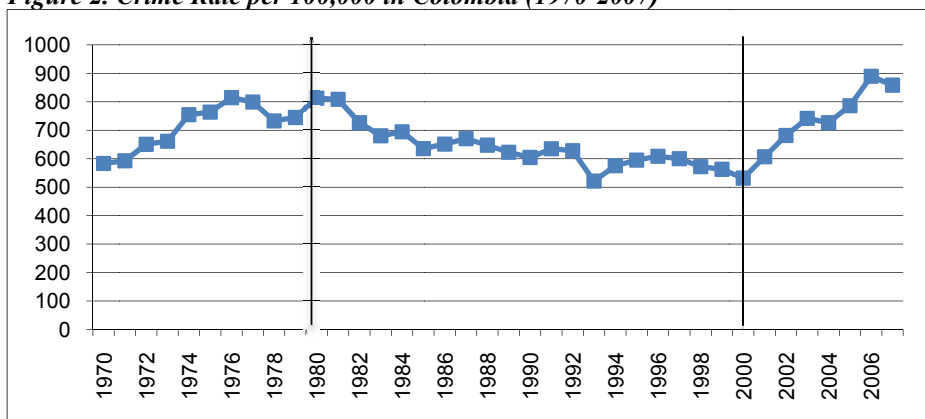
Figure 3 compares the contribution to the general crime rate made by violent crimes (homicide, assault, rape, and robbery), property crimes (theft, motor vehicle theft, and burglary), and other crimes (remainder of acts defined as offenses by the penal law, including other person and property crimes) during the same period. Although there are fluctuations, there is a more or less even split among the three groups throughout most of the period. But starting in 2001 the participation of the "other crimes" category grows dramatically, and the contribution of property crimes shrinks considerably, while that of violent crimes continues to represent about a third of the total crime rate.

Figure 3. Contribution of Violent, Property, and Other Crimes to the General Crime Rate per 100,000 in Colombia (1970-2007)
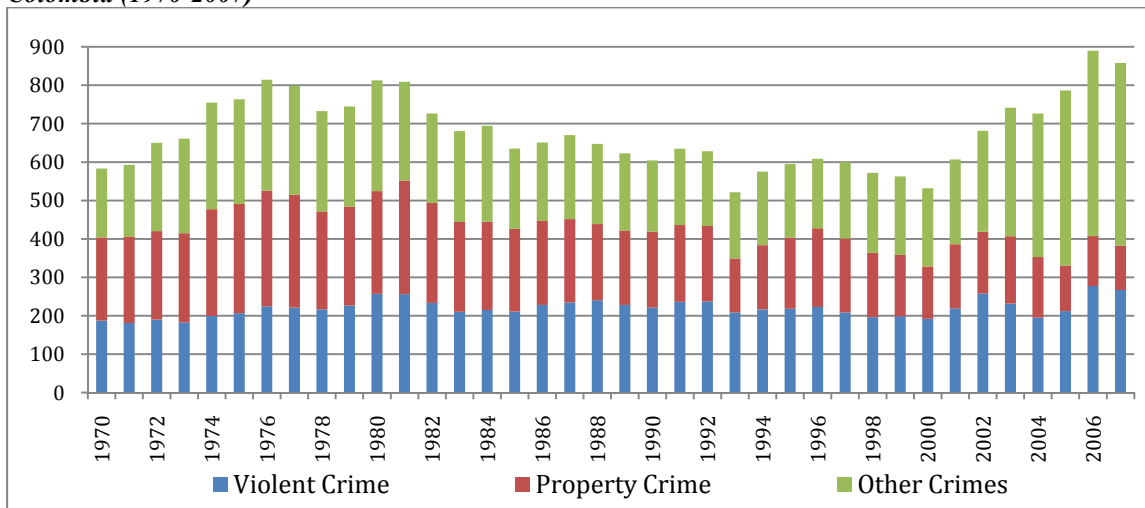
Figure 4. Violent Crime Rate per 100,000 in Colombia by Type of Offense (1970-2007)
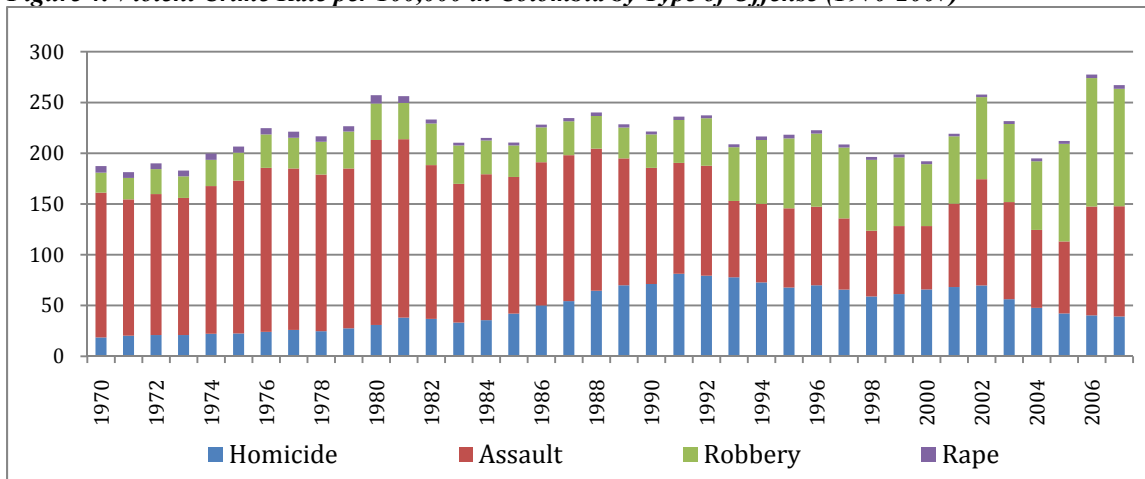
Figure 4 shows trends in the violent crime rate and the distribution of homicides, assaults, robberies, and rapes within it. On average, between 1970 and 2007, there were 220 violent crimes per 100,000 residents reported to the police in Colombia. However, the trend was driven by different offenses across the period. Indeed, while the behavior of assault defined the fluctuations in the violent crime rate during the 1970s and the first half of the 1980s, high homicide rates seem to explain most of the variation in violent crime between 1985 and 2003. In addition, the contribution of robbery, though initially small, gradually increased since the early

1990s to the point of explaining about 45 per cent of the violent crimes by the end of the period. Finally, the participation of rape has been very small relative to the proportions contributed by the other offenses, and it does not seem to affect the fluctuations in the violent crime rate significantly. This is likely the artifact of very high levels of underreporting for this kind of offense.

The behavior of the homicide and assault rates is particularly interesting. During the 1970s both crime rates were moving upwards, and the assault rate was not only growing faster than the homicide rate, but it was also about six times greater in size (see Figure 5). This kind of behavior, although indicative of a gradual increase, can be expected in societies with relatively low levels of violence. For instance, in the United States the assault rate is several times larger than the homicide rate, and both trends have moved in the same direction (up between 1988 and 1991, and down since 1992) during the past two decades.

However, between 1985 and 1993 the homicide rate in Colombia experienced a steep increase, while the assault rate exhibited an uneven, but continuous decline, to the point that in 1993 the homicide rate was slightly greater (78) than the assault rate (75). These trends show that there was an increase in the lethality and intentionality of the violence in Colombia during the 1990s, reaching a point observed only in nations at war.

Figure 5. Homicide and Assault Rates per 100,000 in Colombia (1970-2007)

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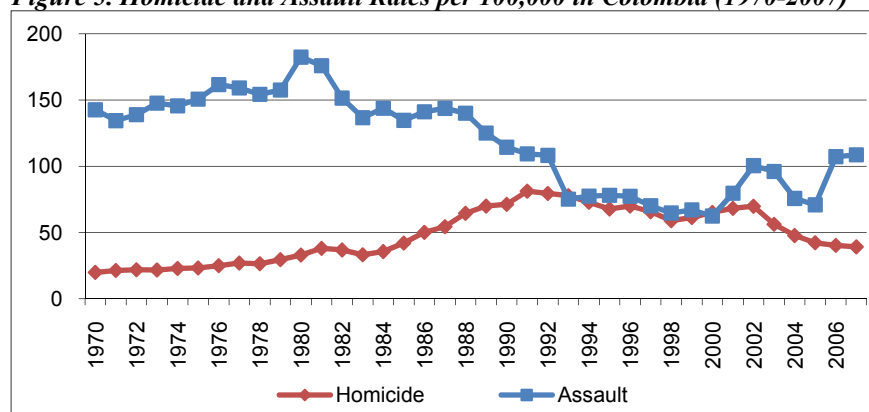
A dirty war waged by right-wing paramilitary groups against alleged supporters of the guerrillas and left-wing politicians; the escalation of the conflict between guerrilla groups, paramilitaries, and the government; and the violence of the drug cartels (terrorist acts, political assassinations, war against the police, intestine wars between and within cartels, among other things) all contributed to the intensification of the lethality of violence in Colombia during this period.

Moreover, all of these criminal organizations recruited, trained, and armed young men in the slums of the main urban centers of Colombia, particularly Medellin and Cali, playing a key role in the reproduction of violence in future years. In fact, although the homicide rates started to decline in 1993 (partially as a consequence of the dismantling of the Medellin Cartel), they continued to be high for the rest of that decade.

After reaching the lowest point of the decade in 1998 (59 homicides per 100,000), the Colombian homicide rate experienced resurgence from 1999 to 2002. This new spike in the violence coincided with the peace negotiations between the government and the Revolutionary Armed Forces of Colombia (*Fuerzas Armadas Revolucionarias de Colombia,* FARC for its acronym in Spanish), in which the government demilitarized an area of the southeast of the country the size of Switzerland. Although this area was intended to serve as a base for the negotiations, the FARC continued with their criminal activities—including kidnapping, extortion, cropping of coca leaf, and production of cocaine paste—and kept on engaging in military operations against the government forces. Furthermore, unhappy with this state of affairs, paramilitary groups—also involved in the distribution and trafficking of cocaine—escalated their violence against civilians across the country in an attempt to weaken what they identified as "social support" for the FARC.

Finally, starting in 2003 there has been a new decline in the homicide rate. A recent unpublished study (Arias, Escobar, & Llorente, 2009) found that this drop seems to be at least partially related to the demobilization of paramilitary groups initiated in 2003. Indeed, although the demobilizations had varying effects across regions of Colombia, this process had a general reductive effect on the homicide rate at the national level. While the demobilization policy was considered a success (about 49,000 alleged former paramilitaries and guerrillas demobilized between 2002 and 2008), former paramilitaries have reorganized into new criminal organizations dedicated primarily to drug trafficking and other contraband, but also engaging in violent acts against civilians. These groups are colloquially known in Colombia as *BaCrim*, an abbreviation for the generic term *bandas criminales* or criminal bands, deliberately used by the police and the government to strip them of any kind of political legitimacy.

In short, violent crime in Colombia has been greatly influenced by the dynamics of the internal conflict and the illicit drugs trade, and has been extremely detrimental to the development of the country. For many years Colombian scholars attributed these levels of violence to the internal armed conflict in rural areas and to interpersonal violence in urban areas. However, a World Bank (1999) report suggested that during the 1990s only about 20 percent of homicides in Colombia could be attributed to the conflict, and that the combination of economic and social violence (i.e. poverty, inequality, rapid urban growth, lack of educational and employment opportunities, family disruption, and situational precipitators such as easy access to alcohol, drugs, and firearms) were responsible for the other 80 percent. This report also concluded that about 70 percent of all homicides in Colombia during that decade took place in urban areas, and that three cities alone—Bogota, Cali, and Medellin—accounted for between 40 and 60 percent of urban homicides.

The majority of empirical studies of violent crime in Colombia have focused on the main urban centers, particularly Bogota, Medellin, and Cali. However, there have been a few serious attempts to conduct national studies. Perhaps the most important of such research efforts is Sanchez and Nuñez's (2007) study on the determinants of violent crime in 711 municipalities. These researchers used official socio-demographic and homicide data for the period 1980-1998 to conduct a panel analysis. Their findings showed that homicide rates in Colombia were mostly related to the presence of illegal armed groups (i.e. guerrillas and paramilitaries) and drug trafficking organizations, and to the inefficiency of the justice system. They also found a weaker positive effect of social variables such as inequality and political exclusion, and a curvilinear effect of poverty whereby extremely poor and extremely wealthy towns had the lowest homicide rates, and higher rates were observed in those communities located in between these extremes. In sum, according to these authors, if it were not for the special dynamics produced by the internal armed conflict and the drug economy, Colombia would have a violent crime rate comparable to that of countries with similar socio-economic and political conditions.

3.2. Bogota: Socio-Structural Conditions and Homicide

Bogota, the capital of Colombia, is the most populous city in that country with a population of approximately seven million people, and a population density of over 4,000 residents per square kilometer. According to the official census, in 2005 69 percent of its residents were under the age of 40, and 13 percent of the population was composed of males between the ages of 15 and 29. The ethnic distribution of the city was rather homogeneous with only 1.7 percent residents self-identifying as belonging to a minority group (Amerindian, Romani, or Afro-Colombian), of which 86 percent were Afro-Colombian. In terms of economic deprivation, 4.6 percent of the population reported that, during the week prior to the census, they

had spent one or more days without consuming any food due to lack of money; and 9.4 percent reported having looked for work during the same time period[4]. Regarding family disruption, the census reported that single, separated, or divorced females are the heads of 15 percent of households with children. There was also a high rate of residential mobility with 32 percent of Bogota residents reporting they changed residences in the five years prior to the census. In fact, 37 percent of Bogota residents were not born in that city, 13 percent of which moved there in the five years before the census. Furthermore, of those who recently migrated to Bogota, 28 percent claimed having difficulties finding a job and six percent having a threat against their lives as their main reason to move.

The city consists of 20[5] political-administrative units known as localities (see Figure 6). A democratically elected Local Administrative Board and a local mayor preside over the administration of each locality. There is variability across neighborhoods for most of the socio-structural characteristics summarized here, particularly those related to issues of disadvantage. By and large, neighborhoods in the northeast area of the city are much more affluent than those located in the south of the city, although there is some internal variation such that spatial patterns can be identified.

According to Uribe-Mallarino (2008), Bogota's north-south socio-economic division dates from the early years of the republic, when the city experienced an expansion process driven by two clear phenomena. On the one hand, the aristocracy controlled the areas to the northeast of the city where they owned land and recreational estates. As the city continued expanding to the north, recreational estates became primary residences for the upper class and new upscale

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[4] Population 15-years old and older. It excludes full-time students, housewives, retirees, disabled people who cannot work, and people in other situations.
[5] One locality (*Sumapaz*) was excluded from the analysis because it is a rural area that was just recently incorporated into the political-administrative structure of the city.

housing was built in the area. On the other, the State embarked in a large-scale project to build public housing (known as social interest housing in Colombia) in the south and west of the city, attracting primarily working class families to these neighborhoods. This general pattern continues to underlie the growth of the city even today. In fact, although there are residential areas from different income levels in both zones, the "social representations" held by Bogota residents identify the south of the city as being poor and dangerous, and the north as being rich and safe (Uribe-Mallarino 2008).

Figure 6. Bogota Localities
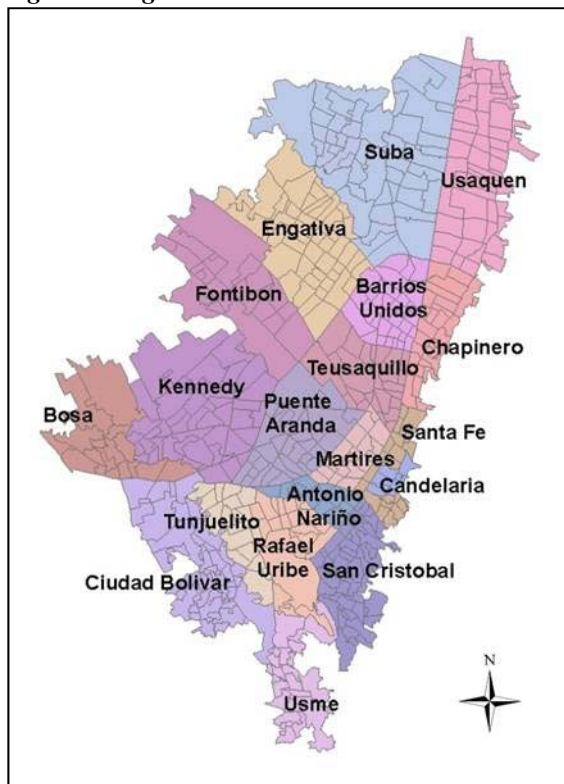
In general terms, the most affluent neighborhoods are located in the *Usaquen* and *Chapinero* localities and the least affluent in the *San Cristobal*, *Rafael Uribe*, *Tunjuelito*, *Ciudad Bolivar*, *Bosa*, and *Kennedy* localities. The remaining areas have a mix of middle- and lower-class residents, with some very affluent neighborhoods located in some areas of *Suba*, *Barrios Unidos*, and *Teusaquillo*.

Although historically being lower than in the rest of the country (see Figure 7), Bogota's homicide rate has experienced a similar pattern to that described for the national case above. Indeed, the city's homicide rate reached the highest point in 1993 (81) and has since then presented a sustained decrease until attaining a rate of only 17 homicides per 100,000 in 2009. Nonetheless, the spike in violence experienced in the rest of the country between 1999 and 2002 did not seem to affect Bogota. This suggests that the city was somewhat shielded against the violence unleashed by the paramilitaries during the failed peace process between the government and the FARC, partially due to a strategy to protect the city from the conflict launched by the government at the time.

Llorente et al. (2001) found that some socio-demographic variables, such as education deficits and proportion of male population, were weakly associated with higher homicide rates in Bogota, while the presence of alcohol outlets, and of criminal structures (e.g., gangs, guerrilla militias, paramilitary cells, drug trafficking groups) and illegal markets (e.g., fencing of stolen goods, drug distribution, and arms trafficking) had a stronger impact on violence. On the other hand, they found that poverty predicted lower levels of homicides. This finding contradicts the national tendency observed by Sanchez and Nuñez (2007), and it might be due to the fact that Llorente and colleagues did not explore the possibility of a curvilinear relationship. In addition, they observed that Bogota localities with higher public expenditure (health, roads, security, education, and recreation) per capita also had higher homicide rates.

Nonetheless, another study by Sanchez, Espinosa and Rivas (2007) found the opposite relationship whereby public expenditure in the social sector (health, education, and social development) actually had a negative, but weak, effect on the homicide rate at the locality level in Bogota. Furthermore, the same study also found that improvements in the efficiency of the

Metropolitan Police (i.e. arrest rates and police officers per capita) explained a 53 per cent drop in the homicide rate and a 76 per cent decrease in the robbery rate in Bogota between 1994 and 2002.

Figure 7. Homicides per 100,000 Population in Colombia and Bogota, 1980-2010
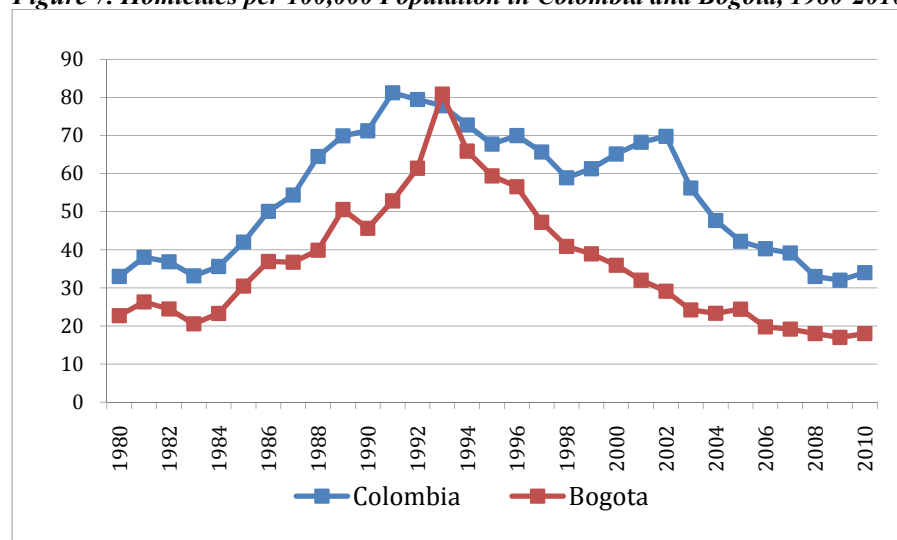
Finally, using spatial analysis, Formisano (2002) concluded that socio-economic variables did not explain the geographic concentration of high homicide rates in Bogota, but the presence of drug distribution and violent criminal groups did.

In summary, research on the socio-structural predictors of homicide in Bogota is inconclusive and, in some instances, even contradictory. Clearly, the presence of organized crime, and illegal markets complicates the understanding of violent crime in that city, and an ecological analysis using a spatial approach could shed some light on this debate.

CHAPTER 4. DATA AND METHODS

4.1. Unit of Analysis

The social processes explained by ecological theories of crime are assumed to take place within communities that reside in relatively small areal units. In spite of the focus on neighborhood dynamics emphasized by Shaw and McKay, early tests of the theory tended to use larger areas such as counties, Statistical Metropolitan Areas, and cities as their units of analysis. Exponents of the systemic approach (see Sampson's and Taylor's work) have argued that the use of large aggregated geographies is inappropriate to test ecological theories of crime because it does not allow measuring the small-scale community dynamics that define neighborhood life, and it is also inefficient because it masks the variability that naturally occurs between neighborhoods. Thus, ecological researchers have favored a return to the neighborhood approach since the 1990s.

Now, there is a great deal of debate in the literature as to what constitutes a neighborhood. Indeed, if neighborhood internal dynamics are to be understood, researchers need to have a definition of neighborhood that more or less matches that of the residents. White (1987) defines neighborhoods as geographic entities with clear physical boundaries and some level of social homogeneity. Moreover, Tienda (1991) argues, "as a theoretical construct, a neighborhood embraces both social and spatial dimensions, yet empirical measurement focuses primarily, if not exclusively, on the spatial to the neglect of the social foundations" (p. 247).

In this way, most studies have used definitions of neighborhood and neighborhood boundaries based on administrative jurisdictions. This approach, as Tienda (1991) points out, ignores the social dimensions of neighborhood life and forces the researcher to assume "that

processes of systemic neighborhood control intervened between the ecological dynamics and the crime rate" (Bursik & Grasmick, 1993a:40) without any empirical evidence to that effect.

Some studies have attempted to overcome this issue by directly asking residents about the boundaries of what they consider their neighborhood to be (e.g., Clear, Rose, Waring & Scully 2003) or by operationalizing neighborhood as the 15-minute walking distance radius around a respondent's residence (e.g., Sampson & Groves 1989). Other studies have artificially created neighborhoods and neighborhood clusters by using census data to identify blocks or census tracts that could be aggregated on the basis of their relative socio-demographic homogeneity and the physical obstacles that could define boundaries between them (e.g., Browning et al. 2004; Mears & Bhati 2006; Sampson et al. 1999; Sampson et al. 1997). Yet, another approach is to simply use individual census tracts (e.g., Morenoff & Sampson 1997; Sampson & Raudenbush 1999; Stretesky et al. 2007), blocks (e.g., Simons et al. 2005), and even buildings (e.g., Saegert & Winkel 2004; Saegert et al. 2002) as the smallest possible ecological units that could be considered as encompassing community life.

All of the aforementioned approaches have their limitations, and the approach employed in this study is not an exception. This dissertation uses the official neighborhood or census urban sector as the unit of analysis. According to the Colombian census authority, *Departamento Administrativo Nacional de Estadística* (2009), a census urban sector can cluster between 20 and 180 blocks.

Although census information exists at the block level, the study was limited by the inability to match census block codes to those block codes available in the digital map of Bogota. Indeed, even though the codes used by the census and the map at the urban sector level were the same, the coding system at the block level appeared to be different in both sources (see

Appendix 1 for a detailed explanation of how census, homicide, interview, and map data were matched). In addition, as it will be discussed later, data collected on the presence of criminal groups and illegal markets was limited to the official neighborhood level providing another reason to use census urban sectors as the unit of analysis.

The main limitation of employing official neighborhoods is that the definition of their boundaries might not reflect the cognitive maps of the residents. In fact, official neighborhoods might be clusters of multiple areas informally identified as neighborhoods by residents and visitors alike. However, the way in which official neighborhoods developed in Bogota might make this an appropriate unit of analysis for the purposes of this study. According to Uribe-Mallarino (2008), neighborhoods in Bogota were first established in the 17th century as parishes around the presence of religious authorities. The secular concept of neighborhood was introduced in 1774 for the purposes of population and crime control, but Bogota residents did not assume this denomination until the 19th century when the number of neighborhoods exceeded the number of parishes and police jurisdictions could not be defined around the geographic boundaries of the parish anymore. Modern official neighborhoods evolved in at least four ways in Bogota: (1) historical neighborhoods that were formed in colonial times around the downtown area where political, cultural, economic, and religious institutions were clustered [6]; (2) neighborhoods that started as illegal settlements, usually in the periphery of the city, and where residents share a history of communal work aimed at gaining access to basic public services and at achieving legal recognition; (3) neighborhoods developed by urban planners and real estate entrepreneurs that enjoyed all or most services from the beginning; and (4) subsidized working-

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[6] The main political (e.g., Mayor's Office, Presidential Palace, Congress, Courts and several ministries), cultural (e.g., several universities, largest library, opera house, several theatres and museums), and religious (e.g., the Primary Cathedral of Bogota) institutions are still located in Bogota's historic downtown, however, economic institutions have moved to the north of the city in the last few decades.

class neighborhoods built by the State (both national and local) since the 19th century, currently known as social interest housing. In short, the official construction of the concept of neighborhood in Bogota includes a number of socially and historically grounded processes that allow residents to feel a sense of belonging there.

In addition, Haining (2003) proposes that administrative regions are ideal for spatial analysis because "[t]hey provide a framework for collecting data, delivering services, [and] distributing government funds" (p. 184). The use of official neighborhoods as the unit of analysis in this study is thus appropriate due to the focus on the availability of public services as a moderating factor between disadvantage and homicides. Indeed, the distribution of public services in Bogota is dependent on the hierarchy of political-administrative units. As it was mentioned before, Bogota is subdivided into 20 localities, and each locality is in turn subdivided into Zonal Planning Units (ZPUs), which are smaller clusters of neighborhoods similar in their socio-structural characteristics (population size, socio-economic status, and transportation and public services needs). Decisions about resource allocation originate in the central administration of the city. However, Local Administrative Boards (LABs) request, manage, and plan the distribution of resources based on an analysis of the locality needs by ZPU. Unlike localities, ZPUs are not decision-making units per se, but rather planning units used by the city administration and the LABs to make decisions about resource allocation to neighborhoods. In this way, in securing neighborhood resources, local communities interact directly with LABs, but neighborhood location within a ZPU is what ultimately determines the amount of resources distributed at that level by the corresponding LAB, thus making the official neighborhood an ideal unit of analysis to study the public level of control.

4.2. Sample

The 2005 census identifies 664 urban sectors or official neighborhoods in Bogota. Fifty-eight sectors that were identified as unpopulated rural areas and that were located at the fringes of the city, and two neighborhoods that were islands sharing no boundaries with any other neighborhood were deleted from the analyses. In addition, 35 units with population sizes smaller than 1,000 were merged to a neighboring sector belonging to the same ZPU to avoid extremely inflated rates in those areas (see Haining 2003, and Kubrin & Weitzer 2003b for a similar approach). In this way, the analyses discussed below look at the spatial distribution of homicides in 569 neighborhoods.

Now, because of the dependent and heterogeneous nature of spatial data, the 569 neighborhoods cannot be considered as a sample or even a population, but as a single observation. According to Anselin (1989), "the proper perspective is not to consider spatial data as a random sample with many observations, but instead as a single realization of a stochastic process" (p. 3). Indeed, the neighborhood distribution of homicides and other socio-structural factors is but one possible combination of values that are determined by a single spatial pattern. As it is elaborated below, the inferential statistics process used with spatial data is not based on uniform theoretical distributions but on a number of possible permutations informed by the spatial pattern in the observed data. Table 1 presents summary statistics for all the variables included in the analyses prior to transformation and dimension reduction.

Table 1. Summary Statistics*

	Mean or %	Median	Std. Dev.	Min	Max
Dependent Variable					
Cumulative Homicide Rate per 10,000	10.82	5.15	25.51	0	326.64
Independent Variables					
% Population Experienced Hunger	4.42	3.73	3.42	.03	26.01
% Population Unemployed	4.28	4.36	1.60	0	11.28
% Population 15+ Illiterate	2.30	1.84	1.80	.12	18.65
% Population 18+ High School Diploma	54.41	53.63	19.99	7.80	91.14
% Female-Headed Households w/Children	4.75	5.12	2.04	0	16.50
% Homes w/ Phone Service	84.06	85.90	10.53	1.98	97.53
% Homes w/ Sewerage Service	93.66	95.42	8.74	11.40	99.52
% Homes w/ Electricity Service	95.26	95.80	3.44	69.20	93.68
% Population Ethnic Minority	1.72	1.36	1.37	.06	11.02
% Population Born in Different Town	36.65	36.81	6.75	10.56	67.97
% Population Moved within Bogota	26.98	26.72	7.96	5.91	71.10
% Population Moved from Another Town	4.26	3.55	3.40	.28	37.58
% Population Moved from Another Country	.63	.16	1.21	0	7.94
Presence of Police Stations or CAIs (Yes)	20.9%				
Rate of Alcohol Outlets per 10,000	13.75	8.45	23.52	0	252.94
Rate of Videogame, Gambling & Lotto Outlets per 10,000	8.18	5.43	18.24	0	340.69
Presence of Community, Religious & Political Associations (Yes)	83.3%				
Control Variables					
Temporal Lag Cumulative Homicide Rate	15.17	6.73	47.32	0	936.78
Population Density per Km^2	30,181.37	21,031.88	36,462.41	498.59	417,973.2
% Population Young Males (15-29 age)	8.99	8.69	4.09	2.54	72.96
% Population Displaced by Conflict	.34	.27	.30	0	2.99
% Residential Units	85.05	89.68	14.45	6.56	99.01
Presence of Gangs (Yes)	37.2%				
Presence of Social Cleansing (Yes)	5.6%				
Presence of Contract Killing "Offices" (Yes)	25.1%				
Presence of FARC Militias (Yes)	8.9%				
Presence of Paramilitary Cells (Yes)	16.7%				
Presence of Drug Markets (Yes)	72.8%				
Presence of Arms Markets (Yes)	19.3%				
Presence of Chop Shops (Yes)	30.4%				

*Summary statistics are presented for raw variables prior to transformations and dimension reduction.

4.3. Dependent Variable

The foregoing discussion suggests that ecological attributes of communities have consistently proven useful in understanding and predicting disorder, delinquency, and crime. Moreover, a great deal of research on the ecology of crime has used homicide as the dependent variable because of its rather high reliability and low levels of underreporting.

The homicide data used in this study are part of a much larger dataset collected by researchers from *Centro de Estudios sobre Desarrollo Ecómico* (Center for Economic Development Studies, CEDE for its acronym in Spanish) at *Universidad de Los Andes* in Bogota. The CEDE partnered with *Instituto Nacional de Medicina Legal y Ciencias Forenses* (National Institute of Forensic Medicine, INMLCF for its acronym in Spanish), which centralizes all forensic information about non-natural deaths in Colombia. Using the death protocols kept by the INMLCF in paper (1977-1995) and electronic (1996-2005) form, CEDE created a panel dataset for all of the homicide events that took place in Bogota between 1977 and 2005. The data contain information on the characteristics of the victim and on the circumstances of the homicide. However, data prior to 1996 have a great deal of missing information related to sloppy record keeping before the system was computerized, and the dataset is therefore more reliable from 1996 on.

For the purposes of this study, only a subset panel data (2000-2005) is employed in constructing the dependent variable (2003-2005), as well as one of the covariates that will be discussed later in this chapter (temporal lag of homicide rate [2000-2002]). Since the focus of this dissertation is not on the longitudinal characteristics of homicides in Bogota, but on their ecological attributes, the use of only a cross-section of data is justified. On the other hand, the additional data used to construct the predictors that are introduced in the models are only available for cross-sections of time between 2003 and 2005. Using these data to predict earlier homicides would violate the assumption of temporal causality.

The event data were geocoded to the X- and Y-coordinate level based on the address where the murder occurred (or where the body was found by the authorities). To create the neighborhood homicide counts, the data were projected on a digital map of Bogota using the GIS

software *ArcMap*©, and then the points were joined to the neighborhood polygons to get the aggregated counts. A tabular join procedure was then used to merge the attributes of the homicide map to those of the predictor variables.

The outcome variable of the study is the cumulative homicide rate per 10,000[7] residents for the years 2003 to 2005. The variable was created by summing up the homicide counts for the years 2003, 2004 and 2005, dividing the sum by the average population size across the three years[8], and then multiplying by 10,000. Although it produces an inflated rate, a cumulative is preferred to an averaged approach because it allows the researcher "to reduce measurement error and the problem of volatility in homicide counts from one year to the next" (Mears and Bhati 2006:251; see also Baller et al. 2001; Blau and Blau 1982; Messner et al. 2002; Rosenfeld et al. 2001).

Similarly, Messner and colleagues recommend aggregating trend data to reduce the potential effect of temporal instability (Messner, Anselin, Baller, Hawkings, Dean & Tolnay 1999). In other words, if there is relatively large variation in homicide rates from one year to the next the use of spatial analysis is not advisable because patterns that might be considered as being spatial in nature (e.g., clustering) could be caused by the temporal pattern instead. Messner et al. (1999) argue that "[t]his instability could be overcome by aggregating or averaging over several years, such as 3-year periods or 3-year moving averages. Alternatively, one could employ the temporal regimes revealed" in the data (p. 436). These authors suggest examining temporal equilibrium using graphical and statistical methods.

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[7] The average neighborhood population size is about 12,000, thus, 10,000 seems like a reasonable base to standardize the data.
[8] Population size for 2003 and 2004 was estimated by creating a shrinkage factor of the 2005 census population based on the population growth of the locality within which each neighborhood is located reported by the city's administration for those years.

