HOT SPOTS IN THE CITY: THE RELATIONSHIP BETWEEN NEIGHBORHOOD CHARACTERISTICS AND THE DEMAND FOR LOCAL GOVERNMENT EMERGENCY SERVICES

by

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ABSTRACT

REID AARON WODICKA. Hot spots in the city: the relationship between neighborhood characteristics and the demand for local government emergency services. (Under the direction of DR. HARRISON S. CAMPBELL, Jr.)

There is a common understanding among members of local government emergency services professionals that some neighborhoods require a substantially larger amount of services than others. This phenomenon is primarily driven, it is believed, by the characteristics of the residents who live in those neighborhoods. This is consistent with the arguments of William Julius Wilson, who notes that the public discourse surrounding poverty and urban decay in the last several decades has largely focused on the effects that the cultural characteristics of the poor have on neighborhood outcomes. Following Wilson's call for a bridge between concern about cultural characteristics and the challenges faced by residents in decayed neighborhoods, the purpose of this dissertation is to refocus the conversation about the experience of the urban poor by exploring the spatial nature of clustered calls for fire and police department service delivery, a representation of the socially disorganized nature of the certain neighborhoods in cities. This is accomplished by drawing on the theories of social disorganization and fiscal spillover to develop a spatially explicit model that explores the relationship between neighborhood characteristics and the occurrence of various types of emergencies requiring attention by local fire and police departments: aggregate police calls, assaults, burglaries, domestic violence incidents, aggregate fire calls, emergency medical services calls, and structure fires. This dissertation utilizes U.S. Census data and emergency response data from the City of Charlotte, North Carolina to develop global and local indicators of spatial association calculations, as well as econometric models that employ ordinary least

squares, spatially lagged regression, and spatial Durbin models that test the relationships that are posited in the literature. This dissertation concludes that spatial models that are informed by neighborhood characteristics are necessary for local governments to understand the nature of the demands for emergency services and to understand the daily life experiences of those living in urban ghettos. Further, policies that improve neighborhood stability and cohesion, economic well-being, and a positive relationship between city government and residents can reduce the demands for emergency services, reducing costs to the government of providing services and improving the quality of life of residents.

DEDICATION

This dissertation is dedicated to my parents, Dr. David and Sonya Wodicka, who raised me to value the lifelong acquisition of knowledge, who taught me to challenge myself, and who have supported me through all of my endeavors.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION AND THEORETICAL FRAMEWORK

Walking the streets in any major city in the United States, it becomes clear that there are neighborhoods to which the poor and impoverished are relegated. These neighborhoods have a distinct characteristics, but in particular the inhabitants of those neighborhoods tend to have life experiences that are far more in common with one another than they do with those who live outside of the "bombed out" (Wacquant 2008, 53) ghettos inhabited by the urban underclass (Wilson 2012). This structural reality of cities as they are experienced by their inhabitants is certainly nothing new. As Wilson (2012) explores, the plight of the urban underclass has been studied expansively by urban scholars. However, discussions related to the experience of the urban poor that founded the conversation in earlier years of work have largely been replaced by an accusatory public dialogue that equates cultural concerns with the causes and effects of poverty in cities. In his seminal work, William Julius Wilson calls for a return to empirical study of the life experiences of residents in urban ghettos "to provide a more balanced public discourse on the problems of the urban underclass" (2012, 19).

The purpose of this dissertation is to explore a specific component of life in urban ghettos, an increased need for emergency services. This is intended to characterize challenges and circumstances that flow from living in neighborhoods in which there are major social problems, rather than to paint those living in poverty conditions as the inherent problem in cities. Specifically, the analyses found within this work seek to explore the

particular characteristics of neighborhoods that require high degrees of services from fire departments and police departments. This is informed by Wacquant's (2008) "violence from above" factors that affect the life experiences of those living in urban ghettos: mass unemployment, or more broadly massive degrees of poverty; relegation to decaying neighborhoods, or the concentration of social ills in neighborhoods; and heightened stigmatization of those living in certain neighborhoods, specifically with reference to a relationship with local authorities.

Wacquant's (2008) three forces are theoretically reminiscent of an older theory of urban decay which has been used to explore that effects of concentrated social problems have on crime rates, Social Disorganization Theory, first explored in the 1940s, but more recently studied in empirical terms, even within the last several years. Admittedly a dated theory, Social Disorganization meshes well with both Wacquant's understanding that there are broad neighborhood-level forces that affect the life experiences of the residents of urban ghettos, as well as Wilson's call to draw a bridge between characteristics and the life experiences of those living in neighborhoods that have experienced substantial decay. Rather than the simplistic arguments the blame the poor for social concerns in cities, Social Disorganization Theory provides a more holistic view of the experience of those living in poverty conditions, and even though an old theory, likely is still relevant in the understanding of today's urban ghettos.

With respect to the urban ghettos referenced by both Wilson and Wacquant, it has been well documented that the distribution of socioeconomic groups within United States cities is characterized by spatial concentrations of various groups. As Wilson (2012, 58) notes, "If I had to use one term to capture the differences in the experiences of low-income

families who live in inner-city areas from the experiences of those who live in other areas of the central city today, that term would be *concentrated effects*". While it is clear that wealthy people tend to live near wealthy people and poor people tend to live near poor people, what is less clear is the impact that those spatial concentrations have on the needs of residents for local public services. An important characteristic of the spatial distribution of socioeconomic groups within cities is that it tends to not be evenly distributed throughout the city but instead concentrated in particular areas and neighborhoods. This leads to the premise that there may be varying demands for public services; that is, there might be a relationship between socioeconomic characteristics and the levels of demands for services in extreme areas. Pack (1998) suggests that higher levels of poverty impact the expenditure demands for local public services that are not typically associated with fighting poverty (fire, police, general services) at an interjurisdictional level (comparing multiple large cities in this aggregate), finding that higher rates of poverty lead to higher expenditures (which she uses to operationalize impact of poverty). Pack's work is an examples of both Wacquant's and Wilson's point on the public discourse on poverty – rather than exploring the life experiences of urban ghettos residents, the analysis essentially blames those who are living in poverty for increase service demand costs, and does so in a relatively simplistic way.

This work begins with an analysis considering the impacts that intra-city concentrated poverty has on the need for fire and police services as is expected by modern discourse on urban poverty, but ends with the understanding that a variety of other characteristics related to the daily experiences people in neighborhoods, rather than a simple calculation of poverty, are more strongly related to emergency service needs.

Essentially, this dissertation contributes to the conversation about the health and welfare experiences of the urban poor by adding the extent to which emergencies are experienced by living in neighborhoods that are characterized as socially disorganized. Finally, this work addresses areas in which policy improvements can be made in order to improve the life experiences of those presently living in neighborhoods in which social concerns are represented in the needs for emergency services.

The analyses found within this work are driven by two theories that lend some suggestion that neighborhood characteristics will drive the need for services. First, Social Disorganization Theory suggests that the social makeup of a neighborhood will determine the amount of crime that occurs within the community. This theory provides some suggestion for reasons that these relationships exist. Second, this study focuses on the theoretical externalities of poverty concentration in the urban environment. Combining the work of Janet Pack with the theoretical framework of the study informs the research questions for this study.

There are two major research questions associated with this dissertation. First, I will address the existence of highly concentrated areas of poverty within the city and the geographic concentration of calls for services. Poverty pockets, as they are labeled in literature, are defined as neighborhoods in cities where a large number of people are living without the prospect of socioeconomic progress. Scholars typically define areas of severe socioeconomic deprivation as census tracts in which forty percent or more of households live in poverty (van Kempen 1997; Friedman and Lichter 1998; Coulton et al. 1996; Jargowsky and Bane 1991, Kneebone et al. 2011). The first set of research questions explores the distribution of higher concentrations of lower socioeconomic groups and is as

follows: How do we characterize the distribution of socioeconomic groups in the urban environment? Do some higher concentration areas exert influence over neighboring areas? If so, how many are there and how might we characterize their spatial distribution? Are there similar characteristics found in the geographic distribution of calls for services in those areas? Second, I am interested in the impact that the existence of socioeconomic concentrations has on the demand for fire and police services. Therefore, the second set of research questions is as follows: Does low socioeconomic status within a neighborhood lead to increased demand for public fire and police services in Charlotte, North Carolina? If so, are increased demands isolated to the areas of extreme socioeconomic decline? Or, do census tracts surrounding poverty pockets also exhibit higher levels of demand, other things being equal? Is the relationship between poverty concentration and demand for services consistent between firefighting and police services? Are some call types within each of those services more highly affected by the existence of poverty? If there is a relationship, is the magnitude of the relationship consistent across all levels of declined socioeconomic status? Overall, the purpose of this study is to learn about the service delivery demands that are placed on local governments as a result of the socio-spatial sorting that occurs within cities for services that are not typically associated with social services.

This research will fill a gap in both the context of urban studies and in public administration by quantitatively measuring the relationship between the socio-economic makeup of geographically concentrated groups within urban environments and the demands for service delivery that local governments face. As such, there are important implications for the practical delivery of public services in locations that are characterized

as having low to moderate socioeconomic status. Should the study find support for the hypothesis that higher levels of poverty are associated with to greater demands for public services, fire and police chiefs could alter staffing and resource allocation decisions in such a way that takes into account the variance in socio-economic characteristics of space. Finally, this research serves to bridge the gap between those who would "blame the victim" and those who desire a stronger understanding of the plight of those living in urban ghettos.

In order to analyze the relationships discussed in the research questions, I utilize several quantitative methods that take into account the spatial attributes associated with the socioeconomic characteristics of neighborhoods and their relationship to demands for service. For the first set of research questions, I perform a descriptive analysis of the distribution of socioeconomic characteristics and calls for service structure through mapping and calculating the Moran's I statistic for the poverty rates and calls for service in census tracts within the City of Charlotte. Moran's I the determination of the degree of spatial association that exists within the city. Used as a global measure of the entire city, this constitutes a formal test to determine if the geographic distribution of poverty pockets is random. I hypothesize that the distribution is not random. More importantly, though, a significant Moran's I statistic represents the need to take into account spatial association in a regression model that will be used to analyze the second research question. If poverty pockets and the call structure are found to exhibit spatial autocorrelation as revealed through Moran's I, the next step is to determine if these pockets tend to cluster in particular ways. Such a determination is performed via a local Moran's I called LISA statistics (local indicators of spatial association) (Anselin 1995) and can be used to determine the exact spatial structure of poverty and allow the identification of the units that are driving the

autocorrelation. Because ordinary least squares regression assumes independence among observations, autocorrelation among poverty pockets, should the Moran's I statistic return statistically significant results, will signal the need to develop a spatially weighted model that takes into account the characteristics of neighboring census tracts when determining if higher levels of poverty lead to greater demands for service delivery. Though unlikely, if there is no spatial autocorrelation, ordinary least squares can be used to address the impact of poverty pockets on service delivery demand.

The dependent variables, demand for fire and police services, are operationalized in as the calls for service per capita received by the Charlotte Fire Department and the Charlotte-Mecklenburg Police Department within the City of Charlotte. Geo-coded calls for service data from calendar years 2006 through 2010 for the fire department and the police department have been obtained from the City. These data points are spatial points which have been aggregated up to the census tract level. I use the R statistical software, as well as Quantum GIS, to aggregate the point data to the census tract and create frequency tables that can be merged with census data measuring other socioeconomic characteristics. First, in order to determine the existence and the degree of spatial autocorrelation, a very simple script in R was developed that creates a spatial weight matrix that is used to calculate the Moran's I. This spatial weight matrix will also used later to perform the spatially weighted regression needed to calculate relationships if Moran's I returns a significant value. Finally, the challenge of spatially associated dependent variables is also addressed.

There are two major research questions associated with this project. Each revolves around the idea that the spatial concentration of demographics of people living within the urban environment might impact the demand for urban services by local governments. In

particular, this study focuses on the demand for public safety functions of local government, firefighting and law enforcement.

Prior to discussing the impacts of urban poverty, it is important that this study addresses the question of whether or not spatial concentrations of different socioeconomic groups actually exist. Further, it is necessary to explore the spatial distribution of calls for service in the city and to determine whether that spatial distribution is similar to that of socioeconomic characteristics. Because this study focuses on the City of Charlotte, North Carolina, the first research question is as follows: Are there spatial concentrations of urban poverty and calls for police and fire services in Charlotte, North Carolina?

The second research question to be addressed in this research relates to the impact of socioeconomic characteristics as a driver of demand for public services. Therefore, the second questions can be stated as: Does the increase of various spatially concentrated socioeconomic groups drive demand for fire and police services? Further, are there differences in the types of calls for service in which this has an impact on demand?

Hypotheses

Without taking into account the impact that space plays on the existence of poverty in the City of Charlotte, the relationships that have been described suggest that each census tract behaves independently of the others and, while the place of certain behaviors matter, the existence of problems in a city do not cross borders of census tracts. This is likely an oversimplification. In order to first address the question of the existence of spatial concentrations of socioeconomic groups in Charlotte, North Carolina, the first set of hypotheses deals with this importance of space.

H1a: There is positive spatial autocorrelation associated with the existence of poverty in the City of Charlotte.

H1b: There is positive spatial autocorrelation associated with calls for service for fire and police services in the City of Charlotte.

H1c: The spatial distribution of calls for service varies with respect to the types of calls for service in the City of Charlotte.

H1d: The spatial distribution of various socioeconomic characteristics in the city demonstrates positive spatial autocorrelation

The second set of hypotheses deals with the impact that spatial concentration exhibits on local government. There are two separate cases (fire and police) that are being analyzed in order to develop an understanding of the impact that socioeconomic status has on the demand for local public services that are not typically associated with poverty alleviation. They are further explored by considering types of calls for service.

H2a: Lower socioeconomic characteristics within a census tract within the city is associated with increased demand for local government public safety services.

H2b: The impact that socioeconomic characteristics have on a census tract's demand for service is different for various call types.

These hypotheses first relate to Social Disorganization Theory and the question of the impact of spatially related social decay in an urban area. This is logical because when social decay that is related to the existence of poverty is more prevalent, there will more likely be more prevalent behaviors that impact the conditions that local governments are facing when attempting to build implementation strategies for these programs. However, it also deals with the spillover question as well.

It is a reasonable assumption that an increased call load will lead to greater expenditures for local government. It is reasonable to assume that if hypothesis *H2a* is supported, then there will likely be more expenditures on public services in areas that have reduced socioeconomic characteristics. The second set of hypotheses also relates to the spillover component because the relationship between socioeconomic characteristics and the amount of spending that results from the provision of public safety response programs in urban areas becomes clearer.

Importance of the Topic

Social problems that are associated with low socioeconomic status are frequently discussed. What is less well discussed is the impact that allowing those conditions to exist has on the public policy implementation environment. That is, how does the existence of decreased socioeconomic status of residents impact the services that local government bureaucrats implement? This is an important topic to address because it expands the conversation about policy regarding an impact of socioeconomic characteristics away from a primarily moral and normative argument and to a more analytical, practical matter. When we discuss issues of poverty, it is usually on the basis of what is morally right or wrong, coming from somewhat of an egalitarian perspective. Instead, this study attempts to uncover how the existence of concentrated poverty in American cities can drive costs to taxpayers living in other parts of the city by means of driving the demand and use of public services.

There has been a recent conversation in the City of Charlotte that has focused around the investment in public infrastructure that is aimed at reducing the concentrations of poverty in the city. While the purpose of this study is in no way to address the claims

that those interventions will reduce the level of poverty in the city, what has been interesting is that many members of the community and a majority of the City Council have been unwilling to commit tax dollars to work towards the projects that may alleviate the poverty conditions. In short, several City Council members have argued that residents of other parts of the city should not be burdened with additional taxes to build infrastructure within proposed areas.

Since most people generally agree that everyone is entitled to fire and police protection, spending is unlikely to be reduced on the basis of sheer political forces as has been with the City's capital investment program. If the evidence suggests that there are spillover effects outside of the areas that have poverty concentration problems, it is possible that this debate would be better informed. Information derived from this study could help drive a policy conversation addressing costs and benefits of the investments and other policy decisions the city wishes to make.

Theoretical Framework

For the purposes of this research, I rely upon two primary theories: Social Disorganization Theory and fiscal spillover theory. In general, these theories suggest that there are externalities associated with existence of social decay within areas of a city. Drawing from these two theories, I am able to explain geographically both the internal impacts of social decay and poverty as a well as the external service delivery demand impacts on the areas that are outside of the problem areas.

The primary focus of Social Disorganization Theory, first posited by Shaw and McKay (1942), is that lack of social capital in neighborhoods correlates with higher rates of crime. The inability of the community to self-police leads to increasing rates of criminal

behavior. This inability of the community to self-police results from the inability of the community to develop networks of both formal and informal association ties due to structural barriers (Sampson and Groves 1989).