Figure 8 shows the homicide rate trend in Bogota for the study period (2000-2005). The graphic clearly displays two temporal regimes. The first regime (2000-2002) shows a downward trend with some temporal instability and homicide rates varying from 35.92 in 2000 to 29.11 in 2002. The second temporal regime (2003-2005) exhibits some level of stabilization with homicide rates hovering around 24.

Figure 8. Bogota Homicide Rate Trend (2000-2005)
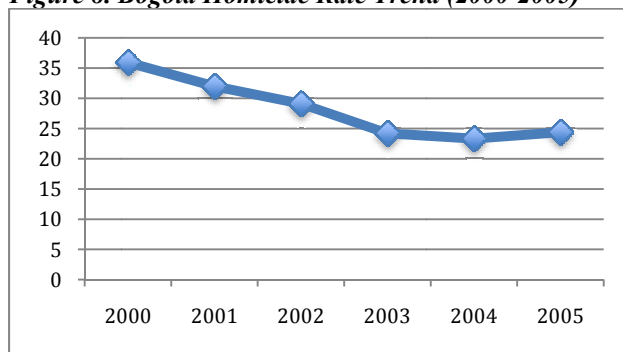
In addition, Messner and colleagues (1999) suggest examining annual global spatial correlation statistics (Moran's *I*) to determine whether there are consistent patterns of spatial autocorrelation over time. Moran's *I* differs from classic correlation coefficients in that the spatial arrangement of the units of analysis is explicitly taken into account through the inclusion of a spatial weights matrix. This study employs a row-standardized second-order contiguity matrix using queen criteria. Queen contiguity matrices define neighbors as those units that share boundaries and vertices with a given node. As it is depicted in Figure 9, first order neighbors are those units *j* (gray cells) directly sharing boundaries and vertices with node *i* (black cell). The matrix moves out one more level to include the first order neighbors of each unit *j* (white cells) as the second order neighbors of unit *i*. A second order queen matrix was selected for two reasons. First, the areas of the census urban sectors in Bogota vary widely making it difficult to

create a matrix based on distance[9]. Second, if spatial diffusion processes are identified, it can be argued that the spillovers of homicide rates not only affect those neighborhoods that are contiguous to a nodal unit, but that the effect will diffuse outwardly diminishing in size until it reaches the city limits (LeSage & Pace 2009).

Figure 9. Second Order Queen Contiguity Matrix

k	*k*	*k*	*k*	*k*
k	*j*	*j*	*j*	*k*
k	*j*	*i*	*j*	*k*
k	*j*	*j*	*j*	*k*
k	*k*	*k*	*k*	*k*

Table 2 presents the global Moran's *I* statistics for each annual homicide rate as well as for the cumulative homicide rates for the two temporal regimes identified above. The evidence presented in this table suggests that there is some level of temporal equilibrium as the global Moran's *I* statistics for all years, as well as for the two temporal regimes, are significant and relatively stable. Indeed, there seems to be a pattern of spatial correlation across the study period with an increase in strength during the 2003-2005 temporal regime. Based on the graphic and statistical evidence presented here, this study utilizes the identified temporal regimes to construct the criterion and one of the predictors, as it was discussed above.

The average neighborhood cumulative homicide rate is 10.82 (M=5.15) with a standard deviation of 25.51 homicides per 10,000 residents. The variable was normalized using a natural

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[9] The average neighborhood area is 0.60 square kilometers (M = .40; s = .75; min = 0.02; max = 7.69).

log transformation to reduce the large positive skew observed in the raw data and to reduce the influence of extreme outliers.

Table 2. Global Moran's I Statistics for Annual and Cumulative Homicide Rates[†]

Year	*I* Statistic
2000	.14*
2001	.14*
2002	.16*
2003	.15*
2004	.16*
2005	.21*
2000-2002	.15*
2003-2005	.20*

[†]Empirical pseudo-significance based on 9,999 random permutations
*pseudo-p≤.0001

Finally, it is worth mentioning that the deaths caused by two car bombs placed by the FARC in 2003 (*Club El Nogal* on February 27, 2003, 35 deaths; and *San Andresito* commercial area on October 8, 2003, eight deaths) were excluded from the analysis to avoid biasing the spatial patterning of homicide rates. In particular, the terrorist attack against *Club El Nogal* (an upscale private club frequented by the city's elite) would have artificially inflated the homicide rates of the *Rosales* neighborhood where the club is located, which has no homicides for the study period otherwise. These terrorist attacks were identified in the raw event data by observing a concentration of several homicides on the same address, date, and time. An Internet news search for terrorist attacks in Bogota on the identified dates was then conducted, confirming the occurrence of the events mentioned above. Because the original data are missing a great deal of information related to the affiliation of the suspected author of the homicide, it is not possible at this time to identify other homicides that might be classified as the outcome of political violence.

4.4. Independent Variables

This section discusses the alternative measures of social disorganization proposed by this study to explain the spatial distribution of homicide rates in Bogota: concentrated disadvantage and social isolation, ethnic and cultural heterogeneity, residential mobility, social disorder, parochial control, and public control.

The following census variables were selected as potential measures of the above latent constructs in Colombia: (1) percent of population who experienced hunger for one or more days due to lack of money (HNGR); (2) percent of population 15-years old or older who sought work in the past week (UNMP); (3) percent of population 15-years old or older who is illiterate (ILLT); (4) percent of adult population who have at least a high school degree (HGSC); (5) percent of households with underage children headed by a single, separated or divorced woman (SFHH); (6) percent of homes with phone service (PHN); (7) percent of homes with electricity service (ELCT); (8) percent of homes with sewerage service (SWRG); (9) percent of population who self-identified as belonging to an ethnic minority (MNRT); (10) percent of population who was born in a town or city other than Bogota (BNBG); (11) percent of population who moved from a different Colombian town in the past five years (MNBG); (12) percent of population who moved from a different country in the past five years (MCTR); (13) percent of population who moved within Bogota in the past five years (MIBG); (14) rate of alcohol outlets per 10,000 residents (LQR); and (15) rate of video game arcades, gambling, and lotto outlets per 10,000 residents (GMBL).

Because not all of the selected items have been used in the literature to measure social disorganization, a preliminary exploratory Principal Components Factor Analysis (PCFA) including all variables at once was conducted using *IBM SPSS*[©]. Non-normally distributed

variables were improved using a square root or natural log transformation when the skewness was positive, or reflecting the variable then taking its square root or natural log and then re-reflecting it when the skewness was negative (Tabachnick & Fidell 2007). Normalization is desirable to improve the linearity of relationships between variables (Gorusch 1983) and to enhance the factor solution (Tabachnick & Fidell 2007). Table 1 above summarizes the descriptive statistics of the raw variables, and Table 3 below presents correlations (sub-diagonal elements only) among variables after transformations were conducted.

The first model utilized a Direct Oblimin rotation (results not shown), which allows factors to correlate, to discard potential associations among latent factors (Tabachnick & Fidell 2007). All correlations among factors were below zero suggesting the factors are indeed uncorrelated. Subsequently, a PCFA using Varimax [10] rotation (results not shown), which enhances the correlations among items within each factor and produces uncorrelated factors, yielded five latent constructs with Eigenvalues greater than one (80.65 percent variance explained) (see Figure 10): (1) concentrated disadvantage and social isolation, (2) basic public services, (3) ethnic and cultural heterogeneity, (4) social disorder, and (5) residential mobility.

Figure 10. Exploratory PCFA Scree Plot

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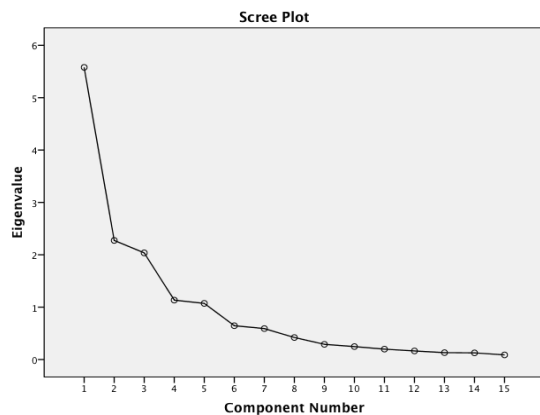
[10] Varimax is a technique of orthogonal rotation whose goal "is to maximize the variance of factor loadings by making high loadings higher and low ones lower for each factor...Emphasizing differences in loadings facilitates interpretation of a factor by making unambiguous the variables that correlate with it." (Tabachnick & Fidell 2007:620).

Table 3. Factor Analysis Correlations Matrix† (N=569)

	HNGR	UNMP	ILLT	HGSC	SFHH	PHN	ELCT	SWRG	MNRT	BNBG	MNBG	MCTR	MIBG	LQR	GMBL
HNGR	HNGR														
UNMP	.596*	UNMP	-	-	-	-	-	-	-	-	-	-	-	-	-
ILLT	.850*	.560*	ILLT	-	-	-	-	-	-	-	-	-	-	-	-
HGSC	-.808*	-.485*	-.855*	HGSC	-	-	-	-	-	-	-	-	-	-	-
SFHH	.683*	.690*	.670*	-.660*	SFHH	-	-	-	-	-	-	-	-	-	-
PHN	-.743*	-.432*	-.729*	.720*	-.595*	PHN	-	-	-	-	-	-	-	-	-
ELCT	-.021	.042	-.029	-.028	.116*	.279*	ELCT	-	-	-	-	-	-	-	-
SWRG	-.186*	-.011	-.208*	.170*	.017	.420*	.832*	SWRG	-	-	-	-	-	-	-
MNRT	.407*	.210*	.305*	-.185*	.278*	-.323*	-.058	-.106*	MNRT	-	-	-	-	-	-
BNBG	-.168*	-.070	-.204*	.260*	-.155*	.019	-.077	-.073	.158*	BNBG	-	-	-	-	-
MNBG	-.293*	-.305*	-.343*	.472*	-.430*	.164*	-.059	-.051	.215*	.736*	MNBG	-	-	-	-
MCTR	-.632*	-.559*	-.602*	.733*	-.732*	.507*	-.138*	-.041	-.066	.269*	.555*	MCTR	-	-	-
MIBG	-.113*	.022	-.143*	.140*	.141*	.014	.023	.055	-.006	.344*	.147*	-.032	MIBG	-	-
LQR	.343*	.196*	.284*	-.276*	.245*	-.324*	.011	.038	.247*	.212*	.067	-.149*	.010	LQR	-
GMBL	.236*	.179*	.178*	-.197*	.287*	-.211*	.094*	.174*	.089*	.180*	-.043	-.286*	.118*	.572*	GMBL

*p≤.05, two-tailed.

†The following variables were transformed: HNGR (square root); ILLT (natural log); PHN (reflected, square root, reflected again); ELCT (reflected, natural log, reflected again); SWRG (reflected, natural log, reflected again); MNRT (natural log); MNBG (natural log); MCTR (square root); LQR (natural log); GMBL (natural log).

Separate confirmatory PCFA procedures including only the items loading on each factor were then modeled to improve factor loadings. Factor scores were created using a regression approach, which produces "the highest correlations between factors and factor scores. The distribution of each factor's scores has a mean of zero and a standard deviation of 1" (Tabachnick and Fidell 2007:650). The resulting factors are discussed below.

4.4.1. Concentrated Disadvantage and Social Isolation

The ecological literature has redefined the measurement of the proximate causes of social disorganization by looking at issues of concentrated disadvantage and social isolation instead of poverty alone. Researchers in the United States have traditionally measured concentrated disadvantage by combining indicators of economic deprivation, family disruption, and racial heterogeneity in the United States (see Browning et al., 2004; Kubrin & Weitzer, 2003b; Sampson & Raudenbush, 1999).

This study creates a concentrated disadvantage index that is somewhat analogous to those commonly used in ecological research in the United States, but that includes additional variables that may more closely reflect felt poverty (i.e. percent population that experienced hunger for more than one day due to lack of money, and percent population 15 years-old and older who are illiterate), isolation (i.e. percent of homes with phone service), and geographic concentration of affluence due to immigration patterns (i.e. percent of population who moved from a different country in the past five years) in Bogota. The remaining variables (i.e. percent population unemployed, percent adult population with a high school diploma, and percent of single-female-headed households with underage children) are standard measures of disadvantage used in the literature.

The concentrated disadvantage and social isolation index explains 71.15 percent of the variance in the confirmatory PCFA and includes seven items (see Table 4), two of which were unexpected. Indeed, phone service was expected to load onto the basic public services factor, and population who moved from another country was expected to load onto either a residential mobility or an ethnic and cultural heterogeneity factor. Nonetheless, these two items are conceptually consistent with the latent construct of disadvantage and isolation in Bogota. On the one hand, the negative factor loading of phone service suggests an element of social isolation. Severely disadvantaged communities may be less likely to have home phone service, which in turn reduces their ability to seek out social support from other sectors of the community and increases their isolation from the rest of society.

In addition, the negative loading of population who moved from a different country shows that international immigration patterns in Bogota are radically different to those in the United States. Indeed, the majority of immigrants to the United States usually have a low socio-economic status and a poor educational background, which is one of the reasons high concentrations of immigrants were considered by the classic ecological approach as being an indicator of disorganization. International immigrants in Bogota, on the other hand, are usually highly educated and from a more comfortable background, and tend to be associated with the diplomatic corps and with multinational companies. Moreover, Colombians who move back to Bogota from a different country usually do so after receiving a graduate degree from a higher education institution or after having worked abroad, which usually symbolizes some level of affluence.

These are in and of themselves interesting findings because they show how migratory, urban, and residential dynamics in Bogota might differ from those in the United States,

suggesting the possibility of differences in how social disorganization should be conceptualized and measured in the two countries.

A Pearson's correlation between the concentrated disadvantage and social isolation index and homicide rates (natural log) shows a rather weak association between these two variables (r=.245, see Table 12, Appendix 4). This association will be revisited in the spatial analysis sections to account for issues of spatial autocorrelation.

Table 4. Concentrated Disadvantage and Social Isolation Factor

Variable	Factor Loadings
% Population Experienced Hunger (SQRT)	.907
% Population 15+ Illiterate (NL)	.901
% Population 18+ High School Diploma	-.900
% Single Female-Headed Households w/Children	.850
% Population Moved from Another Country (SQRT)	-.806
% Homes w/ Phone Service (SQRT)	-.805
% Population Unemployed	.720
Factor Eigenvalue	**4.981**
% Variance Explained	**71.15**

4.4.2. Ethnic and Cultural Heterogeneity

In the American context, conditions of disadvantage are closely tied to racial differences in the population, thus ecological studies in that country have either included a measure of racial heterogeneity in their concentrated disadvantage index or entered it in their models as a separate predictor (see Browning et al. 2004; Kubrin & Weitzer 2003b; Sampson & Raudenbush 1999). The assumption stemming from the classic social disorganization approach is that highly heterogeneous communities are less likely to share the same values and agree on solutions to common problems, thus exhibiting a reduced ability to exercise informal social control.

The role of racial heterogeneity on crime rates has not been explored in the past in Colombia. In fact, the issue of race tends to be less contentious in Colombia than in the United States. Indeed, although there is a long history of socio-cultural and institutional racism that has

put Afro-Colombian and Amerindian communities at the highest levels of disadvantage in Colombia, the issue of race does not ignite passions in that country as strongly as it does in the United States. Moreover, most residents of Bogota self-identify as *mestizo* (part Spanish, part Amerindian), *mulato* (part Spanish, part Black) or White (direct Spanish/European ancestry) and very few actually identified as belonging to an ethnic minority (Afro-Colombian, Amerindian, or Roma) in the 2005 census (1.72 percent).

Consequently, this study proposes a measure of heterogeneity that complements ethnic background with other indicators of cultural heterogeneity such as the percent of residents who were born in a different Colombian town, and the percent of residents who moved from a different Colombian town in the past five years. The rationale behind the inclusion of the latter two variables in the heterogeneity index also relates to migratory patterns to the city. Indeed, Bogota is not just the largest city in the country but it is also the main economic, cultural, educational, and institutional center in Colombia. As such, it is a constant receiver of migrants from other cities and towns who move to the capital in search of work, to get a college degree, or fleeing from violence caused by the internal armed conflict in rural areas. In fact, in interviews conducted by Uribe-Mallarino (2008) with Bogota residents for a study on social stratification in that city, most migrant respondents identified moving to Bogota as a form of upward social mobility, particularly when they originated from rural areas.

Bogota is often referred to as a *ciudad de nadie*, a city that belongs to nobody, due to the high influx of migrants from the rest of the country (36.65 percent of the population in 2005 were born in a different town). These migrants, though sharing similar general mainstream values with the rest of Bogota residents, also tend to adhere to different social co-existence norms. For instance, a common conflict between Bogota residents and immigrants from other

towns revolves around loud music and disorderly behavior in residential areas. In this sense, it is argued that these conflicts reflect heterogeneity of values among residents, which might hamper their ability to agree on common problems and engage in collective solutions.

The confirmatory PCFA described above yielded a heterogeneity factor in the solution that includes the percent of the population who self-identifies as belonging to an ethnic minority (natural log), the percent of the population who was born in a different town, and the percent of the population that moved from a different town in the five years prior to the census (natural log) (see Table 5), explaining 60.70 percent of the variance in the solution.

Because the concept of ethnic and cultural heterogeneity has not been used in the past to explain crime rates in Colombia, its inclusion in this study is largely exploratory. In general, following the classic social disorganization tradition, it is hypothesized that higher levels of ethnic and cultural heterogeneity in Bogota neighborhoods predict higher homicide rates. However, the bivariate Pearson's correlation between these variables is not statistically significant (see Table 12, Appendix 4). This association will be revisited in the spatial analyses.

Table 5. Ethnic and Cultural Heterogeneity Factor

Variable	Factor Loadings
% Population Moved from a Different Town (NL)	.916
% Population Born in a Different Town	.901
% Population Belongs to Ethnic Minority (NL)	.413
Factor Eigenvalue	**1.821**
% Variance Explained	**60.70**

4.4.3. Residential Mobility

The association between residential mobility and crime rates is so common place in the literature that Bursik (1986) considers that ecological models that do not test for the residential mobility assumption "will not only have limited degree of theoretical power, but they will have

an interpretive framework that is generally unrelated to the dynamics of modern urban areas"

(p.59).

The initial exploratory PCFA described in the introduction to this section produced a fifth factor with only one item loading on it: percent population five-years old or older who changed residence within Bogota in the past five years (square root). This study uses this item (outside of the PCFA context) to measure residential mobility. The measure excludes residents that moved from other towns and countries because these two items loaded on the ethnic and cultural heterogeneity, and concentrated disadvantage and social isolation factors respectively.

The original intent for disaggregating residential mobility in this way was to see whether different types of mobility had different effects on the spatial distribution of homicide rates in Bogota. However, the fact that each type of mobility loaded on a different factor is, again, an interesting finding in and of itself because it has implications for the measurement of social disorganization indicators not only in Bogota, but in the United States as well. Indeed, residential mobility in the United States has been traditionally measured simply as the percentage of people who moved in the past five years, but care has not been taken to look at different types of mobility based on the place of origin: within the city, from another city in the same country, from another country. As it has been argued here, each type of mobility has different implications as they relate to the ability of a community to exercise social control. Furthermore, future research should also include a separate measure of coerced mobility (Clear et al. 2003) by looking at the percentage of residents who have been incarcerated in the past five years. Unfortunately, this information is not available for Bogota at the time of this study.

On average, 26.98 percent (M=26.72) of residents of Bogota neighborhoods moved within the city in the five years prior to the 2005 census. Following the ecological literature this

dissertation hypothesizes that residential mobility has a positive association with homicide rates. Interestingly, though, the bivariate association between homicide rates and residential mobility is not significant (see Table 12, Appendix 4); nonetheless the study will explore the spatial correlation between these two variables before reaching any conclusions about the explanatory power of residential mobility in understanding homicide rates in Bogota.

4.4.4. Social Disorder

There is some debate in the literature as to what actually constitutes disorder in the eyes of residents from different social backgrounds. For instance, in her research on the organizational features of community gardens in the Lower East Side of New York, Martinez (2010) found that newcomers from a middle-class background disagreed with longtime Puerto Rican residents on the aesthetics of community gardens, and assigned negative qualities to traditional ways of protecting vegetable gardens from vermin using wood and barbwire cages. The White, middle-class gardeners felt that the cages reflected "the mistrust, danger, and social disorganization of the neighborhood" (Martinez 2010:57). The existence of divergent perceptions of what disorder entails within small communities has important implications for the study of social disorganization in the international context because it suggests that standard measures may not necessarily translate to other socio-cultural environments.

Skogan (1999) argues that social disorder is signaled by the presence of disruptive social elements such as rowdy teenagers, prostitutes, public drinking, open gambling and drug use. In addition, Triplett and colleagues (2005) argue that the high presence of bars and other alcohol outlets is a sign of social disorder and is consistently associated with crime rates (see also Pridemore & Grubesic 2011) because it hampers residents' willingness to intervene to solve collective problems for three reasons: (1) in areas where bars and nightclubs concentrate, people

tend to be more concerned about their individual safety and are less likely to intervene in situations they normally would under different circumstances; (2) potential victims are dismissed simply as drunks; and (3) social control is ultimately delegated to formal agents such as the police or private security.

Systematic Social Observation is recommended as the most reliable way of collecting data on social disorder (Taylor 2001a; Sampson & Raudensbush 1999, 2001). In the absence of direct field observations, this study utilizes two proxy indicators obtained from the 2005 census: the rate of alcohol outlets per 10,000 residents ($\bar{x}$=13.75, M=8.45), as a proxy measure of public drunkenness and disorderly conduct, and the rate of video game, lotto, and gambling outlets per 10,000 residents ($\bar{x}$=8.18, M=5.43), as a proxy measure of public gambling and congregations of rowdy teenagers. These two items loaded on a single social disorder factor explaining 78.60 percent of variance in the PCFA solution (see Table 6).

Table 6. Social Disorder Factor

Variable	Factor Loadings
Rate of videogame arcades, gambling and lotto outlets per 10K (NL)	.887
Rate of alcohol outlets per 10K (NL)	.887
Factor Eigenvalue	**1.572**
% Variance Explained	**78.60**

Two-item factors are problematic and should be interpreted with caution. Tabachnick and Fidell (2007) suggest that a two-variable factor might be reliable "if the two variables are highly correlated with each other (say, r >.70) and relatively uncorrelated with other variables" (p. 646). Unfortunately, this does not seem to be the case for the proposed social disorder factor. The two items composing it, namely the rate of alcohol outlets (natural log) and the rate of video game, lotto, and gambling outlets (natural log) are strongly correlated (r=.572), but the correlation coefficient does not exceed the .70 threshold proposed by Tabachnick and Fidell above. In

addition, both items present significant correlations that range from moderate to weak with some of the other variables included in the analysis (see Table 3).

Even though the evidence presented here suggests that this factor is rather unreliable, the social disorder proxy index might still be useful in exploring the effects of social disorganization on homicide rates in Bogota, and it is thus included in the analyses below. In fact, the bivariate Pearson's correlation between social disorder and homicide rates is significant, though weak (r=.264, see Table 12, Appendix 4)

4.4.5. Parochial Control

The systemic approach to the ecology of crime proposes that local associational ties, through which social control is ultimately exercised, moderate the proximate causes of social disorganization (disadvantage, isolation, heterogeneity, mobility) (Kornhauser 1978; Sampson et al. 1997; Sampson & Groves 1989). Furthermore, Bursik and Grasmick (1993a, 1993b, 1995) argue that the Systemic Model of Crime Control proposes that community social control takes place at three different but interconnected levels (private, parochial, and public). Local interpersonal networks and institutions such as churches, voluntary organizations, and stores exercise the parochial level of social control. These institutions and organizations play an important role in defining the rules of behavior that are expected within a community and in supervising the behavior of residents and visitors.

The 2005 census long form administered to a sample of residents in Bogota (and the rest of the country) contains questions asking respondents about their participation in community associations and community events. However, this information is only available at the locality level and is thus not useful to understand the effect of the parochial level of control on homicide

rates at the neighborhood level, unless a multilevel analytic framework is utilized, which is beyond the scope of this study.

Nonetheless, the general census collected information on economic census units, including the type of business or service they provide, at the most disaggregated level (i.e. census block). In the absence of direct information about the participation of residents in community associations the study utilizes a dichotomous measure indicating the presence or absence of community, youth, sports, religious, or political associations in the neighborhood (83.3 percent of neighborhoods have at least one such association). This measure was constructed using the type of service delivered by economic census units classified as associations or organizations.

It is hypothesized that the presence of local associations predicts lower average homicide rates. Indeed, a preliminary bivariate analysis shows a significant difference in the mean homicide rates (natural log) in neighborhoods where local associations are present ($\bar{x}$=1.75) and those where associations are absent ($\bar{x}$=2.06) (t(115.03)=2.13, p≤.05).

4.4.6. Public Control

As noted above, the research on the public level of control has been very meager and, consequently, there is no agreement on a single measure of the concept. Indeed, residents' perceptions and satisfaction with the local government's involvement with the neighborhood (Velez 2001); residents' willingness to cooperate with the police and the existence of active police-community partnerships (Taylor 2001a); overall city expenditure per capita (Stucky 2003); residents' connections to city bureaucracies (Carr 2003); and the availability of general services such as parks and playgrounds, neighborhood watch programs, health services, block groups and tenant associations, mental health centers, after-school programs, etc. (Belnar et al. 2008) have all been advanced as measurements of the public level of control.

Bursik and Grasmick (1995) contend that the likelihood of crime is higher in those areas where networks of public control fail to effectively provide services to the neighborhood. According to these authors, there are two types of public services related to crime control. The first type involves a relationship between the neighborhood and the police department, which may have a more direct effect on the ability of a community to control crime. The second type involves relationships with city bureaucracies in charge of allocating quality of life services and may have an indirect effect on the regulatory capacity of neighborhoods. For instance, the distribution of basic services "such as garbage collection, street and sewer repair, physical maintenance of local public facilities, the funding and staffing of educational institutions, safeguards on environmental quality, and so forth" (Bursik and Grasmick 1995:123), are all measures of the ties a community has to the local government.

Moreover, public resources are often limited and neighborhoods must compete with one another to secure needed services. In this way, the systemic model assumes that crime will be more likely in those areas where "the networks of public control cannot effectively provide services to the neighborhood" (Bursik and Grasmick 1993b:279).

This study proposes to measure public control by using indicators of the two types of public services suggested by Bursik and Grasmick (1995). First, the distribution of basic public services is proposed as a measure of the ability of a community to secure resources needed to guarantee a minimum level of quality of life for the residents. As it can be observed in Table 1, the coverage of public services in Bogota is, on average, quite large; however, there is great variation in its spatial distribution across neighborhoods. Thus differences in the availability of basic public services might serve as a proxy measure for the public level of control and might help explain differences in homicide rates across neighborhoods.

The PCFA procedure described above yielded a factor with large loadings from the percent of homes with sewerage service and the percent of homes with electricity service, explaining 91.61 percent of the variance (see Table 7). It is once again important to be cautious with the interpretation of a two-item factor. Nonetheless, unlike the social disorder factor, the correlation patterns suggest that this basic public services factor might be rather reliable. Indeed, the correlation between the two items that loaded in the factor, namely percent of homes with sewerage service (reflected, natural log, re-reflected) and percent of homes with electricity service (reflected, natural log, re-reflected) is quite strong (r=.832). Furthermore, with the exception of the moderate correlation between sewerage and phone service (r=.420), the two items composing the basic public services factor are either uncorrelated or very weakly correlated with the remaining variables in the analysis (see Table 3).

Table 7. Basic Public Services Public Control Factor

Variable	Factor Loadings
% of homes with sewerage service (NL)	.957
% of homes with electricity service (NL)	.957
Factor Eigenvalue	**1.832**
% Variance Explained	**91.61**

It is hypothesized that lower levels of public services coverage are associated with higher homicide rates. This association, though weak, is confirmed at the bivariate level (r=-.177, see Table 12, Appendix 4), and it will be further explored within a spatial and multivariate context.

The second type of public control involves a dichotomous indicator of the presence of police stations and Immediate Response Police Commands (*Comandos de Atención Inmediata*, CAI for its acronym in Spanish)[11] in the neighborhood (20.9 percent of neighborhoods have

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[11] The CAIs are police units with jurisdiction over smaller areas that are aimed at providing a faster response to citizens' calls for service.

either a police station or a CAI in 2005). The Metropolitan Police of Bogota provided data on the location (address) of police stations and CAIs.

Triplett and colleagues (2005) argue, "differences in the provision of services by the police are recognized by members of the neighborhoods and affect both attitudes towards the police and willingness to call or cooperate with the police" (p.93).

It is thus hypothesized that neighborhoods where police are present may be more effective at exercising the public level of control and, therefore, should present lower homicide rates. An independent samples t-test shows a significant difference in mean homicide rates between neighborhoods with a police station or a CAI ($\bar{x}$=2.12) and those without the presence of these police commands ($\bar{x}$ =1.71) (t(567)=-3.719, p≤.001), but in the opposite direction to what it was hypothesized. Indeed, neighborhoods with police presence seem to have higher average homicide rates (natural log). This relationship is further explored in the spatial analysis.

4.5. Control Variables

This section offers a description of variables commonly used in the literature to control for alternative explanations that might account for the variance in the spatial distribution of homicide rates: temporal lag of homicide rate (2000-2002), population density and composition, and land use. In addition, the models control for variables related to crime and political violence in Colombia: population displaced by the conflict, organized crime, criminal structures, and illegal markets.

4.5.1. Temporal Lag of Homicide Rate (2000-2002)

Homicide studies commonly include a temporal lag of the homicide rate to control for the effect of prior levels of homicide (autocorrelation) over time. Mears and Bhati (2006) argue that

"homicides in communities can be relatively stable over time, and ignoring this can yield misleading inferences. First, there may be persisting heterogeneity among the neighborhoods for unmeasured reasons that can depress asymptotic standard errors on all parameters." (p. 524) In addition, this heterogeneity might be associated with the predictors and could potentially bias the parameter estimates.

This study utilizes the first temporal regime identified in section 4.3 to create a temporal lag consistent with the dependent variable: the sum of homicide counts for the years 2000, 2001, and 2002 was divided by the average population size across the three years, and the resulting quotient was multiplied by 10,000. A natural log transformation was used to reduce large positive skewness.

In addition, also consistent with the outcome variable, the deaths caused by two terrorist attacks by the FARC (*Tunjuelito* police station on January 25, 2002, five deaths; and Uribe's Presidential Inauguration on August 7, 2002, 16 deaths) were removed to avoid biasing the analysis.

This dissertation hypothesizes that the 2000-2002 cumulative homicide rate will be associated with the cumulative homicide rate in 2003-2005. The average raw 2000-2002 cumulative homicide rate per 10,000 residents is 15.17 (M=6.73). Note that this average is about five points larger than the mean 2003-2005 cumulative homicide rate ($\bar{x}$=10.82), which suggests a decline in homicides during the six-year period (see Figure 8 above). Nonetheless, there is a strong significant Pearson's correlation between the temporal lag of homicide rates (natural log) and the dependent variable (r=.723, see Table 12, Appendix 4). This association is further evaluated in the Exploratory Spatial Data Analysis section, focusing on whether the same spatial

clustering patterns persist over time, and in the spatial regression analysis assessing the predictive value of the temporal lag.

4.5.2. Population Density and Composition

When analyzing the behavior of crime across ecological units, it is prudent and customary to control for the density and composition of the population. The literature generally finds that crime rates tend to be positively associated to population density and the proportion of young males in the population. This study follows suit by using census information to control for the population density per square kilometer ($\bar{x}$=30,181.40; M=21,031.88), and the percent of males aged 15 to 29 ($\bar{x}$=8.99; M=8.69). Both variables were transformed to improve large positive skewness: population density was normalized using a square root transformation, and population composition was transformed to its natural log.

Interestingly, population density is negatively and moderately associated to the 2003-2005 cumulative homicide rate (natural log) (r=-.337, see Table 12, Appendix 4), and the percent of young males in the population is only weakly associated to the dependent variable (r=.083, see Table 12, Appendix 4). These relationships will be reevaluated in a spatial and multivariate context below.

4.5.3. Land Use Mix Index (LUMI)

Burgess (1984[1925]) theorized that the "zone in transition" was particularly criminogenic in part because the coexistence of different types of urban environments (i.e. commercial, industrial, residential) reduced the likelihood of residents to get attached to the neighborhood and create long lasting networks of social support. In addition, the presence of commerce and/or industry in these areas meant that a large number of people were continuously

coming in and out of the neighborhood, making it more difficult for residents to supervise the behaviors of both visitors and neighbors. The residential areas (zone of workingmen's homes, residential zone, and commuter's zone) are, on the other hand, more organized and less prone to exhibit criminal activity precisely because supervision of behavior there is less complicated. Furthermore, Schuerman and Kobrin (1986) observed that changes in neighborhood crime were preceded by changes in land use. In general, the literature has found a positive association between mixed land use and crime rates.

In addition to information about residents, households and housing units, the 2005 census also collected data on units dedicated to commercial and industrial purposes. In this way, it is possible to calculate the proportion of census units within a neighborhood dedicated to residential ($\bar{x}$=.85; M=.90), commercial ($\bar{x}$=.12; M=.08) or industrial ($\bar{x}$=.01; M=.01) purposes.

This study uses the Land Use Mix Index (Frank, Andresen & Schmid 2004, cited in http://geodacenter.asu.edu/%5Btermalias-raw%5D/land-use-mix-0), a measure of entropy that reflects the evenness of distribution of several land uses within a neighborhood. The Land Use Mix Index (LUMI) is calculated as follows:

$$LUMI = -\sum_i = 1nP_i \times (ln(P_i)/ln(n)), \qquad\qquad (1)$$

where *n* is the number of land use type classes in the region (n=3), P_i is the proportion of census units in type *i* in the region, and *i* represents residential type units.

The resulting index varies from 0 to 1, where values closer to 0 are more homogeneously residential and values closer to 1 are the most mixed ($\bar{x}$=.34; M=.27). The Land Use Mix Index presented significant positive skewness and it was normalized using a square root transformation. There is a weak positive association between the Land Use Mix Index (square

root) and homicide rates (natural log) (r=.27, see Table 12, Appendix 4), suggesting that the more mixed the land use the higher the homicide rates.

4.5.4. Forced Displacement

Colombia has been immersed in an internal armed conflict for almost four decades now. It is calculated that since 1985 between 3.3 and 4.9 million people have been forcefully displaced by the conflict (Serralvo 2011). Most displaced people originate from rural areas or smaller townships and tend to move to the largest cities, including Bogota. Following the arguments regarding the effect of heterogeneity on social organization and social control, their arrival to a complex urban ecosystem could potentially destabilize the receiving communities. Having been exposed to violence they may (1) alienate themselves for fear of experiencing violence again, or (2) be more tolerant of the use of violence to solve interpersonal conflicts. Moreover, it is also possible that their stigma as displaced people makes them easier targets of violence. It is important, then, to control for the effect of forced displacement in any model trying to understand urban violence in Colombia.

A forced displacement index was created using the 2005 census to calculate the percentage of individuals who moved in the past five years due to threats to their lives. The index is limited to persons coming from outside Bogota to better measure the impact of the internal armed conflict on community crime in that city ($\bar{x}$=.34; M=.27). This variable was also normalized using a square root transformation to solve problems of skewness. There seems to be a significant but weak association between forced displacement and homicide rates (natural log) at the neighborhood level in Bogota (r=.252, see Table 12, Appendix 4).

4.5.5. <u>Criminal Structures, Organized Crime and Illegal Markets</u>

Llorente et al. (2001) use the term "criminal structures" to refer to a range of groups dedicated to illegal activities in Bogota that may vary in their levels of organization and in the types of activities they perform, but that share the use of violence as their main means of action to gain control over markets and places. In addition, this term also works to differentiate these criminal groups from drug mafias, guerrillas, and paramilitaries, which in Colombia are considered as manifestations of organized crime.

Between 2003 and 2004, the CEDE research group, led by Maria Victoria Llorente and Rodolfo Escobedo, conducted interviews with the commanders of the 19 police precincts of Bogota (or their delegates) to obtain indications of the presence of several criminal conducts and organizations at the neighborhood level. During the interviews, the researchers showed a matrix containing a list of official neighborhoods to the police commanders and asked them to identify those where the following criminal structures, organized crime groups, or illegal markets were present: gangs (37.2 percent of neighborhoods have a gang), contract killing "offices" (*oficinas de sicarios*—25.1 percent), social cleansing (5.6 percent), FARC militias (8.9 percent), paramilitary cells (16.7 percent), arms trafficking (19.3 percent), drug distribution (72.8 percent), and chop shops (30.4 percent). The data was then coded as 1 to indicate the presence or 0 to indicate the absence of these groups or markets in each neighborhood. Contract killing offices and social cleansing were combined in an indicator of selective murder groups (present in 26.1 percent neighborhoods). The rest of the variables are included in the analysis without combining them in the hopes of assessing the effects of different types of criminal structures on the neighborhood homicide rates.

Preliminary independent-samples t-test analyses showed that, with the exception of the presence of gangs and FARC militias, all other indicators of criminal structures, organized crime and illegal markets significantly predict higher average homicide rates (see Table 8).

Table 8. Cumulative Homicide Rate (LN) Mean Differences across Criminal Structures, Organized Crime, and Illegal Markets

	N	Mean	Std. Dev.	t-test
Gangs				$t(567)=-1.26^{n.s.}$
No	358	1.76	1.11	
Yes	211	1.87	.98	
Selective Murder Groups				$t(567)=-4.43^{***}$
No	420	1.68	1.04	
Yes	149	2.13	1.07	
FARC Militias				$t(567)=-1.19^{n.s.}$
No	518	1.78	1.07	
Yes	51	1.97	1.09	
Paramilitary Cells				$t(567)=-2.83^{**}$
No	474	1.74	1.04	
Yes	95	2.08	1.18	
Drug Distribution				$t(567)=-2.78^{**}$
No	155	1.60	1.03	
Yes	414	1.87	1/07	
Chop Shops				$t(567)=-3.03^{**}$
No	396	1.71	1.09	
Yes	173	2.00	.99	
Arms Trafficking				$t(567)=-3.33^{***}$
No	460	1.73	1.04	
Yes	109	2.10	1.15	

$***p\leq.001$; $**p\leq.01$; $*p\leq.05$; n.s. not significant. Two-tailed.

4.6. Data Analysis

The plethora of geographic data collected by all sorts of agencies and the development of sophisticated Geographic Information Systems (GIS) have made the use of spatial techniques more common in the study of social phenomena. Moreover, following Tobler's *first law of geography*, according to which "everything is related to everything else, but near things are more related than distant things" (Anselin 1996:112), research on the spatial dimensions of social problems has shown that spatial dependence is usually to be expected (Anselin 1996).

Indeed, the literature shows that homicide rates in the United States generally present such patterns of spatial dependence or autocorrelation (see Baller et al. 2001; Cohen & Tita

1999; Kubrin & Weitzer 2003; Mears & Bhati 2006; Messner et al. 1999). According to Messner and colleagues (1999), these patterns are generated by so-called "contagious transmission," a process that uses social networks and communication flows to spread information about the occurrence of violent events in one neighborhood to its surrounding areas, thus influencing violence in those nearby communities in a nonrandom geographic way.

This study utilizes Exploratory Spatial Data Analysis (ESDA) techniques to explore the spatial distribution of homicide rates in Bogota and determine whether patterns of spatial dependence or spatial heterogeneity exist; and Spatial Regression Analysis (SRA) to explore the effects of social disorganization and public control on homicide rates, controlling for potential spatial dependence.

4.6.1. Exploratory Spatial Data Analysis (ESDA)

Exploratory Spatial Data Analysis (ESDA) is a combination of graphical and statistical techniques that allow the researcher to visualize and describe spatial distributions, and detect spatial patterns, spatial clusters, and spatial outliers (Anselin 1996). ESDA techniques include the estimation of global and local statistics of spatial autocorrelation such as Moran's I and Local Indicators of Spatial Association (LISA), and visualization methods such as Moran scatterplots and LISA maps. This study employs the open source software $GeoDa^{TM}$, a trademark of Luc Anselin, to conduct all ESDA analyses. ESDA in $GeoDa^{TM}$ employs an interactive framework known as linking or brushing, which allows dynamically linking different views of the data (e.g., scatterplots, boxplots, maps, or histograms), so that when a specific case is selected in one view of the data (say, the Moran scatterplot) the same case will be highlighted in the remaining open views of the data (say, the LISA map and the boxplot). In addition, the software offers the option

to exclude selected cases from analyses (say, the calculation of the slope in the Moran scatterplot) to look at the influence a potential outlier is exercising over coefficients.

4.6.1.1. Global Measure of Spatial Autocorrelation: Moran's I

The first step in the ESDA process is to test the null hypothesis of spatial randomness by estimating whether spatial autocorrelation is present in the data. The global Moran's *I* is perhaps the most frequently used method to test for spatial dependence (Baller et al. 2001). Formally, Moran's *I* indicates "the degree of linear association between a vector of observed values *y* and a weighted average of the neighbouring (sic) values, or spatial lag, W_y" (Anselin 1996:115).

In this context, *W* is an $n \times n$ positive and symmetric spatial weights matrix that defines the structure of nodes and neighbors assumed to underlie the random spatial processes (Anselin 2002; Anselin & Bera 1998). Neighbors are set to have a value equal to one, while nodes (the diagonal elements of the matrix) are set to have a value equal to zero (a unit cannot be a neighbor to itself). It is common practice to standardize the spatial weights matrix by dividing the weight of each neighbor (w_{ij}=1) by the total number of neighbors, so that the elements of a row sum to one. For instance, if a node has four neighbors, each neighboring unit will have a weight of 0.25 (or 1/4). "This ensures that all weights are between 0 and 1 and facilitates the interpretation of operations with the weights matrix as an averaging of neighboring values" (Anselin & Bera 1998:243).

In addition, weights matrices can be specified using either contiguity or distance criteria. There is no formal recommendation in the literature as to which criterion is more desirable (Anselin 2002), therefore, the selection of a weights matrix should be informed by theory and the hypothesized spatial processes expected to underlie the data. As it was briefly noted earlier, this study employs a row-standardized second-order queen contiguity matrix (see Figure 9 above) for

reasons that are practical—units vary widely in size—and theoretical—a spatial diffusion or spillover effect is expected to explain the spatial distribution of homicide rates in Bogota—in nature.

The global Moran's *I* statistic can be formally expressed as "a weighted, scaled cross-product:

$$I = \frac{n\sum_i\sum_{j\neq i}w_{ij}(y_i-\bar{y})(y_j-\bar{y})}{(\sum_i\sum_{j\neq i}w_{ij})\sum_i(y_i-\bar{y})^2}, \qquad\qquad (2)$$

where *w* denotes the elements of the row-standardized weights matrix **W** and *y* is the variable of concern" (Ward & Gleditsch 2008:23). Note that the observations in Moran's *I* are conceptualized as deviations from the mean. The expected value of Moran's *I* if the null hypothesis of spatial randomness is true is -1/(n-1) (or -.0018 in this study) rather than 0. Thus positive autocorrelations are observed when neighboring units experience similar levels of a given phenomenon (spatial dependence), while negative associations signal that neighboring units have dissimilarities in the levels of the variable being measured (spatial heterogeneity). For instance, a pattern of spatial dependence implies that a node with high homicide rates is in the vicinity of neighborhoods with similarly high homicide levels, whereas a pattern of spatial heterogeneity indicates that a node with high homicide rates has neighbors with low homicide rates (Cohen & Tita 1999).

Now, because spatial data violate the classical sampling theory assumption of independence of observations, inferences cannot be made based on a uniform distribution. Instead, estimation and inference in spatial data analysis must rely on random permutations that reshuffle the observed values over space to estimate how likely the actual spatial distribution would be. In other words, as it was discussed earlier, because of spatial dependence, spatial data cannot be considered as a sample or even a population, but instead they are conceptualized as a

single realization of a random process. The randomization exercise produces a reference distribution of possible combinations of values over space. The observed coefficient, in this case Moran's *I*, is then compared to the reference distribution to determine the likelihood that it could stem from a random distribution (Anselin & Bera 1998). This process produces pseudo-significance levels based on the number of permutations performed (up to 49,999 in *GeoDa*™). According to the *GeoDa*™ *Center*'s website:

> The pseudo significance is computed as $(M+1)/(R+1)$ where R is the number of replications and M is the number of instances where a statistic computed from the permutations is equal to or greater than the observed value (for positive local Moran) or less or equal to the observed value (for negative local Moran). (http://geodacenter.asu.edu/node/390#ppvalue).

4.6.1.2. The Moran Scatterplot

Anselin (1996) proposes that Moran's *I* can be interpreted as a regression coefficient of W_y on *y*, which allows visualizing the linear association between *y* (on the x-axis) and its spatial lag, W_y, (on the y-axis) in the form of a bivariate scatterplot. The slope of the linear regression in the plot corresponds to the value of Moran's *I*.

In this way, the Moran scatterplot can be used to identify pockets of positive and negative association, outliers and leverage points, and spatial regimes. Indeed, the quadrants in the Moran scatterplot represent different types of spatial correlation: the quadrants in the upper right (associations between values above the mean, or high-high correlations) and the lower left (associations between values below the mean, or low-low correlations) represent positive spatial correlation, while the quadrants in the upper left (low values surrounded by high values) and the lower right (high values surrounded by low values) represent negative spatial association (see Figure 11). The relative densities of these quadrants provide valuable information as to the extent to which the global measure of spatial autocorrelation is dominated by one pattern or the other.

In addition, the presence of both positive and negative patterns of association suggests that spatial regimes may be present and, thus, the global Moran's *I* might be a poor indicator of the dependence process in the data. Moreover, an examination of points in the scatterplot that fall far away from the central tendency of the regression line allows for the identification of spatial outliers, or cases that do not follow the general pattern of spatial dependence (Anselin 1996).

Figure 11. Moran Scatterplot

Low-High	High-High
Low-Low	High-Low

W_y

y
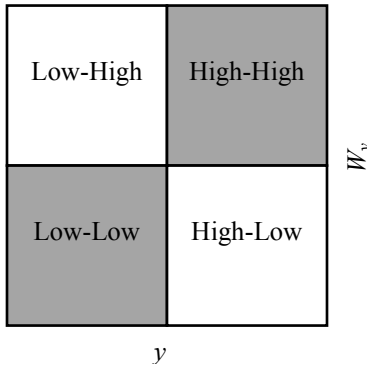
4.6.1.3. Local Indicators of Spatial Association (LISA)

Although the global Moran's *I* helps determining whether there is a general pattern of spatial dependence in the whole study region, it is not very useful in identifying the specific source of the autocorrelation when there is heterogeneity in spatial dependencies. Local Indicators of Spatial Association (LISA) (also known as local Moran statistics) disaggregate the global indicator of correlation by calculating indicators of spatial association between each unit and the average of its neighbors (Baller et al. 2001). Formally, the LISA statistic for an observation *i* can be expressed as

$$I_i = (z_i/\textstyle\sum_i z_i^2)\textstyle\sum_j w_{ij} z_j, \tag{3}$$

where *z* refers to the observation in deviations from the mean and w_{ij} refers to the spatial weights matrix. Similar to Moran's *I*, inference for LISA statistics is based on a randomization process that holds the value of *y* at location *i* fixed (i.e. not used in the permutation) while the values of

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the neighbors are randomly permuted over space. This is known as conditional randomization (Anselin 1995).

LISA statistics are a more efficient tool in identifying spatial clusters and spatial outliers. Indeed, local spatial clusters can be identified as those contiguous areas for which LISA is significant, while outliers, or "locations that contribute more than their expected share to the global statistic" (Anselin 1995:97), can be observed when local values are very different from the mean. The average of LISA will be approximately equivalent to the global Moran's I, so extreme cases can be identified using the two standard deviations rule (Baller et al. 2001).

4.6.1.4. LISA Maps

Local Indicators of Spatial Association can be visualized using significance and cluster maps. Significance maps show locations with significant LISA (color-coded by their significance level), while cluster maps classify those areas with significant local autocorrelations according to the type of association they exhibit or, in other words, their location in one of the Moran scatterplot's quadrants (Anselin, Syabri & Kho 2006; Baller et al. 2001).

In addition to aiding in the identification of local clusters of spatial autocorrelation, LISA maps are also useful in identifying spatial outliers (locations with High-Low or Low-High patterns of spatial association) "that are *significant* in the sense that these patterns are highly unlikely (at the chosen significance level) to have occurred as the outcome of a spatially random process" (Messner et al. 1999:425).

4.6.1.5. Bivariate Global and Local Spatial Correlation

The foregoing discussion has focused on univariate ESDA techniques. However, the Moran and LISA statistics can also be used in a bivariate context. Indeed, Anselin, Syabri and Smirnov (2002) propose an extension of Moran's I to look at "the extent to which values for one

variable (z_k) observed at a given location show a systematic (more than likely under spatial randomness) association with another variable (z_l) observed at the "neighboring" locations" (p. 4). In other words, the bivariate Moran's *I* estimates the correlation between the spatial lag of one variable and a second variable of interest. Anselin and colleagues (2002:5) formally define the bivariate Moran's *I* as

$$I_{kl} = z'_k w z_l / n, \tag{4}$$

where *z* are the standardized variables, *W* is the row-standardized spatial weights matrix, and *n* is the number of observations.

The bivariate Moran's *I* can also be visualized in scatterplot form, where the spatial lag of variable *l* is displayed in the y-axis and the standardized variable *k* is depicted in the x-axis. In this way, the slope represents the regression coefficient of the spatial lag of *l* regressed on *k*. Inference here is also based on a randomization approach.

Similarly, the LISA statistic can also be generalized to a bivariate local measure of spatial association. The bivariate LISA test estimates the degree of linear association between the spatial lag of a variable and the value of another variable at a given location *i*. A positive bivariate LISA indicates a spatially similar cluster in the two variables, and a negative value suggests that there is dissimilarity in the spatial clustering of the two variables. Anselin and colleagues (2002:6), define the bivariate LISA as:

$$I^i_{kl} = z^i_j \sum_j w_{ij} z^j_l, \tag{5}$$

using the same notation as in equation (4). Bivariate Moran's *I* and LISA statistics are used in this study to explore bivariate spatial relationships between the dependent variable and continuous predictors.

4.6.1.6. Conditional Maps

Conditional maps are useful to visualize potential interactions between two variables in the way they relate with a third variable of interest. This technique creates subsets of the data based on two conditioning variables. A micromap is created for a third variable within each of the subsets (in a 3×3 matrix), displaying the behavior of that variable within different levels of the other two (Anselin 2004). Interactions are present when the distribution of a micromap in a subset differs from the rest (the conditioning ranges can be controlled by the analyst in *GeoDa*[TM]) (https://geodacenter.asu.edu/node/390#c).

This study hypothesizes that the parochial and public levels of control moderate the effect of some of the proximate causes of social disorganization (disadvantage and isolation, and social disorder) on homicide rates in Bogota. Conditional maps are employed to explore this hypothesis and decide whether to include interaction effects in the spatial regression analysis.

4.6.2. Spatial Regression Analysis (SRA)

It is today widely recognized that classic Ordinary Least Squares (OLS) regression is inappropriate when analyzing lattice (or area) data, because spatial data usually violate the assumptions of homogeneity of variance (i.e. observational areas are generally of different size thus causing the residuals to be heteroscedastic), and independence of residuals (i.e. spatial units are usually correlated to their neighbors). The violation of these laws of OLS yields biased, inconsistent, and inefficient regression coefficients because the standard errors are overestimated for positive values and underestimated for negative values, making the tests of significance partial toward rejecting the null hypothesis. In addition, R^2 estimates are exaggerated and, therefore, inferences are incorrect (Loftin 1983). In brief, "ignoring spatial dependence will tend to underestimate the real variance in the data" (Ward & Gleditsch 2008:10).

Spatial Regression Analysis pays explicit attention to the location and arrangement of geographic units by including in the model a spatial weights matrix that reflects the expected geographic processes. In addition, due to the constraints described above, "classical sampling theory no longer holds for spatially autocorrelated data, and estimation and inference" must rely on Maximum Likelihood Estimation, which selects the values of model parameters that produce the distribution with the greatest probability of representing the observed data (Anselin & Bera 1998:253-255).

Assuming a pattern of spatial dependence is detected during the ESDA, the next step in building a spatial regression model is to select the most appropriate specification. Two main approaches are suggested in the literature: the *spatial lag* and the *spatial error* models.

4.6.2.1. Spatial Lag Model

A *spatial lag* model is recommended when the analyst has evidence that a pattern of spatial dependence exists (the values of *y* in location *i* are suspected to be influenced by the values of *y* in *i*'s neighbors), and the effect is above and beyond other predictors specific to *i* (Ward & Gleditsch 2008). In a *spatial lag* model the spatial dependence is entered into the model as an additional covariate, "a so-called spatial lag, or weighted average of values for the dependent variable in "neighboring" locations" (Baller et al. 2001: 566).

The spatially lagged model can be expressed as:

$$y = \rho w_y + x\beta + \epsilon$$

$$\epsilon \sim N(0, \sigma^2 I) \tag{6}$$

where *y* is a vector for the dependent variable, ρ is the coefficient of the spatially lagged dependent variable *y*, *W* is the connectivity matrix used to represent the pattern of interactions at locations *i* and *j*, *X* is an n × (k + 1) matrix of predictor variables augmented by a column of

ones to represent the intercept, β is a $k \times 1$ vector of parameters, and ϵ is a vector of disturbances assumed to be independent and normally distributed with a mean=0 and constant variance (Ward & Gleditsch 2008). If $\rho = 0$, there is no spatial dependence and the OLS regression model is appropriate. However, if $\rho \neq 0$, there is spatial dependence and OLS is inappropriate.

The interpretation of the β coefficients in spatial lag models differs from that in OLS in that the spatially lagged model assesses the effect of x on y, while controlling for the extent to which the value of y in neighboring units j influences the value of y in unit i (Ward & Gleditsch 2008).

4.6.2.2. Spatial Error Model

A *spatial error* model is more appropriate if the researcher suspects that spatial dependence is present for unmeasured reasons. This type of model treats dependence as nuisance and not as an explanatory factor. In the words of Baller and colleagues (2001), spatial autocorrelation in the error terms "is indicative of omitted (spatially correlated) covariates that if left unattended would affect inference" (p.566).

Ward and Gleditsch (2008) formally define the *spatial error* model as:

$$y_i = x_i\beta + \lambda w_i \xi_i + \epsilon_i, \tag{7}$$

where ϵ is a spatially uncorrelated error term that would fulfill the OLS assumption of independence of residuals, ξ represents the spatial component of the error term, and λ indicates the extent to which the spatial elements of the error ξ are autocorrelated for nearby observations, as defined by the weights matrix w. If $\lambda = 0$, the residuals are independent and the conventional OLS model can be estimated. However, if $\lambda \neq 0$ the residuals are correlated and OLS would be inappropriate.

4.6.2.3.Spatial Lag vs. Spatial Error Models

The choice between a *spatial lag* versus a *spatial error* model is not always straightforward. In addition to regression diagnostics such as the Jarque-Bera test of normality of errors (if significant, residuals are not normally distributed), and the Breusch-Pagan test for homoscedasticity of residuals (if significant, errors are heteroskedastic), *GeoDa*[TM] includes some functionality that allows obtaining spatial diagnostics when running a classic OLS model. The OLS output produces a battery of six diagnostics to test for spatial dependence including the Moran's *I* to test for the spatial autocorrelation in the residuals after the effect of the predictors has been controlled for (if significant, spatial dependence exists in the data), the Lagrange Multiplier (lag) and its robust variant to test for a missing spatially lagged dependent variable in the possible presence of error dependence (if significant, a spatial lag model is preferable), and the Lagrange Multiplier (error) and its robust version to test for error dependence if a spatially lagged dependent variable is missing (if significant, a spatial error model is preferable). In addition, if both lag and error robust LMs are significant, the largest value suggests the most likely model (Anselin 2004).

Nonetheless, the selection of one model over the other based solely upon the revision of these diagnostics can be difficult. The literature suggests that if spatial dependence is detected in the OLS model then both spatial lag and spatial errors models be attempted (Anselin 2002, 2004; Anselin & Bera 1998; Ward & Gleditsch 2008). The selection of one over the other could be made based on goodness of fit statistics such as the Log Likelihood value (the higher the value, the better the fit), and more robust tests that are not sensitive to the number of parameters in the model such as the Akaike Information Criterion (AIC) and the Schwarz Criterion (SC) (the smaller the value the better the fit). In addition, *GeoDa*[TM] provides a Likelihood Ratio Test

comparing the spatial model to the OLS regression, which, if significant, indicates that the spatial model is a better fit.

In the end, though, the decision should be based on the theoretical question posed by the study. If the study expects to find feedback in the dependent variable among observations, then the spatial lag model is more appropriate. If the research, on the other hand, believes that there is a spatial pattern that is reflected in the error term but that is unmeasured in the model, then the spatial error model is a better option.

This study hypothesizes that a feedback effect in the dependent variable is behind the spatial distribution of homicide rates in Bogota. However, for the sake of thoroughness, the study first explores OLS models with spatial diagnostics, and then it attempts to fit both spatial lag and spatial error models. Conclusions are made based both on statistical evidence and the theoretical basis of the study. In addition, the models are built in a sequential manner starting with the control variables (except for the temporal lag of homicide rates), then introducing the ecological predictors, and finally entering the temporal lag of homicide rates. Since the temporal lag and the outcome variable are highly correlated (r=.72, see Table 12 in Appendix 4), this predictor was expected to explain a large portion of the variance on the cumulative homicide rate and was thus introduced last so that the study would be able to more clearly discern the contribution of ecological variables to the models.

CHAPTER 5. EXPLORATORY SPATIAL DATA ANALYSIS

This chapter presents the results of the Exploratory Spatial Data Analysis procedures discussed in the previous section. The chapter is divided into four sections. The first section explores the temporal stability in the spatial clustering of homicide rates by comparing the LISA maps of the raw rates across the six years under study. The second section examines the univariate spatial distribution of the dependent variable and the quantitative predictors using the Moran's *I* statistic, Moran's scatterplots, and Local Indicators of Spatial Association (LISA) maps. The spatial distribution of dichotomous predictors is examined using simple choropleth (or thematic) maps. The analysis of the spatial data in this section is complemented with information from Escobedo's (2005) field notes from interviews with the police. The third section examines bivariate correlations between the spatially lagged dependent variable and the predictors using the bivariate Moran's *I* statistic and bivariate LISA maps. Finally, the last section assesses the effect on the criterion of potential interactions between predictors by looking at Conditional LISA maps.

5.1.   Temporal Stability in the Spatial Clustering of Homicide Rates, 2000-2005

Table 2 in chapter 4 shows the Moran's *I* statistics, using a second-order queen contiguity matrix, for the annual raw homicide rate for each of the years under study. The global spatial correlation is significant for all years, varying from a low of .14 in 2000 and 2001, and a high .21 in 2005. This suggests that there is a general pattern of spatial dependence in the distribution of homicide rates that is somewhat stable across the study period. However, as mentioned before, the global Moran's *I* is not very efficient at identifying the source of the autocorrelation when spatial regimes exist in the data. Thus Local Indicators of Spatial Association (LISA) are used to

disaggregate the global coefficient into the localized correlation between each unit and the average of its neighbors.

Figure 12 presents the LISA maps for the raw (untransformed) homicide rate for each of the years included in the analysis. Red clusters represent the concentration of neighborhoods with above average homicide rates or "high-high" spatial correlations; dark blue clusters denote the concentration of neighborhoods with below average homicide rates or "low-low" spatial correlations; light blue areas are neighborhoods with below average homicide rates surrounded by communities with above average rates or "low-high" spatial correlations; pink areas are neighborhoods with above average homicide rates surrounded by areas with below average rates or "high-low" spatial correlations; and white areas represent non-significant spatial relationships.

Although most of the city is characterized by non-significant local autocorrelations, spatial regimes can be identified for each of the six years under study. In general terms, the LISA statistics present a pattern of positive spatial autocorrelation, with low-low clusters found primarily in the north of the city, and a very stable high-high cluster[12] in the downtown area.

This latter cluster contains 16 neighborhoods that are consistently classified as high-high throughout the study period, and includes five neighborhoods from the *Santa Fe* locality[13], eight neighborhoods from the *Los Martires* locality [14], and three neighborhoods from the *La Candelaria* locality[15]. At the center of the cluster is the neighborhood *La Capuchina* (see Map 12.1).

When the Spanish first arrived in Bogota in 1538, they settled in what is today known as *La Candelaria*. Throughout the colony the city started growing around this locality, and most of

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[12] Because the data used for these maps are the raw homicide rates, which are highly positively skewed, the high-high cluster here denotes the most extreme homicide rates throughout the study period.
[13] La Alameda, La Capuchina, Las Cruces, San Bernardo, and Veracruz.
[14] El Liston, La Estanzuela, La Favorita, La Pepita, La Sabana, San Victorino, Santa Fe, and Voto Nacional.
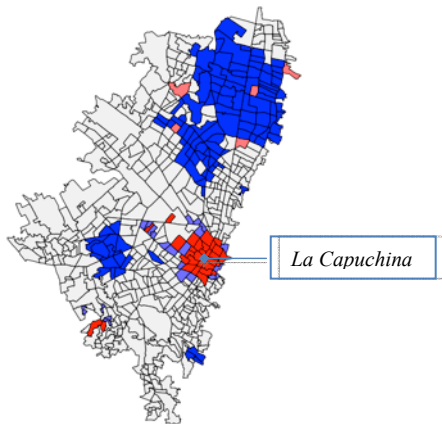[15] Centro Administrativo, La Catedral, and Santa Barbara.

the neighborhoods included in the high-high cluster were affluent well into the mid-20th century, when the assassination of a popular presidential candidate in 1948 led to looting and violence, which practically destroyed the downtown area. The zone then experienced a period of gradual decay as the upper- and middle-class residents moved to the north of the city, and new settlers arrived from violence-ravaged rural areas (a bus terminal formerly located here facilitated these settlements [Góngora & Suárez 2008]) and from lower-income neighborhoods. By the 1980s the *Santa Inés* neighborhood (merged to *La Capuchina* for the purposes of this study) in the *Santa Fe* locality had experienced the most extreme case of deterioration. After years of disinvestment, the rundown tenements in the neighborhood were gradually taken over by homeless people, drug dealers, heavy drug-users, arms traffickers, prostitutes, and other criminal elements. The zone was commonly known as *El Cartucho*, and it was infamous for its dangerousness, so much so that not even the police would dare enter it (Góngora & Suárez 2008).

The story of downtown Bogota exemplifies the process of social decay brought about by the proximate correlates of social disorganization: residential mobility (upper- and middle-class flight), concentration of poverty (general disinvestment and arrival of low-income residents), and heterogeneity of values (influx of people from different rural areas who were escaping the mid-century violence).
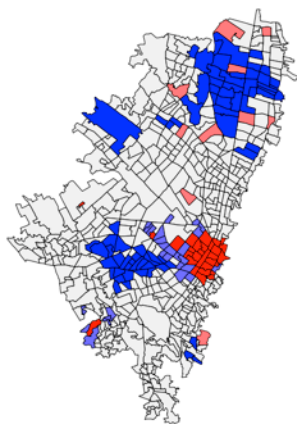
Between 1998 and 2000 the administration of Mayor Peñalosa evicted *El Cartucho* residents, razed the whole area to the ground, and built a 16.5 hectares park (*Parque Tercer Milenio* – Third Millennium Park) on the recovered land. The strategy was inspired by situational crime prevention principles adhered to by the administration, and it was mainly aimed

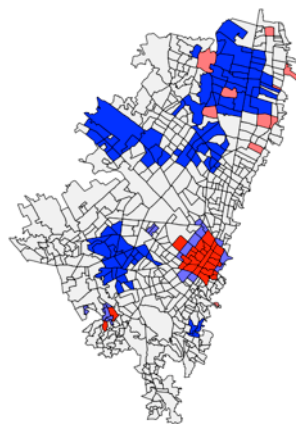**Figure 12. Temporal Stability in Homicide Rates Spatial Clustering (2000-2005 LISA Maps*)**
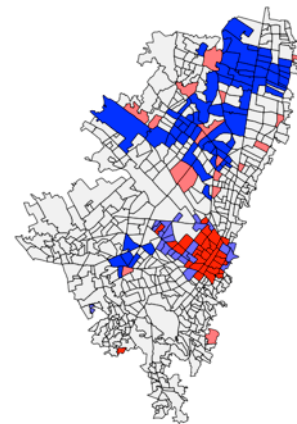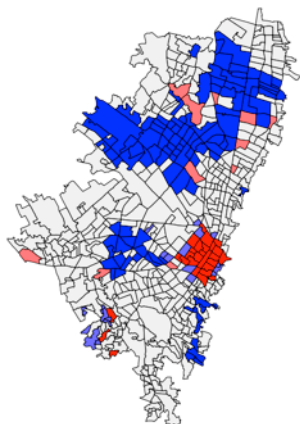
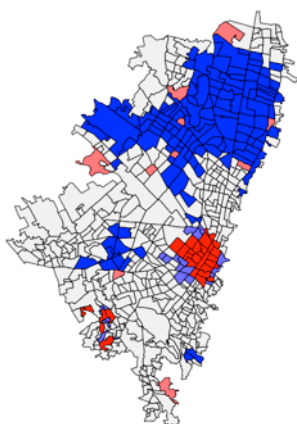**12.1. Homicide Rate 2000**   **12.2. Homicide Rate 2001**   **12.3. Homicide Rate 2002**   **12.4. Homicide Rate 2003**

La Capuchina

12.5. Homicide Rate 2004   **12.6. Homicide Rate 2005**

Not Significant
High–High
Low–Low
Low–High
High–Low

N

*Empirical pseudo-significance based on 9,999 random permutations, pseudo-p≤.05.

at disrupting the drug markets that had engendered so much violence in the zone (Góngora &

Suárez 2008).

Nonetheless, the main shortcoming of the specific approach to *El Cartucho* was that the

individuals who were evicted from there were not offered a relocation plan including housing or

job options. Therefore, instead of eliminating it, the problem was displaced into the surrounding

neighborhoods.

The maps in Figure 12 show a process of contagious diffusion of homicide rates in the

downtown area of Bogota, which originates from *La Capuchina/Santa Inés*. Even after the

measures taken by the Peñalosa administration, this area continued to be at the center of the

high-high downtown homicide cluster throughout the 2000-2005 period.

5.2.   Spatial Distribution of Outcome and Predictor Variables

Table 9 shows the global Moran's *I* spatial correlations for the outcome and the

continuous predictor variables. All spatial correlations are significant (pseudo-p≤.0001) and

positive with varying degrees of strength. Indeed, the strongest spatial autocorrelation is

exhibited by the concentrated disadvantage and social isolation index (*I*=.60), while the weakest

is observed in the population composition variable (*I*=.07). The remaining spatial correlations

vary from weak to moderate, and the outcome variable, the natural log of the cumulative

homicide rate (2003-2005), presents a moderate spatial autocorrelation (*I*=.25) (see Moran

Scatterplots in Figure 17, Appendix 2). These statistics suggest that the variables included in the

study present a general pattern of spatial dependence whereby the scores in a given

neighborhood *i* are influenced by the scores in neighboring units *j*.

Figure 13 presents the LISA maps for each of the variables summarized in Table 9. In

addition to presenting significant local spatial autocorrelations, the maps highlight in yellow the

neighborhoods that are univariate (not spatial) outliers in the cumulative homicide rate (2003-2005, natural log). Indeed, through a brushing procedure it was possible to highlight in all maps those neighborhoods that had a cumulative homicide rate (natural log) at least two standard deviations larger than the mean (n=19, including 10 identified as persistent high-high in Figure 12). When these univariate outliers were excluded from the calculation of the cumulative homicide rate's global Moran's I, the spatial correlation was reduced from .25 to .21. Thus, though these outliers are influencing the spatial autocorrelation, they are not necessarily driving it, which justifies keeping them in the analysis.