Shaw and McKay (1942) develop three major internal characteristics of a neighborhood that drive social disorganization within the community (Sampson and Groves 1989). First, if a community is unable to supervise youth groups (gangs), there will be less chance that the community will be able to control the crime rate at the adult level as well. Second, when a community experiences fewer informal social ties between residents, it will be less likely to engage in protective behavior over the neighborhood, easing the path toward criminal activity. Third, when a community engages in fewer formal organizations, such as Neighborhood Watch or faith communities, the stability of the community is reduced, resulting from weak community institutions. These characteristics, however, can be difficult to measure accurately.

As a result, Shaw and McKay (1949) identify a number of exogenous variables that drive the ability of a community to create social organization. Socioeconomic status of the residents of a community, the residential mobility of residents (length of time in a home), and ethnic heterogeneity were all linked to social disorganization in sub-city urban contexts. Additionally, Sampson (1987) identifies marriage and family disruption and Fischer (1982) identifies the degree of urbanization as factors that weaken local networks.

Inherently, space and place matter when considering Social Disorganization Theory. Within the context of police, this is simple to understand. When there are neighborhood characteristics that drive social disorganization with resultant increases in crime (Sampson and Groves 1989), criminal behavior is prevalent among more residents,

generally. As it has become somewhat of a social norm and there are fewer social controls over personal behavior, at least more so than in less socially decayed areas, criminal activity should be greater in socially problematic areas as a result of the spread of criminal activity. As a result, the drivers of social disorganization should lead to a higher level of demand for police services with concomitant higher costs for providing the service.

From the perspective of the fire service delivery demand, the idea of social disorganization is a bit more complicated. However, I conceptualize Social Disorganization Theory in the context of fire service by demonstrating that when people engage in behaviors that are fire un-safe, that is, they engage in behaviors that are dangerous for the spread of fires (intentional or not), those behaviors are more likely to be mimicked by others within their particular proximate space. It is important to note that unlike the conceptualization of social disorganization as it relates to the demand for police service, fire service demand may be driven by people simply having no other choice than to engage in, or be subject to, risky behaviors, such as living in sub-standard housing or using non-standard heating sources. As one person engages in the behavior and it spreads to others virally, this creates a negative social behavior that places the entire community more at risk than it would in areas with access to better buildings and more traditional sources of heating. Additionally, I deal with the issue of emergency medical services. If there is increased demand in impoverished areas, this could be attributed to lack of access to good healthcare.

However, the impacts of social decay do not necessarily end within the problematic areas of a city. When there are severe social conditions within a certain geographic area, it is likely that government will attempt to step in and deal with those problems in one way

or another. From the perspective of poverty, government has understandably in the past chosen to provide assistance programs to people who are living in impoverished conditions. Since we know that people living in poverty tend to be concentrated in certain areas of an urban area, it is reasonable to conclude that those government services are demanded at a higher rate in those areas that have a lower socio-economic status.

While their resources may be used at times to deal with problems of poverty, the local police department and fire department are far from social welfare organizations. If these local government services are provided on the basis of property taxes, then it is conceivable that taxes paid by wealthier inhabitants of a city could be used to provide services to the lower income areas of a city. So, fiscal spillover theory suggests that the impact of poverty within a city creates a financial drain from wealthier areas of a city, leading to the idea that the problems of poverty are not compartmentalized to the geographic areas that they directly affect. In fact, due to the engagement of local government in these services, the impacts of poverty might be felt beyond the traditional realm of the squalor of the urban ghettos. This leads to the second theory involved in this research.

Unlike Social Disorganization Theory, the idea of fiscal spillover effects in the urban environment is less formalized in the academic sphere. However, the idea of spillover effects has been used widely throughout a number of theoretical frameworks in many academic disciplines, from psychology (Mullen and Nadler 2008) to economics (Romer 1994). In an attempt to reconcile the idea of spillover effects with the problems that are faced by cities battling urban poverty concentrations, several scholars have addressed the concept that there are in fact externalities associated with poverty in the urban

environment. It is assumed that externalities of poverty throughout an urban area will be negative.

Paul Gottlieb (2000) provides a review of the research that deals with impacts that poverty has on the economic performance of a metropolitan area. The study of the research on this issue was primarily at the regional level, but Gottlieb (2000) organizes the arguments related to the externalities of poverty into several categories: a) complementarity of central city and suburban economies (the association of poverty and regional economics development), 2) fiscal spillover arguments (costs of poverty spill over from the poor to the non-poor driven by the need to provide social programs, increasing deadweight loss), 3) spatial spillover arguments (social problems related to poverty will sneak into neighboring jurisdictions), 4) other political arguments, and 5) human capital/social capital arguments (the drag on the economy due to a large group of poor and unskilled workers in poor living conditions).[1]

The most appropriate area of literature to apply to this research is the idea of fiscal spillover of poverty conditions. As Gottlieb (2000, 23) notes, "These studies hypothesize that the costs of poverty (i.e., welfare and court costs), spill over to more affluent residents through their participation in the same taxing jurisdiction". However, to the extent that this has been addressed, this question has been primarily addressed at the interjurisdictional scale. Whether considering interdependencies between cities and their suburbs or whether attempting to learn about these effects across major cities (Pack 1998), there has been little or no effort to assess the extent to which spillovers occur intrajurisdictionally.

[1] This is addressed with the inclusion of Social Disorganization Theory in this research. While this does not necessarily deal with the drag on the economy, it does associate the existence of social problems with externalities related to the economy of a city.

The conception of fiscal spillover in this research is related to the dependency of the spending needs in a city on the demand for public services in certain areas of the city that face strong poverty conditions. Instead of dealing with questions of spillover in a regional perspective or of the city as a whole, this expands the use of the theory to explain the financial impacts of poverty at the sub-city level. Further, this dissertation does not deal with fiscal impact, but rather the assumption that greater demands for services are associated with greater costs for providing the service.

This inherently suggests a question of a cost-benefit analysis that attempts to determine whether poverty reduction strategies and programs create benefits that outweigh their costs. While the purpose of this research is not to address specific costs and benefits of poverty alleviation programs, the concept and measurement of fiscal spillover informs the discussion on the adequacy and propriety of policy actions related to urban poverty.

CHAPTER 2: LITERATURE REVIEW

The nature of general purpose local governments and the cities that they serve is an interdisciplinary one itself. A review of the literature that deals with the theoretical framework of this study comes from a diverse set of social science disciplines that have all attempted to develop an understanding of the processes and phenomena that drive the demand for public services. The purpose of this literature review is to provide a broad sketch of the approaches that scholars have taken in their attempt to provide explanations for behaviors, measurements of the impacts of those behaviors, and a broader perspective of social problems. This is accomplished by reviewing the literature on Social Disorganization Theory. The literature review examines the work of scholars as they have defined and explored the consequences of poverty that occurs within cities and explains the spatial nature of distribution of socioeconomic groups within cities, in addition to a discussion regarding racial determinants of the willingness to interact with government. Finally, there is a discussion of the measurements and the social determinants of the demands for firefighting and police services. Studies reviewed for this section span across academic disciplines such as sociology, geography, economics, and criminology. The interdisciplinary nature of the literature review is appropriate for the public policy considerations associated with the demands for firefighting and police services that challenges cities as they continue to develop response mechanisms.

Social Disorganization Theory

Though Shaw and McKay (1942) are credited with developing Social Disorganization during the Second World War, the theory was not widely tested until the late twentieth century. Social Disorganization has been examined through a number of disciplinary lenses, in fields as disparate as criminology (for instance Sampson and Graves 1989) to education (such as Bowen et al. 2002). The purpose of this section is to outline how Social Disorganization has been studied by scholars and to discuss that while the operationalization of the theory varies depending on the discipline, similar phenomena can be identified as the characteristics of neighborhoods. These characteristics drive the degree to which social disorganization exists. This is accomplished through the discussion of the theory and how it has been applied, the identification of the characteristics of neighborhoods which have been found to drive the existence of Social Disorganization, and an overview of the outcome measurements used to operationalize the theory. Additionally, a number of caveats will be given when discussing the problems associated with Social Disorganization.

The first study to directly and empirically test Social Disorganization Theory was until Sampson and Graves (1989) study of the crime rates in British localities. This study was designed to examine the structural characteristics of a community and how they drive criminal activity. Subsequently, the theory has been applied widely to criminology (Veysey and Messner 1999; Rose and Olsen 1998; Lowenkamp et al. 2003; Smith et al. 2000; Martinez et al. 2008; Sun et al. 2009; Mosher 2001; Morenhott et al. 2001). Criminology and sociology are certainly the dominate disciplines in which the phenomenon of social disorganization has been studied, which has largely been related to criminal behavior.

However, criminal behavior is not the only theoretical implication of the existence of social disorganization. For example, education researchers have examined the impacts that structural social disorganization has on the academic performance of children from disadvantaged neighborhoods and homes that are marked by social disorganization (Bowen et al. 2002). Regardless of the discipline or the outcomes measurements provided, the impact on the kinds of places, or the type of neighborhood, in which a person finds himself can lead to a higher favorability for the for socially problematic behavior or outcomes to occur (Kuborn and Weitzer 2003). Simply, the cultural organization of a neighborhood leads to more or less advanced disorganization (Warner 2003). The characteristics of a socially disorganized neighborhood have been well established in research in the field.

These characteristics can be divided into two different general frames. The first, structural problems with the economy and of individual level social indicators of a neighborhood, relies heavily on the externalities associated with declined socioeconomic status and other similar problematic neighborhood characteristics (Sampson and Groves 1989). The second general frame focuses on the social networks that exist within neighborhoods, which theoretically should decrease the social disorganization found within a neighborhood (Cantilla et al. 2003).

The initial empirical analysis of Social Disorganization Theory, Sampson and Groves (1989) tested the hypothesis that low economic status, ethnic heterogeneity, and residential mobility were all sources of social disorganization. From the measurement perspective, these social problems were operationalized through several exogenous variables, socioeconomic status, ethnic heterogeneity, residential stability, family disruption, and urbanization. In order to measure socioeconomic status, Sampson and

Groves (1989) created an index of SES consisting of education, occupation, and income. Residential stability is measured by the percentage of people within the geography that live within a fifteen minute walk from the place in which they were raised. Ethnic heterogeneity is measured by standard calculations. Family disruption is measured by an index consisting of the percentage of divorced people and the percentage of single parents. Finally, urbanization in the Sampson and Groves model is a dichotomous variable that measures whether or not the geography is located in the inner-city. Subsequently, scholars have replicated this model multiple times (Lowenkamp et al. 2003, Veysey and Messner 1999; Oberwitter 2004; Sun et al. 2004). However, some of these studies have added other exogenous variables, such as average age (Oberwitter 2004) and average housing values (Smith et al. 2000), and population density (Smith et al. 2000; Martinez et al. 2008; Rice and Smith 2002).

Scholars, such as Cantilla et al. (2003) also consider the social networks within a community and how they will reduce the existence of social disorganization. This line of research is primarily driven from Sampson and Grove's (1989) finding that increased social disorganization leads to further problems associated with unsupervised youths. Kingston et al. (2009) expand this avenue of research in their findings that suggest that youth's decreasing perceptions of opportunities associated with social disorganization will drive the existence of crime. While this line of research is interesting, it is not the focus of the present research.

While there are general areas of interest with respect to the outcomes of social disorganization, such as criminal behavior or educational outcomes, there is an array of methods by which the phenomenon has been operationalized. One of the major problems

with the question of Social Disorganization Theory is that there has not been a standard method by which the impact of social disorganization is operationalized (Veysey and Messner 1999). In fact, studies rarely provide a justification for the use of one measurement or another. Instead scholars have used one problem or another that is frequently seen as a social ill as evidence of the existence of social disorganization, such as criminal activity (Sampson and Groves 1989) or education outcomes (Bowen et al. 2002). The early quantitative studies focused primarily on criminal activity that occurs within the neighborhoods that were assumed to be experiencing social disorganization. For instance, in the initial quantitative study of social disorganization, Sampson and Groves (1989) simply use the amount of crime that is occurring within neighborhoods as the outcome of the operationalized effects of the abstract idea of social disorganization, though they do use a series of weighted least squared regression models with various types of crime rates. Because quite a few scholars have replicated the work of Sampson and Groves (1989), the standard proxy for social disorganization has been the crime rate in the aggregate (Veysey and Messner 1999; Lowenkamp etal 2003; Smith et al. 2003; Oberwittler 2004; Sun et al. 2001). However, other studies have driven further into the question of the crime rate and have worked to determine if processes vary depending on the type of social ills that occur. Because it is not necessarily possible to determine the presence (or not) of actual social disorganization, the best way to describe social disorganization is through the existence of the predictors variables defined in the research.

In addition to the measurement of crime rates in the aggregate, several scholars have attempted to measure the degree to which social organization has influenced types of criminal activity that occurs within neighborhoods. But, some scholars argue that the social

disorganization processes are not singular processes (Veysey and Messner 1999). Martinez et al. (2008) examines the social disorganization processes within the context of violent crime and drug activity. This expands and is an improvement upon the singular idea of crime rate and considers that not all criminal activity is a result of the same social processes (Martinez et al. 2008). In a similar context Rice and Smith (2002) considers the impact that social disorganization has on the auto theft rates, which is clearly a different type of crime than more violent crimes such as homicide (Morenhoff et al. 2001; Martinez et al. 2001) or drug use (Mosher 2001; Martinez et al. 2001). But crime is not the only social impact that is related to social disorganization.

A number of additional scholars have focused on the outcome effects on children of socially disorganized neighborhoods. Bowen et al. (2002) examine the academic performance outcomes of students who come from neighborhoods and homes that can be characterized as having social disorder. The increase in the degree to which the home or neighborhood from which a student comes to school can be characterized as socially disorganized leads to reduced academic performance (Bowen et al. 2002). Similarly, Peeples and Loeber (1994) find that behavioral outcomes of public school boys are determined by the social conditions in which the child is raised. The outcomes of the problems associated with social disorganization range from direct societal effects to more specific individual outcomes.

An important caveat to make and a major problem with the research conducted by the scholars cited in this section is that, while increased social disorganization could lead to greater crime, it is also possible that police officer bias leads to greater focus on the communities that can be characterized as socially disorganized (Sampson and Groves

1989). This results in greater crime rates because crimes are then reported at a higher rate. Another concern in this line of research from a reciprocal causation perspective is that reliance on incarceration of low-level criminals by law enforcement may actually increase the rate of social disorganization, which then leads to higher rates of crime. Because incarceration leads to the reduction in income, residents in those neighborhoods then have more incentive to engage in illicit activity, leading to a continually worsening cycle of crime and poverty (Rose and Clear 1998).

Because the existence of social disorganization is difficult to define and the measurements have traditionally been somewhat nebulous, a challenge to research on the subject is to determine how to recognize social disorganization. In general, scholars have identified a set of characterstics as defined above as the predictor variables for places that have social ills that, because of theoretical problems in the social fabric, society cannot organize. The extremes of these problem characteristics can be used to suggest that there might be social disorganization problems in neighborhoods that have those extreme characteristics.

The Externalities of Poverty

Before discussing the externalities of place-specific poverty, it is first necessary to briefly discuss why poverty occurs in the first place. Tietz and Chapple (1998) and Van Kempen (1997) provide a number of hypotheses that scholars have argued each having an impact on urban poverty, many of which are likely a function of the discipline in which the scholar is working. The eight causes hypothesized are: structural shifts in the economy; inadequate human capital; racial and gender discrimination; interaction between culture and behavior; spatial mismatch; migration processes; a deficit of endogenous growth; and

negative externalities of public policy. These causes are important because when considering the results of poverty cocentration on the non-poor, several causes also have some impact on them.

While there are still plenty of people living in poverty in the United States, there has been a sharp decline in the number of places that have high concentrations of poverty (Jargowsky 2003). This reduction, though, has not been geographically consistent among urban, suburban, and rural environments, with the rate of suburban poverty reduction occurring at the lowest level, suggesting that poverty is becoming more of a suburban issue than it ever has been before (Jargowsky 2003; Barube and Kneebone 2006).

It has become evident through the longitudinal analysis of census data that the highest concentrations of poverty occur in central cities and rural areas (Crandall and Webter 2004). While the focus of this research is in an urban context, clearly there is room for study on rural poverty that could be addressed. However, the urban focus is an important one from the perspective of the externalities associated with urban poverty. Paul Gottlieb (2000) provides an in depth overview of the research that has been conducted on the external impacts of poverty alleviation in the academic sphere. He identifies five general themes of the academic work that have provided arguments of external impacts of poverty alleviation: general complementarity of central city and suburban economies; fiscal spillover impacts; spatial spillover; other political considerations; and the development of human and social capital. The spatial arguments found within the first three impacts are important ones: the authors treat the existence of declined socioeconomic characteristics almost like a virus that spreads beyond the initial host. The existence of

declined socioeconomic status of residents results in the decline in the overall quality and value of the rest of the neighborhood, potentially even affecting other parts of the city.