Table 9. Global Moran's I[†]

Variable	I Statistic
Dependent Variable	
Cumulative Homicide Rate (2003-2005)	.25*
Independent Variables	
Concentrated Disadvantage and Social Isolation	.60*
Ethnic and Cultural Heterogeneity	.31*
Residential Mobility	.17*
Social Disorder	.15*
Basic Public Services Public Control	.25*
Control Variables	
Temporal Lag Cumulative Homicide Rate (2000-2002)	.26*
Population Density per Km^2	.19*
Population Composition (Young Males)	.07*
Land Use Mix Index	.32*
Forced Displacement	.30*

[†]Empirical pseudo-significance based on 9,999 random permutations.
*pseudo-p≤.0001.

5.2.1. Spatial Distribution of the Cumulative Homicide Rate (2003-2005)

Map 13.1 shows the distribution of LISA statistics for the cumulative homicide rate (2003-2005, natural log). Although, once again, most of the city presents a pattern of non-significant spatial local correlations, clear regimes can be identified. In general terms, the north and west of the city are characterized by low-low spatial correlations, with a number of high-low spatial outliers (neighborhoods with above average homicide rates surrounded by neighborhoods

with below average homicide rates). The map also displays a few low-high spatial outliers (neighborhoods with below average homicide rates surrounded by units with above average homicide rates) around the downtown area and in the south of the city. When these spatial outliers were excluded from the calculation of the spatial correlation, the value of Moran's *I* experienced a slight increase to .29. As before, because the spatial association does not dramatically change when the spatial outliers are excluded, it was decided to keep these cases in the forthcoming analyses.

The spatial distribution of the outcome variable shows three significant high-high clusters accounting for 19.16 percent (n=109) of neighborhoods in the analysis. The first cluster is not surprisingly located in the downtown area of Bogota and includes practically all neighborhoods in the *Santa Fe* (n=20), *Los Martires* (n=16), and *La Candelaria* (n=6) localities, plus one neighborhood from *Chapinero*, two from *Antonio Nariño*, four from *San Cristobal*, and one from *Puente Aranda*. The center of the cluster highlights in yellow those neighborhoods with extreme cumulative homicide rates, with *La Capuchina/Santa Ines* at the core of it. According to the field notes from interviews with the police provided by Escobedo (2005), most of the homicides that took place in these downtown neighborhoods in 2003 and 2004 were the outcome of retaliations and turf wars among drug gangs, some of which also engaged in social cleansing, particularly against homeless people. Several of these neighborhoods have bars, brothels, seedy striptease clubs, and gambling outlets [16], and a proportion of homicides were related to alcohol consumption and interpersonal assaults that took place in these establishments. Escobedo's interviewees also reported the presence of paramilitaries in the neighborhoods of *Los Martires*
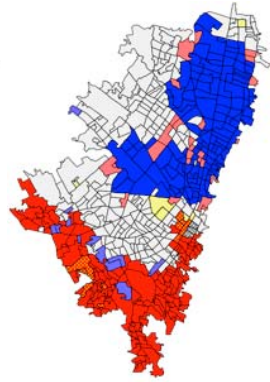
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[16] It is important to note that both prostitution and gambling are legal in Colombia.

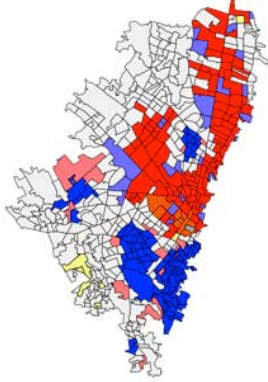**Figure 13. Univariate LISA Maps***
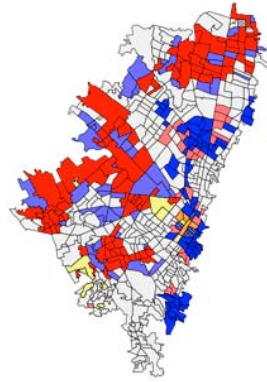
13.1. Cumulative Homicide Rate 2003-2005
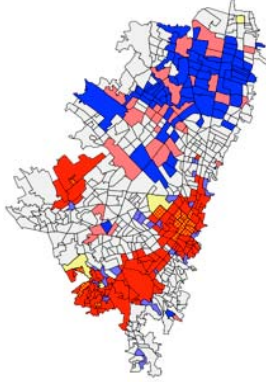
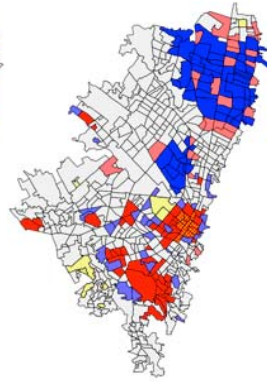**13.2. Concentrated Disadvantage & Social Isolation**

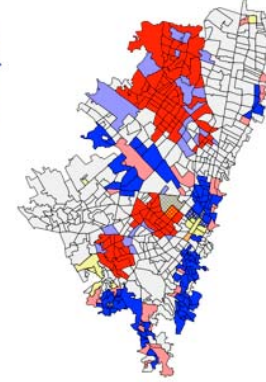**13.3. Ethnic & Cultural Heterogeneity**
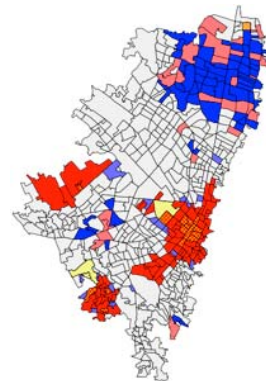
13.4. Residential Mobility
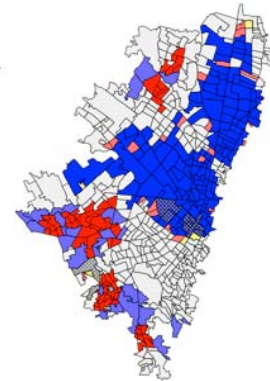
13.5. Social Disorder

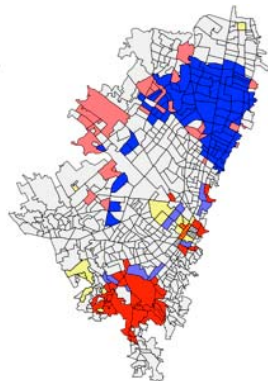**13.6. Basic Public Services Public Control**

13.7. Temporal Lag Cumulative Homicide Rate (2000-2002)

13.8. Population Density
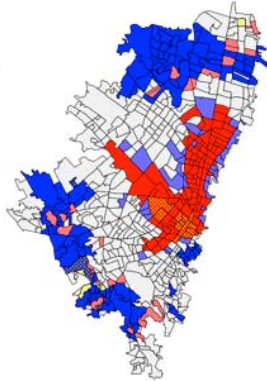
13.9. Young Males
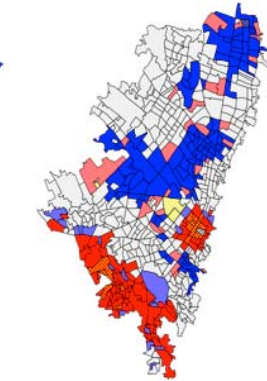
13.10. Land Use Mix Index

13.11. Forced Displacement

Not Significant
High-High
Low-Low
Low-High
High-Low
DV Outlier

N

*Empirical pseudo-significance based on 9,999 random permutations, pseudo-p≤.05.

locality that are included in the high-high cluster. These groups were said to control the brothels and drug distribution in the area, engage in social cleansing against street criminals, and extort money from local businesses for "protection." In addition, according to a former resident of *El Cartucho* interviewed by Góngora and Suárez (2008), the police also occasionally engaged in social cleansing operations in that neighborhood.

Furthermore, a recent news report claims that the criminal activities that used to take place in *El Cartucho* have been displaced to two areas contiguous to the Third Millenium Park: the street known as *El Bronx* located in the *Los Martires* locality, and the neighborhood *San Bernardo* in the *Santa Fe* locality. According to the report, the Metropolitan Police of Bogota estimates that 90 percent of the drugs that are distributed in the city originate from *El Bronx* and violence is as rampant there as it was in *El Cartucho* during the 1990s (Ardila 2011, September 4). Thus this high-high cluster continues to be a problem even today, and because the analyses utilized a second-order queen contiguity matrix, it can be argued that the high levels of violence experienced in the areas surrounding the former *El Cartucho* have had a long reach influencing homicide rates in all directions.

The second high-high cluster is located directly south from the downtown area. This cluster consists of five neighborhoods from *San Cristobal*, three from *Tunjuelito*, one from *Antonio Nariño*, 11 from *Rafael Uribe*, and 27 from *Ciudad Bolivar*. Interestingly, unlike what was observed with the first cluster, the neighborhoods with the most extreme homicide rates (highlighted in yellow) are not located at the center of the cluster but in its periphery, all of them in the *Ciudad Bolivar* locality.

Most of the neighborhoods included in these cluster are peripheral and located in the Eastern Cordillera (*Cordillera Oriental*) that surrounds Bogota to the east and south. They

consist of a mix of low-income housing, public or social interest housing, and illegal settlements that do not receive full basic public services coverage (see Map 13.6) and have high levels of concentrated disadvantage and social isolation (see Map 13.2).

According to Escobedo's (2005) field notes, the neighborhoods from *San Cristobal* included in the cluster are very isolated due to a poor transportation infrastructure. They had both paramilitary and FARC presence, particularly in the higher areas, and they were used by the FARC as a corridor to move coca paste and produce cocaine because of its proximity to the highway (*Avenida al Llano*) connecting Bogota to the Eastern Plains (*Llanos Orientales*) where coca fields were located.

By contrast, the neighborhoods from *Tunjuelito* in this cluster were problematic precisely because several main transportation arteries go across them, which facilitated the commission of muggings in the area by criminals coming from neighborhoods in the localities of *Rafael Uribe* and *Ciudad Bolivar*. The interviewees from the police argued that these *Tunjuelito* neighborhoods had been the "cradle" of criminal structures for 40 years and, although many of their leaders had been arrested or killed, their children had taken over and continued with their operations. Most of these criminal structures engaged in property crimes in the north of the city. In addition, the police reported some cases of social cleansing against small time criminals and drug users in the area.

The one neighborhood from *Antonio Nariño* in this cluster is a highly commercial area with the presence of paramilitary cells dedicated to extorting money from businesses for "protection." Retaliatory homicides were common in this district.

The most complicated neighborhoods, which also make up most of this cluster, are located in the *Rafael Uribe* and *Ciudad Bolivar* localities. In general terms, these neighborhoods

tend to be hard to access and in some cases they are only accessible by foot through precarious stairs built on the steep mountainside. Paramilitaries were present in the higher areas of these localities, where they acted as informal agents of social control keeping criminals and drug users at bay. They were successful in this task thanks to their use of social cleansing to rid the communities of criminal elements and deter potential offenders. Escobedo's (2005) interview notes mention that there was an inverse relationship between the presence of paramilitaries and property crime rates, whereby the latter tended to increase the father away one moved from paramilitary controlled areas. In addition to social cleansing, paramilitary groups engaged in the extortion of commerce and transportation businesses, and the recruitment of young men and women in these communities. The police also reported the presence of FARC militias in these zones, but they tended to maintain a much lower profile than paramilitary groups, and their dominance over these territories had been heavily undermined by the presence of the latter.

The interviewees also reported a high incidence of sexual violence, mostly by offenders known to the victim; the existence of several chop shops used to dismantle vehicles stolen in other areas of the city; some home-made firearm production and arms trafficking, particularly in the higher zones; high drug consumption and distribution rates; conflict among migrants from other regions of the country, particularly between Afro-Colombians from the Pacific and Atlantic coasts; high levels of non-lethal and lethal violence associated to alcohol, gambling, and prostitution outlets; and a high incidence of retaliatory and turf-related homicides (Escobedo 2005).

Finally, the field notes mention that criminals resided in all of the neighborhoods captured by this cluster. These offenders conducted most of their illegal activities—mainly car theft, burglary, robbery, and muggings—in the north of the city. Conflicts related to the

distribution of crime profits and to the protection of crime turfs often emerged among these criminals and ended in lethal violence (Escobedo 2005).

The final high-high cluster is observed in the west side of the city and consists of seven neighborhoods all from the *Kennedy* locality[17]. The locality as a whole has a mix of lower- and middle-class neighborhoods. At the center of the cluster is the *Patio Bonito II* neighborhood, highlighted as having extreme homicide rates during the study period. To the west of this neighborhood is Bogota's largest wholesale produce market, *Corabastos* (or *Central de Abastos*). Escobedo (2005) describes this market as one of the most conflictive areas in this district. FARC militias were traditionally present in the area, but at the time the interviews with the police took place paramilitary cells had gained control over the market. These cells extorted money for "protection" from the more than 5,000 vendors that do business there and the farmers that bring their produce in trucks on a daily basis. The transportation of produce from all over the country to *Corabastos* was exploited by the paramilitaries to traffic weapons and drugs. Unlike the dynamic observed in the second high-high cluster in the south of the city, criminal activity, particularly muggings and car thefts, was high in this area in spite of paramilitary control.

Patio Bonito II is one of the most disadvantaged neighborhoods in the locality, and Escobedo's interviewees maintained that criminals with interests in *Corabastos* lived in this community. Paramilitaries also engaged in extortion, social cleansing, and contract killing in this neighborhood. In addition to social cleansing and retaliatory homicides, the police also reported homicides as the outcome of armed robberies, particularly in the main traffic artery *Avenida Ciudad de Cali*, and of fights that took place in alcohol, gambling, and prostitution outlets. The remainder of neighborhoods had similar characteristics to *Patio Bonito II*, and also reported high levels of drug distribution and consumption.

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[17] Campo Hermoso, Ciudad Kennedy, Corabastos, El Paraiso, Gran Britalia, Gran Britalia I, Patio Bonito II.

In sum, the three high-high clusters identified in this section share some characteristics. They were all located in disadvantaged areas of the city; they all reported the presence of paramilitaries, social cleansing, drug markets, and highly conflictive alcohol, gambling, and prostitution outlets; and they all had criminals amongst their residents.

However, key qualitative differences have been noted. Violence in Cluster I (downtown) seems to be related to decades of decay leading to high levels of social and physical disorder, which allowed for the establishment and consolidation of an extremely conflictive drug market. Paramilitaries in this area were in control of drugs and arms trafficking, as well as the sex market in the brothels located in *Los Martires*.

Homicides in Cluster II (south) appear to be related to the physical and social isolation of these neighborhoods, which facilitated their use as corridors for drugs and weapons to and from the east of the country by both FARC and paramilitaries. These areas were also a breeding ground for the recruitment of young men and women by these irregular groups. In addition, paramilitaries seem to have also worked as effective agents of informal social control in these communities by terrorizing drug users and property criminals through the use of social cleansing. In this way, although criminal residents were reported in all three clusters, those residing in Cluster II were more likely to offend in the north of the city than in their own communities, and much of the violence in these communities was related to conflicts among criminals regarding crime turfs and profits.

Finally, violence in Cluster III (west) seems to be associated to the dynamics of the *Corabastos* wholesale produce market. Paramilitaries here engaged in extortion of vendors and transporters, and used the market's transportation networks to traffic drugs and weapons, but they did not act as agents of social control as the incidence of property crimes was high in the

area. Conflicts emerged due to disputes for the control of informal markets and transportation networks.

In general terms, though, and based on the assessments provided by the police to Escobedo, it appears that homicide rates in the most violent neighborhoods of Bogota were associated to poverty, isolation, social disorder, and the dynamics of the internal armed conflict and the drug economy in Colombia.

5.2.2.   Spatial Distribution of Continuous Predictors

This section discusses the distribution of the local spatial correlations for each one of the continuous predictors to be entered in the multivariate models in Chapter 6, as displayed by the LISA maps 13.2 through 13.11: concentrated disadvantage and social isolation, ethnic and cultural heterogeneity, residential mobility, social disorder, basic public services, temporal lag of the cumulative homicide rate, population density, population composition, land use mix index, and forced displacement.

5.2.2.1.Concentrated Disadvantage and Social Isolation Index

The concentrated disadvantage and social isolation index presents the strongest spatial autocorrelation (*I*=.60, see Table 9) of all of the variables included in the study. Map 13.2 describes the distribution of local autocorrelations for this index and it shows a clear division of the city by social class with most of the neighborhoods in the northern localities of *Usaquen*, *Suba, Chapinero, Barrios Unidos*, and *Teusaquillo* having below average levels of disadvantage, and most of the communities in the downtown and southern localities of *Santa Fe*, *Martires*, *San Cristobal*, *Usme*, *Ciudad Bolivar*, *Tunjuelito*, and *Bosa* having the highest concentrations of socio-economic disadvantages. A few high-low spatial outliers are observed in *Usaquen, Suba, Barrios Unidos* and *Teusaquillo*, while some low-high outliers can be observed in the southern

localities of *San Cristobal*, *Tunjuelito*, and *Bosa*. The remaining localities have a more mixed distribution of wealth and thus do not present significant clusters of disadvantage and isolation in either direction.

As it was noted in Chapter 3, this north-south division is historically rooted in the way the city grew from the downtown area throughout the nineteenth and early twentieth centuries. Indeed, the aristocracy from the early Republic owned land and recreational estates in the north of the city that would later become residential areas for upper- and middle-class families, while the south was primarily developed by state-sponsored public housing programs for the working class (Uribe-Mallarino 2008).

Finally, it is worth noting that most of the areas highlighted in yellow as having an extreme cumulative homicide rate are also included in high-high disadvantage clusters. This relationship is further studied in section 5.3 through an examination of the bivariate correlations between the spatially lagged dependent variable and the predictors using the bivariate Moran's *I* statistic and bivariate LISA maps.

5.2.2.2.Ethnic and Cultural Heterogeneity

The ethnic and cultural heterogeneity index presents a moderate spatial autocorrelation (I=.31, see Table 9). Interestingly, the LISA Map 13.3 shows a spatial distribution that is somewhat opposite to that of the disadvantage and isolation index (Map 13.2). Indeed, an inspection of both the zero-order correlation (r=-.25, p≤.001) and the bivariate Moran's *I* between heterogeneity and the spatial lag of disadvantage (I=-.27, pseudo-p≤.0001) reveals a negative relationship between these two variables, which is contrary to ecological expectations.

 In general terms, above average levels of heterogeneity are observed in the north, center, and parts of the west (in *Fontibon* and *Engativa*) of the city, and below average levels primarily

in the southern localities of *San Cristobal*, *Rafael Uribe*, and *Antonio Nariño,* but also in *Barrios Unidos*, a northern locality. A few low-high spatial outliers are observed in the north, center, and west, with some high-low outliers in the south and in the southwest, particularly in *Kennedy*.

Recall that the heterogeneity index is a composite measure combining three items from the 2005 census: percent of residents who self-identified as an ethnic minority, percent of residents who were born in a different Colombian town, and percent of residents who moved from another Colombian town in the past five years. There are several explanations for the location of the high-high clusters in this map. First, the high levels of heterogeneity in *Santa Fe*, *La Candelaria*, *Chapinero*, and *Teusaquillo* could be partially explained by the location of several large, mostly private universities in these localities[18]. Bogota is the main higher-education hub in Colombia, and people from all over the country move to the city to get a college degree. Most of these out-of-town students find housing either in the vicinity of the universities or near a main transportation artery that connects with the colleges. High-high clusters are thus observed around *Carrera Septima*, *Autopista Norte*, and *Avenida Caracas* all of which connect the north of the city to the downtown area, going through *Usaquen, Chapinero, Teusaquillo,* and *Santa Fe*. Additional high-high concentrations are observed around *Avenida El Dorado,* which connects the city from the west in *Fontibon* to the east in *La Candelaria*.

In addition, high levels of heterogeneity in *Suba*, *Engativa*, and *Fontibon* could partially be explained by the fact that these localities have historically had some concentrations of Amerindian communities whose presence there pre-dates the Spanish conquest. Finally, high concentrations in *Martires* and *Santa Fe* might be partially explained by the influx of people

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[18] <u>Santa Fe and La Candelaria</u>: Universidad de Los Andes, Universidad del Rosario, Universidad Externado de Colombia, Universidad de la Salle, Universidad Jorge Tadeo Lozano. <u>Chapinero and Teusaquillo</u>: Universidad Javeriana, Universidad Piloto de Colombia, Universidad Catolica, Universidad Nacional de Colombia, Universidad Pedagogica, Universidad Sergio Arboleda.

displaced by the violence who settled in these localities. The same reason could explain the high-low spatial outliers in *San Cristobal*, *Rafael Uribe*, *Usme*, *Tunjuelito*, and *Kennedy*.

The only high-high heterogeneity cluster that also highlights extreme cumulative homicide rates is, once again, the downtown area.

5.2.2.3.Residential Mobility

The indicator of residential mobility presents a rather weak global measure of spatial correlation (*I*=.17, see Table 9), and Map 13.4 has patterns of both spatial dependence and spatial heterogeneity. Indeed, although a number of high-high clusters can be observed in the north, west, and south of the city, and a few low-low clusters in the north, downtown, and south, the map is peppered with spatial outliers of both kinds. In general terms, though, the spatial dependence or positive spatial correlation pattern is more prominent (n=172) than the spatial heterogeneity or negative spatial correlation pattern (n=82).

Recall this variable only measures mobility within the city (percent of population who moved in the past five years within Bogota) and it would appear that those high-high clusters and high-low areas located in the north and northwest of the city seem to overlap with areas with low levels of disadvantage, while the low-low clusters and low-high outliers in the southeast overlap with areas with high levels of disadvantage, a pattern that is somewhat contrary to the expectations of ecological theories. However, this potential association does not explain the overall distribution of mobility in Bogota, and an examination of both the zero-order and the spatial correlations between these two variables yielded non-significant results.

It is more likely that residential mobility in Bogota is more related to the official stratification of neighborhoods than to disadvantage and isolation per se. In the 1980s the national government started implementing a stratification system to subsidize public services

(water, electricity, phone, gas, and trash collection) for the poorest members of society. According to Uribe-Mallarino (2008), the system classifies dwellings by the quality of the materials used to build them and the quality of the physical environment in which they are located. The system assumes that these conditions reflect the affluence of their residents, and categorizes blocks into one of six strata whereby the higher the stratum the higher the assumed expending capacity of its residents. In this way, households in the sixth and fifth strata, as well as industrial and commercial units, are overcharged for their use of public services to subsidize households in the first three strata (the highest subsidies go to the first stratum, and subsidies decrease as the system moves up to the second and third strata). Households in the fourth stratum are charged for their exact use. In addition, housing units in historic districts are classified as stratum one to encourage landlords to invest in them and keep them in good shape.

Uribe-Mallarino (2008) argues, "the stratification system has had an effect on the geographic segregation of Bogota, the value of real estate, and property taxes, which makes residents reluctant to aspire to a higher stratum, entrapping people in the strata that receive subsidies," which often times is the same stratum they were born in or where they have resided for a long time (p. 143 – Free translation). In this way, an unintended consequence of the stratification system is to discourage upward social mobility.

Finally, there is no clear pattern in terms of an overlap between mobility and neighborhoods with extreme cumulative homicide rates either, and the only high-high cluster that is common to these two variables is homicide Cluster III located in *Kennedy*. Nonetheless, this variable will still be included in the multivariate analysis for the sake of thoroughly testing the ecological model.

5.2.2.4.Social Disorder

The social disorder predictor also presents a rather weak global Moran's *I* (*I*=.15, see Table 9) and there is evidence of both spatial dependence and spatial heterogeneity patterns in Map 13.5 as well. The spatial distribution of this composite measure of the rate of alcohol outlets and the rate of gambling, lotto, and videogame outlets per 10,000 displays two large low-low clusters in the north of the city (the first one covering *Usaquen* and *Suba*, and the second one located in *Teusaquillo* and *Barrios Unidos*), and two high-high clusters situated in the downtown area (*Santa Fe, Candelaria,* and *Martires*) and the south (*Rafael Uribe, San Cristobal, Usme,* and *Tunjuelito*) of Bogota.

The high-low outliers in the north side coincide with the so-called *Zonas Rosa* (Pink Zones) in neighborhoods of the *Chapinero, Usaquen,* and *Suba* localities where a large number of bars, restaurants, dance clubs, and casinos are concentrated within a few blocks. In addition, a considerable number of low-high outliers are observed throughout the south side.

When comparing maps 13.2 and 13.5, there seems to be an overlap between levels of disadvantage and levels of social disorder. Indeed, an inspection of the zero-order correlation between these two variables (r=.325, p≤.001) and the bivariate Moran's *I* between disadvantage and the spatial lag of social disorder (*I*=.17, pseudo-p≤.0001) reveals a moderate association. This pattern is congruent with ecological expectations.

Finally, there is a clear overlap between high levels of social disorder and extreme cumulative homicide rates in the downtown area, and the two large high-high social disorder clusters in the south seem to partially coincide with two of the high-high homicide clusters as well.

5.2.2.5.Public Control: Basic Public Services

Table 1 shows a rather good coverage of basic public services across the city with an average of over 90% of dwellings receiving electricity, sewerage, and water[19] services. In addition, the Moran's *I* statistic for the composite measure of basic public services in Table 9 is of moderate strength (*I*=.25). Nonetheless, differences in the distribution of these services can be observed in Map 13.6, whereby the northwestern localities of *Suba* and *Engativa*, and the southern localities of *Puente Aranda* and *Tunjuelito* have an above average supply of basic public services, while areas of *Santa Fe*, *Teusaquillo*, *Fontibon*, *Kennedy*, and particularly the peripheral neighborhoods of *San Cristobal*, *Usme*, and *Ciudad Bolivar* present below average coverage. The latter group of neighborhoods includes several areas where illegal settlements have formed over the years, which lack even the most basic of services such as potable water. Residents in these areas often times get their water from nearby creeks, especially in neighborhoods located in the higher sections of the Eastern Cordillera; have no or a poor sewerage infrastructure; their electricity is usually stolen from houses that do receive a legal supply in the lower areas; and, because some of these neighborhood are only accessible by foot, garbage collection is done informally by residents using mules. Even so, there seems to be only a partial overlap between disadvantage and public services distribution (r=-.09, p≤.05; *I*=-.05, pseudo-p≤.001), and although the relationship is weak, it is in the expected direction. Finally, there does not seem to be a discernible pattern of overlay between the basic public services index and neighborhoods with extreme cumulative homicide rates as the latter coincide with all types of local spatial association in the former.

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[19] Since the variable measuring the coverage of water service was extremely highly correlated with the sewerage service variable it was not included in the analysis, but this high correlation allows for the discussion of this public service here.

5.2.2.6.Spatial Distribution of Continuous Control Variables

The temporal lag of the cumulative homicide rate has a moderate global spatial autocorrelation (*I*=.26, see Table 9), and a spatial distribution of LISAs (Map 13.7) that closely resembles that of the cumulative homicide rate in 2003-2005. Indeed, homicide clusters I (downtown) and III (west) observed in the outcome variable were also present in the 2000-2002 period, but Cluster II (south) seemed to have been less connected in the temporal lag. In addition, the low-low clusters and most of the high-low spatial outliers observed in *Usaquen* and *Suba* in 2000-2002 repeat in 2003-2005. Finally, areas with non-significant local spatial autocorrelations in 2000-2002 become significant in the dependent variable, particularly new low-low and high-low areas are observed in the west.

The population density variable presents a rather weak global Moran's *I* (*I*=.19, see Table 9), and Map 13.8 shows that, on average, Bogota is not a very densely populated city. However, some clusters with above average densities can be observed in the south in *Usme*, *Ciudad Bolivar*, *Bosa*, and *Kennedy*, and a couple more are displayed in the northwest in *Suba* and *Engativa*. Moreover, the spatial distribution of population density seems to partially overlap with that of the concentrated disadvantage and social isolation index, with neighborhoods with below average levels of disadvantage displaying lower densities than more disadvantaged neighborhoods. Indeed, zero-order (r=.37, p≤.001) and bivariate spatial correlations (*I*=.26, pseudo-p≤.0001) are both significant and moderate in strength. Finally, it is interesting to note that the neighborhoods with the most extreme cumulative homicide rates tend to have below average population densities. This preliminary finding is somewhat contrary to expectations and to what has been observed in the literature in the United States.

The percent of young males aged 15 to 29 has the weakest spatial autocorrelation of all of the variables included in the analysis (I=.07, see Table 9). Map 13.9 has only a few significant LISAs. Nevertheless, there seems to be a partial overlap between areas with below average concentrations of young males in the population and low levels of disadvantage in the north, and areas with high concentrations of young men and high disadvantage in the south and in some downtown areas (r=.24, p≤.001; I=.19, pseudo-p≤.001). In addition, only two of the neighborhoods highlighted as having extreme cumulative homicide rates have above average concentrations of young men, both of them located in the downtown area: *La Capuchina* (*Santa Fe*) and *San Victorino* (*Martires*).

The land use mix index has a moderately strong global measure of spatial autocorrelation (I=.32, see Table 9), and the distribution of local associations is rather interesting. Indeed, Map 13.10 presents a single connected V-shaped high-high cluster including neighborhoods from *Chapinero*, *Barrios Unidos*, *Teusaquillo*, *Fontibon*, *Puente Aranda*, *Martires*, *Antonio Nariño*, *Santa Fe*, and *La Candelaria*. This map is actually somewhat similar to Map 13.3 (ethnic and cultural heterogeneity), and the distribution of mixed land use in Bogota seems to also closely follow the main transportation arteries connecting the north and the west to the downtown area. In addition, this cluster fully captures the extreme cumulative homicide rates downtown.

Finally, the forced displacement index also yields a moderate Moran's *I* (I=.30, see Table 9), and Map 13.11 exhibits above average concentrations of people who moved to Bogota due to threats to their lives primarily in downtown and in the peripheral areas of *Usme* and *Ciudad Bolivar*. Indeed, according to Uribe-Mallarino's (2008) social stratification study, individuals who have been displaced by the violence in other areas of the country tend to settle in the poorest neighborhoods of Bogota. This is confirmed by moderately strong correlations between the

forced displacement and the concentrated disadvantage indices in the present study (r=.44, p≤.001; *I*=.26, pseudo-p≤.0001). Furthermore, communities with extreme cumulative homicide rates are also located in areas with high numbers of displaced people.
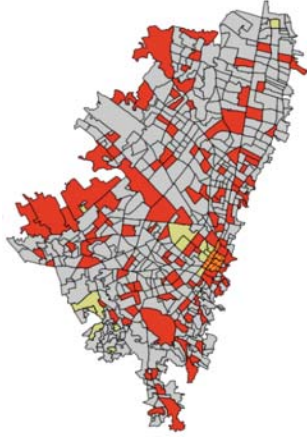
5.2.3. Spatial Distribution of Categorical Predictors

This section discusses the geographic distribution of the categorical predictors included in the analysis using simple choropleth (or thematic) maps. Unfortunately, spatial autocorrelations cannot be calculated for dichotomous variables, so the univariate analyses in this section are simply based on the cartographic information displayed in Figure 14.

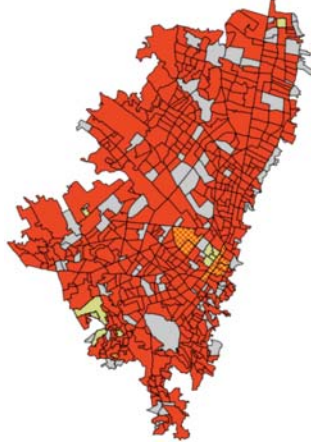#### *5.2.3.1.Public Control: Police Presence*

In 2005, about 21 percent of neighborhoods had a police station or at least one Immediate Attention Police Command (CAI, for its acronym in Spanish) (see Table 1). The deployment of police in Bogota is based on the administrative division of the city and thus there are 19 police precincts, one per locality. In addition, CAIs are built and staffed following police strategic planning, but the community can also request them, and 103 neighborhoods had at least one CAI in 2005. Map 14.1 displays a rather even geographic distribution of neighborhoods with at least one police unit (n=119) across the city. The concentration of police units in the downtown area (overlapping with homicide cluster I) is noteworthy and it relates to the fact that several national and local institutions are situated here, including the Presidential Palace, the Mayor's Office, the Congress, the Supreme Court, and several ministries.

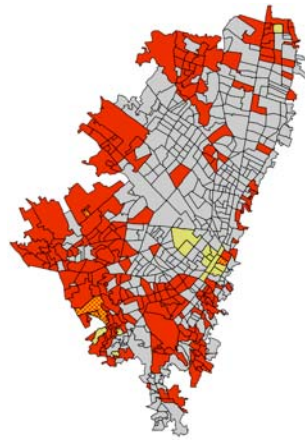*Figure 14. Spatial Distribution of Categorical Predictors (Choropleth Maps)*
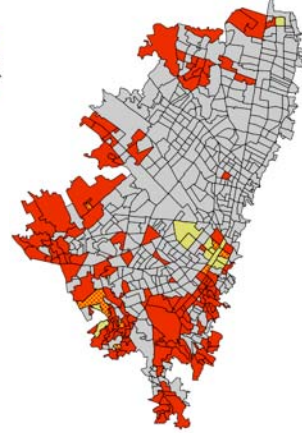
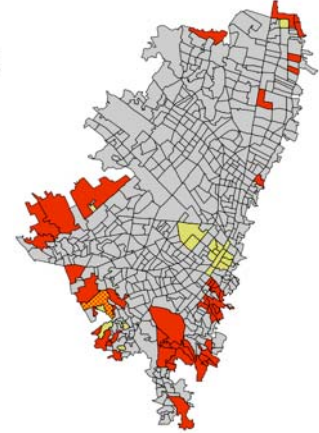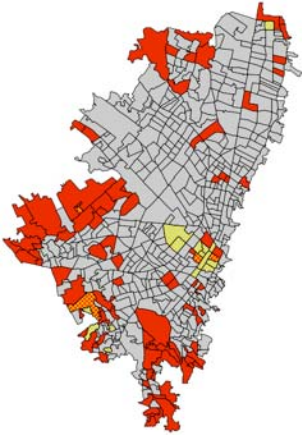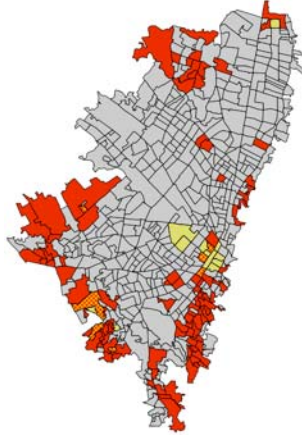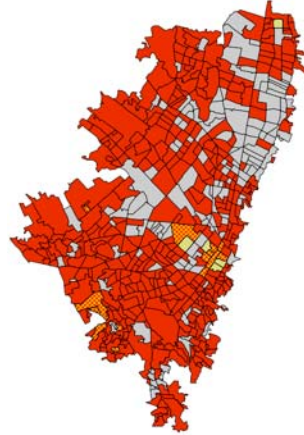**14.1. Police Stations & CAIs**   **14.2. Parochial Control**   **14.3. Gangs**   **14.4. Selective Murder Groups**   **14.5. FARC Militias**
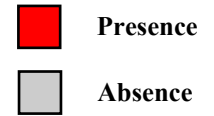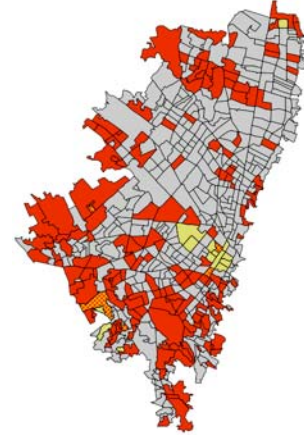
14.6. Paramilitary Cells   **14.7. Arms Trafficking**   **14.8. Drug Distribution**   **14.9. Chop Shops**

Presence

Absence

N

5.2.3.2. Parochial Control: Presence of Voluntary Associations

There is at least one voluntary association (community, youth, sports, religious, or political) in 83.3 percent of Bogota neighborhoods (n=474, see Table 1), regardless of north-south location or levels of disadvantage. Moreover, Map 14.2 displays an even distribution between neighborhoods with extreme cumulative homicide rates that do not have a voluntary association (n=10), and those that do count with the presence of at least one such organization (n=9).