The concerns about the creep of impacts of poverty are not without reason. In addition to Gottlieb's (2000) overview of the complementarity of city-suburb economies, which indicates competing findings over this impact, other studies find that there are creeping impacts of poverty. First, Cook and Marchant (2006) and Raphael and Stoll (2010) make it clear in their research that there is movement of the spatial locations of poverty conditions in urban regions. This re-concentration of poverty in different spatial locations can have an impact on property values outside of the inner city. This is a clear impact on those who otherwise would not feel that they have a concern for concentrations of poverty.

Poverty Pockets in Urban America

Though the United States saw a substantial decline in concentrated poverty in urban areas in the 1990s, the decade between 2000 and 2010 produced a large increase in the concentrations of poverty within metropolitan areas. While the worst growth of poverty concentrations was found in rust belt cities (nearly a fifty percent growth), there was a significant growth in the number of census tracts experiencing the concentration of poverty in southern urban cities as well, amounting to approximately a one-third rate of increase during the decade (Kneebone et al. 2011). The growth of the concentration of poverty in urban areas in the recent decade is reason for concern, and the face of urban poverty concentrations is changing[2], but it is certainly not a new phenomenon. This section will

[2] According to Kneebone et al. (2011), a person living in a concentrated poverty location was far more likely to be white than in previous decade. Though, African Americans still made up a large majority of those living in concentrated poverty conditions.

outline the previous research on the topic of highly concentrated locations of poverty within urban areas (known as poverty pockets). This will be accomplished by outlining how poverty pockets have been defined by scholars, by discussing the causes of the development of poverty pockets, and by discussing how the impacts of this condition have been dealt with in previous research. Finally, this section will outline holes in the existing research that can be filled.

A poverty pocket is simply defined as a neighborhood in a city where a large number of people live without prospect of socioeconomic progress (van Kempen 1997). The spatial differentiation (Friedman and Lichter 1998) between poverty pockets and non-poverty pockets requires a clear definition. Therefore, scholars have provided a more concrete level of the definition of "extreme" poverty. Typically, scholars use a cut-off point of forty percent of people living in poverty to denote locations in which there are extreme levels of poverty (Coulton et al. 1996; Jargowsky and Bane 1991; Kneebone et al. 2011). The unit of analysis for extreme poverty varies by study, with some scholars using the county (for instance, see Levernier et al. 2000). However, the vast majority of studies rely on the census tract to determine the locations of poverty pockets within urban areas (see Crandall and Weber 2004; Hoyt and Scott 2004; Partridge and Rickman 2007). Though county-level analysis might make sense in certain circumstances, for the purposes of intra-urban research, clearly a tract-level analysis provides the best level of resolution to locate poverty pockets within a city (Crandall and Webster 2004).

However, it is not yet clear that the census tract unit of analysis appropriately deals with the "neighborhood" aspect of the definition of poverty pockets. On its face, the concept of neighborhood could be a bit ambiguous. While a person is clearly a neighbor

with the person living in the house next door, to what extent geographically does this neighborhood extend? Galster (2001) concludes that a neighborhood can be defined as "a bundle of spatially-based attributes associated with clusters of residences, sometimes in conjunction with other land uses" (2112). These attributes consist of structural characteristics of buildings, infrastructural characteristics, demographic characteristics, class status, public service characteristics, environmental characteristics, proximity characteristics[3], political characteristics, social-interactive characteristics, and sentimental characteristics. While this remains a bit ambiguous, the United States Census Bureau defines a census tract as, "designed to be homogenous with respect to population characteristics, economic status, and living conditions" and are tied to physical patterns of natural and man-made topographical considerations. The definition of a census tract takes into account half of the attributes of a neighborhood as defined by Galster (2001). Particularly since they deal with demographic and class status, census tracts are likely an appropriate unit of analysis for the location of poverty pockets in metropolitan America. Additionally, census tracts create a concrete and relatively stable bound to the neighborhoods where poverty pockets might exist.

In addition to the identification of poverty pockets in urban areas, there has been a substantial effort to draw conclusions about the causal relationship between social and economic environmental characteristics of the region and the existence of poverty pockets in cities. The focus on the economic characteristics has been on two general areas of concern: characteristics of the economy as a whole and the changes of individuals maintaining meaningful employment for a substantial period of time. The first causal

[3] Such as access to employment, etc.

mechanism that has been indicated for inhabitants of certain geographies is access to job markets (spatial mismatch) (Bigman and Fofack 2000).[4] This indicates that people living in high poverty locations simply do not have ability to physically access jobs and, as a result, do not have stable employment. This might be due to a lack of access to personal or public transportation. In addition to the spatial mismatch problems, others have found that poverty pockets are created by skills mismatch (Levernier et al. 2000).[5] This suggests that while jobs may be available and accessible, those who live in highly impoverished areas of cities simply do not have the training to gain employment.

On a larger economic scale, though, there has been a focus on the structure of the local economy as it relates to poverty pockets. Scholars have pointed to changes in industrial composition of the city as a whole (Friedman and Lichter 1998; Levernier et al. 2000; van Kempen 1997; Crandall and Weber 2004) as a driving mechanism to higher levels of poverty. This is consistent with the finding that several other scholars have outlined suggesting that job growth will reduce the level of poverty within a certain geography (Partridge and Rickman 2007; Levernier et al. 2000; Crandall and Weber 2004). While it seems fairly obvious that as more people work, the rate of poverty would decline, it is an important finding because it is possibly inconsistent with the social explanations for poverty pocket locations.

In contrast to the economic arguments about the causes of poverty pockets in urban environments, the social explanations are driven by the development of endogenous social ills that, scholars argue, lead to further entrenchment of poverty conditions within pockets

[4] There is an enormous body of literature dealing with spatial mismatch but the term was originally coined by John Kain (1968).
[5] Skills mismatch is also a well-researched phenomenon

of the city. For instance, in their study of familial structure, Friedman and Lichter (1998) find that the growth of the single-parent household, particularly single mothers, is highly related to the concentration of child poverty in southern United States counties. Other scholars have used broader strokes related to the decline of social capital (Bigman and Fofack 2000) to explain the growth and concentration of poverty pockets in American cities.

There are two distinct opinions that authors have formed with regard to causes of the development of poverty pockets in cities. However, others (such as van Kempen 1997; Duncan 1989; Bigman and Fofack 2000) have come to the conclusion that all of these circumstances are interrelated and are each acting to drive the existence of poverty pockets. Duncan (1989) coins the term "locality effects" and van Kempen (1997) applies it to this problem, which suggests that specific characteristics of the local social and economic environment drive the likelihood for a location to be highly impoverished. These characteristics relate to access to the job market as well as social capital, but also access to public services and infrastructure as well (Bigman and Fofack 2000). Generally, though, the problem with poverty pockets is not just that people are poor, but that social and economic characteristics of the area reinforce their poverty, making escape from the situation difficult to accomplish (van Kempen 1997; Bigman and Fofack 2000).

A final important component of poverty pockets in the American city is the impact that space has on their existence. Though poverty pockets and their associated neighborhoods have typically been delineated by census tracts, several studies have indicated that that there is spatial association, or clustering, of high poverty areas in urban environments. For instance, Crandall and Weber (2004) find that the likelihood of a census

tract having high poverty is significantly related to the socioeconomic characteristics of neighboring census tracts. This characteristic drives the reality that simple policy solutions that attempt to break up poverty concentrations (such as eliminating housing projects) will actually have minimal impacts (Crump 2002; Galster and Zobel 1998). In fact, the problem, while local, is systemic.

This discussion of the poverty pockets that exist within American cities is reminiscent of the dual city hypothesis that demonstrates a deep social divide between the haves and the have-nots (van Kempen 1994). It is evident from this discussion that the possibility of a person escaping poverty pockets is essentially non-existent (Bigman and Fofack 2000; van Kempen 1994 and 1997). Therefore, the life chances that an individual has living within those conditions are rather minimal. However, this is where the research stops on the topic of the impacts of poverty pockets. The larger question of what impacts these poverty pockets have on the environment (economic, political, social, etc.) surrounding them has not been addressed directly. However, the concept of fiscal spillover of poverty can be applied in this context. Though fiscal spillover has traditionally been applied to inter-jurisdictional cost burdens, the same theory could easily be applied to intra-urban service delivery needs and, as a result, redistribution of public funds.

Intra-urban Spillover of Poverty

In addition to the dynamic spatial concentrations of poverty in urban environments, there is also concern about the impact that the challenges impoverished people face has on local finance. Though Gottlieb's (2000) fiscal spillover has a geographic component in that the local financial decisions can be impacted by the need to deal with poverty, he primarily focuses on the types of services that are easy to associate with poverty concentration,

specifically welfare and courts. However, the impact of challenges associated with poverty on local finance likely extends beyond the social services types of programs. Janet Pack (1998) finds public expenditures of services outside of the realm of what could be traditionally conceived of as social welfare programs are increased when there are increasing levels of poverty in an urban setting.

The services beyond what are mentioned by Gottlieb (2000) that Pack (1998) points to are police, fire, and general administration. This is of particular interest, Pack (1998) notes, because welfare functions are many times largely funded by intergovernmental transfers, not from local taxes. So, when local governments have to spend a larger share of public funds on expenses *indirectly* related to poverty, it either increases the tax rates that individuals have to pay or it leads to the decline in expenditures on (and as a result, efficacy of) other programs.

The problem with the development of human and social capital, as one of Gottlieb's (2000) impacts of poverty alleviation, is that the lack of human and social capital is also listed as a cause of the existence of poverty in the first place (Teitz and Chapple 1998). If the lack of social and human capital is a cause of poverty, then the development of social and human capital cannot be an impact of its reduction, only a result of policy action, a part of a different causal relationship. Therefore, it is clear that there is some disagreement over how human and social capital plays into the equation in the literature.

The measurement of these relationships has been quantitatively modeled in primarily descriptive terms. There are a number of descriptive studies that show the changing face and geography of poverty (such as Jargowsky 2003; Cook and Marchant 2006; and Raphael and Stoll 2010). Those largely measure the rate of poverty and its rate

of change, given certain characteristics. There are also other studies (such as Pack 1998) that are less interested in the measurement, but more on the impact of the rate of poverty on various other circumstances of interest.

Socioeconomic status clearly has a significant impact on the likelihood that a person will need to demand local government services. However, this is likely a dynamic process that is complicated by various factors. Specifically, racial differences appear to mitigate the impact that socioeconomic status has on the likelihood that a person will be willing to interface with local government.

Race as a Predictor of the Relationship with Local Authorities

It is important to note that the relationship residents have with the local government might have a substantial impact on the willingness for a person to cooperate with local authorities. In fact, the existence of poor relationships with local authorities might actually reduce the number of requests for citizen services that are received within a given neighborhood if the residents do not have trust in local authorities (Tyler 2005; Goldsmith 2005). Though trust in firefighters and fire departments has not been a topic of substantial academic research, trust in police officers and police departments has been a topic of great discussion in academic research in several disciplines. However, it is a common understanding that firefighters tend to enjoy great trust from the public while police officers and the criminal justice system, in general, lack a great deal of public trust (Tyler 2005). Of course, there are inherent differences in the business that is conducted by firefighters and police officers. However, Goldsmith (2005) notes that trust in police cannot necessarily be divorced from trust in government in general. So, the differences in the determinants of

the willingness to cooperate with police officers and the willingness to cooperate with firefighters is an issue that must be addressed.

Because calling for service is a form of cooperation from the community, and trust shapes willingness to cooperate with authorities (Tyler 2005), it stands to reason that the determinants of trust in police officers in communities should be included in any model that addresses the question of demands for services. As such, if the determinants of trust in local police are violated in certain geographies, it is reasonable to suggest that cooperation with local authorities might decline. It is also an interesting question to determine whether or not those determinants of trust have a similar relationship to firefighters as they do police.

The study of trust in police officers has primarily been developed through surveys of large and small American city residents, though some studies have focused on British trust in police (Bradford et al. 2009). While the cities vary, many of the findings of the demographics that are related to trust in police are consistent. In general, scholars find that minorities are less trusting of police officers than their white counterparts of comparable socioeconomic status (Tyler 2005; Garofolo 1977; Hindelang 1974; Huang and Vaughn 1996; Schuman et al. 1997).

Minorities tend to report higher levels of fear and actual victimization by police; they are also more likely to be the target of disrespectful, humiliating, and violent treatment from police officers (Tyler 2005; Stoutland 2001). In her study of the nature of the relationship between police and residents, Stoutland (2001) finds that minority residents tend to feel that police officers do not share concerns about neighborhood priorities and the need to maintain a safe neighborhood. In particular, African Americans tend to be more

likely to feel that they have been unfairly targeted by police (MacDonald and Stokes 2006), and those who had actually been stopped and, in their opinion, disrespected by police, were less likely to be willing to cooperate with police officers (Lurigio et al. 2009).

It would also be incomplete to characterize all minorities into one single group. Though many scholars that have dealt with the question of whites vs. minorities, there have also been a number of scholars who have attempted to assess these relationships with regard to the differences between African Americans and Hispanics (Lurigio et al. 2009). In fact, the relationship between Hispanics and the police are deterministically different from the relationships between African Americans and police (Garcia and Cao 2005). While whites tend to have the greatest trust in police and blacks tend to have the least trust in police, Hispanics tend to be somewhere in the middle (Tyler 2005). While, there is not a generally accepted explanation, to some extent immigration may actually play into the difference.

Interestingly, Correia (2010) finds that Hispanic foreign born residents are more likely to view police officers as trustworthy than their United States-born counterparts, underscoring the importance of the development of community policing tactics employed by the professionalized police services in US cities beginning the 1980s (Stoutland 2001; Goldsmith 2005). Compared to corrupt police services of some countries and the impotent police forces of others, this is one possible explanation for the positive relationship between foreign-born status and the trust in police (Correia 2010). But, the longer a person is in the country, the less likely that person will believe that the police are trustworthy, accentuating the notion that negative experiences with police will lead to reduced feelings of trustworthiness (Correia 2010; Lurigio et al. 2009). Understandably, an inability to

communicate (lack of English skills) tends to lead to reduced trust in police (Correia 2010). One other cause of this decline in trust may best the result of public policies that target immigrants.

Domestically, and a particularly important component of the relationship the police have with immigrant communities in Charlotte, North Carolina, is the existence and application of the federal 287(g) program. Immigration policy, enforcement, and procedures are primarily the responsibility of the federal government, specifically the Department of Homeland Security. In 1996, section 287(g) of the Immigration and Nationality Act (INA)[6] allowed the federal government to assign both state and local officers immigration enforcement powers. While the US Immigration and Customs Enforcement (ICE) has multiple partnerships with state and local agencies, the unique characteristic of the 287(g) program is that it denoted the first program that allowed state and local authorities to be direct enforcers of federal immigration law (Capps, et al 2011). This program has come under much criticism from immigrant rights and civil rights organizations and activists. Two of the primary criticisms are that the program impairs local community policing efforts and encourages racial profiling (Michaud 2010; Capps et al 2011). The community policing argument rests on the idea that the agreements create distrust between LEAs and the local immigrant community. As a result, crimes go unsolved and specific communities, those with weak relationship with local law enforcement, become breeding grounds for criminal activity (Michaud 2010). Since Mecklenburg County is a participant in certain components of the 287(g) program, the

[6] Section 287(g) of the INA was added as part of the 1996 Illegal Immigration Reform and Immigrant Responsibility Act (8 U.S.C. 1357(g) (2006). The 287(g) program is part of a larger ICE program called the Agreements of Cooperation in Communities to Enhance Safety and Security Service (ACCESS).

relationship that members of the immigrant community have with police may be a vital component of the likelihood of residents of the Hispanic and immigrant communities to work with local authorities in Charlotte and in other new gateway cities.

When assessing the trust in government and police, scholars have used a number of variables that provide a prediction of the trust in government at the individual level. These studies have almost totally consisted of surveying individuals and using their demographics and experiences with police to predict their perception of the trustworthiness of police. Of course, in this context, race/ethnicity has been used throughout the scholarly study of the phenomenon of trust in police (Tyler 2005; Stoutland 2001; MacDonald and Stokes 2006; Lurgio et al. 2009; Lai and Zhao 2010; Goldsmith 2005; Garcia and Cao 2005; Flexon et al. 2009; Correria 2010). Additionally, scholars have looked to income, poverty, or some measure of socioeconomic status (Tyler 2005; MacDonald and Stokes 2006; Garcia and Cao 2005; Lai and Zhao 2010), gender (Lurigio et al. 2009; Tyler 2005; MacDonald and Stokes 2006; Garcia and Cao 2005), age (MacDonald and Stokes 2006; Tyler 2005; Garcia and Cao 2005; Flexon et al. 2009), population density (MacDonald and Stokes 2006), education level (Tyler 2005; MacDonald and Stokes 2006), and English proficiency (Correia 2010) as predictors in the trust in government.

While the purpose of this study is not to address trust in government per se, and it would be nearly impossible to characterize an aggregate trust in government for an entire census tract, the averages and concentration of these characteristics within a census tract could serve to provide insight into the likelihood that a person living within that census tract would trust government and, thus, would be willing to cooperate with government. That is, in locations that have higher concentrations of minority groups, all else held equal,

the expectation is that there would be fewer calls for police service than in an otherwise equal, primarily white, neighborhood.