5.2.3.3. Criminal Structures: Gangs and Selective Murder Groups

Maps 14.3 and 14.4 indicate the neighborhood presence of gangs (37.2 percent) and selective murder groups (contract killing offices, 25.1 percent; and social cleansing, 5.6 percent) respectively. The spatial distribution of these two types of criminal structures is quite similar, with an observed presence primarily in the peripheral neighborhoods of the south and west, but also occurring in some areas of the north of the city. In general terms, it seems that these groups were more likely to act in neighborhoods with higher levels of disadvantage, and social disorder (this is particularly true of selective murder groups) than in more affluent areas.

5.2.3.4. Organized Crime: FARC Militias and Paramilitary Cells

By 2005, FARC militias had very little presence in the city, with only about 9 percent of neighborhoods being reported by the police as having some FARC activity. In fact, Map 14.5 shows that, with a very few exceptions, the FARC only had presence in a few communities located at the fringes of the city, particularly in the south (*San Cristobal, Rafael Uribe, Usme,* and *Ciudad* Bolivar) and west (*Bosa* and *Kennedy*) of Bogota.

Paramilitary cells (see Map 14.6), on the other hand, had a somewhat larger presence (16.7 percent), including some areas where FARC militias were reported to act. What is more, paramilitary cells were more likely to be reported on or around areas with extreme cumulative homicide rates than FARC militias, especially downtown. Finally, it is again worth noting that these organizations tend to act in communities with higher levels of disadvantage and disorder.

5.2.3.5. Illegal Markets

Map 14.7 reports the presence of arms markets in about 19 percent of neighborhoods, and this spatial distribution follows that of criminal groups very closely. Indeed, illegal arms markets are located mainly in peripheral areas were FARC, paramilitary, gangs, and selective murder groups are present.

Map 14.8, on the other hand, shows that drug markets exist in about 73 percent of neighborhoods in Bogota, mostly in the south, west, and northwest. The most affluent areas of *Chapinero, Usaquen*, and *Suba*, and middle-class areas of *Fontibon, Kennedy*, and *Barrios Unidos* seem to be among the few areas free of drug distribution. Moreover, drug distribution coincides to a great extent with extreme cumulative homicide rates downtown and in the south.

Finally, Map 14.9 depicts the geographic distribution of chop shops, a proxy measure of illegal auto parts markets, which are present in 30.4 percent of neighborhoods. With the exception of *Teusaquillo* and *La Candelaria*, there are chop shops in all localities of Bogota (car theft is one of the most common security concerns for Bogota residents), with the highest incidence presented in *San Cristobal* and *Ciudad Bolivar*, each locality representing about 13 percent (26 percent combined) of all the neighborhoods where chop shops can be found. It was mentioned earlier that criminals residing in neighborhoods within these localities commit a

variety of crimes, including car theft, in other areas of the city, particularly the north. Cars stolen in other parts of the city are then taken to and chopped in these communities.

5.3. Bivariate Spatial Analyses: Exploring Associations between the Spatially Lagged Outcome Variable and Continuous Predictors

Table 10 presents the results of bivariate global Moran's *I* statistics between each of the continuous predictors and the spatial lag of the cumulative homicide rate, following a second-order queen contiguity matrix. These correlation coefficients represent the extent to which values for each predictor observed at a given location show a systematic spatial relationship with the cumulative homicide rate at the neighboring locations (Anselin et al. 2002) (see bivariate Moran scatterplots in Figure 18, Appendix 2).

The third column in the table presents changes in the Moran's *I* value after excluding extreme univariate outliers in the cumulative homicide rate. With the exception of the spatial correlations with heterogeneity and with population density, both of which have a slight increase in strength after removing the outliers, all spatial associations present a slight decrease in strength once these extreme cases are excluded. Thus these outliers are exerting some influence on the correlation coefficient but since there are no dramatic changes in strength, direction, or significance of the associations, it can be argued that these cases are not driving the relationship and it is safe to keep them in the analysis.

The concentrated disadvantage and social isolation index, and the social disorder indicator exhibit the strongest spatial correlations between any of the ecological predictors in the study and the spatial lag of the cumulative homicide rate (see Table 10). Both of these correlations are positive, indicating a pattern of spatial dependence between these two concepts and homicide rates. Furthermore, bivariate LISA maps 15.1 and 15.4 confirm that neighborhoods

with lower levels of disadvantage and disorder tend to be in the vicinity of neighborhoods with lower homicide rates. This pattern is primarily observed in most of *Usaquen* and *Suba*, and some areas of *Teusaquillo* and *Fontibon*. Conversely, areas with higher levels of disadvantage and disorder seem to be more likely to have neighbors with high homicide rates, a pattern that is most predominant in the downtown area, the south, and the western locality of *Kennedy*. These relationships are in the expected direction and provide partial support for social disorganization theory in explaining homicide rates in Bogota.

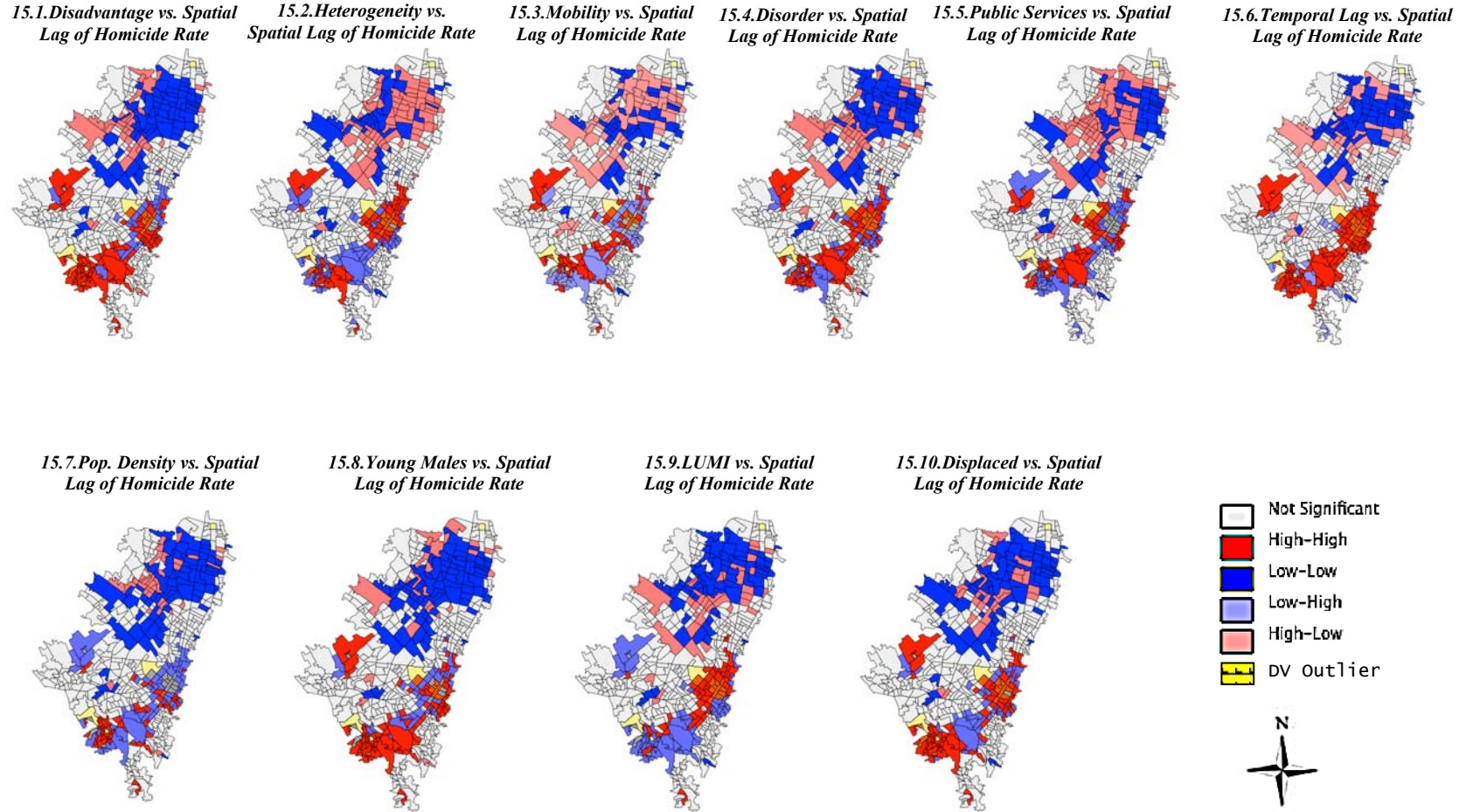**Table 10. Bivariate Global Moran's I[†]: Correlations between Predictors and the Spatially Lagged Outcome**

Variable	I	I (excluding outliers)
Independent Variables		
Concentrated Disadvantage and Social Isolation	.194*	.175*
Ethnic and Cultural Heterogeneity	-.003	-.046
Residential Mobility	-.055*	-.053*
Social Disorder	.123*	.082*
Basic Public Services	-.078*	-.053*
Control Variables		
Temporal Lag Cumulative Homicide Rate (2000-2002)	.244*	.204*
Population Density per Km^2	.010	.034
Population Composition (Young Males)	.122*	.109*
Land Use Mix Index	.096*	.051*
Forced Displacement	.171*	.129*

[†]Empirical pseudo-significance based on 9,999 random permutations.
*pseudo-p≤.0001.

On the other hand, the other two indicators of social disorganization, namely ethnic and cultural heterogeneity and residential mobility, seem to contradict the expectations of the ecological approach. Indeed, ethnic and cultural heterogeneity does not appear to be significantly associated to the spatial lag of homicide rates (see Table 10) and Map 15.2 (see Figure 15) shows a pattern of spatial heterogeneity between the two variables. Furthermore, although the association between residential mobility and the spatially lagged outcome variable is significant, it is negative (see Table 10) and Map 15.3 (see Figure 15) also presents a pattern of spatial

Figure 15. Bivariate LISA Maps between Continuous Predictors and Spatially Lagged Outcome Variable

15.1. Disadvantage vs. Spatial Lag of Homicide Rate

15.2. Heterogeneity vs. Spatial Lag of Homicide Rate

15.3. Mobility vs. Spatial Lag of Homicide Rate

15.4. Disorder vs. Spatial Lag of Homicide Rate

15.5. Public Services vs. Spatial Lag of Homicide Rate

15.6. Temporal Lag vs. Spatial Lag of Homicide Rate

15.7. Pop. Density vs. Spatial Lag of Homicide Rate

15.8. Young Males vs. Spatial Lag of Homicide Rate

15.9. LUMI vs. Spatial Lag of Homicide Rate

15.10. Displaced vs. Spatial Lag of Homicide Rate

Not Significant
High-High
Low-Low
Low-High
High-Low
DV Outlier

N

*Empirical pseudo-significance based on 9,999 random permutations, pseudo-p≤.05.

heterogeneity. According to these findings, areas with high levels of mobility (mostly in the north of the city) are geographically close to neighborhoods with low levels of homicide, while districts low in residential mobility tend to, on average, be closer to communities with higher levels of homicide. These findings challenge the expectations of social disorganization theory, according to which higher levels of heterogeneity should increase conflict at the community level and higher levels of residential mobility should reduce levels of trust and solidarity in the neighborhood, and thus both should lead to higher crime rates. It is possible that the relationship does not translate for the most serious of crimes, homicide, but it could explain less serious offenses. Future research should replicate this study using other outcomes including assaults and property crimes. However, it is also possible that the patterns of social stratification discussed above have an influence on how often and to where Bogota residents move, leading to lower levels of mobility in less affluent communities with higher homicide rates.

The basic public services proxy measure of the public level of control has a weak, but significant negative spatial association with the spatial lag of homicide rates (see Table 10). Map 15.5 (see Figure 15) displays a general pattern whereby neighborhoods with high levels of basic public services coverage tend, on average, to be clustered with communities with low homicide rates (mostly in the north and some parts of the west), while areas with a below average basic public services coverage seem to be more likely to be in the vicinity of high homicide rates. This finding supports the hypothesis testing the Systemic Model of Crime Control in this study. Nonetheless, the relationship is very weak and it may disappear once the effects of other variables are controlled for in the multivariate analyses.

Finally, with the exception of population density, the spatial lag of the cumulative homicide rate has significant and positive correlations with the continuous control variables

included in the study (see Table 10). Indeed, all of these spatial associations are in the expected direction, and communities with a high cumulative homicide rate in 2000-2002 (strongest correlation) (see Map 15.6), an above average percentage of young males in the population (see Map 15.8), mixed land use (see Map 15.9), and where there are higher concentrations of people displaced by the internal armed conflict (see Map. 15.10) seem to be more likely to be clustered in the vicinity of neighborhoods with above average homicide rates.

5.4. Conditional Maps: Exploring Interactions between Predictors

This study hypothesizes that the parochial and public levels of control moderate the effects of disadvantage and disorder on homicide rates. Conditional maps were inspected to determine whether indeed interactions exist among these predictors. This technique creates a matrix with nine micromaps displaying subsets of the dependent variable based on two conditioning variables (the number of cases within each micromap is presented in parentheses). Interactions are present when the distribution of the micromaps differs across ranges of the conditioning variables.

A total of six potential interactions were examined (see Appendix 3). The first group assessed the interactions of the concentrated disadvantage and social isolation index with the presence of local associations, the basic public services coverage index, and the presence of police. The second group evaluated the interactions between the social disorder index and the same three moderating variables. The main variable (concentrated disadvantage, in the first group of conditional maps, and social disorder, in the second) is represented in the X-axis, while the moderating variables (associations, public services, and police) are represented in the Y-axis. The choropleth maps included in the matrix display the cumulative homicide rate, with cooler colors signifying lower homicide rates and warmer colors symbolizing higher homicide rates.

The interval breaks for the continuous conditioning variables were manipulated so that micromaps in the middle row and those in the middle column indicate homicide rates under average levels of each of the conditions[20] (roughly one standard deviation around the mean or half a standard deviation above and below the mean). In this way, the micromap at the center of the matrix represents the homicide rates under average conditions.

On the other hand, conditional maps matrices examining interactions between the main predictors (disadvantage and disorder) and the dichotomous moderators (presence of local associations and presence of police units) have only six micromaps with usable information. Micromaps in the middle row represent varying levels of homicide rates across levels of the main predictor in the X-axis when the dichotomous moderator in the Y-axis equals one (i.e., presence), while micromaps in the bottom row show variation in homicide rates across levels of the main predictor when the dichotomous moderator equals zero (i.e., absence). The three micromaps in the top row contain no data.

Based on the information provided by the conditional maps in Appendix 3, there seems to be an interaction between the concentrated disadvantage index and the basic public services proxy measure of the public level of control. Indeed, Figure 19 (see Appendix 3) illustrates that as the level of disadvantage increases and the coverage of public services decreases homicide rates grow larger. In fact, the highest homicide rates are observed in the bottom right map, which represents the highest levels of disadvantage and the lowest levels of public services coverage. Figures 20 and 21 (see Appendix 3), on the other hand, show that homicide rates increase with higher levels of concentrated disadvantage and social isolation regardless of whether there are police units or voluntary associations in the neighborhoods or not. Thus no interactions are

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[20] The three continuous conditioning variables included in this analysis (disadvantage, disorder, and public services) are standardized (scores are the regression coefficients stemming from the factor analysis) and thus have a mean of zero and a standard deviation of one.

identified between disadvantage and the parochial level of control and the police proxy measure of the public level.

Similarly, Figure 22 in Appendix 3 shows an interaction between social disorder and basic public services. The lowest homicide rates are observed in neighborhoods with below average levels of social disorder and average or above average coverage of public services, while the highest are observed in areas with above average disorder and below average coverage of public services (bottom right map). Conversely, figures 23 and 24 (see Appendix 3) do not appear to support interactions between social disorder and either police presence or parochial control because homicide rates increase with social disorder regardless of whether neighborhoods have police units or voluntary associations.

In light of these findings, the regression models to be discussed in the next chapter will explore interaction terms between basic public services and disadvantage, on the one hand, and disorder, on the other. Because the values in these three variables are regression scores stemming from the factor analyses ($\bar{x} = 0$, s=1) the predictors do not need to be mean-centered prior to the creation of the interaction terms.

CHAPTER 6. SPATIAL REGRESSION ANALYSES

Table 11 presents results for nine regression models sequentially organized in three sets of OLS, Spatial Lag, and Spatial Error models. The first set of models includes the control variables only, excluding the temporal lag of the cumulative homicide rate; the second set adds the ecological predictors; and the last set adds the temporal lag. Since the outcome variable and its temporal lag are so highly correlated (r=.72, see Table 12, Appendix 4), it was expected that the latter would absorb a large portion of the variance on the former. Thus it was decided to enter the temporal lag last so that the effects of ecological predictors could be more clearly discerned.

Only main effects are considered. Interaction effects are not reported because it was determined that they did not add any explanatory power to the models. Indeed, in spite of the evidence obtained in the previous chapter using conditional maps, when the interaction terms between disadvantage and public services, and between disorder and public services were entered in the models no changes in the R-squared coefficients were observed and neither of the interaction terms were significant. Moreover, interaction models presented poorer goodness of fit statistics than the main effects models[21].

Before discussing and comparing results across models, regression assumptions were tested using statistical and graphical methods and are reported in section 6.1 and Appendix 4.

6.1. Regression Diagnostics

Regression diagnostics were carried out using both *GeoDa^TM* and *IBM SPSS^©* (see Appendix 4). Although regression diagnostics in *GeoDa^TM* reported a multicollinearity condition greater than 30 for all OLS models thus suggesting a problem, an inspection of the correlation

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[21] OLS main effects: AIC=1233.77, SC=1320.64; OLS interaction effects: AIC=1235.92, SC=1331.48; Lag main effects: AIC=1215.68, SC=1306.91; Lag interaction effects: AIC=1219.05, SC=1318.96; Error main effects: AIC=1221.52, SC=1308.40; Error interaction effects: AIC=1224.75, SC=1320.32.

matrix and the tolerance and variance inflation factor (VIF) statistics obtained in *IBM SPSS©* do not show any problematically collinear covariates. In fact, the strongest bivariate zero-order correlation among predictors is between the presence of FARC militias and the presence of paramilitary cells and it is only .56[22] (see Table 12 in Appendix 4). Moreover, none of the tolerance statistics were less than .20 and none of the VIF values were greater than 5 (Tabachnick & Fidell 2007) (see Table 13 in Appendix 4), confirming that there are no issues of multicollinearity among predictors in the data.

On the other hand, *IBM SPSS©* regression diagnostics identified six multivariate outliers with residuals larger than two (lowest residual=-2.66; largest residual=2.71) before controlling for spatial dependence. None of these outliers are located in the city limits and their number of neighbors following second-order queen contiguity criteria ranges between 15 and 28. Therefore, eliminating them from the analyses would create voids in the spatial weights matrix making estimation very unstable. For this reason, it was decided to keep these multivariate outliers at the risk of over-influencing the partial slopes in one direction or the other.

The Jarque-Bera test in *GeoDa^{TM}* looks at the combined effect of skewness and kurtosis in the distribution of the residuals; if significant the error terms are not normally distributed. All OLS models present a significant Jarque-Bera statistic suggesting that the assumption of normality of residuals is violated. The distribution of the standardized residuals was also examined in *IBM SPSS©* and it was determined that the lack of normality is due to a leptokurtic (or very peaked) distribution (Kurtosis=1.523, S.E.$_{Kurtosis}$=.204), and not to issues of skewness (Skewness=-.181, S.E.$_{Skewness}$=.102) (see histogram, Q-Q Plot, and Shapiro-Wilk results [if significant, the distribution is not normal] in Appendix 4). If residuals are not normally distributed the standard errors for the coefficients might be biased. An inspection of the

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[22] The non-parametric test of association Phi yielded exactly the same value.

distribution of the residuals for the full models (Models 3) shows that there is an improvement in the distribution when spatial dependence is accounted for, particularly in the Spatial Lag model (see histograms in Appendix 4).

Additionally, the Breusch-Pagan statistic produced by *GeoDa^TM* tests for homoscedasticity in the residuals. Heteroskedastic residuals reduce the predictability of the model. All OLS models have significant Breusch-Pagan values, which is not surprising because the heteroskedasticity of the residuals could be due to spatial dependence in the data. In addition, an inspection of the scatterplot between the OLS standardized predicted values and the standardized residuals (see Appendix 4) suggests that the heteroskedasticity might also be caused by the neighborhoods with no homicides during the study period. The Breusch-Pagan statistic remains in fact significant even after controlling for spatial dependence in the spatial lag and error models. Nonetheless, its size does decrease once spatial dependence is controlled for (see Table 11), and an examination of the scatterplots between the standardized residuals and the standardized predicted values for the spatial models reveals a clear reduction in heteroskedasticity, particularly for the spatially lagged model not including the temporal lag of the cumulative homicide rate (see Appendix 4). In any event, results should be interpreted with caution since the violation of the homoscedasticity of residuals assumption is not fully fixed in the spatial models.

When the linearity of the relationship between the outcome and the continuous predictors was tested, four slightly curvilinear relationships were identified between the cumulative homicide rate and heterogeneity (cubic), social disorder (quadratic), population composition (quadratic), and forced displacement (quadratic) (see Appendix 4). Polynomial terms were introduced in the models to control for these curvilinear relations but no significant change in the

R-squared, or in effect size and significance of coefficients was observed. Furthermore, models including polynomial terms presented a poorer fit than the models without them, as evidenced by increases in AIC and SC statistics[23]. Besides Gorsuch (1983) suggests, "minor curvilinear relationships are represented fairly well by a linear approximation" (p. 119). Consequently, and for the sake of parsimony the models discussed in the next section do not include polynomial terms. Once again, results should be interpreted with caution because non-linear residuals reduce the power of the analysis to the extent that the models cannot capture the full degree of the relationship between the predictors and the criterion.

Finally, the Moran's I (error) statistic reported by the OLS models confirms that residuals are not independent and that there is spatial dependence in the data. The univariate global spatial autocorrelation for the cumulative homicide rate was .25, this value decreases (see Table 11) as the effects of predictors are controlled for, meaning that the regressors explain part of the spatial dependence in the outcome variable. Nevertheless, the Moran's I remains significant across OLS models, indicating that spatial dependence exists above and beyond the effect of any of the covariates.

6.2. Regression Results

Table 11 presents the results of sequential OLS, Spatial Lag, and Spatial Error Models predicting neighborhood homicide rates in Bogota using ecological predictors and controlling for prior homicide rates, population structure and composition, land use, and the presence of variables somewhat idiosyncratic to the Colombian context of violence.

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[23] OLS no polynomials: AIC=1233.77, SC=1320.64; OLS with polynomials: AIC=1235.30, SC=1339.55; Spatial Lag no polynomials: AIC=1215.69, SC=1306.91; Spatial Lag with polynomials: AIC=1219.05, SC=1327.65; Spatial Error no polynomials: AIC=1221.52, SC=1308.40; Spatial Error with polynomials: AIC=1223.84, SC=1328.10.
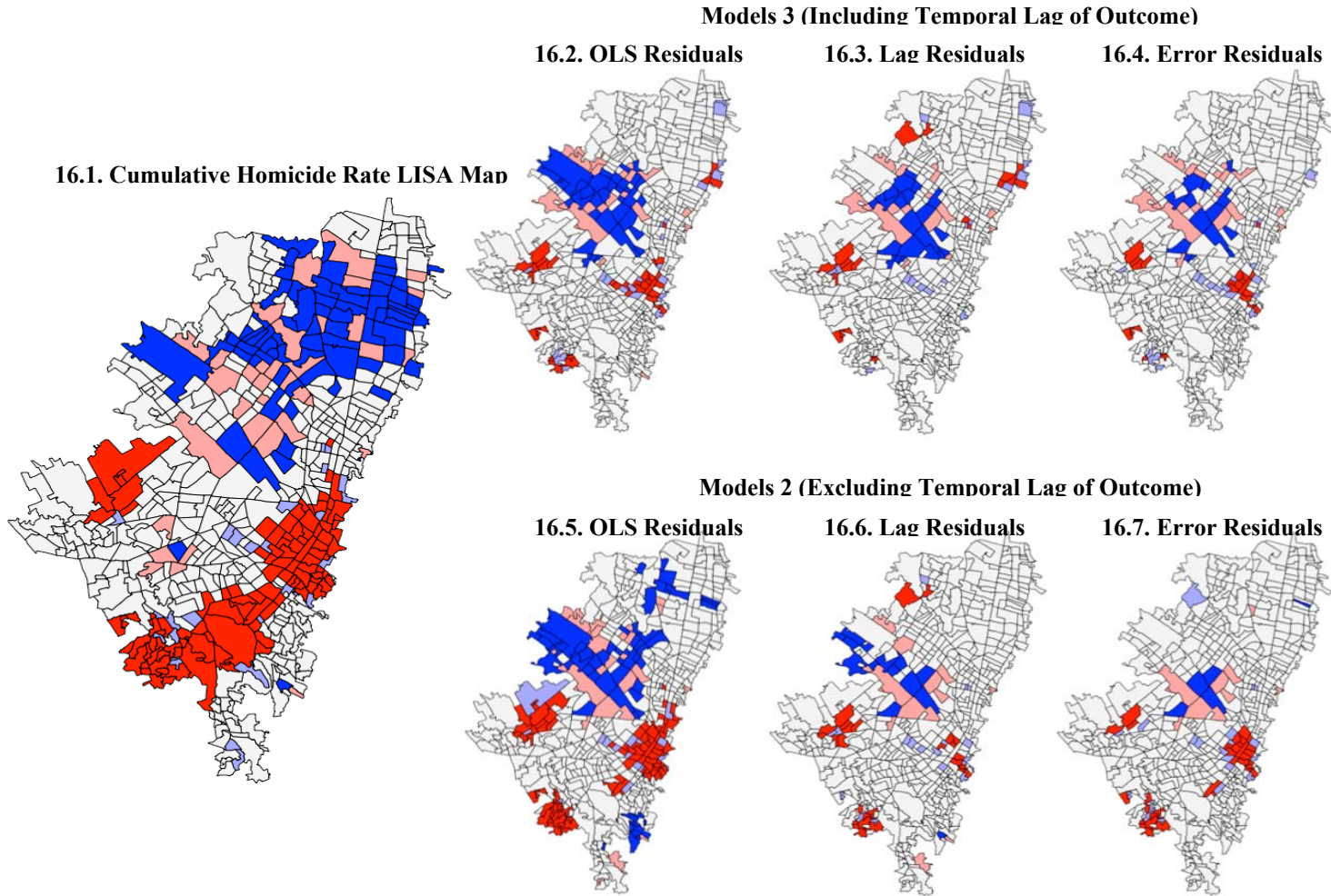
Table 11. Sequential Regression Analysis Results[†]

Predictor	Models 1 OLS B(SE)	Models 1 Lag B(SE)	Models 1 Error B(SE)	Models 2 OLS B(SE)	Models 2 Lag B(SE)	Models 2 Error B(SE)	Models 3 OLS B(SE)	Models 3 Lag B(SE)	Models 3 Error B(SE)
Constant	1.22(.37)***	.92(.35)**	2.44(.37)***	1.71(.55)	1.24(.51)*	2.37(.54)***	.17(.46)	.07(.45)	.47(.46)
Disadvantage	-	-	-	.29(.06)***	.23(.05)***	.20(.06)***	.18(.05)***	.16(.05)***	.17(.05)***
Heterogeneity	-	-	-	-.05(.05)	-.02(.05)	.01(.06)	-.04(.05)	-.03(.04)	-.03(.05)
Mobility	-	-	-	.09(.05)§	.12(.05)*	.12(.05)*	.10(.04)**	.12(.04)**	.11(.04)**
Disorder	-	-	-	.12(.06)*	.12(.05)*	.12(.05)*	.04(.05)	.05(.04)	.06(.05)
Public Services	-	-	-	-.05(.04)	-.04(.04)	-.07(.04)§	-.04(.03)	-.04(.03)	-.04(.03)
Police	-	-	-	.24(.09)**	.18(08)*	.15(.08)§	.03(.08)	.02(.07)	.03(.07)
Parochial Control	-	-	-	-.23(.11)*	-.11(.10)	-.09(.10)	-.04(.09)	.004(.08)	-.02(.09)
Temporal Lag	-	-	-	-	-	-	.58(.04)***	.50(.04)***	.52(.04)***
Population Density	-.005(.001)***	-.005(.001)***	-.006(.001)***	-.006(.001)***	-.006(.001)***	-.006(.001)***	-.003(.001)***	-.003(.001)***	-.003(.001)***
Pop. Composition	-.13(.17)	-.28(.15)§	-.38(.15)*	-.16(.18)	-.32(.16)§	-.33(.17)*	-.06(.15)	-.16(.14)	-.11(.15)
Land Use Mix Index	1.30(.22)***	.93(.20)***	1.19(.22)***	1.05(.28)***	.64(.26)*	.65(.27)*	.66(.23)**	.48(.23)*	.55(.24)*
Forced Displacement	1.17(.19)***	.80(.17)***	.55(.19)**	.72(.23)**	.43(.21)*	.21(.23)	.19(.19)	.08(.18)	.06(.19)
FARC Militias	-.28(.17)§	-.27(.16)§	-.24(.16)	-.25(.16)	-.23(.15)	-.17(.16)	-.04(.14)	-.05(.13)	-.04(.14)
Paramilitary Cells	.10(.13)	.09(.12)	.09(.13)	.002(.13)	.03(.12)	.04(.12)	-.07(.10)	-.05(.10)	-.08(.11)
Sel. Murder Groups	.44(.11)***	.25(.10)*	.11(.11)	.30(.11)**	.17(.10)§	.11(.11)	.12(.09)	.07(.09)	.09(.09)
Gangs	.05(.10)	.08(.09)	-.01(.09)	-.05(.09)	-.02(.09)	-.06(.09)	.02(.08)	.03(.07)	-.02(.08)
Drug Distribution	.16(.10)§	.09(.09)	-.03(.09)	.001(.09)	-.03(.09)	-.08(.09)	.03(.08)	.01(.07)	-.01(.08)
Arms Trafficking	.20(.12)§	.14(.11)	.12(.12)	.11(.12)	.07(.11)	.06(.12)	-.03(.10)	-.03(.10)	-.03(.10)
Chop Shops	.07(.10)	.16(.09)§	.24(.09)**	.10(.10)	.18(.09)*	.25(.09)**	.06(.08)	.12(.08)	.12(.08)
Spatial Lag (ρ)	-	.59(.06)***	-	-	.53(.06)***		-	.28(.06)***	-
Spatial Error (λ)	-	-	.75(.05)***	-		.69(.06)***	-	-	.41(.09)***
Pseudo-R^2	.28	.41	.44	.36	.46	.46	.57	.60	.59
F-Statistic	21.37***	-	-	18.92***	-	-	39.99***	-	-
Log Likelihood	-743.87	-701.16	-694.69	-706.96	-674.89	-677.90	-596.88	-586.85	-590.76
AIC	1511.74	1428.29	1413.39	1451.91	1389.78	1393.79	1233.77	1215.69	1221.52
SC	1563.87	1484.76	1465.51	1534.45	1476.66	1476.33	1320.64	1306.91	1308.40
Jarque-Bera	13.39**	-	-	21.63***	-	-	56.41***	-	-
Breush-Pagan	48.69***	34.23***	25.67**	92.68***	82.78***	83.57***	114.82***	107.51***	109.00***
Moran's I (error)	.17***	-	-	.12***	-	-	.05***	-	-
Robust LM (lag)	28.83***	-	-	36.48***	-	-	12.73***	-	-
Robust LM (error)	7.40**	-	-	1.29	-	-	.71	-	-
Likelihood Ratio	-	85.45***	98.36***	-	64.13***	58.12***	-	20.08***	12.25***

[†]The first group of models includes only the control variables, except for the temporal lag of homicide rates. The second group includes all predictors, except for the temporal lag of homicide rates. The third group includes all predictors.

*p≤.05; **p≤.01; ***p≤.001; § approximates significance at the .10 alpha level

Figure 16. LISA Maps of Residuals

Models 3 (Including Temporal Lag of Outcome)

16.2. OLS Residuals **16.3. Lag Residuals** **16.4. Error Residuals**

16.1. Cumulative Homicide Rate LISA Map

Models 2 (Excluding Temporal Lag of Outcome)

16.5. OLS Residuals **16.6. Lag Residuals** **16.7. Error Residuals**

*Empirical pseudo-significance based on 9,999 random permutations, pseudo-p≤.05.