Estimating the Demand for Fire Service Delivery

According to the National Fire Protection Association's Fire Analysis and Research Division, there were approximately 1,389,500 fires in the United States in 2011. This means that every twenty-three seconds, there is a fire somewhere in the United States, and every sixty five seconds, there is a fire in a structure. During that year, there were over 3,000 people killed in fires, 2,520 who were in structures, with an additional 17,500 civilian injuries. Finally, during 2011, fire destroyed $11.7 billion worth of property, the majority of which occurred in structures. While the number of fires has declined in the last fifty years, the adjusted average fire damage has nearly doubled since the 1970s. As a result, there is clearly still a significant need for firefighting service delivery. However, from a decision-making standpoint of local government, how should the need for fire service delivery be modeled? While the literature to this point fails to provide a metric to deal with this question directly, much of the existing research can be used as a starting point to develop a model of efficient allocation of resources. This section outlines how scholars have measured the degree of demand for fire service delivery in communities in the United States, followed by what predictors they have developed.

Between the 1970s and the 1990s, there were a number of scholars who were interested in the estimation of the demand for public firefighting services delivery in the urban setting. While there have been a number of methods used to determine the level of demand, using different inputs and calculations, the types of measurements can be divided into two distinct categories: measurements that consider the choice to engage in local

government public spending on the service (or costs), and measurements that consider the amount of output actually requested by the public. This section will outline the different analytical strategies used by the two sets of scholars considering the issue of measurement of fire service demand.

Scholars focusing on the measurement of fire service demand by means of determining costs were primarily writing in the 1970s and were focused more on the behavior of bureaucrats and local elected officials, their desire to provide for the service delivery desires of the public (Ahlbrandt 1973; Borcherding and Deacon 1972; Deacon 1978), and the applicability of the Samuelson public goods model to the urban fire service (Rider 1979; Bruekner 1981; Ahlbrandt 1973). As a result, these scholars primarily considered how much a local government chose to spend on this particular service. Additionally, scholars have considered the production function of fire service delivery, some finding evidence for constant returns to scale (Borcherding and Deacon 1972) and some finding for increasing returns to scale (Bruekner 1981).[7] Still, others have found diseconomies of scale in the fire service (Beaton 1974; Erickson et al. 1974).

There is clearly a difference of opinion relating to the nature of fire service as a public or private good. But, one thing that is consistent among all of the studies reviewed that use cost as an estimate of local service delivery demand is that they all use the total expenditures of the service. While many of the studies control for population and density for the entire local government (Ahlbrandt 1973; Borcherding and Deacon 1972; Bruekner

[7] Borcherding and Deacon (1972) assumed Cobb-Douglas technology, with capital and labor as the only two inputs of production of the service. They assumed that rent for capital is the same for all jurisdictions in their study, while wage rates could vary. In contrast, Bruekner (1981) considered pumping capacity and water delivery capacity to be the two inputs of production, finding that increasing a community's population should not reduce the level of fire protection, holding capacity fixed.

1981; Deacon 1978), assuming non-discrimination of both taxes and expenditures (Borcherding and Deacon 1972), none have considered potential differences that are associated with intra-urban variation in demographics of residents and how those differences might impact the costs associated with providing the service.

As the study of fire service demand delivery expanded in the 1980s and 1990s, scholars began to branch out from a simple expenditure metric as a proxy for the level of demand. From the perspective of questions related to the transference of the desires of the public into local public policy, it made sense to consider public expenditures (Deacon 1978). However, from a standpoint of detailed service delivery decisions, the simple expenditures metrics fell short of providing a means to measure how much of the service was necessary, given a certain set of characteristics of residents living within a city. Instead of focusing on what a jurisdiction chooses to spend on a particular service, later scholars attempt to measure what happens when an emergency occurs, presumably with the assumption that the fire department is reactionary in nature and, as a result, will be structured in accordance with what actually occurs within the jurisdiction.

In both his 1991 and 1992 articles, William Duncombe defines the level of production, or supply of the service as "(the inverse of) property losses from fire as a percentage the total property value" (1992, 182). If we assume that the fire service is structured such that the level of service supplied by the local government is efficiently provided at a level equal to that demanded from the public as a result of firefighting-related emergencies, it would also be reasonable to consider demand for the service as equal to property losses from fire as a percentage of total property value. In fact, some studies (such

as Syron 1972 and Blum 1979) have used this metric as a means to determine the degree to which fire service delivery is demanded by the public.

An earlier study of the economics of fire service delivery, Southwick and Butler (1985), agreed with Duncombe that, due to its inherent relationship to outcomes of the service, this metric is a flawed tool to determine demand. As a result, Southwick and Butler (1985) put forth a methodology that takes into account five different measurements that characterize the need to supply fire service delivery: rates of fire related deaths, fire related property losses, total fires, building fires, and alarms. However, in this context, Southwick and Butler (1985) are incorrect in their understanding of the causal mechanism and direction. Fires (or any of the other five measurements) do not occur because firefighters exist. Rather, firefighters exist because there are fires. That is, the number of fires should be characterized as the circumstantial demand for the supplied fire service delivery (firefighters). This research strategy inherently suggests a lagged relationship in which a fires and deaths occur, and then decisions for the provision of fire services are provided as a reaction to environmental circumstances.

While the development of measurements related to how many fires and other emergencies actually occur is likely an improvement over the expenditures measures if the question is related to how cities are impacted by spatial concentrations of demographics within the cities, these studies still fail to take into account intra-urban variation. That is, they assume that the demands for the services are consistent throughout the geography of the city. Additionally, it should be noted that many of these studies make the assumption that decisions are made on the basis of the median voter.

Because of the disagreement over how demand for fire service delivery is measured, there is clearly some natural inconsistency among the determinants of that demand. Studies that focus more on, or at least have component of, the expenditures of local government related to firefighting service delivery take into account variables that likely drive costs, such as the wage index (Ahlbrandt 1973; Deacon 1978; Ehrenberg 1973); the number and types of personnel (volunteers versus paid personnel); the number of fire stations and vehicles (Ahlbrandt 1973); taxable capacity and tax rates (Borcherding and Deacon 1972); mutual aid responses (Duncombe 1991); and relative wages (Southwick and Butler 1985). However, this section will focus on the variables that are related to the demographics and environmental characteristics of the service area being studied.

First, the existence of poverty, or poverty-like conditions, is consistently held constant in nearly every study considering the demand for fire service delivery. Poverty concentration is very rarely the variable of interest, but there appears to be some agreement in the notion that the rate of poverty in a certain jurisdiction might impact the level of fire service delivery demand. However, how that is operationalized varies among the different studies cited in this section. For instance, Ahlbrandt 1972 controls for the percentage of houses in the 1970 Census that lacked basic plumbing facilities, and Duncombe 1991 controls for the percentage of old houses; others control for per capita income (Borcherding and Deacon 1972) of the residents of the jurisdiction; still others simply control for the percentage of residents living in poverty, probably the simplest measurement (Duncombe 1991; Southwick and Butler 1985). In each of these studies, higher rates of poverty were associated with a higher degree of demand for fire service delivery in the urban setting.

Some studies consider the impact of other characteristics of the community that might likely drive the degree of fire service that is demanded by the existence of spontaneously occurring or maliciously set fires in the urban setting. Several studies have examined population and population density (Ahlbrandt 1972; Borcherding and Deacon 1972; Deacon 1978; Duncombe 1991; Southwick and Butler 1985; Ehrenberg 1973). These are both logical variables to consider because, assuming that non-natural fires[8] are the result of human action or inaction, when there are more people, there will be more fires. Some additional variables that are considered are the degree of urbanization in a jurisdiction (Borcherding and Deacon 1972); the physical size of the jurisdiction (Ahlbrandt 1972); percentage of non-white population; median education level (Ehrenburg 1973); percentage of building that are a) industrial and b) greater than two stories; percentage of mutual aid responses; and the percentage of medical responses (Duncombe 1991). Ehrenburg's (1973) contributions would also likely be highly correlated with higher levels of poverty as well.

It is clear that the socioeconomic status of the residents of a city has been an important determinant of the likelihood that fires will take place in a community. However, again, the aggregate level that has been studied in the past suggests that there is very little variation in the impact of these characteristics within individual communities, seemingly leaving much room for error in the model. This research could be improved by considering intra-urban variation in socioeconomic characteristics of residents and learning about how those characteristics impact the demand for fire services at the neighborhood level. This

[8] That is, fire occurring for reasons other than lightning strikes, etc.

would provide a more focused and clearer description of the impact of the failure to de-concentrate highly impoverished areas of a city.

Estimating the Demand for Police Services

According to the National Crime Victim Survey conducted by the United States Department of Justice's Bureau of Justice Statistics, there were nearly nineteen million violent and property crime victimizations in 2010 in the United States. While that number has been declining in recent years, this still accounts for millions of serious violent crimes and property victimizations that lead to the need for local governments to respond with police department resources (Truman 2011). Most interestingly, the highest rates of crime victimization occur in conjunction with lower income households. In fact, the highest rates of crime victimization occur in households that earn $25,000 or less annually. Therefore, it seems reasonable the since there is a higher rate of crime victimization occurring in locations that have lower levels of income that there would be a corresponding higher demand for police services. From the local government policymaking perspective, the degree to which this is the case has real implications on the production of public safety. Unlike the fire service, there is a substantial amount of literature that deals directly with measuring the demand for police services, but mostly towards an analysis of various tactics of police patrols. This section will outline the methods that scholars have used to measure the degree to which police services are demanded by the public and will conclude with a discussion of how scholars have predicted these levels of demand.

Unlike the question of firefighting service delivery, there has been a plethora of studies that have considered the demand for police services within both urban and rural communities throughout the United States in the last fifty years. While some of those

studies have focused on the impacts of different methodologies of policing, such as Community Policing, they all have a similar characteristic: they all attempt to measure the degree to which police coverage is necessary in various jurisdictions. This section will outline the use of expenditure data and the use of direct calls for service measurements that have been used to study the degree to which police services are needed.

Similar to the fire service, economists and other scholars have studied local police department expenditures in hopes of developing an explanation for those policy choices, and this has occurred in a number of different ways. First, Schwab and Zampelli (1987) discuss the spending habits of local governments, attempting to determine if there is a relationship between socioeconomic characteristics and spending. Though the majority of their findings are rather uninteresting, they find that as a city's population of non-white residents increases, so too does spending on police services. While this finding is far from a link between socioeconomic demographics and the demand for local services, it does suggest that demographics may be at least tangentially related to the demand for public services and, as a result, demand could be measured by the level of spending in a community.

Other studies, such as Bergstrom and Goodman (1973) and Hamilton (1983), similarly find that expenditures of police departments in local governments can be used as a measurement of demand and, when controlling for socioeconomic characteristics and total local government expenditures, the choices of local government spending can be operational as spending. However, this measurement undoubtedly requires a leap of faith that there are no other factors that are driving spending. The studies cited previously all suggest that spending must be related to an increase in resources, which must be related to

higher levels of activity, which must be related to socioeconomic characteristics. Another approach that has been developed, however, is to simply measure how often police departments are called for their service by the public.

Compared to the question of public expenditures in measuring the demand for police services, there is a much more developed literature on the analysis of calls for police service. These studies simply analyze the frequency with which citizens activate the local law enforcement system by any means, such as a calling 9-1-1 (Atunes and Scott 1981; Cohn 1993; Johnson and Rhodes 2009; Heller and Markland 1970); actual crime events (that is, crime rates) (Cahill and Mulligan 2003; Gorman et al. 2001; Andresen 2006; Chapman 1976); and analysis of police work activities and patterns (Liederbach and Frank 2003; Parks et al. 1999; Schuessler and Slatin 1964; Smith et al. 2001). While each of these measurements approaches generally the same thing, citizen requests for service, the differences in the use of these depends on the precise research question being examined. For instance, the use of 9-1-1 calls in Atunes and Scott (1981) is used because they are measuring the demand for service as predicted by the demographic group calling. On the other hand, Liederbach and Frank (2003) discover the differences in work patterns and use of police personnel in urban versus rural policing environments, and in the application of different policing strategies (such as community policing).

As a note of caution, it is reasonable to conclude that the demand for police services, if determined by environmental and social characteristics, is often intended as a proxy for the amount of crime occurring within a community. There are, however, detractors to the idea that measurement of the demand (or need) for police service through means of output measurements like calls for service, crime rates, etc. Klinger and Bridges (1997) note that

by using calls for service or reported crime rates, there is a danger of bias in the estimation of the need for police service within a certain community. When using, for instance, calls for service, the number of calls within a certain geography is probably more dependent upon a victim's willingness to call, the accuracy of the caller's description of the crime, confusion of the call taker, and the reporting of crime when there is no actual crime. Because, Klinger and Bridges (1997) note, there may be differences between demographics of who calls and who does not, the demand can be biased with this measure. The willingness for various racial groups to interface with government is an important measure here and will be discussed further below.

On the other hand, Chapman (1976) argues that while crime, police output, and demand for police are typically analyzed separately, they are all likely interdependent. So, there is some disagreement within the literature on how a measurement of the calls for service is related to the degree of crime occurring within a certain community. However, while how often people call 9-1-1 or official crime rates may not be a particularly good measure for how much crime is actually occurring, how much the law enforcement system is used by the public is of interest to local government decision-makers who are trying to predict needed staffing levels in a police department.

The literature on the subject of the demand for police services largely does not divorce criminal activity from the rate of demand for the services of police departments in local governments. For that reason, it is useful to take into account two competing theories of how to predict criminal activity within a community. Chapman (1976) differentiates between an ecological perspective and an economic perspective. From the ecological perspective, the spatial distribution of demographics is related to criminal behavior of the

inhabitants of that space (Walks 1967). On the other hand, an economic perspective would suggest that a rational criminal chooses illegal wages over legal wages and, presumably, the risk of engaging in illicit activity is outweighed by the higher illegal wage (Chapman 1976).

It is true that crime may not be a perfect and unbiased measurement of the demand for police services, but it is clear that the existence of crime leads to a need for police services (Cahill and Mulligan 2003). While there are important distinctions between the two perspectives, both make a spatial association argument. From the ecological perspective, when there is more crime around a person, that person is more likely to engage in crime and, as a result, create a demand for police services. From the economic perspective, when a person lives in a place in which illicit employment is better rewarded than legal employment, a rational person will choose to engage in crime, which ultimately creates a demand for law enforcement.

Regardless of what leads someone to commit a crime, and thus create a demand for police service, it is clear that from both perspectives that space and place matter. In a study of actual crime events, Andresen (2006) finds that the socioeconomic and familial characteristics of the geography in question are what drive the crime rate: ethnic heterogeneity, unemployment, poverty, population changes, typical family structure, income, rental vs. homeowners, education, population density, age, and dwelling age. In this study, Andresen (2006) was considering Canadian enumeration areas and census tracts, but the method could easily be applied to census tracts in American cities. An earlier study by Schuessler and Slatin (1964), finds that similar characteristics (using the census tract as the unit of analysis) add the component of differential disorganization of the social context

within the study area. Largely, the social disorganization in problem areas, "[suggest a] social process which leads to demoralization in the person with a consequent abandonment or denial of generally recognized social obligations" (Schuessler and Slatin 1964, 147). This would clearly suggest that in urban locations that have a higher degree of social ills should be expected to have more crime and, as a result, more calls for service for the police departments.

However, when considering the aggregate spending of local police departments in a city, Schwab and Zampelli (1987) find that while race and homeownership predict higher levels of spending in the expected direction, income at the city aggregate level does not relate to spending on the police department in the way that social disorganization might predict. In fact, they find that higher levels of income are actually associated with higher levels of spending. This is not surprising because if a community has more money, it is also able to spend more on policing. However, this fails to take into account the spatial variation within cities.

While studies have dealt with the issue both directly and indirectly, it is clear that the socioeconomic characteristics at the intra-urban community likely have an impact on the degree to which law enforcement is needed within a community. Some studies focus on the individual decision-making practices of those who live in the communities and other studies focus on the development of criminal activity as a social diffusion process. However, they all agree that environmental characteristics lead to further crime. However, unlike the economic perspective which focuses on individual circumstances, the social disorganization perspective provides an explanation of the behavioral changes in the aggregate of the community and can provide an opportunity to measure the degree to which

these socioeconomic characteristics impact the need for police services within certain geographies.

Integration of the Literature

It is evident from the above literature review that the variables indicative of a problem of social disorganization are very similar to the variables that can be used to predict demands for both police and fire service delivery. The characteristics that define the population and the built environment within a neighborhood can, evidently, be used to help practitioners develop an understanding of the causal mechanisms that drive the need for services that are provided by city governments. All of these variables are easily observable.