Model fit statistics in Table 11 and residual diagnostics in Figure 16 seem to favor a spatial lag over a spatial error model. Indeed, the Robust Lagrange Multiplier testing for a missing spatially lagged dependent variable in the possible presence of error dependence (Robust LM(lag)) is significant across all OLS models, while the Robust LM (error) testing for error dependence if a spatially lagged dependent variable is missing is only significant for the OLS model including control variables exclusively (Model 1), but its size is still smaller than that of the Robust LM(lag). In addition, goodness of fit statistics are all better (i.e. larger Log Likelihood, smaller AIC and SC, and larger Likelihood Ratio) for the spatial lag than for the spatial error models including ecological predictors (Models 2 and 3). Likewise, the standard errors for the coefficients are somewhat larger in the spatial error models than in the spatial lag models, indicating that the latter do a better job at predicting the outcome variable.

Furthermore, Figure 16 presents LISA maps for the residuals across models with ecological predictors and compares them among themselves and to the LISA map of the outcome variable. In general terms, the spatial lag models (Maps 16.3 and 16.6) seem to do away with most of the spatial autocorrelation in the residuals when compared to both the OLS and spatial error models. In particular, it seems the spatial lag model is very efficient at explaining spatial dependence in the three high-high homicide clusters in Map 16.1 (downtown, south, and *Kennedy*), but less effective at explaining spatial patterns in a few neighborhoods at the north of *Puente Aranda*, east of *Fontibon* and *Engativa*, and west of *Teusaquillo*. Generally speaking, though, the evidence supports this study's assumption that homicide rates in Bogota have a pattern of spatial dependence whereby rates in neighborhood i are influenced by those of surrounding areas j. Based on this information, the remainder of this chapter will focus on comparing the spatial lag models summarized in Table 11.

Consistent with the rest of the spatial analyses in this monograph, the spatial lag models use a second-order queen contiguity weights matrix. Four ecological predictors in Model 2 are significant after controlling for the spatially lagged dependent variable. Indeed, concentrated disadvantage and social isolation, residential mobility, and social disorder positively predict homicide rates, as hypothesized in this dissertation. The presence of police units, a proxy measure of the public level of control, on the other hand, behaves in the opposite direction to what was hypothesized and positively predicts homicide rates as well.

The only two ecological predictors that remain significant in Model 3 are the concentrated disadvantage and social isolation index, and residential mobility. Although the disadvantage index experiences a reduction in its effect size, it retains its significance level. The mobility measure, on the other hand, keeps the same effect size but increases its level of significance after controlling for the temporal lag of homicide rates. These findings provide partial support for the explanatory value of social disorganization theory to understand homicide rates in Bogota.

The behavior of the residential mobility measure, though aligned with ecological expectations and the hypotheses in this dissertation, is somewhat surprising since the non-spatial bivariate tests did not show an association between this predictor and the dependent variable, and the spatial bivariate correlation showed a weak and negative association between mobility and the spatially lagged outcome. When a predictor X_1 that was uncorrelated to the outcome Y in bivariate tests becomes significant or changes the direction of its effect in a regression model it means that a suppressor variable X_2 that removes unwanted variance and enhances the relationship between X_1 and Y is present in the model (Cohen, Cohen, West & Aiken 2003). To identify which variable or variables accounted for the suppression in variance in the correlation

between mobility and homicide rates several models including only mobility and one other predictor (counting the spatial lag among them) were tested. It was concluded that the spatial dependence and the temporal autocorrelation in the outcome variable improved the relationship between homicide rates and mobility since the coefficient only became significant once the spatial lag was controlled for, and its significance level increased after the temporal lag was included.

The ethnic and cultural heterogeneity index, the parochial control measure, and the basic public services proxy of public control did not reach significance in any of the models, and the social disorder index was only significant in Model 2 before the temporal lag was accounted for. These findings detract some support for the application of ecological theories to homicide rates in Bogota.

In addition, four of the control variables are significant and two more approximate significance at the .10 alpha level in Model 2. The Land Use Mix Index is significant in all models (including OLS and spatial error) and performs in the expected direction. The more mixed the land use the higher the homicide rates. Population density, although having a very small effect size, is highly significant in all models, while population composition merely approximates significance in the models excluding the temporal lag of the outcome, and loses its effect in the full model. Surprisingly, though, both are negatively associated to homicide rates.

Moreover, as hypothesized, forced displacement, the presence of chop shops, and the presence of groups dedicated to committing selective murder (approximates significance) predict higher homicide rates in Model 2, but are not significant in the full model controlling for the temporal lag.

Ultimately, it seems like, once the spatial and temporal lags of homicide rates are controlled for (both have highly significant effects), only two ecological predictors (i.e. disadvantage and mobility) and two controls (i.e. population density and land use) significantly predict the cumulative homicide rate for the 2003-2005 period (natural log) in Bogota neighborhoods. These findings provide partial support for the application of ecological theories to the study of violent crimes in an urban Latin American context. Indeed, although the Colombian literature summarized in this dissertation tends to find that socio-structural conditions are either weakly or not correlated at all with homicide rates and that the presence of criminal structures, organized crime, illegal markets, and indicators of social disorder, particularly alcohol outlets, are the main factors in explaining violent crime in Bogota, the evidence presented in this study suggests that this might not necessarily be the case. In fact, it seems that conditions of disadvantage, isolation, and residential instability have an effect on homicide rates in Bogota that is above and beyond that of the aforementioned usual suspects. It is entirely likely that social disorganization is a precursor of both high violence levels and the installation of illegal groups in the same communities. This conclusion is further supported by the fact that the introduction of the temporal lag did not remove the significant effect of the two social disorganization variables found to be significant in Model 2.

The next chapter discusses theory, methodological, and policy implications of these findings, as well as this study's contributions to the field, its limitations, and recommendations for future research.

CHAPTER 7. DISCUSSION AND IMPLICATONS

The current study makes important contributions to the ecological understanding of homicide rates in an urban context outside of the United States. First, the study provides some support for the external validity of ecological theories of crime by testing alternative measures of social disorganization that are more reflective of the socio-structural and cultural context in Latin America. In particular, the fact that social disorganization measures had an effect above and beyond that of criminal structures, organized crime, and illegal markets should bring attention to the fact that disadvantage and isolation might be much more socially detrimental than the mere existence of criminal organizations.

As noted earlier, concentrated disadvantage and social isolation minimize social advancement opportunities, cutting the links to mainstream society, and hindering the generational transmission of mainstream values. In addition, families and other social institutions see their ability to regulate the behavior of children reduced by the constant demand to provide for their wellbeing with very scarce social and economic resources. Under these conditions, residents of disadvantaged neighborhoods resort to alternative solutions to the social advancement problem, some of which involve engaging in illegal activities. Furthermore, the illegal nature of these alternatives implies that those who engage in them must compete among themselves to gain the control of markets and places. This competition tends to involve the threat and use of violence, routinizing it to secure a more or less stable position within these systems.

Kubrin and Weitzer's (2003b) found "that neighborhoods with higher levels of concentrated disadvantage are *especially* likely to experience greater numbers of retaliatory than non-retaliatory killings" (p. 169) (emphasis in original). These findings support the idea that concentrated disadvantage promotes a routinization of violent responses to daily problems,

especially among youth, in deprived communities. In addition, the detrimental effects of concentrated disadvantage may also spread to neighboring areas by increasing their homicide rates, independent of their own socio-structural conditions (Mears & Bhati 2006). In sum, perhaps the most deleterious by-product of concentrated levels of economic, social, and cultural disadvantage in urban areas is the attenuation of mainstream cultural values (Warner 2003) that protect a community from the spread of deviance and violence.

These processes were illustrated in the exploratory spatial data analysis through the interviews conducted by Escobedo (2005) with the police. Indeed, neighborhoods located within homicide hotspots had high levels of disadvantage and social isolation. In addition, their social networks were infiltrated by criminal elements that engaged in a variety of conflicts involving crime turf and profit protection, and in the violent control of residents and "undesirables." Moreover, the spatial analysis showed that patterns of contagious diffusion were present in the data meaning that high homicide rates at the core of the hotspots (or high-high clusters) spread toward communities in the vicinity.

Furthermore, the results of the present study contradict long-held assumptions about violence in Colombia and some of the findings of prior research. Indeed, studies of violence in Colombia have concluded that the presence of illegal armed groups and markets accounts for much of the variance in homicide rates, while socio-structural factors such as poverty and inequality explain only a small amount (see Formisano, 2002; Llorente et al. 2001; Sanchez and Nuñez, 2007). Perhaps, the shortcoming of those studies has been the way in which they have measured poverty by using indexes such as GINI and the Unsatisfied Basic Needs Index. The measure of concentrated disadvantage and social isolation proposed here might be a more realistic reflection of felt poverty, particularly because it includes the census questions regarding

the inability to consume any food due to lack of money and the lack of home phone service. These, in combination with family disruption, illiteracy, education, unemployment, and recent imports of people who moved from a different country might provide a truer depiction of disadvantage and isolation.

In addition, the literature has supported the effect of residential mobility on crime rates for almost a century. The findings of the present study relating the positive effect of mobility on homicide rates in Bogota provide further evidence that the ecological approach is useful in explaining violent crime in a Latin American context. In fact, this dissertation proposes an improved measure of residential mobility that focuses exclusively on changes of residences within the same city. Residential mobility in the United States has been traditionally measured simply as the percentage of people who moved in the past five years, but the implications of different types of mobility based on the place of origin (i.e. within the city, from another city, from another country) on social disorganization and a community's ability to exercise social control have not been explored. The evidence presented here suggests that each type of mobility relates to a different social disorganization construct in Bogota, and it would be interesting to test whether the same patterns take place in the United States context. Furthermore, future research on social disorganization in Bogota should also include a separate measure of coerced mobility (Clear et al. 2003) by looking at the percentage of residents who have been incarcerated in the past five years. It was also interesting to find that the effect of residential mobility on homicide improved once the spatial lag of the dependent variable was controlled for, indicating a geographic patterning of residential and social mobility in Bogota. It was hypothesized earlier that this pattern might be associated to the stratification system used by the city administration to

subsidize public services in low-income communities. Future research should directly test this hypothesis and control for stratification effects.

In a similar fashion, although the ethnic and cultural heterogeneity index did not have a significant effect on homicide rates, the measurement of the concept is a methodological contribution of this study as well. Heterogeneity has been usually measured as either the percent of minority or non-White population in the United States. The index constructed for this study included minority population, people who moved from other cities to Bogota, and people who were born in other cities, providing a more nuanced account of not just ethnic but cultural heterogeneity as well. The inclusion of this index in the analyses was largely exploratory, as this concept has not been used in the past to study crime rates in Colombia. As it was noted earlier, the population of Bogota is rather homogeneous in ethnic terms, though there is a large influx of individuals from other areas of the country. It was originally hypothesized that this cultural heterogeneity explained conflicts among residents usually revolving around noise levels and disorderly conduct in residential areas. Perhaps this construct is not associated to serious crimes, such as homicide, and future research should explore its potential explanatory power with less serious offenses. It is also possible that the idea of heterogeneity should be revisited within the social disorganization framework as something that might be desirable instead of pernicious for the life of a community. It could be argued that communities with high levels of ethnic and cultural heterogeneity might actually be more tolerant of diverse points of view and values and less prone to conflict in modern Western societies, particularly in large cosmopolitan cities, than very homogeneous communities. Future research should reconsider this construct from the perspective of cultural, not just ethnic, heterogeneity.

The proxy measure of social disorder, which included the rate of alcohol and gambling outlets, was only significant when the temporal lag of homicide rates was not controlled for. This is interesting because most of the literature reviewed concludes that homicide rates in Bogota are largely explained by alcohol consumption, but the evidence presented here seems to contest this assertion. As it was mentioned in the measures section, the most reliable way of collecting social disorder data is through systematic social observations. Future research should attempt to include measures derived from direct observations, and to conceptualize social and physical disorder based on local perceptions as well. Indeed, it was discussed above that different social groups might hold different ideas of what disorder means even within the same communities (Martinez 2010). For instance, a former community organizer interviewed by e-mail for this study argues that residents of the affluent north would identify the presence of street peddlers as a sign of social disorder, while for residents of the more disadvantaged south street-peddling is an option of informal employment and they would be more concerned with poor garbage management and litter in their neighborhoods (L. Ramirez, e-mail communication, March 17, 2012).

The lack of significance of the measure of parochial control is not that surprising as the literature provides very little support for the effect of this construct on homicides. In addition, the variable created in this study merely measures the presence or absence of voluntary associations in the neighborhood, which does not mean that residents actually participate in the activities of these associations or that these activities are in any way related to crime control. It was mentioned in the measures section that the long form of the census included questions about residents' participation in community associations and community events. These items might be better suited for gauging the parochial level of control than the measure used in this study; unfortunately, the data are only available at the locality, not the neighborhood level. But future

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research should strive for collecting this kind of information because, according to Ramirez (e-mail communication, March 17, 2012), community associations seem to be more likely to be formed in more disadvantaged areas where residents have had to work hard to legitimize their neighborhood. In fact, these associations are based on solidarity and promote community participation to present projects to and request services from the city administration, collect funds to invest in neighborhood improvements, and organize trash pick-up campaigns, among other things (L. Ramirez, e-mail communication, March 17, 2012). These activities are certainly theoretically related to the exercise of systemic social control and they might affect local homicide rates. Furthermore, Ramirez's insight on community organization provides support for what was hypothesized here regarding differences between urban areas in the United States and Latin America in terms of how communities cope with conditions of disadvantage. Indeed, it seems in Latin America disadvantaged communities are more likely to get organized for action than their more affluent counterparts, while the opposite seems to be the case in the United States. Either way, the findings of this study suggest that disadvantage is highly associated to violent crime rates, regardless of how communities cope with it.

Although the basic public services proxy measure of the public level of control did not reach significance, its coefficient is in the hypothesized negative direction. This finding invites a wider discussion about the conceptualization and measurement of the public level of control. Perhaps a stronger measure should include more types of services (similar to Belnar et al. 2008); and the extent of public and private investment in different social sectors (similar to Sánchez et al. 2007). In the case of Bogota, a 2004 city ruling created a new administrative unit known as Zonal Planning Units (ZPU – *Unidades de Planeación Zonal*). These ZPUs are clusters of neighborhoods that share similar demographic and socio-structural characteristics and through

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which the locality and the city channel resources to the neighborhoods. Information collected at this level might provide better insight into the public level of control and the city administration could require that detail information about the allocation of public resources be collected by all ZPUs to evaluate the effectiveness of social programs.

On the other hand, the police measure was only significant when the temporal lag of homicide rates was not controlled for, but its effect was in the opposite direction to what was hypothesized. A possible explanation for this relationship may be that the allocation of police resources tends to be more reactive than proactive. In other words, both city bureaucracies and community residents may push for the investment of this kind of resources in the areas with the highest crime rates. This might be particularly the case with the placement of CAIs, since residents can request them from the police. This account is further confirmed in Model 3 as the police proxy measure of public control loses its significance once the prior homicide rate is controlled for. More nuanced measures of police control including manpower dedicated to patrol and community policing, the proportion of blocks with neighborhood watch programs, and arrest rates at the neighborhood level could offer a better explanation of the effect formal social control may have on homicide rates than the simple presence of police units used in this study. During the early stages of this dissertation, attempts were made to collect these types of police data. Unfortunately, because police strategic deployment is conducted at the locality/precinct, not the neighborhood level, this information is not available at the level of disaggregation required for an ecological study. In 2007, the Metropolitan Police of Bogota started implementing a mobile CAI program to improve police response to street crimes. The units are regularly relocated based on the spatial distribution of crimes. These units might prove effective not just in terms of preventing and reacting to crime, but also in improving police-citizens relationships as they are

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also equipped to respond to less serious complaints. Thus the performance of these mobile CAIs could be evaluated as a measure of public control in the future to determine if these resources are being appropriately apportioned.

The positive effect of mixed land use on homicide rates is consistent with the U.S. literature and provides support for the ecological approach in Bogota. Nonetheless, it is possible that the association is localized and mostly accounted for by the downtown area since the V-shaped high-high LUMI cluster fully covers the downtown high-high homicide cluster. Geographically Weighted Regression (GWR), which allows for the estimation of regression parameters at the local level, could be used in future research to disentangle local patterns observed in the ESDA.

The findings regarding the negative effects of population density (highly significant in all models) and population composition (approximates significance in models 1 and 2) were rather surprising. It is possible that in areas with low population density there are less capable guardians with the ability to exercise informal social control and, thus, the opportunity for conflicts to end in lethal violence and for criminals to dispose of victims murdered elsewhere is greater there. The finding regarding the percent of young males in the population is more puzzling, since this measure has been consistently found to explain crime rates in the literature. Some researchers argue that the inclusion of community population characteristics as covariates in models predicting violent victimization might be misleading because neither the offenders nor the victims need be residents of the area where the incident took place (see Pridemore 2011; Rosenfeld, Bray & Egley 1999). Thus it is conceivable that the percent of young males in a community does not necessarily account for the levels of violence that neighborhood experiences.

The effects of forced displacement, chop shops, and selective murder in model 2 are noteworthy, even though they disappear once the temporal lag is introduced. According to Escobedo's (2005) field notes, neighborhoods in the high-high homicide clusters tend to have a larger representation of residents who were displaced by the internal armed conflict in other parts of the country. Perhaps their arrival to a complex urban environment destabilizes the receiving communities and, having been exposed to violence in the past, displaced individuals may be more tolerant of violent resolution of conflicts. On the other hand, their stigma as victims of forced displacement may make them easier targets of violence themselves. For instance, a displaced woman interviewed by Uribe-Mallarino (2008), stated that Bogota simply "eats displaced people alive", and that communities end up losing track of them (p. 163). Escobedo (2005) also discusses the presence of chop shops as a source of conflict in the neighborhoods in the homicide hotspot in the south of the city, where criminal residents who engage in car theft in other areas of Bogota end up having violent fights over the control of crime turfs and profits. Lastly, based on Escobedo's interviews with police, it seems like the presence of selective murder groups is ubiquitous in the neighborhoods within all of the high-high homicide clusters. These groups often work at the behest of drug cartels, paramilitaries, and even disgruntled citizens who want to exert retaliation against those who do not act within expectations. In addition, these groups also serve as agents of illegal social control when they dispose of "undesirables" (e.g., homeless people, prostitutes, drug addicts, homosexuals, pedophiles, street criminals, social activists) in the community by exerting the ultimate punishment of death.

7.1. Policy Implications

Bogota's administration and the national government should make a greater effort at reducing the concentration of social disadvantages. First, the eligibility criteria for the

identification and classification of potential beneficiaries of social programs should be expanded by increasing the minimum wage required to qualify as "below the poverty line" to be able to receive public assistance. Currently, this is set at 190,000 Colombian pesos (or about 108 US dollars) monthly income, which is not even enough to pay rent in a small, one-bedroom apartment in a stratum one neighborhood. Individuals making more than that are not eligible for public aid programs, thus excluding a vast amount of people living in extreme conditions of disadvantage.

In addition, the programs offered by the *Secretaría de Integración Social* (Social Integration Secretariat), in particular those that deal with at-risk children and youth, food policies, education, and family stability, should be expanded and evaluated to make sure that they are reaching the intended populations.

Interventions that have been successful in dealing with unemployment and underemployment in other parts of the world, such as providing microloans to women with small-business projects, should be promoted by the city administration in association with international organizations such as UNICEF, and NGOs such as My Fight (www.myfight.org), Accion (www.accion.org), Care (www.care.org), and Women for Women International (www.womenforwomeninternational.org), among others.

The local government should also strive to increase the coverage of basic public services to 100 percent of the population as a way of improving the quality of life of residents in disadvantaged communities. This might help reduce illegal behaviors, such as stealing electricity service, and thus cultural attenuation and social conflict.

Also, the social stratification system currently in place to provide subsidies to disadvantaged households in the payment of public services discourages social mobility and it

effectively entraps people in the same social stratum practically for life. The system should be modified so that it encourages more mixed-income housing options, thus improving the ability of residents to access social resources favorable to upward social mobility such as employment networks.

Finally, it is worth noting that policies that attempt to deal with urban decay by focusing only in the physical recovery of neighborhoods, but that do not improve the conditions of the residents in the aforementioned areas, are bound to simply displace the violence to other communities, as it was the case with *El Cartucho* and the Third Millennium Park. Moreover, public works inspired by situational crime prevention principles that focus on recovering public space but that do not include an educational campaign focusing on enhancing the sense of belonging and fostering peaceful co-existence, are also unlikely to be effective at reducing crime and disorder. For instance, Ramirez argues,

> The construction of the mass transportation system, *Transmilenio*, allowed for the improvement of the physical environment, but it did not imply changes in the behavior of public transportation users. Even more, *Transmilenio* has become a target of vandalism every time Bogota residents want to express social discontent of any kind (e-mail communication, March 17, 2012).

7.2. Limitations and Future Research

The limitations of some of the measures included in this study and potential ways of improving them have already been discussed. Additional limitations are addressed in this section. First, the ecological model implemented carries a certain amount of aggregation, also known as the ecological fallacy, because the effects of individual resident attributes are not being controlled for in the model. Future analyses should consider a spatially lagged multilevel approach.

Similarly, as it was noted earlier, the use of official neighborhoods as the unit of analysis limits the ability to capture the social dimensions of social organization (Tienda 1991). Future research should collect data on socially defined neighborhoods, so that the cognitive maps of residents are reflected in the unit of analysis. The problem with this approach in Bogota is that it would be difficult to use census data to conduct the analysis.

Another shortcoming is the cross-sectional nature of the study. Although it has been argued here that the behavior of homicides as well as of the predictors tends to be stable from one year to the next, changes do take place in the long term. For instance, in the case of Bogota, there have been dramatic changes in the homicide rates in both upward and downward directions since the 1980s (see Figure 7). Therefore, a spatio-temporal longitudinal study could arrive at more accurate causal conclusions about the nature of homicides in Bogota.

Furthermore, as mentioned above, the construct validity of the measures of public control and social disorder is suspect in this study and future studies should attempt to collect more sophisticated data.

On the other hand, the outcome variable in this study did not discriminate among types of homicides. It is possible that the ecology of homicides may vary by type. Future research should replicate this study using different types of homicides (i.e. instrumental vs. expressive; criminal vs. political) as the outcome variables to test this.

Additionally, although purporting to test the Systemic Model of Crime Control, this study did not collect information on the private level of control embodied by interpersonal networks. Future research should include survey data on social cohesion and collective efficacy at the neighborhood level.

Moreover, the final models reported here, although improving over the OLS models, still violated some of the assumptions of regression analysis. Thus the findings should be interpreted with caution as estimates might be somewhat biased.

Finally, there is some debate in the literature as to what is the best way to standardize outcomes and predictors (e.g., rates, densities, cumulative counts) to conduct ecological studies. Indeed, most studies utilize population-standardized rates to create their measures. However, some studies have argued that it is misleading to assume that offenders and victims reside in the area where the criminal event happened. For instance, offender search theory argues that offenders seek and stumble upon crime opportunities as they travel between nodes or areas where they conduct most of their routine activities. These nodes include, but are not limited to their place of residence (Bratingham & Bratingham 1993). This was exemplified in Escobedo's (2005) interview notes by the neighborhoods in the high-high cluster in the south of the city where criminals were residents but committed their offenses elsewhere. Consequently, some researchers favor the use of cumulative counts (Rosenfeld et al. 1999) and others the use of densities (Pridemore 2011) to study the ecology of crime. Future research should compare the three approaches and assess whether the same kind of predictors are associated to the ecology of homicides.

7.3. Conclusion

In sum, this study makes several contributions to the literature. First, the study advances social disorganization theory by testing its external and construct validity. Alternative measures are proposed and applied to an urban setting outside of the United States. Findings support the idea that neighborhood disadvantage, social isolation, and residential mobility increase the

chances that a community will experience higher levels of violent crime than its wealthier counterparts, regardless of the socio-cultural context.

The study also provided a test of the Systemic Model of Crime Control by including proxy measures of the parochial and public levels of control in the analyses. Although the effects of these variables were not significant, the dissertation adds to the discussion of how these constructs should be measured.

Additionally, the dissertation makes methodological contributions in combining a variety of data sources using a mixed-methods approach. Indeed, principal components factor analysis, exploratory spatial data analyses, spatial regression models, and interviews complemented each other in providing a more nuanced evaluation of the ecological covariates of homicide rates in Bogota.

Finally, the results suggest important policy implications to reduce the effects of disadvantage as potentially effective strategies in preventing violent crime at the neighborhood level.

In conclusion, the study provides some evidence in favor of the usefulness of social disorganization theories to understand violent crime in Latin American cities. Similar models should be replicated across the region to confirm whether the evidence from Bogota is generalizable to other urban areas in the continent.

APPENDIX 1. MATCHING THE DATA

This study utilized a variety of data sources including officially recorded homicide events, census information, cartographic data, and interviews. Several steps were taken to carefully match all the data. First, the digital map of Bogota required extensive manipulation in *ArcView*©. Indeed, polygons representing blocks in the original shapefile were separated by spaces representing streets. The fact that the boundaries of the polygons did not touch each other meant that a contiguity spatial weights matrix could not be constructed. To fix this, blocks sharing the same census urban sector code were combined using a dissolve procedure and then the boundaries of the new polygons (now representing official neighborhoods) were manually edited so that they would be fully adjacent.

Then homicide events geocoded at the X- Y-coordinate level were projected on the map. The data were clipped to remove homicide points outside of city limits. Joining the points to the neighborhood polygons created neighborhood homicide counts. In addition, the homicide data had a column identifying the name of the neighborhood where the homicide was recorded. This information was imported into the map's attribute table.

The next step involved matching the urban sector codes in the map to those reported by the census. About 400 codes present in the map did not exist in the census. This was due to the fact that the digital map was purchased in 2009; four years after the census took place. In the interim the Urban Planning Department split areas into new official neighborhoods. Using the map's attributes table, units with codes not in the census were merged with the most logical census unit, based on adjacency/proximity, population size, and location within the same ZPU. To ensure the process yielded accurate neighborhoods, each new polygon was compared to its equivalent in the online version of the official digital map available at

http://mapas.bogota.gov.co/geoportal/#. The comparison made sure that census codes, neighborhood names, and polygon shapes matched.

The resulting table was then exported to *IBM SPSS*[©] where the census files were merged into the dataset. Finally, data on the presence of criminal structures, organized crime, and illegal markets from interviews with the police was merged to the file using the neighborhood name. These data were missing for 48 units. Missing values were replaced with the median of two nearby points sorted by X-coordinate, which yielded the most conservative approach.

APPENDIX 2. MORAN SCATTERPLOTS

Figure 17. Univariate Moran Scatterplots

17.1. Cumulative Homicide Rate
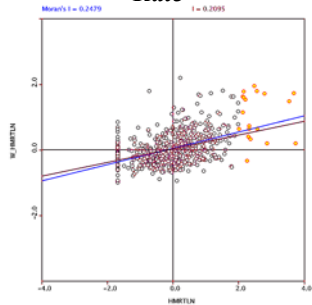
17.2. Concentrated Disadvantage & Social Isolation
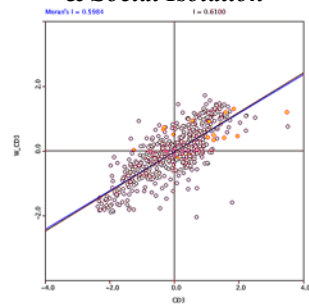
17.3. Ethnic & Cultural Heterogeneity
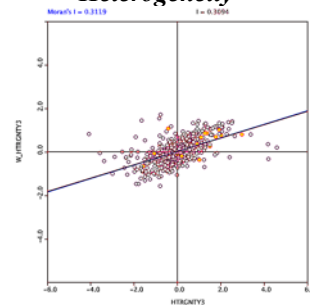
17.4. Residential Mobility
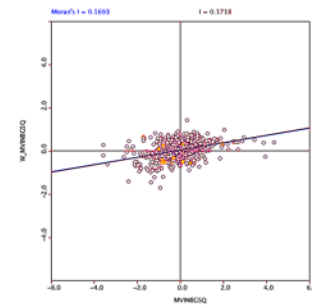
17.5. Social Disorder
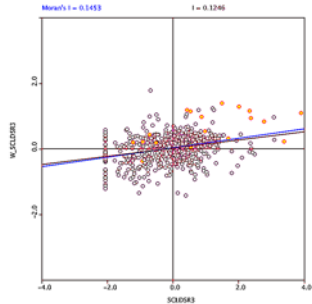
17.6. Basic Public Services Public Control
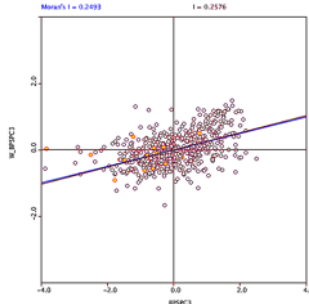
17.7. Temporal Lag Cumulative Homicide Rate (2000-2002)
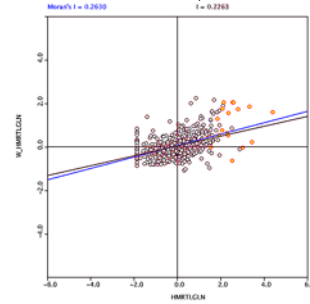
17.8. Population Density
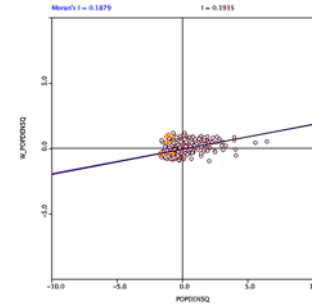
17.9. Land Use Mix Index
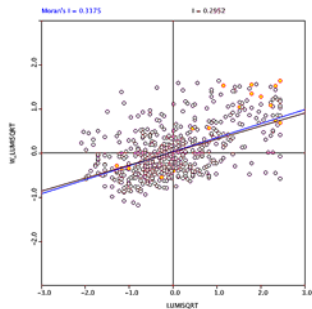
17.10. Young Males
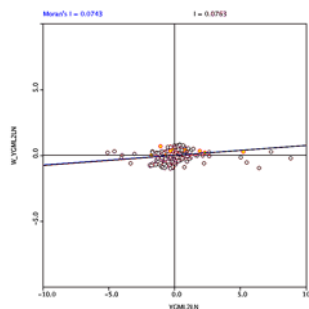
17.11. Forced Displacement

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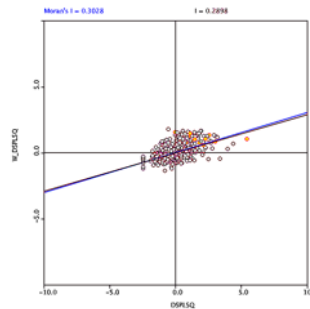
Figure 18. Bivariate Moran Scatterplots

18.1.Disadvantage vs. Spatial Lag of Homicide Rate
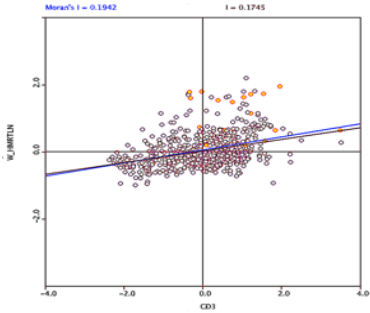
18.2.Heterogeneity vs. Spatial Lag of Homicide Rate
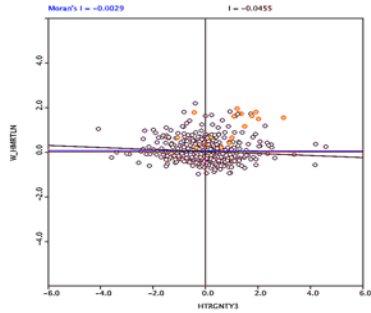
18.3.Mobility vs. Spatial Lag of Homicide Rate
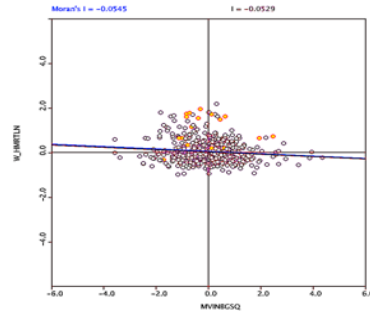
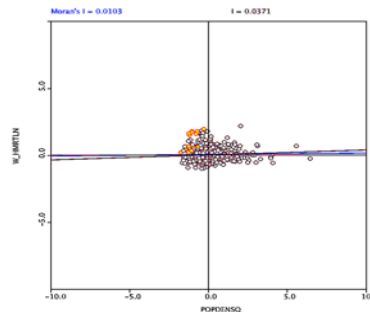**18.4.Disorder vs. Spatial Lag of Homicide Rate**
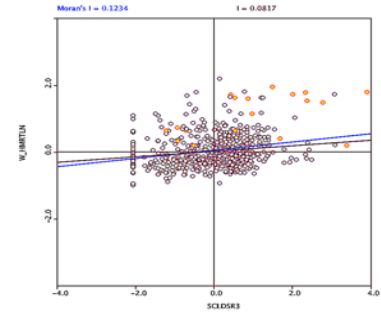
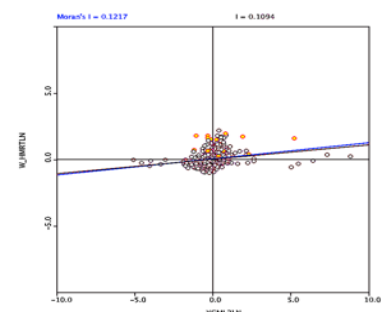**18.5.Public Services vs. Spatial Lag of Homicide Rate**
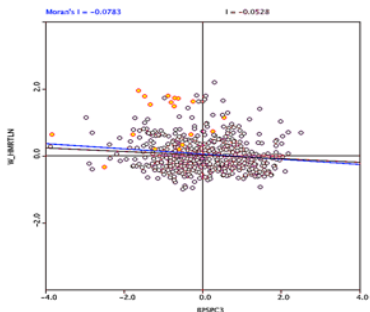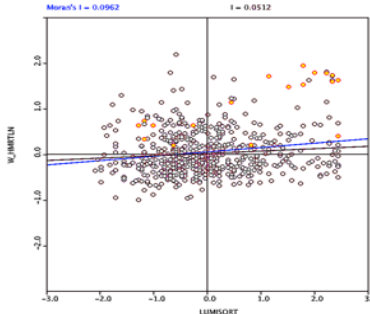
18.6.Temporal Lag vs. Spatial Lag of Homicide Rate
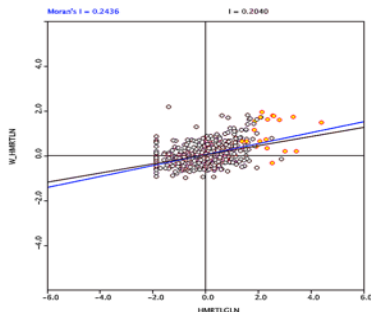
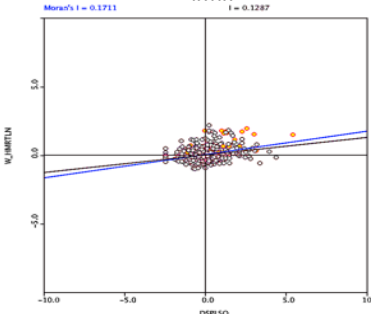**18.8.Pop. Density vs. Spatial Lag of Homicide Rate**