Additionally, the poverty pocket and fiscal spillover literature suggests that many of the characteristics of neighborhoods can have impacts beyond the boundaries of the neighborhoods that are being observed. In fact, the relationships that are found within the demands for service literature are probably much more complex and dynamic than the literature would generally suggest. By taking into account the impacts of social characteristics on neighboring parts of the community, a more precise model can be developed that acknowledges the spillover that is explored in spatial spillover models. These models have traditionally focused on the regional relationships of aggregate jurisdictions.

For these reasons, it is appropriate to fuse the various research designs found within the literature reviewed into a single research project that explores interrelationships between the variables that can allow a greater understanding of the challenges that are faced by a community, given a certain set of characteristics. Further, while the independent

variables that provide predictive capability to the analyst are similar for both fire and police services, the magnitude of those relationships with respect to various call types are of particular interest. While each of the variables mentioned has some impact, the degree to which they influence the outcome variables might vary among the dependent variable, which in itself is a potentially important contribution to our understanding of the impacts of geographic concentration of various demographics.

CHAPTER 3: DESCRIPTION OF STUDY AREA

City of Charlotte Demographics

The City of Charlotte has an approximate population of 750,000 residents, with another 200,000 living in the rest of Mecklenburg County not covered by the City of Charlotte. Within that population, approximately 50 percent is white, 35 percent is African American, 13 percent are Hispanic or Latino, and five percent are Asian. 15 percent of the City's population is foreign born, which is approximately double that of the state average and, as a result, nearly 20 percent of households speak a language besides English, compared to 10 percent in the state as a whole. However, there is a comparable percentage of persons living below the poverty line in the City compared to the rest of the state, at 16 percent and 16.8 percent, respectively.

Compared to the rest of the state, Charlotte is relatively well-educated, with 39 percent of the population over age 25 holding a bachelor's degree, compared to twenty-six percent statewide. Similarly, 88 percent of residents hold a high school diploma, compared to 84 percent in the state as a whole.

However, homeownership rates tend to be substantially lower in Charlotte compared to the rest of the state, at fifty-seven and sixty-seven percent, respectively. This may be related to some extent to the fact that among residential units, double the ratio of housing units in the city are multi-family units compared to the rest of the state, which are 34 and 17 percent, respectively.

Finally, the population in the City of Charlotte is far denser than the rest of the state, with nearly 2,500 persons per square mile, compared to 200 persons per square mile statewide. While it is, of course, meaningless to compare the whole state with the city since there are areas that are basically uninhabitable to large populations (mountains, etc.), it is important to note the concentration of the state's population within the city.

Given the characteristics provided within this section, it appears that Charlotte has the potential to experience substantial social disorganization. Compared to the state, Charlotte is far more ethnically heterogeneous, there is a substantially higher renter rate, and the population is relatively dense. On the opposite, the aggregate education is relatively high, but it is not clear from this data how that varies throughout the City. For those reasons, it is necessary to address the impacts that these characteristics have on the emergency services the city provides to the residents of the city and how those effects vary throughout the city.

Charlotte Fire Department

The municipal fire department was formed in the City of Charlotte in 1887, taking the place of volunteer fire departments as a result of increasing service demands and a growing city. The City of Charlotte's Fire Department is a full service emergency services agency that provides structural firefighting, heavy technical rescue, hazardous materials response, aircraft fire and rescue, dive rescue, and urban search and rescue. The Fire Department provides these services through the employment of 1,164 full time uniformed positions, with 1,044 serving in the fire suppression division. These employees operate 42 engine companies, 16 ladder companies, two heavy rescue companies, four hazardous materials companies, six aircraft rescue companies, a dive team, three urban search and

rescue teams, a fire boat, and a diver rescue boat. These services are provided through 42 fire stations throughout the city.

In addition to the City of Charlotte, the Fire Department routinely responds to emergencies within the areas surrounding Mecklenburg County, depending on how close they may be. As a result, the study area includes both the City of Charlotte and the area just outside of the city. The Charlotte Fire Department is presently led by Fire Chief Jon Hannan, as well as multiple division deputy chiefs.

Charlotte-Mecklenburg Police Department

The Charlotte Mecklenburg Police Department provides police services to the City of Charlotte and the unincorporated areas of Mecklenburg County, North Carolina. The Police Department provides these services through 13 field patrol divisions, which are also divided into north and south groups. Law enforcement responsibilities are carried out through the employment of 1,791 uniformed police officers, with the support of 473 civilian personnel, with 572 volunteers, and 57 reserve police officers. Organizationally, the department includes several groups overseen by Deputy Chiefs, which include Administrative Services, Investigative Services, Field Services (north and south), and Support Services. The Charlotte-Mecklenburg Police Department is led by Chief Rodney Monroe, who has been the Chief of Police since 2008.

CHAPTER 4: RESEARCH DESIGN

Conceptualization and Measurement

This research utilizes census tracts as the units of analysis. This is an appropriate unit because it allows the researcher to analyze the spatial variation in the various measured circumstances within the city. According to the literature reviewed, intra-urban demands for services delivery are frequently measured at this level. Because census tracts can reasonably assumed to be indicative of neighborhood characteristics, this unit of analysis allows for the aggregation of socioeconomic characteristics throughout the neighborhood. Further, census data at units such as a block groups can be somewhat sparse due to confidentiality considerations. Additionally, a higher aggregation of data, presumably be the city level, lacks the spatial resolution to make inferences about the effects of socioeconomic variation within the city. Because the Fire Department responds routinely to areas outside of the City, census tracts just outside of the city have been included in both models, but only census tracts in which both the police department and the fire department routinely respond are included in the dataset.

The first analysis that will be conducted is to determine if, and the extent to which, there is spatial autocorrelation in poverty, and calls for service for fire and police at the census tract level. The specific methods of how this will be accomplished are listed below in the Analytical Methods section, but this particular component of the analysis will explore spatial variation and clustering of poverty throughout the City. The

conceptualization and measurement of socioeconomic status is the rate of poverty within a census tract during the years analyzed, as well as a number of other socioeconomic characteristics. I anticipate that I will observe positive spatial association.

Dependent Variable

A general description of the dependent variable for the second hypothesis is an outcome derived from how the demand for public services has been defined in the literature. It is operationalized in this research as the number of calls per capita for service for two public safety services (fire and police) within Charlotte census tracts. I conduct separate analyses for the a) fire department's calls for service and b) police department's calls for service. This operationalization attempts to measure how often residents are contacting emergency services for their services. According to the hypotheses described above, the dependent variable should vary with socioeconomic characteristics of the census tract in which it exists.

In addition to the aggregate calls for police and fire, the frequency of various call types will also be considered. There is reason to believe that certain social compositions might lead to greater levels of burglary versus homicide, for example. On the fire side, it is reasonable to suggest that the processes associated with an increased number of structure fires may be different than an increased number of medical calls. For instance, census tracts with a higher average age might lead to a greater number of medical calls for service.

Because the national reporting systems for both firefighting and police services define well over one hundred different call types, only specific calls types are chosen for additional analysis. These calls types are those that have a particularly interesting relationship to the health and welfare of the community. In particular, additional analysis

was conducted on house fires and emergency medical calls on the fire side. On the police side, additional analysis will be conducted on the distribution of violent crimes, such as burglaries, assault, and domestic violence. This is required because there is not necessarily a logical relationship between socioeconomic characteristics of the neighborhood and, for instance, technical rescue calls or phone scam calls.

Data for this variable is taken from publicly available records of fire and police calls for service which are available directly from the Charlotte Fire Department and Charlotte-Mecklenburg Police Department, respectively. While the departments typically track responses based on the resources called for to respond to the emergency, it is a simple task of geo-coding addresses of responses and aggregating to the census tract to which the response address belongs. It is necessary to assign locations of calls for service from the data from the tracking mechanism that the departments use because response boundaries for various emergency service units are based solely on space and do not take into account socioeconomic characteristics of the response area. Therefore, the boundaries of the response areas are not necessarily consistent with the census tract measurements that must be used for the independent variables.

Independent Variables

The primary independent variable of interest for this research is the rate of poverty in census tracts over several time periods. This data will be collected from the United States Census Bureau's Annual Community Survey. In studies of Social Disorganization Theory, some scholars (Sampson and Groves 1989) have used an index of socioeconomic status, consisting of components such as education level, occupation, and income as characteristics of social disorganization. Because I am also interested in poverty

specifically, I use the poverty measurement in the model as the primary independent variable, other socioeconomic characteristics are also considered.

While the concept of poverty pockets suggests a dichotomous variable (that is, does the census tract have greater than forty percent poverty or not), it is more interesting to determine if the degree of poverty has a linear relationship with the outcome variables or whether lower levels of socioeconomic status have a larger or smaller impact on demands for service. That is, is the relationship between poverty concentration and demand for police and fire services consistent across the levels of poverty? For example, is the relationship the same at twenty percent poverty and seventy percent? Therefore, this variable will be measured as a continuous variable. Further specific attention will be given when calculating descriptive statistics to the linearity of the relationship between poverty concentration and the demands for police and fire services in Charlotte.

Control Variables

In addition to the primary independent variable, there are a number of control variables that need to be considered. First, the population of the census tract must be used as a control (Sampson and Groves 1989). It is reasonable to assume that population size will drive the demand for public services: simply, there will be more people who need services. Therefore, failing to control for population will result in a specification error. Additionally, population density should be controlled for in this model (Smith et al. 2000). Particularly in the model of calls for service to the police, it is reasonable to conclude that when people are living closer together that there might be more need for police interaction. If people are not living close to each other, there is less opportunity for negative (police-

demanding) interactions. Further, when people are living in closer proximity, there is more likely to be behavior that leads to accidental or intention fire starts (Smith et al. 2003).

Ethnic heterogeneity is consistently controlled for in literature describing Social Disorganization and poverty pockets (Sampson and Groves 1989; Schwab and Zampelli 1987). In order to calculate the ethnic heterogeneity of the census tract, the Simpson Diversity Index is used, which allows me to account for the degree to which any racial group dominates the population. This is calculated[9] by

$$D = \frac{\sum n(n-1)}{N(N-1)}$$

Where *n* is the population of any one racial group and *N* is the entire population of each census tract within Charlotte. Simpson's D ranges from 0 to 1, where 1 represents no diversity. The larger value of the Simpson's D, the lower the diversity. It is unclear what effect ethnic heterogeneity will have on the outcomes variables. Several studies have found that greater ethnic heterogeneity results in increased social disorganization and, as a result, a higher demand for service. This is because ethnic heterogeneity is classically held to be a cause of criminal activity (Smith et al. 2000), though the idea seems a bit counterintuitive. As the idea of social disorganization as a predictor of fire behavior develops, the social processes associated with the concentration of ethnic groups that drive criminal activity will likely also drive behavior that is not fire safe, etc. However, it is also possible that concentrations of racial groups might impact the demands for service in different ways. Therefore, I will also control for the percentages of each racial group within the census tract.

[9] Simpson, EH. 1949. "Measurement of diversity" *Nature* 163, p. 688.

One component of Social Disorganization Theory is the idea that people living within an impoverished neighborhood might be more likely to engage in socially deviant behavior because they do not believe they have any chance of leaving the neighborhood for additional opportunities, resulting in social disorganization (Kingsten et al. 2009). While it would be impossible to measure the degree to which people believe in their opportunities within the census tracts, I use the concentration of residents with at least a bachelor's degree as a proxy for the perception of the opportunity to achieve greater things in the future. Additionally, literature addressing Social Disorganization Theory has used median age, the percentage of renter-occupied properties, and the percentage of single parent households as indicators of increased social disorganization within a geography. Additionally, because of the literature discussing the relationship between race and willingness to interface with government, I utilize the concentrations of African Americans and Hispanics. Additionally, the percentage of the population living in their home for less than five years is used as a measure of residential mobility, plumbing availability as a measurement of quality of housing, and vehicle availability as a measurement of the ability to access employment. These variables are used in the analysis as controls for social disorganization within a neighborhood.

All of these variables are readily available from the United States Census Bureau's Annual Community Survey and were downloaded directly from the Census Bureau's website. Therefore, receipt of this information was relatively simple, but because they are all from different data files from the American FactFinder utility on the Census website, this method has required some merging of databases. This was accomplished using the R

statistical software and consisted of merging each of the data frames based on the geographic identifier of the census tract.

Model Specification

Table 1: Dependent variables

Dependent Variables	Description
Fire Calls for Service Aggregate	The number of calls for service per capita for the fire department in each census tract (continuous)
Fire Calls – EMS Calls Only	The number of calls for services per capita that are emergency medical services related with no fire or other hazardous component (continuous)
Fire Calls – Dwelling Fire Only	The number of fires per capita that occur within census tracts that occur within dwellings (continuous)
Police Calls for Service Aggregate	The number of calls for service per capita for the police department in each census tract (continuous)
Police Calls – Burglaries	The number of burglaries per capita that occur within each census tract in which there is no assault associated with the incident (continuous)
Police Calls – Non-domestic assault	The number of assaults incidents per capita in which the subjects were not co-habitants in the same dwelling (continuous)
Police Calls – Domestic Violence	The number of assaults per capita in which the subjects were co-habitants (continuous)

Table 2: Independent variables

Independent Variables	Description
Population	Total population (continuous)
Population density	Population/square mile (continuous)
Poverty	Rate Percentage (bounded at 0 and 100)
Racial Concentrations	Percentages of African Americans and Hispanics (separate variables) (bounded at 0 to 100)
Median Household Income	In 2010 US Dollars; Continuous
Median Age	Median age of residents (continuous)
Management Occupations	Percentages of population in management (bounded 0 to 100)
Ethnic heterogeneity	Simpson's D of tract (bounded 0 to 1)
Foreign Born Population	Percentage of population born outside of the USA (bounded 0 to 100)
Limited English	Percentage of population that have limited English speaking capabilities (bounded 0 to 100)
Single parent households	Percentage of households single parent (bounded 0 to 100)
Rental-occupied residences	Percentage of residences occupied by renters (bounded 0 to 100)
Housing Tenure	Percentage of population that has lived in the present residence for less than five years (bounded 0 to 100)
Vehicle Availability	Percentage of households with one vehicle available (bounded 0 to 100)
Plumbing Availability	Percentage of households with no plumbing (bounded 0 to 100)
Education	Percentage of population with each level of education (bounded, 0 to 100 with bachelor's degree as reference category)

It is necessary to assess the correlations between the proposed independent variables in order to ensure that the variables are in fact independent of one another. A correlation matrix is available in the appendix, but has been presented graphically in Figure 1 showing the relationships that are found between some of the independent variables. The ellipses define the degree of either positive or negative correlation. Positive correlation between variables is indicated by the ellipse leaning right (top of the ellipse is pushed right)

and negative correlation is indicated by the ellipse leaning left (top of the ellipse is pushed left). The most circular ellipses indicate a lack of correlation between the two variables. In this model, there are few surprises with respect to variables that are correlated to some degree. For instance, census tracts in which there are high percentages of residents with management occupations also have high concentrations of residents with at least a bachelor's degree. Similarly, census tracts that have a high concentration of Hispanic residents also tend to have a high concentration of both limited English speakers and foreign born residents. Conversely, census tracts that have high concentrations of African Americans are negatively associated with high concentrations of residents in management occupations. Further, that relationship is stronger for African Americans compared with Hispanics. Additionally, census tracts with high rates of single parenthood tend to also have low rates of bachelor's degree recipients and locations that have high rates of rental occupancy tend to have lower median household incomes. There are a few variables that have relatively strong correlations, though they measure different considerations. For instance, the correlation between single parenthood and African American residential concentration is over 0.6.

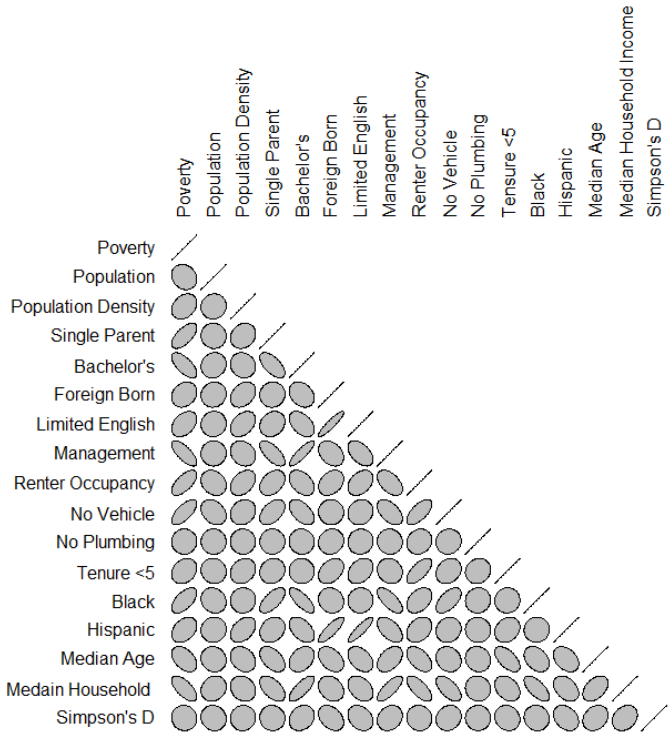

Figure 1: Correlation Matrix

This could raise concerns about multicollinearity. Both Gujarati and Porter (2009) and Kennedy (2008) identify a number of practical consequences of multicollinearity. They are stated simply in Gujarati and Porter (2009) on page 327.