18.9.Young Males vs. Spatial Lag of Homicide Rate

18.10.LUMI vs. Spatial Lag of Homicide Rate

18.11.Displaced vs. Spatial

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APPENDIX 3. CONDITIONAL MAPS

Figure 19. Effect of Interaction between Concentrated Disadvantage and Basic Public Services on Homicide Rates
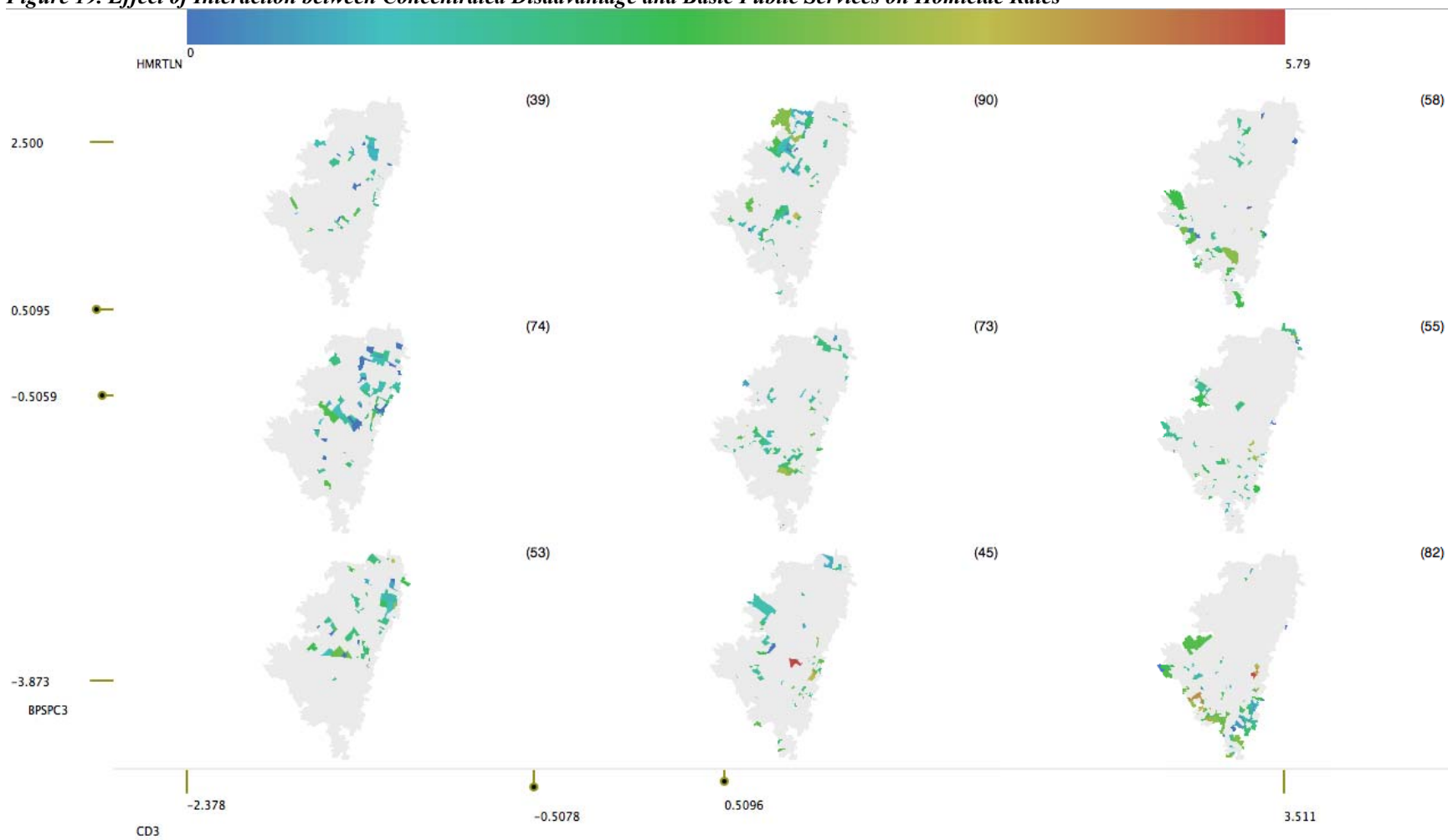
Figure 20. Effect of Interaction between Concentrated Disadvantage and Police Presence on Homicide Rates
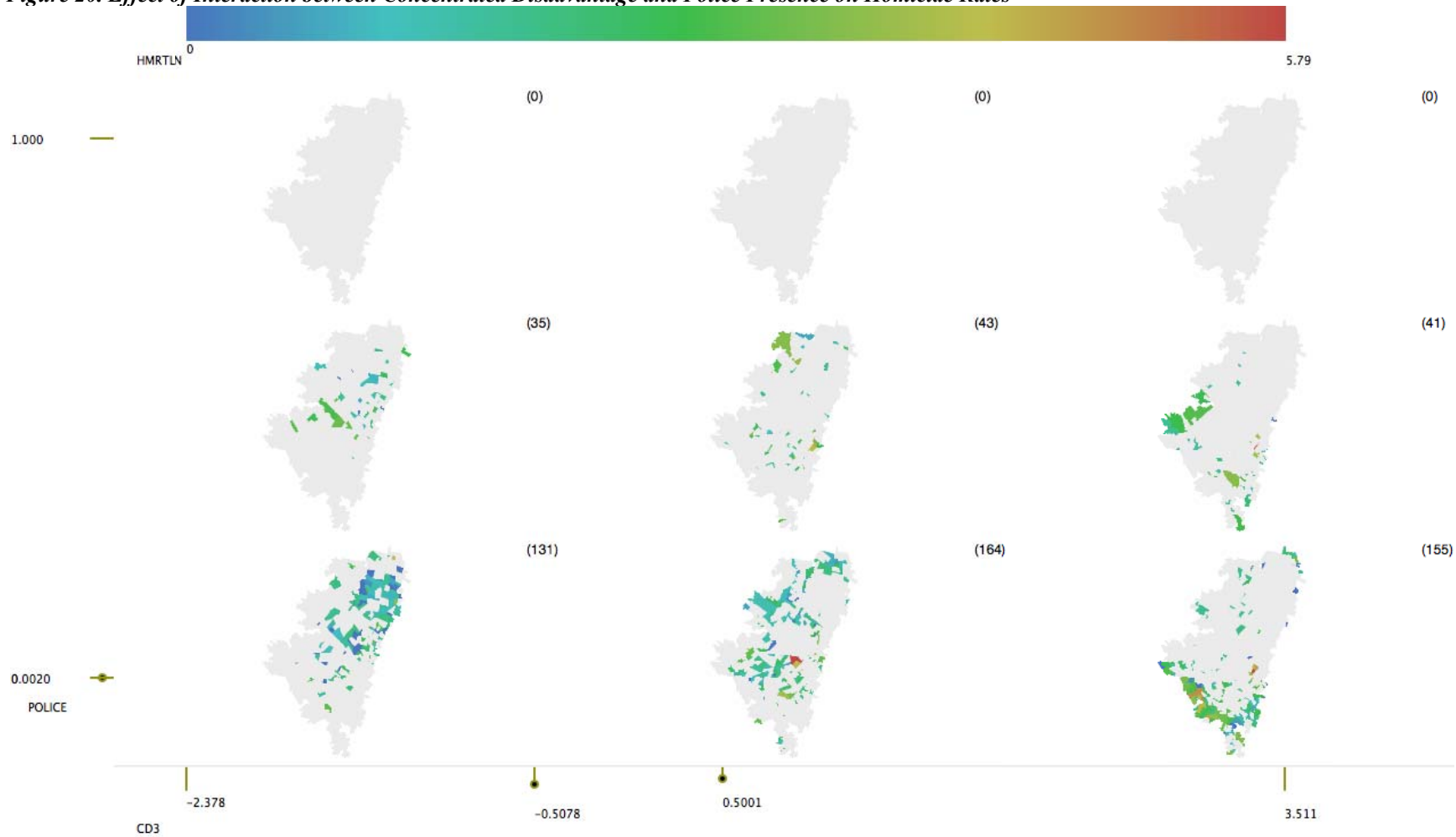
Figure 21. Effect of Interaction between Concentrated Disadvantage and Parochial Control on Homicide Rates
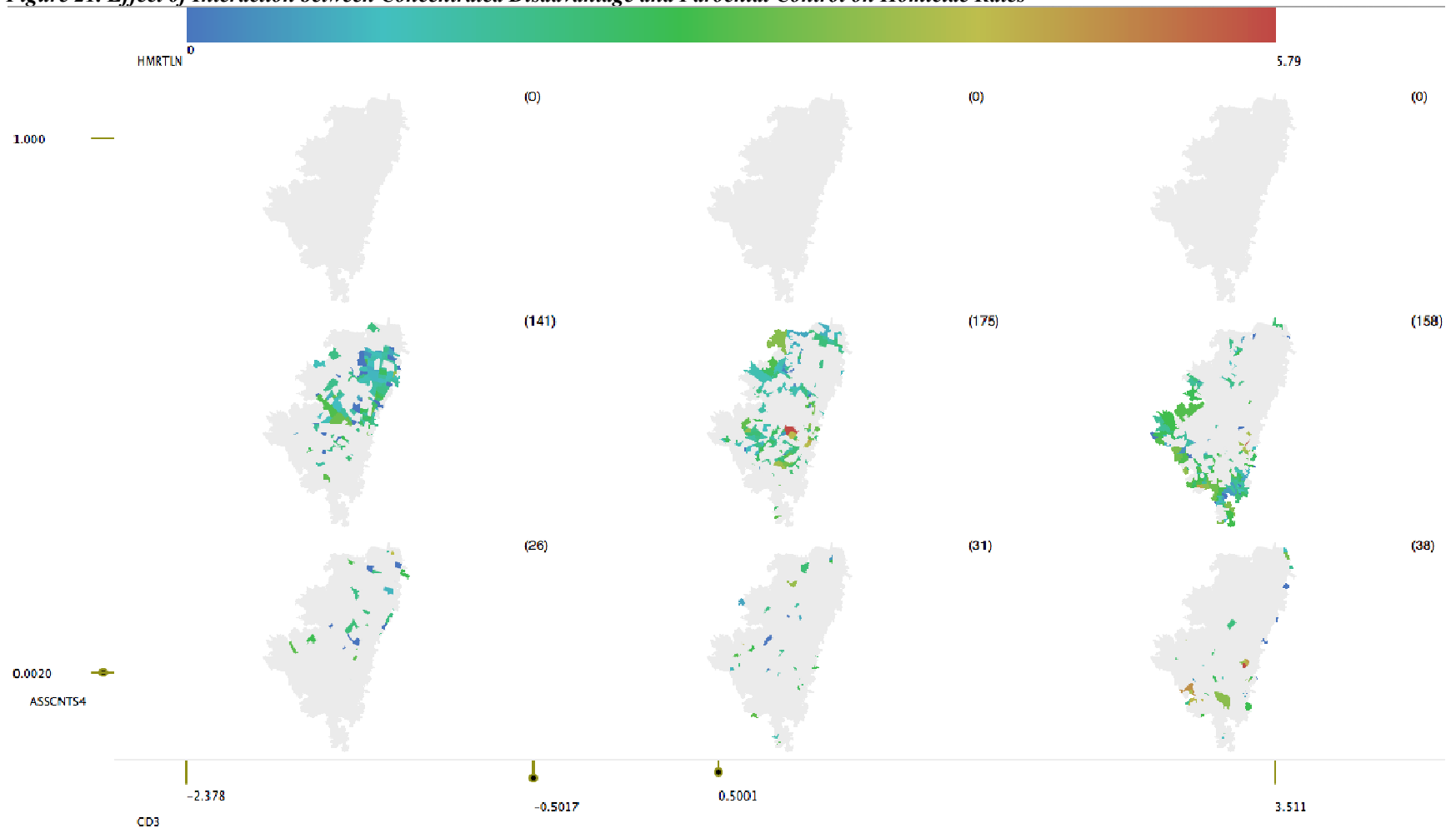
Figure 22. Effect of Interaction between Social Disorder and Basic Public Services on Homicide Rates
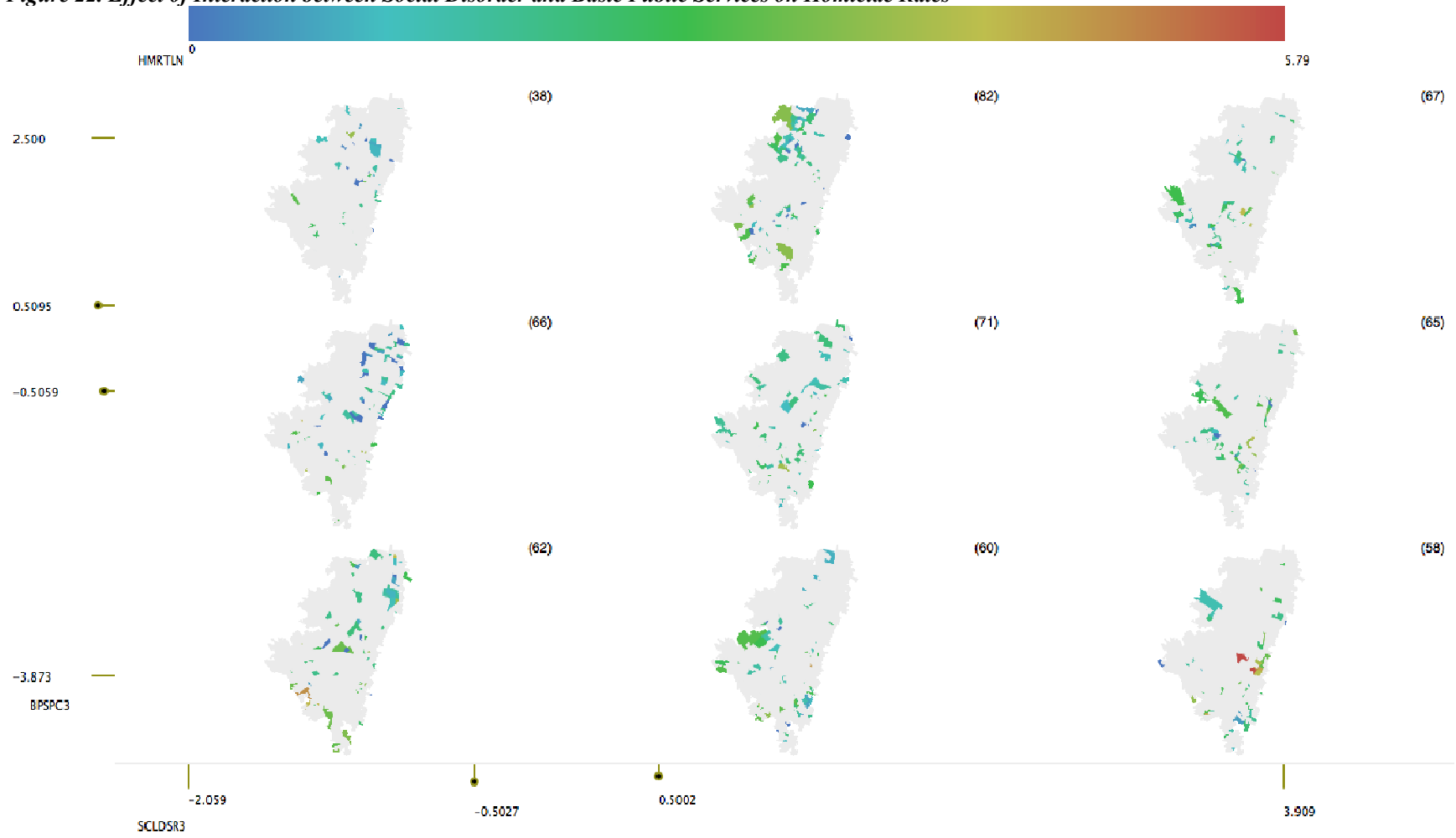
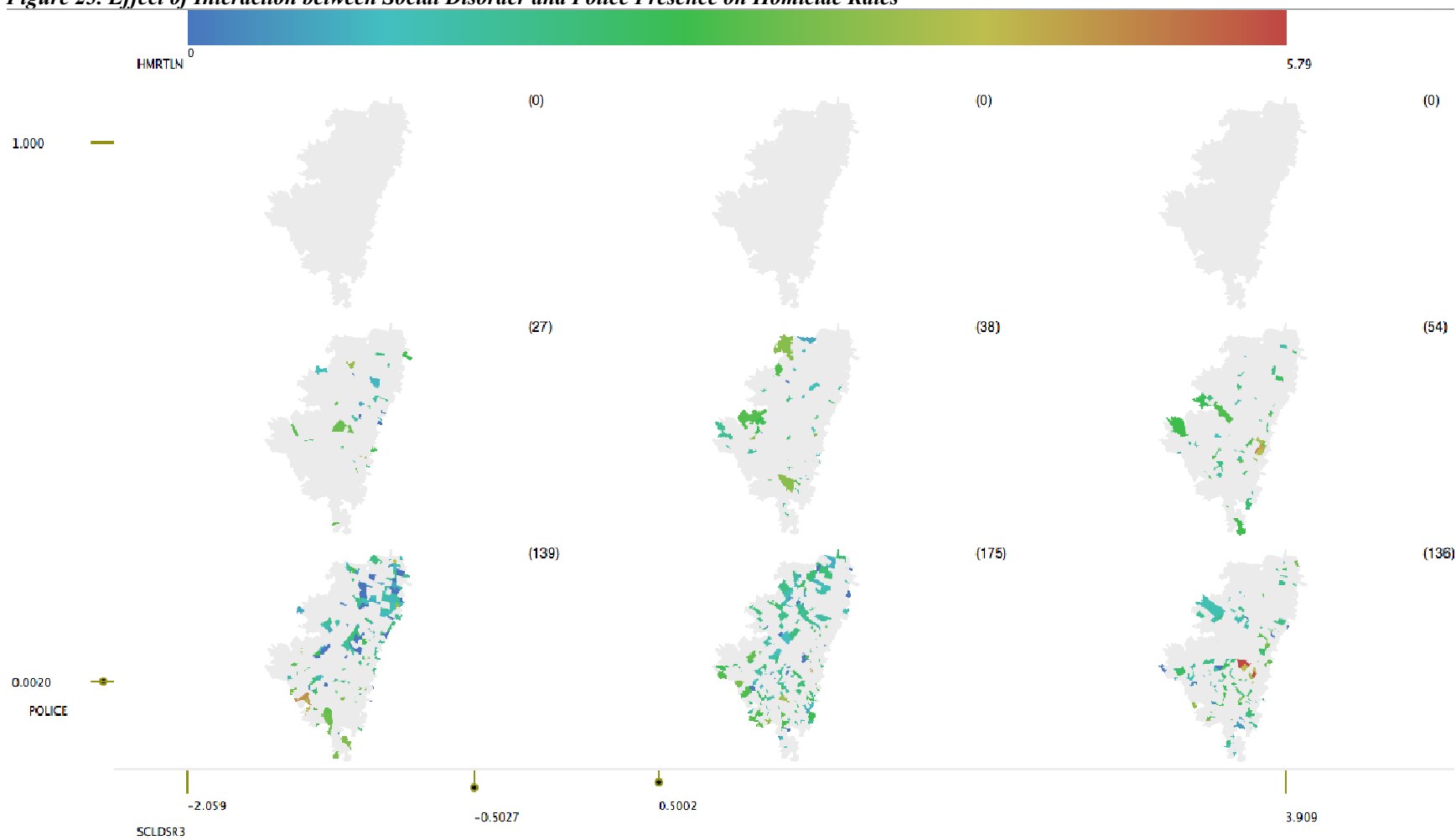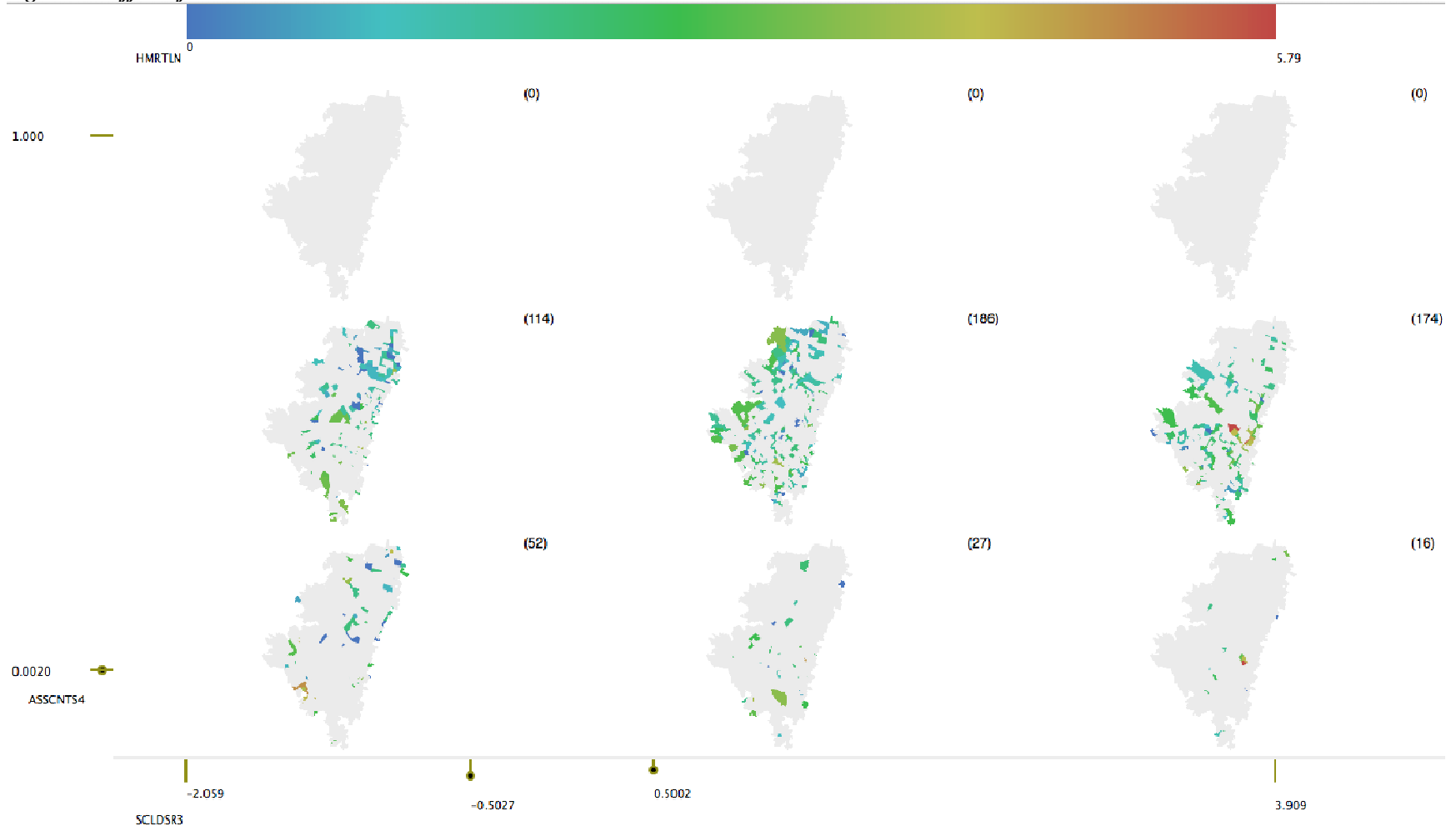*Figure 23. Effect of Interaction between Social Disorder and Police Presence on Homicide Rates*

Figure 24. Effect of Interaction between Social Disorder and Parochial Control on Homicide Rates

APPENDIX 4. REGRESSION DIAGNOSTICS

Table 12. Regression Correlation Matrix[†] (N=569)

|	HMC	CD	ECH	MOB	SDR	BPS	POL	PAR	TLG	PDN	YGM	LUM	DSP	FRC	PRM	ORM	GNG	DRG	ARM	CHS
HMC	HMC																			
CD	.25*	CD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ECH	.07	-.25*	ECH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOB	.03	-.04	.24*	MOB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SDR	.26*	.33*	.16*	.07	SDR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BPS	-.18*	-.09*	-.09*	.04	.09*	BPS	-	-	-	-	-	-	-	-	-	-	-	-	-	-
POL	.15*	-.02	-.01	-.03	.15*	.04	POL	-	-	-	-	-	-	-	-	-	-	-	-	-
PAR	-.11*	-.02	.09*	-.05	.27*	.12*	.05	PAR	-	-	-	-	-	-	-	-	-	-	-	-
TLG	.72*	.18*	.11*	-.04	.22*	-.16*	.20*	-.14*	TLG	-	-	-	-	-	-	-	-	-	-	-
PDN	-.34*	.37*	-.19*	.05	.14*	.15*	-.08	.20*	-.38*	PDN	-	-	-	-	-	-	-	-	-	-
YGM	.08*	.24*	.37*	.06	.09*	-.04	-.07	-.05	.08	.02	YGM	-	-	-	-	-	-	-	-	-
LUM	.27*	-.17*	.31*	-.04	.54*	-.08	.14*	.18*	.25*	-.25*	.04	LUM	-	-	-	-	-	-	-	-
DSP	.25*	.44*	.38*	.01	.22*	.14*	.01	.06	.26*	.11*	.34*	.02	DSP	-	-	-	-	-	-	-
FRC	.05	.22*	-.14*	-.07	.02	.01	.05	-.04	.04	.04	.10*	-.11	.07	FRC	-	-	-	-	-	-
PRM	.12*	.25*	-.13*	.02	.08	.05	.09*	-.10	.13*	.04	.06*	-.06	.09*	.56*	PRM	-	-	-	-	-
ORM	.18*	.40*	-.19*	.05	.10*	.09*	-.02	-.03	.16*	.17*	.10*	-.16*	.17*	.42*	.44*	ORM	-	-	-	-
GNG	.05*	.32*	-.18*	.10*	.14*	-.02	.03	-.02	.004	.20*	.07	-.17*	.07	.32*	.34*	.40*	GNG	-	-	-
DRG	.12*	.35*	-.10*	.10*	.15*	.03	.05	-.02	.07	.13*	.15*	-.11*	.15*	.16*	.22*	.30*	.38*	DRG	-	-
ARM	.14*	.35*	-.13*	-.03	.06	.05	.07	-.02	.15*	.13*	.08	-.16*	.15*	.41*	.39*	.50*	.39*	.26*	ARM	
CHS	.13*	.28*	-.13*	.04	.01	.07	.03	.02	.10*	.09*	.04	-.16*	.15*	.25*	.24*	.42*	.42*	.34*	.42*	CHS

*p≤.05, two-tailed.

[†]Abbreviations: HMC=Cumulative Homicide Rate (2003-2005); CD=Concentrated Disadvantage and Social Isolation; ECH=Ethnic and Cultural Heterogeneity; MOB=Residential Mobility; SDR=Social Disorder; BPS=Basic Public Services; POL=Police; PAR=Parochial Control; TLG=Temporal Lag of Cumulative Homicide Rate; PDN=Population Density; YGM=Population Composition (Percent of Young Males); LUM=Land Use Mixed Index; DSP=Foreceful Displacement; FRC=FARC Militias; PRM=Paramilitary Cells; ORM=Organized Muder Groups; GNG=Gangs; DRG=Drug Distribution; ARM=Arms Trafficking; CHS=Chop Shops.

Table 13. Regression Multicollinearity Diagnostics

| Predictor	Tolerance	VIF
Concentrated Disadvantage	.372	2.687
Ethnic & Cultural Heterogeneity	.435	2.299
Residential Mobility	.842	1.187
Social Disorder	.415	2.409
Basic Public Services	.810	1.235
Police	.905	1.105
Parochial Control	.817	1.224
Temporal Lag Homicide Rates	.608	1.644
Population Density	.579	1.726
Population Composition	.695	1.439
Land Use Mixed Index	.461	2.170
Forceful Displacement	.498	2.009
FARC Militias	.579	1.727
Paramilitary Cells	.575	1.739
Organized Murder Groups	.556	1.797
Gangs	.637	1.570
Drug Distribution	.744	1.344
Arms Trafficking	.604	1.655
Chop Shops	.661	1.513

Normality of Residuals Diagnostics
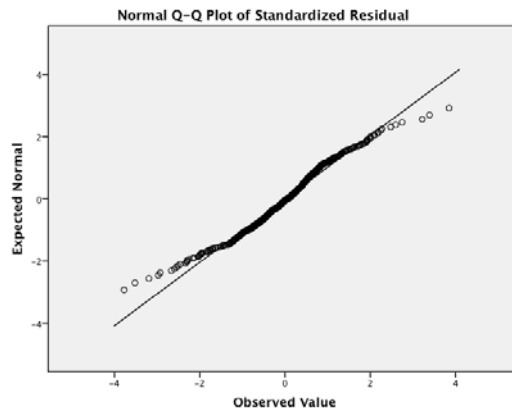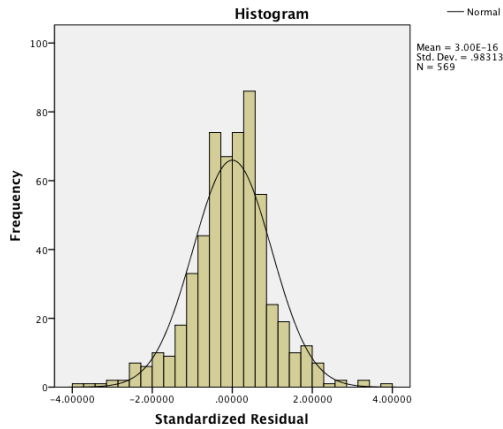
Test of normality: Shapiro-Wilk(569)=.980, p<.001.

OLS Residuals   **Lag Residuals**   **Error Residuals**
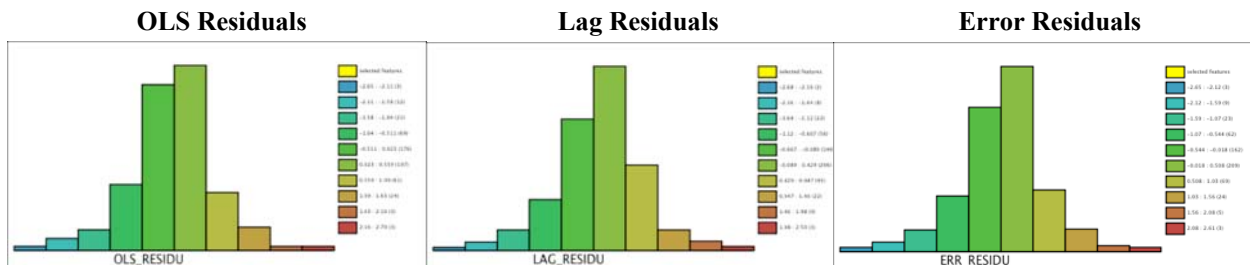
Homoscedasticity of Residuals Diagnostics

Models 3 (Including Temporal Lag of Outcome)

OLS Model	Spatial Lag	Spatial Error Model

Models 2 (Excluding Temporal Lag of Outcome)
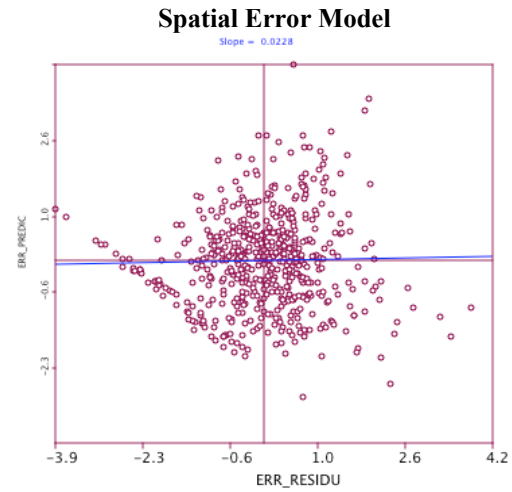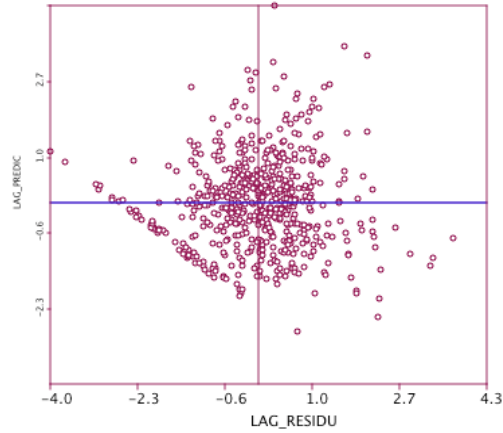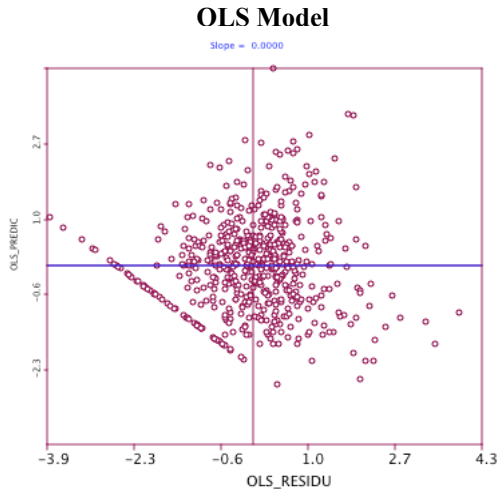
OLS Model	Spatial Lag Model	Spatial Error Model
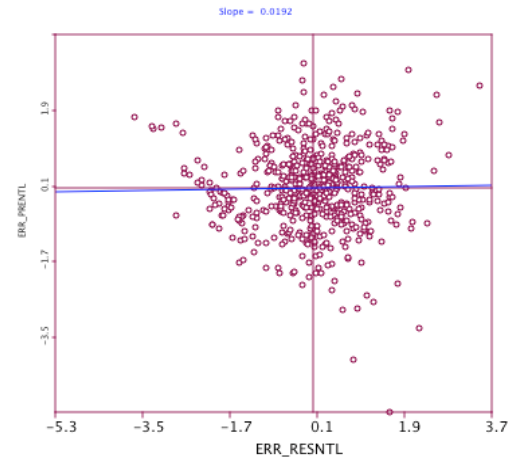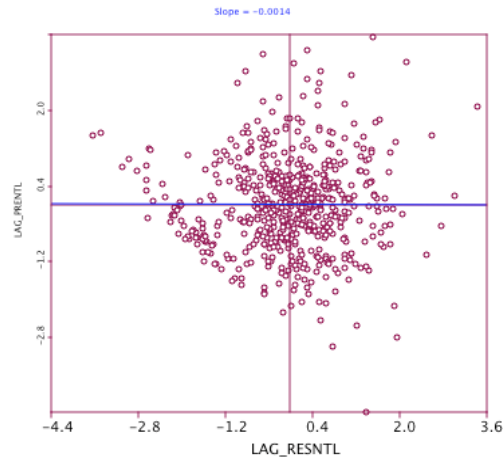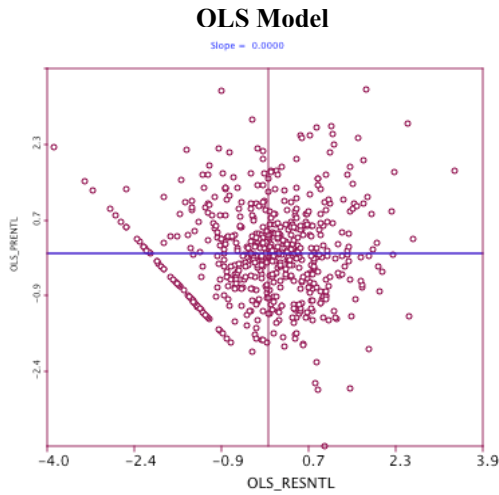
Linearity Diagnostics – Scatterplot Matrix

REFERENCES

Anselin, L. (2004). *GeoDa^{TM} 0.9.5-i Release Notes*. Retrieved from:
http://geodacenter.org/downloads/pdfs/geoda095i.pdf.

Anselin, L. (2002). Under the Hood: Issues in the Specification and Interpretation of Spatial
Regression Models. *Agricultural Economics* 27:247-267.

Anselin, L. (1996). The Moran Scatterplot as an ESDA Tool to Assess Local Instability in
Spatial Association. In M. Fischer, H.J. Scholten & D. Unwin (Eds.). *Spatial Analytical
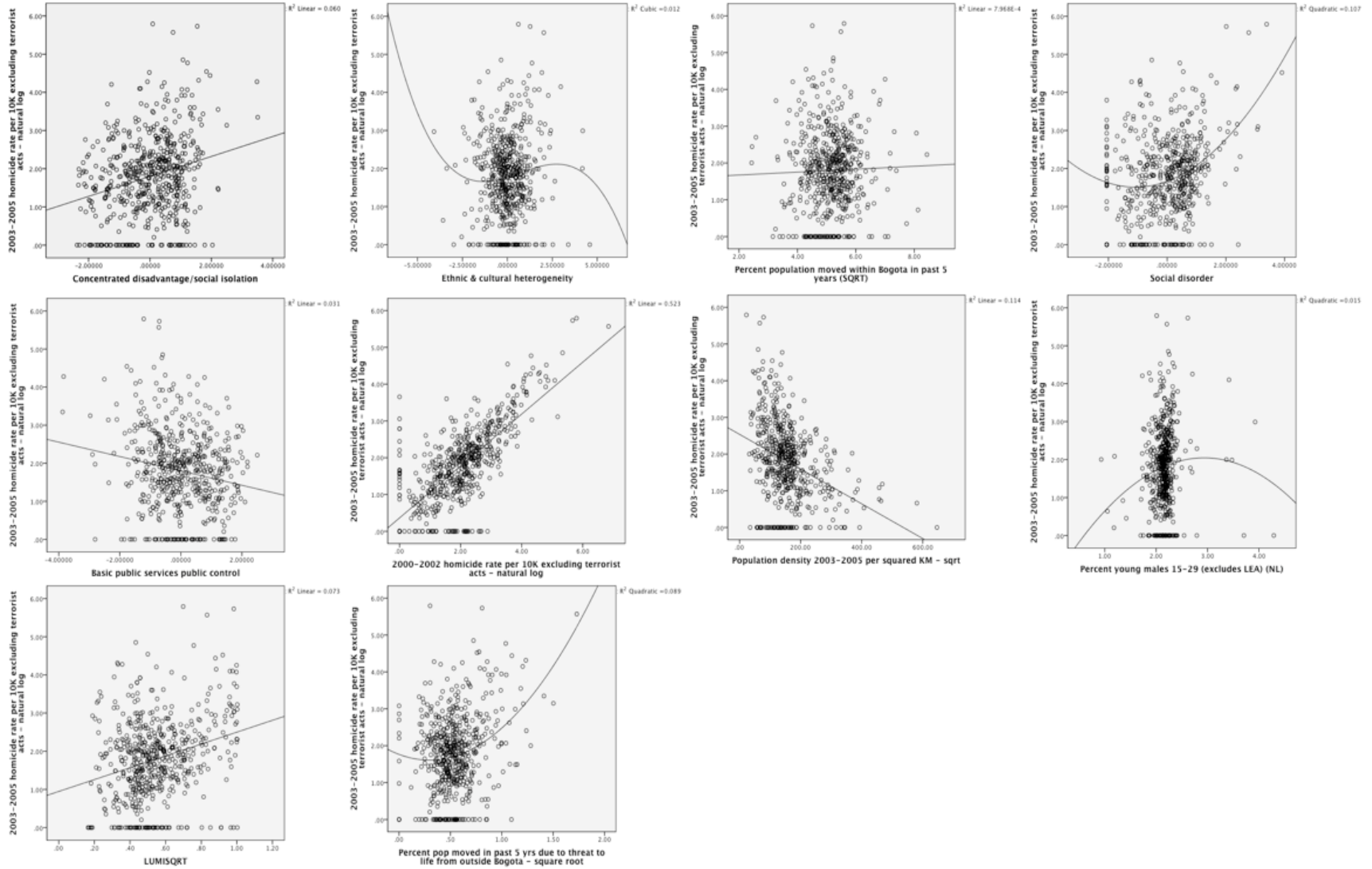Perspectives on GIS: GISDATA 4*. London, UK: Taylor & Francis.

Anselin, L. (1989). What is Special About Spatial Data? Alternative Perspectives on Spatial Data
Analysis. Paper presented at the Spring 1989 *Symposium on Spatial Statistics, Past,
Present and Future*, Department of Geography, Syracuse University.

Anselin, L. & A. Bera (1998). Spatial Dependence in Linear Regression Models with an
Introduction to Spatial Econometrics. In A. Ullah & D. Giles (Eds.). *Handbook of
Applied Economic Statistics*. New York, NY: Marcel Dekker, p.p. 237-289.

Anselin, L., I. Syabri & Y. Kho (2006). *GeoDa*: An Introduction to Spatial Analysis.
Geographical Analysis 38(1):5-22.

Anselin, L., I. Syabri & O. Smirnov (2002). Visualizing Multivariate Spatial Correlation with
Dynamically Linked Windows. In L. Anselin & S. Rey (Eds.) *New Tools for Spatial Data
Analysis: Proceedings of the Specialist Meeting*. Santa Barbara, CA: Center for Spatially
Integrated Social Sciences, University of California, CD-ROM.

Ardila, Laura (2011, September 4). Hay Cuatro Nuevos Cartuchos. *El Espectador*. Retrieved
from http://www.elespectador.com.

Arias, E.D. (2006). The Dynamics of Criminal Governance: Networks and Social Order in Rio
de Janeiro. *Journal of Latin American Studies* 38:293-325.

Arias, D., G. Escobar & M.V. Llorente (2009) *Understanding Colombia's Paramilitary
Demobilization: A Sub-National Analysis of State Efforts to Control Right Wing Violence
since 2002*. Unpublished manuscript.

Baller, R.D., L. Anselin, S.F. Messner, G. Deane & D.F. Hawkins (2001). Structural Covariates
of U.S. County Homicide Rates: Incorporating Spatial Effects. *Criminology* 39(3):561-
590.

Bellair, P.E. (1997). Social Interaction and Community Crime: Examining the Importance of
Neighbor Networks. *Criminology* 35(4):677-703.

Belnar, B.E., M. Cerdá, A.L. Roberts & S.L. Buka (2008). Effects of Neighborhood Resources on Aggressive and Delinquent Behaviors Among Urban Youths. *American Journal of Public Health* 98(6):1086-1093.

Berry, B.J.L. & J.D. Kasarda (1977). *Contemporary Urban Ecology*. New York, NY: Macmillan.

Blau, J.R. & P.M. Blau (1982). The Cost of Inequality: Metropolitan Structure and Violent Crime. *American Sociological Review* 47(1):114-129.

Brantingham, P.J. & P.L. Brantingham (1993). Nodes, Paths, and Edges: Considerations on the Complexity of Crime and the Physical Environment. *Environmental Psychology* 13:3-28.

Browning, C.R. (2009). Illuminating the Downside of Social Capital: Negotiated Coexistence, Property Crime, and Disorder in Urban Neighborhoods. *American Behavioral Scientist* 52(11):1556-1578.

Browning, C.R., S.L. Feinberg & R.D. Dietz (2004). The Paradox of Social Organization: Networks, Collective Efficacy, and Violent Crime in Urban Neighborhoods. *Social Forces* 83(2):503-534.

Burgess, E.W. (1984[1925]). The Growth of the City: An Introduction to a Research Project. In R.E. Park & E.W. Burgess (Eds.). *The City*. Chicago, IL: University of Chicago Press, p.p. 47-62.

Burns, R. (director and producer) (2001). *New York: A Documentary Film. Episode Six: City of Tomorrow* [motion picture]. Steeplechase Films: United States.

Bursik, Jr., R.J. (1999). The Informal Control of Crime Through Neighborhood Networks. *Sociological Focus* 32(1):85-97.

Bursik, Jr., R.J. (1995). Neighborhood-Based Networks and the Control of Crime and Delinquency. In H.D. Barlow (Ed.) *Crime and Public Policy: Putting Theory to Work*. Boulder, CO: Westview Press, p.p. 107-130.

Bursik, Jr., R.J. (1986). Ecological Stability and the Dynamics of Delinquency. In A.J. Reiss, Jr. & M. Tonry (eds.). *Communities and Crime,* Chicago, IL: The University of Chicago Press pp. 35-66.

Bursik, Jr., R.J. & H.G. Grasmick (1993a). *Neighborhoods and Crime: The Dimensions of Effective Community Control*. New York, NY: Lexington.

Bursik, R.J. & H.G. Grasmick (1993b). Economic Deprivation and Neighborhood Crime Rates, 1960-1980. *Law & Society Review* 27(2):263-283.

Bursik, Jr., R.J. & J. Webb (1982). Community Change and Patterns of Delinquency. *The American Journal of Sociology* 88(1):24-42.

Carr, P.J. (2003). The New Parochialism: The Implications of the Beltway Case for Arguments Concerning Informal Social Control. *American Journal of Sociology* 108(6):1249-1291.

Carr, P.J. L. Napolitano & J. Keating (2007). We Never Call the Cops and Here Is Why: A Qualitative Examination of Legal Cynicism in Three Philadelphia Neighborhoods. *Criminology* 45(2):445-480.

Casas, P. & P. González (2005). Políticas de Seguridad y Reducción del Homicidio en Bogotá: Mito y Realidad. In Casas, P. (Ed.) *Seguridad Urbana y Policía en Colombia: Ensayos de Seguridad y Democracia*. Fundación Seguridad y Democracia. Retrieved from: http://www.seguridadydemocracia.org/docs/pdf/seguridadUrbana/FSD%20Libro%20Seguridad%20Urbana%20y%20Polic%C3%ADa%20en%20Colombia%20-%20Cap%204%20Pablo%20Casas.pdf

Cerdá, M., J.D. Morenoff, L.F. Duque & S.L. Buka (2008). The Limits of Collective Efficacy: Investigating the Influence of Neighborhood Context on Levels of Violence in Medellin and Chicago. *Paper presented at the annual meeting of the American Sociological Association, Sheraton Boston and the Boston Marriott Copley Place, Boston, MA.* Online ≤PDF>. Retrieved from http://www.allacademic.com/meta/p241636_index.html.

Clear, T.R., D.R. Rose, E. Waring & K. Scully (2003). Coercive Mobility and Crime: A Preliminary Examination of Concentrated Incarceration and Social Disorganization. *Justice Quarterly* 20(1):33-64.

Cohen, J., P. Cohen, S.G. West & L.S. Aiken (2003). *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences* (3rd Ed.). New York, NY: Routledge.

Cohen, J. & G. Tita (1999). Diffusion in Homicide: Exploring a General Method for Detecting Spatial Diffusion Processes. *Journal of Quantitative Criminology* 15(4):451-493.

Departamento Admnistrativo Nacional de Estadística (2009). *Metodología Sistem de Información Geoestadístico*. Retrieved from: http://www.dane.gov.co/files/investigaciones/fichas/Sistema_informacion_geoestadistico.pdf

Elliot, D.S., W.J. Wilson, D. Huizinga, R.J. Sampson, A. Elliot & B. Rankin (1996). The Effects of Neighborhood Disadvantage on Adolescent Development. *Journal of Research in Crime and Delinquency* 33(4):389-426.

Escobar, G. (2011). Colombia: Crime Trends, Criminal Justice, and Criminology in a Society in Turmoil. In C.J. Smith, S. Zhang & R. Barberet (Eds.). *Routledge Handbook of International Criminology.* New York, NY: Routledge.

Escobedo, R. (2005). *Escenarios del Crimen en Bogotá: Informe de Trabajo de Campo.* Unpublished manuscript.

Fagan, J., D.L. Wilkinson & G. Davies (2007). Social Contagion of Violence. In Flannery, D. A. Vazsonyi & I. Waldman (Eds.) *The Cambridge Handbook of Violent Behavior.* Cambridge, UK: Cambridge University Press, pp. 688-724.

Fagan, J. & G. Davies (2004). The Natural History of Neighborhood Violence. *Journal of Contemporary Criminal Justice* 20(2):127-147.

Formisano, M. (2002). Econometría Espacial: Características de la Violencia Homicida en Bogotá. *Documentos CEDE* 2002(10).

Frank, L., M. Andresen & T. Schmid (2004). Obesity Relationships with Community Design, Physical Activity, and Time Spent in Cars. *American Journal of Preventive Medicine* 27(2):87-96.

Galea, S., A. Karpati & B. Kennedy (2002). Social Capital and Violence in the United States, 1974-1993. *Social Science & Medicine* 55:1373-1383.

Gibson, C.L., J. Zhao, N.P. Lovrich & M.J. Gaffney (2002). Social Integration, Individual Perceptions of Collective Efficacy, and Fear of Crime in Three Cities. *Justice Quarterly* 19(3): 537-564.

Góngora, A. & C.J. Suárez (2008). Por una Bogotá sin Mugre: Violencia, Vida y Muerte en la Cloaca Urbana. *Universitas Humanística* 66:107-138. Retrieved from: www.javeriana.edu.co/Facultades/C_Sociales/universitas/66/05gongora.pdf.

Gorusch, R.L. (1983). *Factor Analysis* (2nd Ed.). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc., Publishers.

Granovetter, M.S. (1973). The Strength of Weak Ties. *American Journal of Sociology* 78(6):1360-1380.

Haining, R. (2003). *Spatial Data Analysis: Theory and Practice.* Cambridge, UK: Cambridge University Press.

Heitgerd, J.L. & R.J. Bursik (1987). Extracommunity Dynamics and the Ecology of Delinquency. *The American Journal of Sociology* 92(4):775-787.

Hunter, A. (1985). Private, Parochial and Public School Orders: The Problem of Crime and Incivility in Urban Communities. In G.D. Suttles & M.N. Zald (Eds.). *The Challenge of Social Control, Citizenship and Institution Building in Modern Society*, Norwood, NJ: Ablex, p.p. 230-242.

Kane, R.J. (2005). Compromised Police Legitimacy as a Predictor of Violent Crime in Structurally Disadvantaged Communities. *Criminology* 43(2):469-498.

Kasarda, J.D. & M. Janowitz (1974). Community Attachment in Mass Society. *American Sociological Review* 39(3):328-339.

Kennedy, B.P., I. Kawachi, D. Prothrow-Stith, K. Lochner & V. Gupta (1998). Social Capital, Income Inequality, and Firearm Violent Crime. *Social Science & Medicine* 47(1):7-17.

Kornhauser, R.R. (1978). *Social Sources of Delinquency: An Appraisal of Analytic Models*. Chicago, IL: University of Chicago Press.

Krivo, L.J., R.D. Peterson, H. Rizzo & J.R. Reynolds (1998). Race, Segregation, and the Concentration of Disadvantage: 1980-1990. *Social Problems* 45(1):61-80.

Kubrin, C.E. & R. Weitzer (2003a). New Directions in Social Disorganization Theory. *Journal of Research in Crime and Delinquency* 40(4):374-402.

Kubrin, C.E. & R. Weitzer (2003b). Retaliatory Homicide: Concentrated Disadvantage and Neighborhood Culture. *Social Problems* 50(2):157-180.

Land, K.C., P.L. McCall & L.E. Cohen (1990). Structural Covariates of Homicide Rates: Are There Any Invariances Across Time and Space? *American Journal of Sociology* 95:922-963.

Latorre, M.C. (2004). Sobre la Relación Positiva entre el Capital Social y la Violencia Urbana: Un Análisis Teórico y Empírico. *Documento CEDE* 36. Retrieved from: http://economia.uniandes.edu.co/es/investigaciones_y_publicaciones/cede/publicaciones/documentos_cede/2004/sobre_la_relacion_positiva_entre_el_capital_social_y_la_violencia_urbana_un_analisis_teorico_y_empirico.

Lederman, D., N. Loayza & A.M. Menenedez (2002). Violent Crime: Does Social Capital Matter? *Economic Development and Cultural Change* 50(3):509-539.

Lee, M.R. & J.P. Bartkowski (2004). Civic Participation, Regional Subcultures, and Violence: The Differential Effects of Secular and Religious Participation on Adult and Juvenile Homicide. *Homicide Studies* 8:5-39.

Lee, M.R. & G.C. Ousey (2005). Institutional Access, Residential Segregation, and Urban Black Homicide. *Sociological Inquiry* 75(1):31-54.

LeSage, J., and R.K. Pace (2009). *Introduction to Spatial Econometrics*. Boca Raton, FL: CRC Press.

Llorente, M.V., R. Escobedo, C. Echandia & M. Rubio (2001). Violencia Homicida y Estructuras Criminales en Bogota. *Paz Publica – Documento de Trabajo No. 20*. Centro de Estudios sobre Desarrollo Económico. Universidad de Los Andes. Bogotá. Retrieved from:

http://economia.uniandes.edu.co/es/investigaciones_y_publicaciones/cede/publicaciones/documentos_cede/documentos_de_paz_publica.

Loftin, C. & S.K. Ward (1983). A Spatial Autocorrelation Model of the Effects of Population Density on Fertility. *American Sociological Review* 48(1):121-128.

MacDonald, J. & R.J. Stokes (2006). Race, Social Capital, and Trust in the Police. *Urban Affairs Review* 41(3):358-375.

Martinez, M.J. (2010). *Power at the Roots: Gentrification, Community Gardens, and the Puerto Ricans of the Lower East Side*. Lanham, MA: Lexington Books.

McGahey, R.M. (1986). Economic Conditions: Neighborhood Organization, and Urban Crime. In A.J. Reiss, Jr. & M. Tonry (eds.). *Communities and Crime.* Chicago, IL: The University of Chicago Press, p.p. 231-270.

Mears, D.P. & A.S. Bhati (2006). No Community is an Island: The Effects of Resource Deprivation on Urban Violence in Spatially and Socially Proximate Communities. *Criminology* 44(3):509-548.

Messner, S.F., L. Anselin, R.D. Baller, D.F. Hawkins, G. Deane & S.E. Tolnay (1999). The Spatial Patterning of County Homicide Rates: An Application of Exploratory Spatial Data Analysis. *Journal of Quantitative Criminology* 15(4):423-450.

Messner, S.F., E.P. Baumer & R. Rosenfeld (2004). Dimensions of Social Capital and Rates of Criminal Homicide. *American Sociological Review* 69(6):882-903.

Messner, S.F., L.E. Raffalovich & P. Shrock (2002). Reassessing the Cross-National Relationship between Income Inequality and Homicide Rates: Implications of Data Quality Control in the Measurement of Income Distribution. *Journal of Quantitative Criminology* 18(4):377-395.

Morenoff, J. & R.J. Sampson (1997). Violent Crime and the Spatial Dynamics of Neighborhood Transition: Chicago, 1970-1990. *Social Forces* 76:31-64.

Ousey, G.C. & M.R. Lee (2007). Homicide Trends and Illicit Drug Markets: Exploring Differences Across Time. *Justice Quarterly* 24(1):48-79.

Park, R.E. (1984[1925]). Community Organization and Juvenile Delinquency. In R.E. Park & E.W. Burgess (Eds.). *The City*. Chicago, IL: The University of Chicago Press, p.p. 99-112.

Patillo, M.E. (1998). Sweet Mothers and Gangbangers: Managing Crime in a Black Middle-Class Neighborhood. *Social Forces* 76(3):747-774.

Pattavina, A., J.M. Byrne & L. Garcia (2006). An Examination of Citizen Involvement in Crime Prevention in High-Risk Versus Low- to Moderate-Risk Neighborhoods. *Crime & Delinquency* 52(2):203-231.

Pratt, T.C. & F.T. Cullen (2005). Assessing Macro-Level Predictors and Theories of Crime: A Meta-Analysis. *Crime and Justice* 32:373-450.

Pratt, T.C. & T.W. Godsey (2003). Social Support, Inequality, and Homicide: A Cross-National Test of an Integrated Theoretical Model. *Criminology* 41(3):611-644.

Pridemore, W.A. (2008). A Methodological Addition to the Cross-National Empirical Literature on Social Structure and Homicide: A First Test of the Poverty-Homicide Thesis. *Criminology* 46(1):133-154.

Pridemore, W.A. (2002). What We Know About Social Structure and Homicide: A Review of the Theoretical and Empirical Literature. *Violence and Victims* 17(2):127-156.

Pridemore, W.A. & T.H. Grubesic (2011). Alcohol Outlets and Community Levels of Interpersonal Violence: Spatial Density, Outlet Type, and Seriousness of Assault. *Journal of Research in Crime and Delinquency* 000(00):1-28.

Reisig, M.D. & R.B. Parks (2000). Experience, Quality of Life and Neighborhood Context: A Hierarchical Analysis of Satisfaction with Police. *Justice Quarterly* 17(3): 607-630.

Reiss Jr., A.J. (1986). Why Are Communities Important in Understanding Crime? In A.J. Reiss, Jr. & M. Tonry (eds.). *Communities and Crime.* Chicago, IL: The University of Chicago Press, p.p. 1-34.

Reiss Jr., A.J. & M. Tonry (eds.) (1986). *Communities and Crime.* The University of Chicago Press: Chicago, IL.

Rosenfeld, R., E. Baumer & S.F. Messner (2007). Social Trust, Firearm Prevalence, and Homicide. *Annals of Epidemiology* 17(2):119-125.

Rosenfeld, R., S.F. Messner & E.P. Baumer (2001). Social Capital and Homicide. *Social Forces* 80(1):283-309.

Rosenfeld, R., T.M. Bray & A. Egley (1999). Facilitating Violence: A Comparison of Gang-Motivated, Gang-Affiliated, and Nongang Youth Homicides. *Journal of Quantitative Criminology* 15(4):495-516.

Rubio, M. (1997). Perverse Social Capital—Some Evidence from Colombia. *Journal of Economic Issues* XXXI(3):805-816.

Saegert, S. & G. Winkel (2004). Crime, Social Capital, and Community Participation. *American Journal of Community Psychology* 34(3/4):219-233.

Saegert, S., G. Winkel & C. Swartz (2002). Social Capital and Crime in New York City's Low-Income Housing. *Housing Policy Debate* 13(1):189-226.

Sampson, R.J. (2003). The Neighborhood Context of Well-Being. *Perspective in Biology and Medicine* 46(3):S53-S64.

Sampson, R.J. (2002a). Organized for What? Recasting Theories of Social (Dis)organization. In Waring, E. & D. Weisburd (Eds.). *Crime & Social Organization: Advances in Criminological Theory Volume 10*. Transaction Publishers: New Brunswick, NJ, p.p. 95-110.

Sampson, R.J. (2002b). Transcending Tradition: New Directions in Community Research, Chicago Style. *Criminology* 40(2):213-230.

Sampson, R.J. (1991). Linking the Micro- and Macrolevel Dimensions of Community Organization. *Social Forces* 70(1):43-64.

Sampson, R.J. (1986). Crime and Cities: The Effects of Formal and Informal Social Control. In A.J. Reiss, Jr. & M. Tonry (eds.). *Communities and Crime*. Chicago, IL: The University of Chicago Press, p.p. 271-312.

Sampson, R.J. & W.B. Groves (1989). Community Structure and Crime: Testing Social-Disorganization Theory. *The American Journal of Sociology* 94(4):774-802

Sampson, R.J., J.D. Morenoff & F. Earls (1999). Beyond Social Capital: Spatial Dynamics of Collective Efficacy for Children. *American Sociological Review* 64(5):633-660.

Sampson, R.J.& S.W. Raudenbush (2001). *Disorder in Urban Neighborhoods—Does It Lead to Crime*. Research in Brief. National Institute of Justice: Washington, D.C.

Sampson, R.J. & S.W. Raudenbush (1999). Systematic Social Observation of Public Spaces: A New Look at Disorder in Urban Neighborhoods. *American Journal of Sociology* 105(3):603-651.

Sampson, R.J., S.W. Raudenbush & F. Earls (1997). Neighborhoods and Violent Crime: A Multilevel Study of Collective Efficacy. *Science* 277:918-924.

Sampson, R.J. & W.J. Wilson (1993). Toward a Theory of Race, Crime, and Urban Inequality. In Hagan J. & R. Petersen (Eds.). *Crime and Inequality*. Stanford University Press: Stanford, CA, pp. 37-54.
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Sánchez, F., S. Espinosa & A. Rivas (2007). ¿Garrote o Zanahoria? Factores Asociados a la Disminución de la Violencia Homicida y el Crimen en Bogotá, 1993-2002. In Sánchez, F. (ed.). *Las Cuentas de la Violencia*. Grupo Editorial Normal: Colombia, p.p. 301 - 355.

Sánchez, F., S. & J. Núñez (2007). Determinantes del Crimen Violento en un País Altamente Violente: El Caso de Colombia. In Sánchez, F. (ed.). *Las Cuentas de la Violencia*. Grupo Editorial Normal: Colombia, p.p. 25-61.

Schuerman, L. & S.Kobrin (1986). Community Careers in Crime. In A.J. Reiss, Jr. & M. Tonry (eds.). *Communities and Crime.* Chicago, IL: The University of Chicago Press, p.p. 67-100.

Serralvo, J. (2001). Internal Displacement, Land Restoration, and the Ongoing Conflict in Colombia. *Journal of Humanitarian Assistance.* Retrieved from: www.sites.tufts.edu/jha/archives/1189.

Shaw, C.R. & H.D. McKay (2011[1942]). Juvenile Delinquency and Urban Areas. In Cullen, F.T. & R. Agnew. *Criminological Theory: Past to Present (3rd Ed.).* Roxbury: Los Angeles, CA, p.p. 95-108.

Sherman, L.W. (1986). Policing Communities: What Works? In A.J. Reiss, Jr. & M. Tonry (eds.). *Communities and Crime.* Chicago, IL: The University of Chicago Press, p.p. 343-386.

Shihadeh, E.S. & N. Flynn (1996). Segregation and Crime: The Effect of Black Social Isolation on the Rates of Black Urban Violence. *Social Forces* 74(4):1325-1352.

Simons, R.L., L.G. Simons, C.H. Burt, G.H. Brody & C. Cutrona (2005). Collective Efficacy, Authoritative Parenting and Delinquency: A Longitudinal Test of a Model Integrating Community – and Family – Level Processes. *Criminology* 43(4):989-1029.

Skogan, W. (1999). Measuring What Matters: Crime, Disorder and Fear. In R. Langworthy (Ed.) *Measuring What Matters: Proceedings From the Police Research Institute Meetings.* U.S. Department of Justice, National Institute of Justice and Office of Community Oriented Policing Services: Washington, DC, p.p. 37-53.

Skogan, W. (1990). *Disorder and Decline: Crime and the Spiral of Decay in American Neighborhoods.* University of California Press: Berkeley, CA.

Skogan, W. (1986). Fear of Crime and Neighborhood Change. In A.J. Reiss, Jr. & M. Tonry (eds.). *Communities and Crime.* The University of Chicago Press: Chicago, IL, pp. 203-229.

Smith (1986). The Neighborhood Context of Police Behavior. In A.J. Reiss, Jr. & M. Tonry (eds.). *Communities and Crime.* The University of Chicago Press: Chicago, IL, pp. 313-341

Snell, C. (2001). *Neighborhood Structure, Crime, and Fear of Crime: Testing Bursik and Grasmick's Neighborhood Control Theory.* LFB Scholarly Publishing LLC: New York, NY.

Stretesky, P. B., Schuck, A. M., & Hogan, M. J. (2004). Space matters: An analysis of poverty, poverty clustering, and violent crime. *Justice Quarterly* 21: 817-841.

Stucky, T.D. (2003). Local Politics and Violent Crime in U.S. Cities. *Criminology* 41(4):1101-1135.

Tabachnick & Fidell (2007). *Using Multivariate Statistics* (4th Ed.). Needham Heights, MA: Allyn and Bacon.

Taylor, R.B. (2001a). *Breaking Away from Broken Windows: Baltimore Neighborhoods and the Nationwide Fight Against Crime, Grime, Fear, and Decline.* Westview Press: Boulder, Colorado.

Taylor, R.B. (2001b). The Ecology of Crime, Fear, and Delinquency. In R. Paternoster & R. Bachman (eds.), *Explaining Criminals and Crime*, p.p. 124-139, Roxbury Publishing Company.

Taylor, R.B. (1997) Order and Disorder of Streetblocks and Neighborhoods: Ecology, Microecology and The Systemic Model of Social Organization. *Journal of Research in Crime and Delinquency* 34: 113-155.

Tienda, M. (1991). Poor People and Poor Places: Deciphering Neighborhood Effects on Poverty Outcomes. In J. Huber (ed.) *Macro-Micro Linkages in Sociology.* Newbury Park, CA: Sage Publications, p.p. 244-262.

Triplett, R.A., R.R. Gainey & I.Y. Sun (2003). Institutional Strength, Social Control and Neighborhood Crime Rates. *Theoretical Criminology* 7(4):439-467.

Triplett, R.A., I.Y. Sun & R.R. Gainey (2005). Social Disorganization and the Ability and Willingness to Enact Control: A Preliminary Test. *Western Criminology Review* 6(1):89-103.

Uribe-Mallarino, C. (2008). Estratificación Social en Bogotá: De La Política Pública a la Dinámica de la Segregación Social. *Universitas Humanística* 65:139-171.

Velez, M.B. (2001). The Role of Public Social Control in Urban Neighborhoods: A Multi-Level Analysis of Victimization Risk. *Criminology* 39(4):837-864.

Villareal, A. & B.F.A. Silva (2006). Social Cohesion, Criminal Victimization and Perceived Risk of Crime in Brazilian Neighborhoods. *Social Forces* 84(3):1725-1753.

Ward, M.D. & K.S. Gleditsch (2008). *Spatial Regression Models*. Series: Quantitative Applications in Social Sciences. Thousand Oaks, CA: Sage Publications, Inc.

Warner, B.D. (2007). Directly Intervene or Call the Authorities? A Study of Forms of Neighborhood Social Control within a Social Disorganization Framework. *Criminology* 45(1):99-129.

Warner, B.D. (2003). The Role of Attenuated Culture in Social Disorganization Theory. *Criminology* 41(1):73-98.

Warner, B.D. & P.W. Rountree (1997). Local Ties in a Community and Crime Model: Questioning the Systemic Nature of Informal Social Control. *Social Problems* 44(4):520-536.

White, M. (1987). *American Neighborhoods and Residential Differentiations.* New York, NY: Russell Sage.

Wilson, G.L. & J.Q. Wilson (March 1982). Broken Windows: The Police and Neighborhood Safety. *The Atlantic* 249(3):29-38.

Wilson, W.J. (1991-1992). Another Look at the Truly Disadvantaged. *Political Science Quarterly* 106(4):639-656.

Wilson, W.J. (1987). *The Truly Disadvantaged: The Inner City, the Underclass, and Public Policy*. Chicago, IL: The University of Chicago Press.

World Bank, The (1999). *Violence in Colombia: Building Sustainable Peace and Social Capital.* The World Bank: Washington, D.C.

Zhang, H. & M.P. Peterson (2007). A Spatial Analysis of Neighbourhood Crime in Omaha, Nebraska Using Alternative Measures of Crime Rates. *Internet Journal of Criminology*. Retrieved from: http://www.internetjournalofcriminology.com/Zhang%20Peterson%20-%20A%20SPATIAL%20ANALYSIS%20OF%20NEIGHBOURHOOD%20CRIME.pdf