1. *Although [Best Linear Unbiased Estimators], the OLS estimators have large variances and covariances, making precise estimation difficult.*
2. *Because of consequence 1, the confidence intervals tend to be much wider, leading to the acceptance of the "zero null hypothesis" more readily.*
3. *Also because of consequence 1, the t ratio of one or more coefficients tends to be statistically insignificant.*
4. *Although the t ratio of one or more coefficients is statistically insignificant, R^2, the overall measure of goodness of fit, can be very high.*
5. *The OLS estimators and their standard errors can be sensitive to small changes in the data.*

More simply put, in the presence of perfect multicollinearity, OLS will produce estimators that suggest weak evidence when in fact it is not possible to make that determination. Of course, this information does not demonstrate perfect multicollinearity. As another important point to make with regard to multicollinearity, while it does not violate the assumptions of OLS, but high (but imperfect) multicollinearity can also be a concern because it can lead to estimates being unreliable and standard errors being inflated so that it would make observing statistical significance difficult, increasing the change of a Type II error. Future studies should add observations from various cities and time periods to reduce concerns about multicollinearity.

Quantitative Analytical Methodology

The first hypothesis in this research deals with the question of spatial association of poverty and calls for service within the City of Charlotte. In order to test for the spatial concentrations of socioeconomic characteristics in the City, it is first necessary to collect socioeconomic data for the geographic unit of interest for the time periods of interest in this study. In this case, I have collected socioeconomic data from the United States Census Bureau's American FactFinder 2 for the City of Charlotte census tracts for the 2010 five-year American Community Survey estimates in separate files. Additionally, I have collected the Topologically Integrated Geographic Encoding and Referencing (TIGER) shape files from the United States Census Bureau and use the 2000 Census Tract definitions.

In order to determine the degree of spatial association between census tracts within the City and because I am using a shape file, it is necessary to calculate a weights matrix

file that provides a stronger weight to nearby observations, which can be conducted using the R software with the following method[10]:

```
>library(maptools)
>library(spdep)
>clt<-readShapePoly("file_name.shp", IDvar=Null)
>centroids<-coordinates(clt)[11]
```

This provides a coordinate system to identify the center of each census tract which is used to merge the coordinate systems with the additional data needed for analysis, which was previously downloaded from the Census. This first requires use of the `write.table` function in R to create a .txt file that can be utilized elsewhere. While it is possible to complete this in R using the `merge` function, it is much easier to simply copy and paste the values of the coordinate system as they relate to the census tracts in a Microsoft Excel worksheet. This is a cleaner way of dealing with the problem and allows for easier manipulation of the variable names. Once the newly merged file is created, and a coordinate system is associated with the census tracts for which we already have demographic data, it can be read into R for further manipulation. A simpler method of creating the weights file is using the GeoDa software, which will calculate various types of weights matrices, depending on the needs of the research question. In this case, for simplicity, I used GeoDa to calculate a queen weights matrix. This was conducted after merging the data tables from Census with the shape files in Quantum GIS.

[10] This code adapted from the University of California at Los Angeles's Institure for Digital Research and Education.

[11] This will return coordinates, but the coordinate name columns will need to be renamed "lat" and "lon" for latitude and longitude, respectively for the remainder of the analysis to work correctly.

The appropriate statistic that needs to be calculated to determine the degree of spatial association is Moran's I (Kalkhan 2011)[12]. Because I am interested in the degree of spatial association across the City of Charlotte as a whole, a global estimate of the degree of spatial association is appropriate for this analysis. Later, in order to assess a local indicator of spatial association (LISA), I will use a local version of Moran's I (Kalkhan 2011). This allows the identification of tracts that have particular influence on tracts around them.

Moran's I returns a value for interpretation that "behaves like a Pearson correlation coefficient. Its value is generally between -1 and 1, but can sometimes exceed -1 or +1 (Legendre and Fortin 1989). Positive values indicate position autocorrelation and vice versa." (Kalkhan 2011, 66). Moran's I is calculated by the following function:

$$I(d) = \frac{\frac{1}{W}\sum_i \sum_{i \neq i} w_{ij}(z_i - \bar{z}) \cdot (z_j - \bar{z})}{\frac{1}{n}\sum_i (z_i - \bar{z})^2}$$

"where *I(d)* is the Moran coefficient for the distance class d, z_i's are the value of the variable, and i and j vary from 1 to n. w_{ij}'s take the value 1 when the pair of locations (i,j) pertains to distance class d and 0 otherwise. W is the sum of the w_{ij}'s." (Kalkhan 2011, 66). In this case, z is defined as the variable of poverty concentration and then for calls for service. Thankfully, this can be easily calculated globally using the GeoDa spatial statistical software with a few clicks. This can also be accomplished fairly simply with the R statistical software, using the various spatial statistics packages that are available, such as `ape`, `spdep`, and `maptools`.

[12] An alternative to Moran's I is Geary's C. The two statistics have similar outputs, but Geary's C is more appropriate to when calculating a local statistics and Moran's I is more powerful when calculating global statistics (Cliff and Ord 1975).

Using the built-in function in the space menu returns an observed Global Moran's I, the mean of the Moran's I, the standard deviation, and a p value that allows me to test for significance against a theoretical distribution. The null hypothesis is that there is no spatial association (Bivand et al. 2008). Of course, similar to other methods, a p value less than 0.05 allows us to reject the null hypothesis that zero spatial association exists for the variables of interest with a ninety-five percent confidence interval. This is conducted for each of the dependent variables in the model, as well as the poverty variable.

It is also of interest to calculate a "local indicator of spatial association" for each census tract within the city. This allows me to develop an understanding of the census tracts that exert considerable influence over neighboring census tracts. For the purposes of this research, I will utilize the local Moran's I statistic, though the local version of Geary's C is also available. The local Moran's I is calculated as follows (Bivand et al. 2008, 269):

$$I_i = \frac{(y_i - \bar{y}) \sum_j^n w_{ij}(y_i - \bar{y})}{\frac{\sum_{i=1}^n (y_i - \bar{y})^2}{n}}$$

This is easily calculated in the R statistical software by using the `spdep` package. Since the spatial weights matrix has already been constructed for the Global Moran's I calculation, it can simply be substituted in the following code[13]:

```
>local.moran.a<-localmoran(clt$[calltype], listw =
+    nb2listw([weights], style="C"))
```

Again, it is easier to just use the built-in function in the GeoDa software than to work through R. GeoDa's Local Moran's I function is simple and provides a significance map, clustering map, and plot with the Moran's I calculation and the significance value. We can

[13] The package used for this technique was developed by Roger Bivand, but based on the findings of Anselin (1995).

apply the Local Moran's I score of the given variables to the census tracts to which they are associated which will then be mapped for informative purposes.

The second hypothesis in this research relates to the impact that poverty concentrations have on the demand for police and fire services that are experienced by the local government in Charlotte. Information regarding the calls for service was taken directly from the agencies providing the service in the city, the Charlotte Fire Department and the Charlotte-Mecklenburg Police Department. Information from their computer-aided dispatch system provided information on the location of each call for service within the city. Each of those calls can then be geocoded to a census tract within the city. Once completed, it is a simple matter of using the Quantum GIS software to aggregate the individual calls for service up to the census tract level. That was merged with additional data about the census tract from the United States Census Bureau. For the purposes of this hypothesis, all calls for service will be aggregated for the census tract as a whole.

Because there is an inherently suggested relationship between space and calls for service in the city, it is necessary to perform the Global Moran's I for the dependent variable in these two models, aggregate calls for service. This is conducted using a similar method to that defined above when calculating the degree of spatial autocorrelation for poverty in the city. Should I find that there is a spatial autocorrelation with respect to calls for service in the city, it will be necessary to implement a regression with a spatially lagged dependent variable on the right hand side of the equation (Ward and Skrede Gleditsch 2008). It is also appropriate to calculate the Local Moran's I statistic for each census tract with respect to calls for service for the police department and the fire department. While this will not be used in the analytical model it is interesting to see which locations drive

spatial dependence in the model. Further, there could be potential policy and operational implications for the departments that result from this statistic. This information will be used later in the analysis when discussing the particular characteristics of influential tracts in an attempt to drill into the causal relationship, as well as address the propriety of the statistical model used.

When considering the appropriate way to deal with spatial autocorrelation of the dependent variable, there are two main approaches: the spatially lagged dependent variable and the spatial error model (Ward and Skrede Gleditsch 2008). The spatial error model simply takes into account the residual variation of the independent variable of interest, which in this case would simply estimate the association between the rate of poverty and the number of calls for service. However, the spatially lagged model allows me to take into account the possible societal influences that drive dependence on emergency services in census tracts in the City of Charlotte which may not otherwise be measured. In short, this allows for the exploration of the substantive features of the areas and not just deal with the spatial autocorrelation as a "statistical nuisance" (Ward and Skrede Gleditsch 2008, 36). However, if there is no spatial dependence associated with calls for service in the city, it will be appropriate to simply use a standard ordinary least squares model. It appears to be convention to also estimate the OLS regression model without the spatial dependence so the two models can be compared. This will be conducted with the model and dataset that is deemed appropriate (this is discussed in the next section on sampling and other issues).

The spatially lagged model allows me to devise a model in which the calls for service is a function of both its own characteristics, and also of the number of calls for service among its neighbors. This suggests a parameter as defined as $w_i y_i$, where $w_i$is a

connectivity vector that has been defined as the inverse distance from y neighbor, and $y_i$is the calls for service that the neighbor receives. As distance increases from the observation, the impact of the neighboring census tract's calls for service approaches zero. So, therefore, the spatially lagged dependent variable model appears in the following form:

$$y_i = \beta_0 + \beta_1 x_1 + \rho w_i y_i + \epsilon_i$$

This method is similar to time series functions which places a previous time period's outcomes observation, y_{t-1}, on the right side of the equation to take into account unobserved forces at work that vary over time. Instead, the spatially lagged model takes into account unobserved forces at work that vary over space. This could be access to transportation and healthcare, cultural norms, etc. An alternative to the spatially lagged model is the addition of several dichotomous variables that indicate spatial location in the city (or industrial category, etc. that have similar spatial autocorrelation properties). This is not appropriate in this case because it is not possible to delineate, for instance, cultural regions of the city. That variation is likely much more fluid than can be addressed using dummy variables. Therefore, the spatially lagged model provides the most accurate estimation of unobserved spatially-based drivers.

Utilizing the dependent, independent, and control variables outlined, scatter plots are be used to approximate the appropriate functional form of the model. The spatially lagged dependent regression model is estimated utilizing the linear modeling function in the GeoDa software after potentially appropriate adjustments are made to the data to deal with non-linearity, if it exists. Results for the various models (for the various types of fire calls and police calls) are then be presented and discussed for implications, with respect to sampling, time, and other spatial issues for dataset use and model generation.

While the traditional use of census data has been a tabulation of the entire population, use of the American Community Survey methodology uses a sampling method of the population that presents another factor that is of importance to researchers and practitioners alike. When dealing with the census data as an information source related to the demographics of various neighborhoods within a city, those using American Community Survey data are faced with the question of which dataset to use, a one year, three year, or five year sample. There are benefits to each. Though the one year, one percent sample provides the most up to date sample of the community, it also provides the least complete sampling method. In contrast, while the five year, five percent sample provides the largest sample size, which suggests a better understanding of the actual characteristics of the geography, the data presented in some cases are up to five years old. So, researchers are constantly faced with the question of which dataset to use.

There are no determinant reasons to use one dataset over another, given the various benefits and detriments that are associated with each data set. Therefore, when proposing this dissertation it appeared important to assess how well the model fits with the various datasets in use. In practice, though, that assessment was inconclusive and the results were not interesting and, thus, were left out of the analysis because much of it appeared to be superfluous.

Should I find that it is appropriate to use a spatially lagged regression model, it is additionally advantageous to compare the spatially lagged model with the corresponding ordinary least squares regression model. This provides a demonstration of the differences in output that are associated with the use of spatial regression models instead of using

ordinary least squares regression models in a practical estimation of the socioeconomic impact on the demand for public operations throughout the cities.

These considerations are of particular importance and in their own right and are an important contribution of this research. The use of spatially lagged models can be used as a tool for predicting the demand for services that are provided by local governments and provide a potentially stronger toolset to practitioners and policymakers as they deal with the challenging issue of resource allocation.

CHAPTER 5: QUANTITATIVE RESULTS

The quantitative results of this study are presented in a manner that is consistent with the progression of the hypotheses developed in Chapter 1. Generally, this chapter deals with the issues of spatial association first, both on the left hand and the right hand side of the equations and then explores the results of the various methods of regression which are interpreted within the causal model developed around the ideas found in the theoretical framework of this study. This is all accomplished by starting with the calculation of the Global Moran's I statistics for each of the dependent variables and with a visual exploration of the actual per capita calls for service (the dependent variables) for the various call types within this study. Areas that appear to have more prevalent calls for service are identified and discussed.

Next, the degree to which these locations are clustered together among neighboring census tracts is examined in the Local Indicator of Spatial Association (LISA) analysis. In this analysis, locations are identified in which there are clusters, or pockets, or extremely high outcome results, as well as clusters of census tracts in which there are extremely low outcome results. Additionally, tracts that are high and have low neighbors, and the opposite, are also identified via mapping. There is additional discussion about spatial structure, including the location of clusters in each variable and how that compares to other variables in the model.

The third section of this chapter provides the regression results and a comparison between the ordinary least squares models and the spatially lagged regression (maximum

likelihood estimation) models that take into account spatial association. Discussion of the appropriate models to be used, as well as discussion of the meaning of the output, is addressed with particular focus on the significant variables.

Finally, through the analysis, it becomes clear that the issue of heterskedasticity in the models needs to be addressed. Through the LISA analysis, it is evident that not only is there spatial association in the dependent variables, but there is also spatial association in the independent variables. The final section of the quantitative analysis invokes the use of a spatial Durbin model in which the independent variables, in addition to the dependent variables, are lagged. This handles much of the heteroskedasticty issue, as well as provides the indirect impact of some of the variables, which is of interest to the spatial clustering issues that are addressed in the literature.

Spatial Distribution of Calls for Service

An important point to note before the discussion of the spatial distribution of calls for service is that in both fire and police services, the City departments routinely respond to the census tracts that are actually outside of the city. Certainly, this is to be expected in the police department because the Charlotte-Mecklenburg Police Department provides services countywide. However, the fire department also routinely responds to calls for service in census tracts just outside of the city because in some cases, city fire stations are closer than county fire stations. As a result, maps that are provided below also include census tracts that are outside of the city. However, only mapping for the census tracts that both agencies routinely respond to are provided. Additionally, in the component of this analysis that relates to calls for service, I use the calls for service per capita since that is the how I operationalize the dependent variables in the series of analyses in the next section.

However, maps of the actual number of calls for service for each call type and year dataset are available in the appendix.

The first set of research questions revolves around the spatial structure of the calls for service within the City of Charlotte. Below, Table 3 provides the Global Moran's I for poverty in the city, as well as all of the dependent variables that are analyzed in the econometric analysis in the subsequent set of research questions. This tables provides an indication that there is some degree of spatial association with all of the analyzed characteristics. However, there are substantial differences in the magnitude to which poverty and the calls for service data are spatially associated, depending on the call types.

Table 3: Global Moran's I

Characteristic	**Global Moran's I**
Poverty	0.27
Police Aggregate	0.03318
Assault	0.038795
Burglary	0.0385621
Domestic Violence	0.0377413
Fire Aggregate	0.388392
EMS	0.406262
Structure Fires	0.486082

The poverty concentration in Charlotte is relatively well associated with space. As you can see from the table above, Charlotte's concentration of poverty demonstrates a Global Moran's I of 0.27. While this is not as great as the concentrations of some of the measurements, this implies that there is positive spatial association of poverty within the county. From this information, I can reject the null hypothesis from Hypothesis 1A that the distribution of poverty in the City of Charlotte is completely random. This would tend to

suggest that in Charlotte, there are pockets of the City in which poverty exists and that they are spatially associated with each another and with the surrounding areas.

Below, Figure 2 demonstrates that percentage of residents in the City of Charlotte's census tracts who are living in poverty conditions. From this demonstration, there is a clear spatial pattern of poverty. Interestingly, in this map, the southern wedge that is popularly discussed in local issues in Charlotte is prominently displayed, as is the more impoverished crescent. Additionally, it is clear that the locations with the highest levels of poverty (in this dataset maximizing at about 61 percent) tend to be in the areas around the north, east, and west of uptown Charlotte. Moving past the first ring, bands of reducing levels of poverty are apparent, though the eastern and western areas of the city tend to have higher levels of poverty at further distances from the central business district, most of which occurs in the east.

It is additionally easy to identify the poverty pockets from the darkest areas on the map and it is clear that there tends to be an association with the neighboring census tracts that are also highly impoverished, but not to the same degree that the individual pockets are. There appear to be several major poverty pocket locations in which very high levels of poverty exist in the city, but there are also other areas that have relatively high poverty levels which all appear to be relatively close to the poverty pockets.

A visual inspection of the map of poverty locations, in addition to the calculation of the Global Moran's I, provides a sufficiently robust indication that poverty pockets do exist in the city.

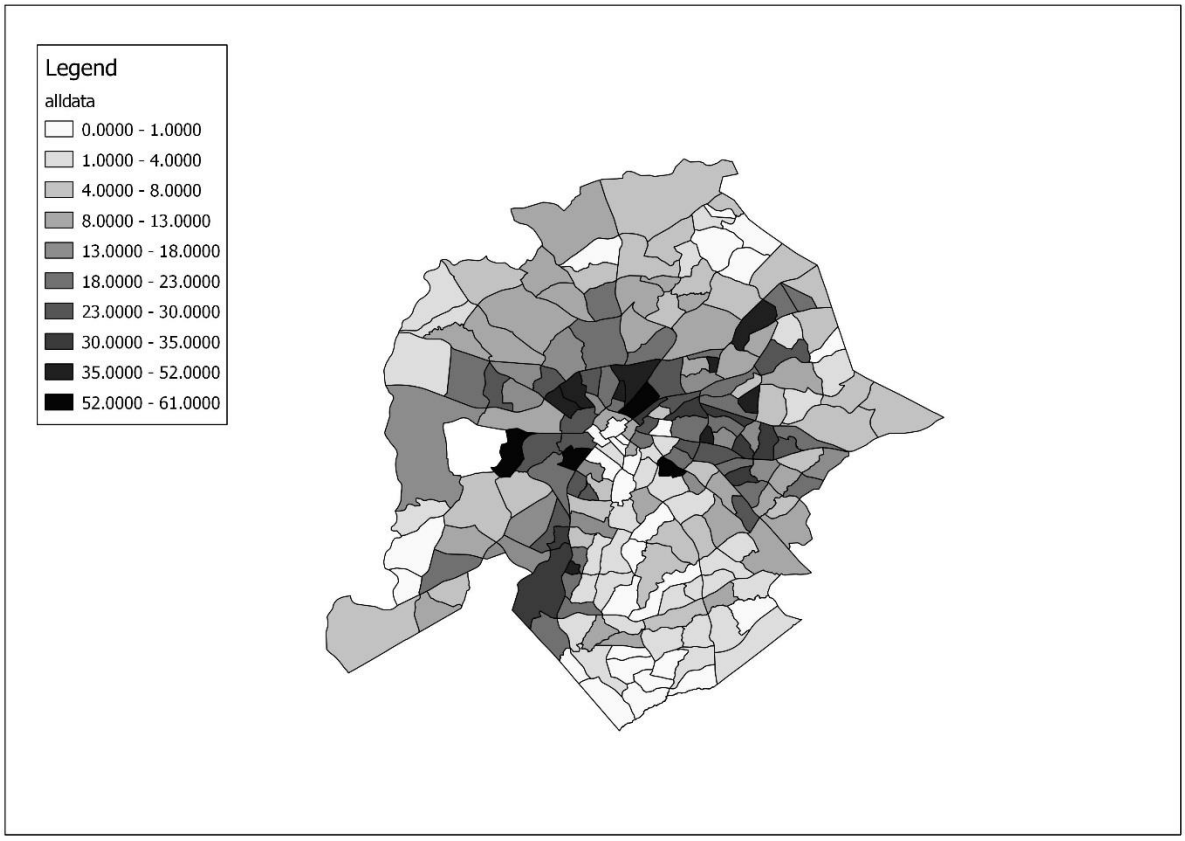

Figure 2: Poverty concentrations in Charlotte

Police Department Calls Distribution

When considering the calls for service in the police department, the spatial distribution characteristics are substantially different from the poverty characteristics. When reviewing the chart identifying the Moran's I for each of the various types of calls as well as all police calls in the aggregate, it is evident that any spatial association that does exist is much weaker than the poverty concentration spatial association. Additionally, in some cases the spatial association varies substantially with the various calls types.

For the aggregate per capita police calls in each census tract, the Global Moran's I is 0.033. Again, while there is some degree of spatial association related to the location of all police calls for service, the spatial association is relatively weak. The following map, Figure 3, demonstrates that the spatial distribution of aggregate police calls for service is

more random than the poverty structure, though the structure is clearly not completely random with pockets of higher rates and spatially proximate other higher rate census tracts.

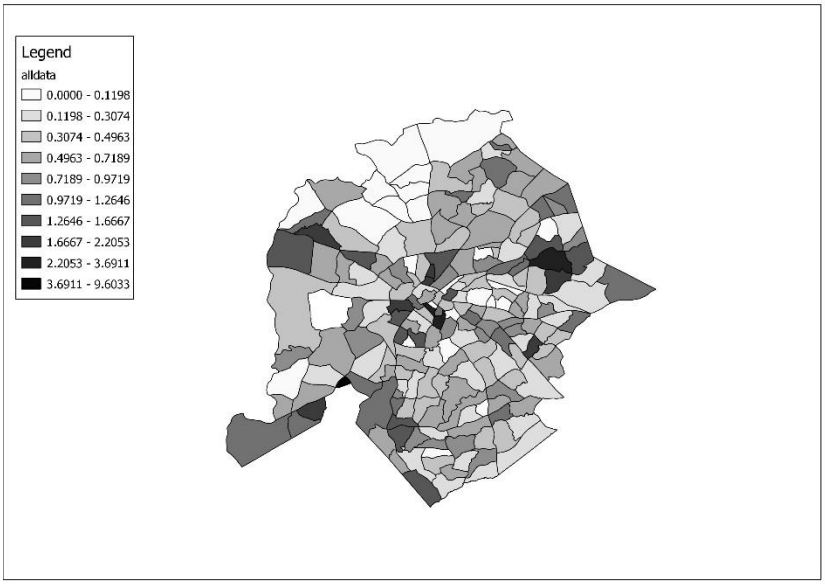

Figure 3: Aggregate police calls for service

The degree of spatial association associated with the per capita assaults that occur within census tracts is relatively consistent with the other calls models, with a global Moran's I of 0.0387. The following map, Figure 4, demonstrates the spatial distribution of assaults within the city in the overall five year time frame. This distribution tends to be similar to the police calls for service aggregate.

While the distribution of calls for service for assaults is relatively similar to that of the aggregate calls for service, there are also some slight differences in the size of the clusters of concentrations. Later in this section, there is an analysis in which the Local Moran's I is conducted and provides a description of the occurrences of highly influential areas. The analysis of clusters will examine how these structures vary over space.

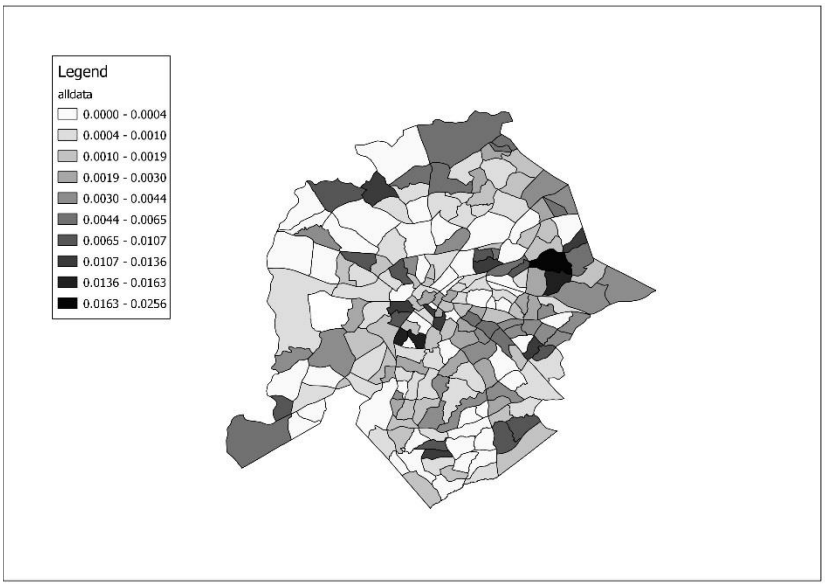

Figure 4: Assaults per capita

The Global Moran's I calculation for the burglaries, presented in Figure 5, that are occurring in the city are similarly strong in their demonstration of spatially associated distribution compared with assaults and police aggregate calls for service. With a Global Moran's I at 0.0385, the spatial distribution of burglaries per capita in Charlotte tends to be stronger at the edges of the city and in the first tier areas of the center city. While the aggregate police calls for service tend to be heavier in the first tier areas and decline further away from center city, the burglaries tend to be much more often located in those particular areas.

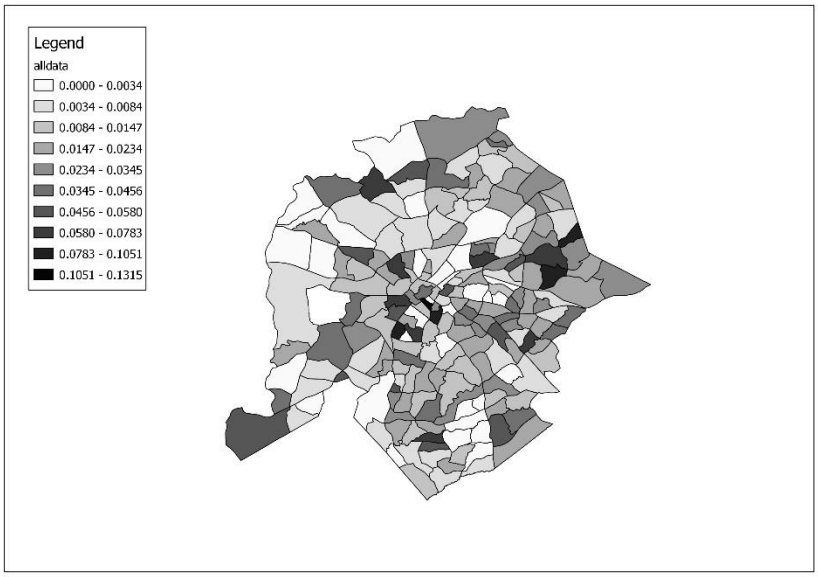

Figure 5: Burglaries per capita

There is also substantially stronger spatial concentrations of domestic violence incidents within the city than the aggregate calls for service of the whole police department, with a Global Moran's I of 0.03774. Additionally the calls for service per capita for domestic violence tends to have a larger magnitude than both burglaries and assaults; in some places the rate is over 330 domestic violence incidents per 1,000 residents.

However, upon a visual inspection of the data, it appears that relative to census tracts overall, the distribution of the concentration of these domestic calls for service are similar to the burglary calls for service. It also appears that concentrations of calls for domestic violence are more widely spread over the entire city than the aggregate calls for service, indicating that the domestic violence may be more of a widespread problem than crime overall.

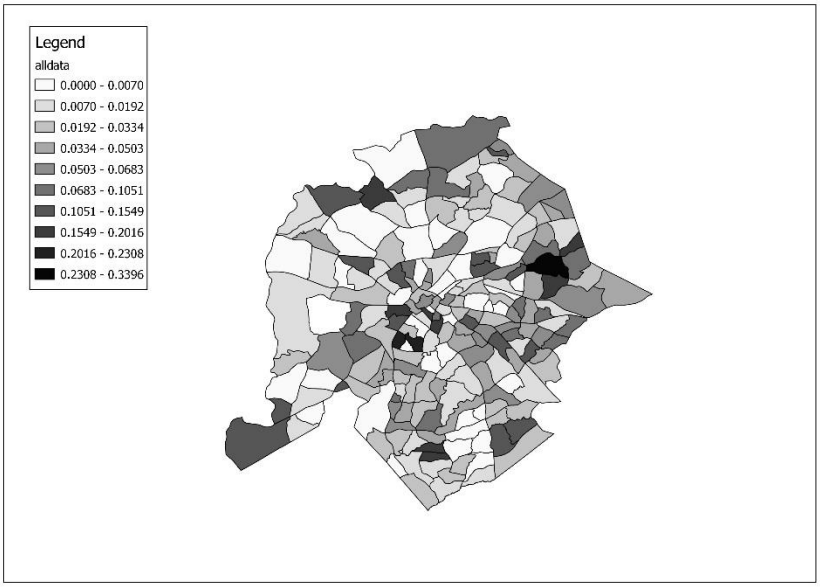

Figure 6: Domestic violence incidents per capita

Fire Department Calls Distribution

In general, the fire department calls for service per capita distribution throughout the city are far more spatially associated than both the poverty in the city and all of the police calls for service. While there tend to be far fewer actual calls for service per capita than in the police department in general, where there are a significant number of calls, the areas are much more highly concentrated. Additionally, there is a very clear delineation of the more affluent southern wedge section of the city, though that is not necessarily the case in all call types. However, like the police department calls for service, the degree of spatial association measured with the global Moran's I does vary to some degree.

In the aggregate, the Global Moran's I for all fire calls is 0.3883. Relative to both poverty concentrations and police calls for service, the fire calls for service tend to be much more strongly spatially associated, demonstrating a moderately strong positive spatial association. As demonstrated in Figure 7, in comparison to the police department calls for service, the fire department aggregate calls for service appear to be much more similar to the poverty spatial distribution. However, the busiest per capita areas of the city in the

police department have nearly three times as many calls for service per capita than the fire department, which could lead to some policy implications questions.

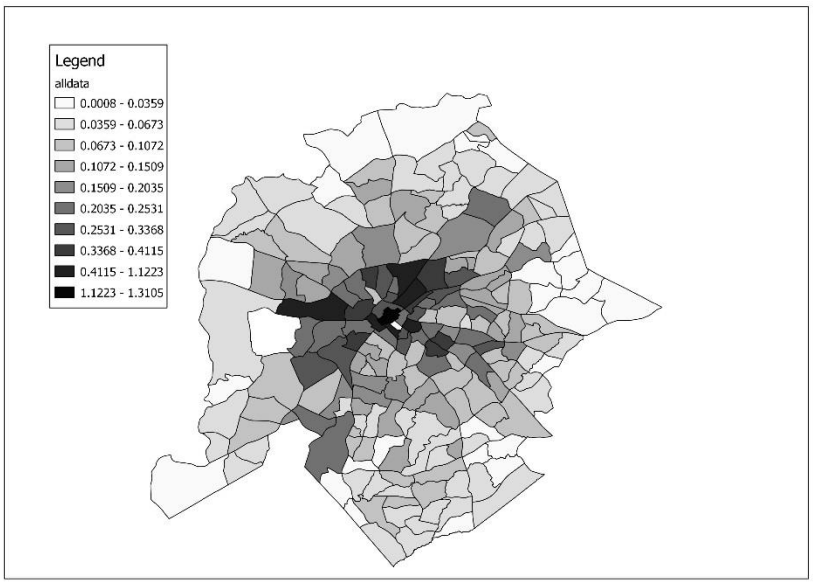

Figure 7: Aggregate fire calls per capita

The calls for service per capita in census tracts in the City of Charlotte for Emergency Medical Service provided by the fire department have a similar spatial structure to the fire calls for service in the aggregate, except that they tend to be more highly spatially associated than all of the fire calls, indicating that certain census tracts tend to receive the majority of these services. The EMS calls per capita global Moran's I is 0.4062.

Additionally, upon visual inspection in Figure 8, it appears that the emergency medical services calls for service have a relatively similar spatial structure to the aggregate calls for fire service. The center city and northern, western, and to some degree eastern first tier areas tend to have the strongest concentrations of EMS calls for service compared to the rest of the city, which is likely the reason for such as strong a Global Moran's I.

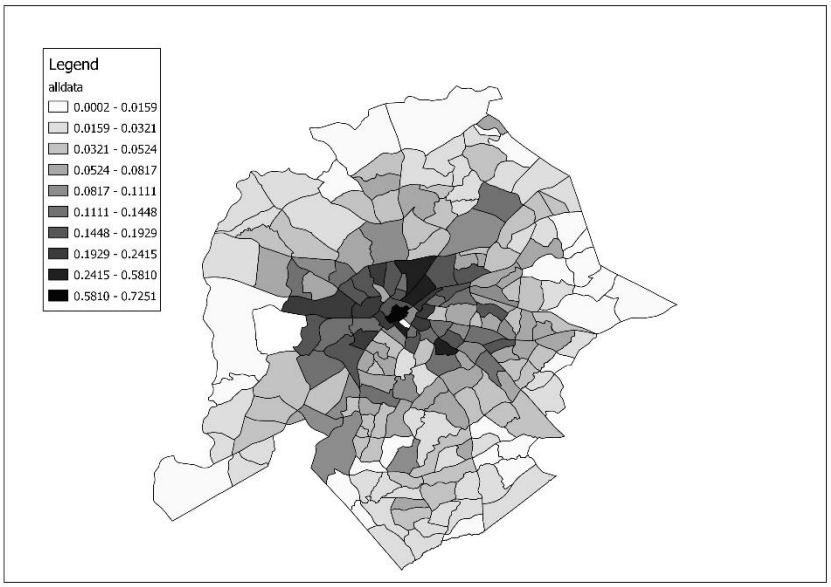

Figure 8: EMS calls per capita

The magnitude of the number of calls for service for structure fires in the City of Charlotte is substantially smaller than the number of emergency medical calls for service. However, the structure of the spatial distribution of the calls for service appears in Figure 9 to be relatively similar to both the aggregate calls for service and the emergency medical calls. It can be noted, though, that the degree of spatial association that is found within the structure fire calls for service is substantially greater than either the other two analyses of the fire department and the police department in the long run with a Global Moran's I of 0.4861.

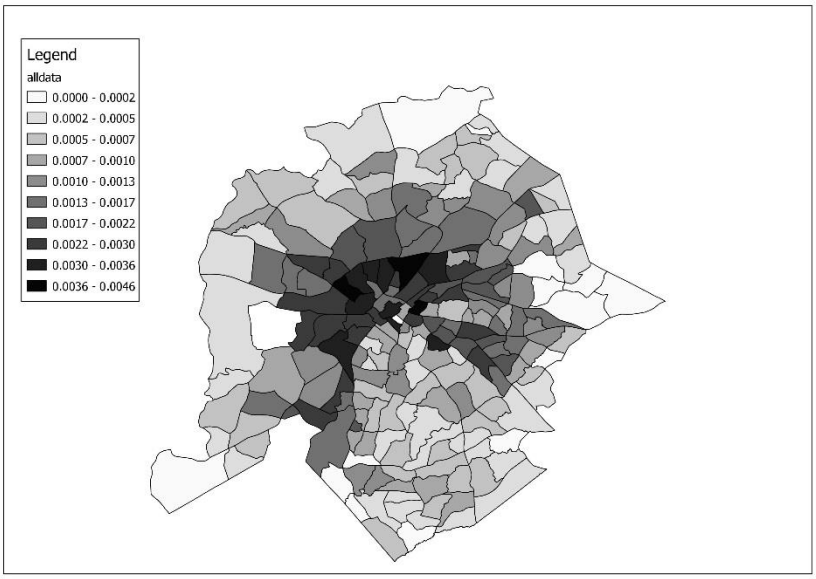

Figure 9: Structure fires per capita

Through a visual inspection of the map of the calls for service data for the aggregate fire calls, the EMS calls, and the structure fire calls, just north of center city, there is a very strong concentration of all types of calls and within the two call types that I am breaking down. However, those concentrations drop off substantially when moving into the next tier of suburbs. As an interesting aside, I wondered how geographic characteristics could be related to this drop-off line. In Figure 10, I show the area to which I am referring.

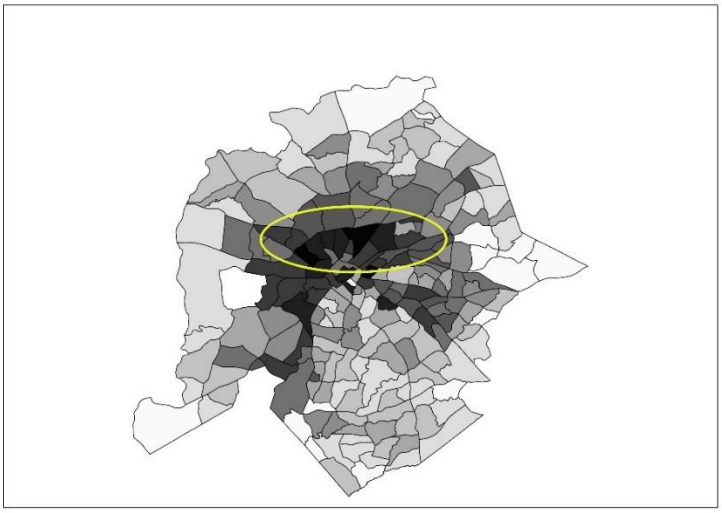

Figure 10: Drop off ring for fire calls

When I overlay a map of the road system in the Charlotte area in Figure 11, specifically in that area, we can see that Interstate 85 passes directly between the tracts that have the extremely high concentration of calls for service per capita and the census tract in which it begins to drop off. Of course, from this data, it is not possible to draw any conclusions, but it should be an avenue of future research.

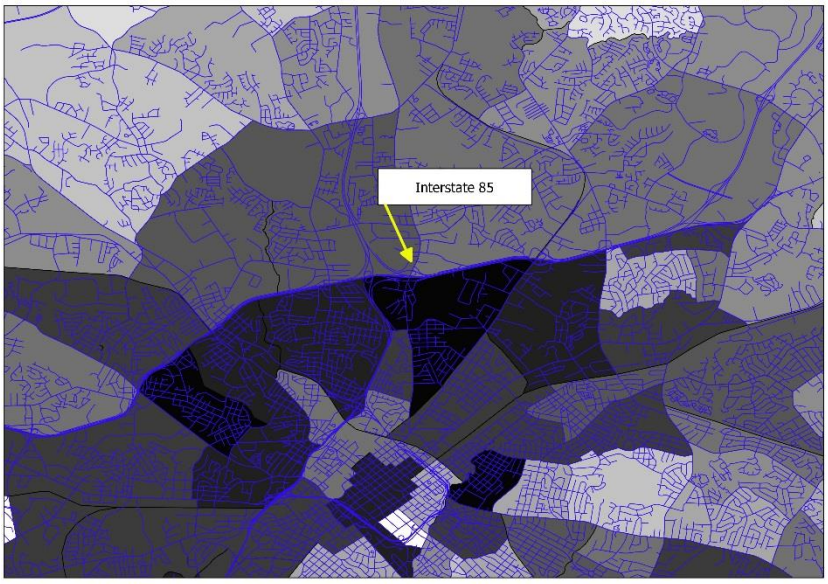

Figure 11: Interstate 85 relationship to drop off ring

Local Indicator of Spatial Association (LISA) Analysis

According to Anselin (1995, 94), a LISA analysis provides an "indication of the extent of significant spatial clustering of similar values around that observation". The purpose of the LISA analysis is to explore the spatial clustering of variables that occur and could have a significant impact on the validity of the statistical tools used later in the model. A LISA analysis can also provide important insight on the locations within the city that have those clusters and how those variables are related. Traditionally, a LISA analysis would be applied to the dependent variables, but this analysis also includes the

independent variables because there is some concern about spatial clustering in the explanatory variables as well. This is a concern for both the statistical reasons, as well as the theoretical concerns related to the spillover theory that is described in the literature. In general, there are some similarities between the variables with respect to the outcome of the LISA analysis, and there are several interesting differences with respect to the findings within this section. Some of those findings are explored more in depth with the regression results explored later in the chapter.

It is clear from the analysis that the fire department's calls for service are much more strongly spatially associated than the police department calls. This is interesting, particularly since much of the literature focuses more on police calls, while the fire department clustering receives very little attention. With respect to colors, dark red means that the tract is "high-high", meaning tract *i* has a high rate, while its neighboring *k* queen contiguous tracts are also high. Dark blue indicates "low-low" tracts meaning tract *i* has a low rate, while its neighboring *k* queen contiguous tracts are also low. Light red indicates a "high-low" tract while light blue indicates a "low-high" tract.

Generally, the Police Department calls for service, shown in Figure 12, are not nearly as spatially associated as the fire calls for service. This is apparent in the aggregate calls for service over the five year period studied. There are a few hot spots in this model, though, such as in the uptown area and on the west side, south of the airport. There is additionally a large low-low site on the north side of the city, along the I-77 north corridor.

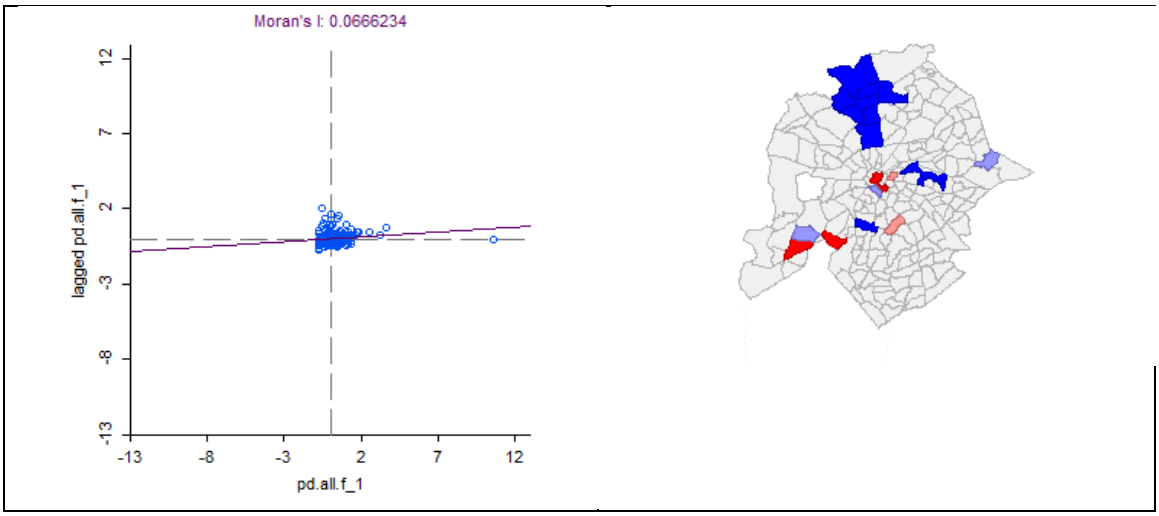

Figure 12: Police aggregate per capita calls

The assaults per capita model throughout the city has a stronger spatial association set of characteristics, with more clear hot spots of activity. The primary hot spots are on the west side and on the east side of the city near the University City area. This is demonstrated below in Figure 13.

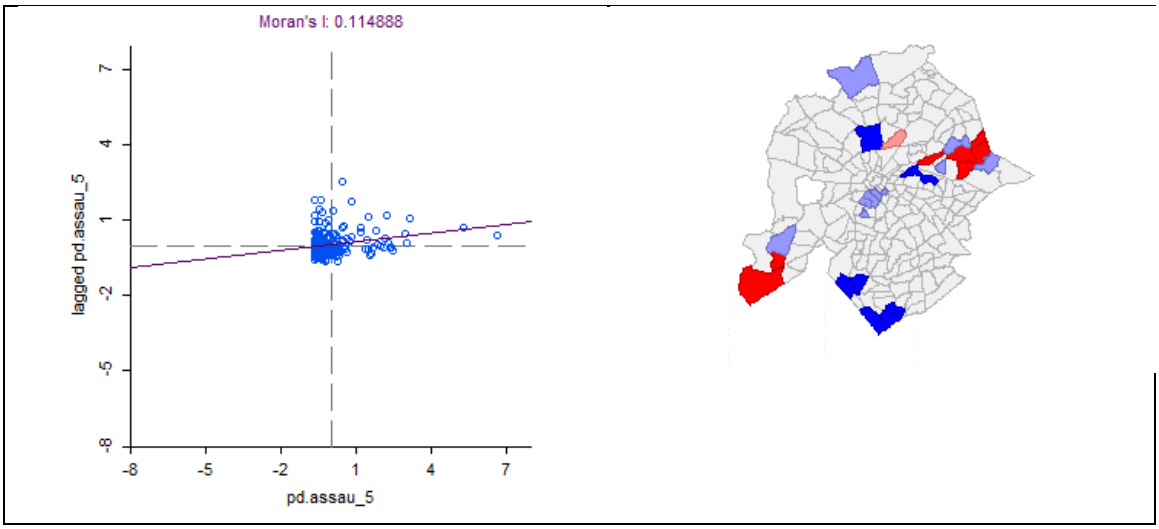

Figure 13: Assaults calls per capita

There are similar characteristics of spatial association in the burglaries per capita in the city to the other three call types-specific models, as seen in Figure 14. In particular, it is interesting that the high-high locations are the same generally as the assault and the domestic calls. There is also an interestingly large cluster of low-low just north of the uptown area, which also experiences some of the areas in which there are high levels of fire incidents. This could suggest that dwellings and commercial property in this area are less valuable and, thus may be in poor condition, which might attract fewer burglary attempts.

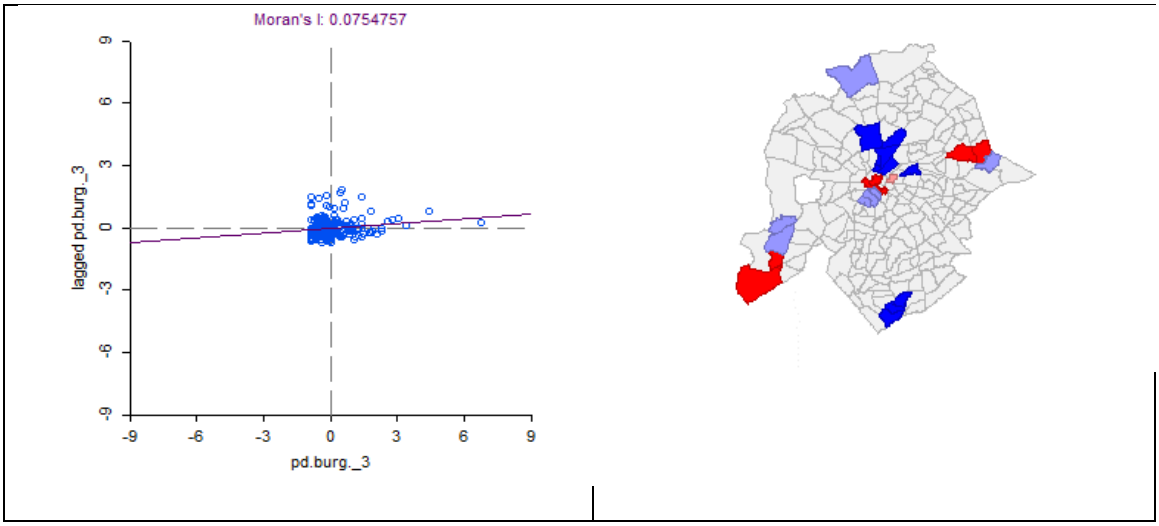

Figure 14: Burglary calls per capita

Domestic violence incidents, demonstrated in Figure 15, also have a similar structure to the other violent crimes that are discussed above. Again, the spatial structure is slightly different from the other two, but the high-high clusters tend to be in the same place. In addition to the high-high and the several low-low areas, there are a number of high-low and low-high areas that are scattered more randomly throughout the city. This implies another area of future research: do low-high areas over time become high-high? That is, are these issues contagious among census tracts?

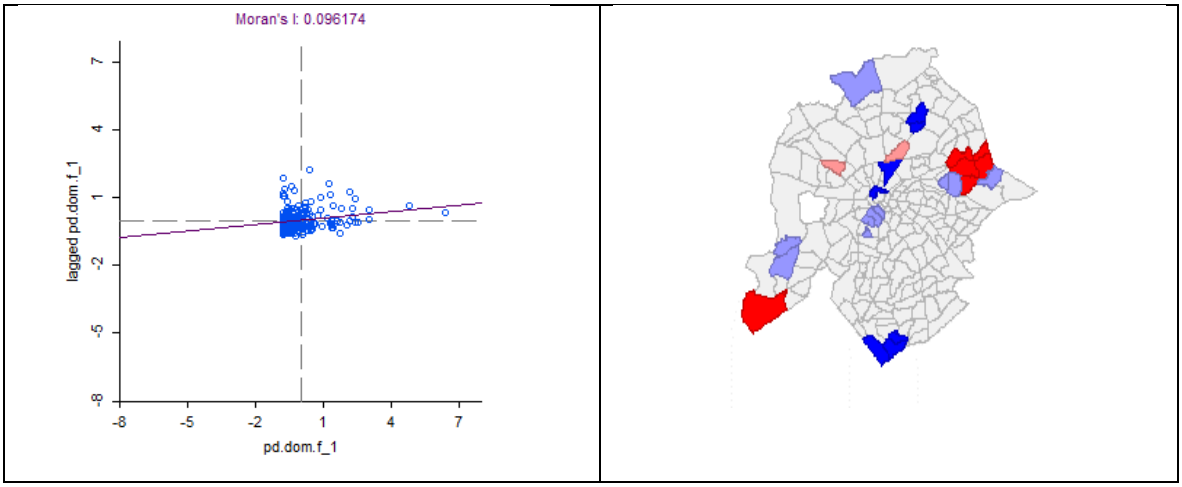

Figure 15: Domestic violence calls per capita

The fire department in general provides a much stronger spatial association with respect to the calls for service within the city. The aggregate calls for service, shown in Figure 16, demonstrate a very strong high density high-high structure in the center of the city and the first tier suburbs, while the outer lying areas are much lower. There are no census tracts in which there are no calls for service, but there are several that have very few. These areas tend to be clustered on the edges of the city.

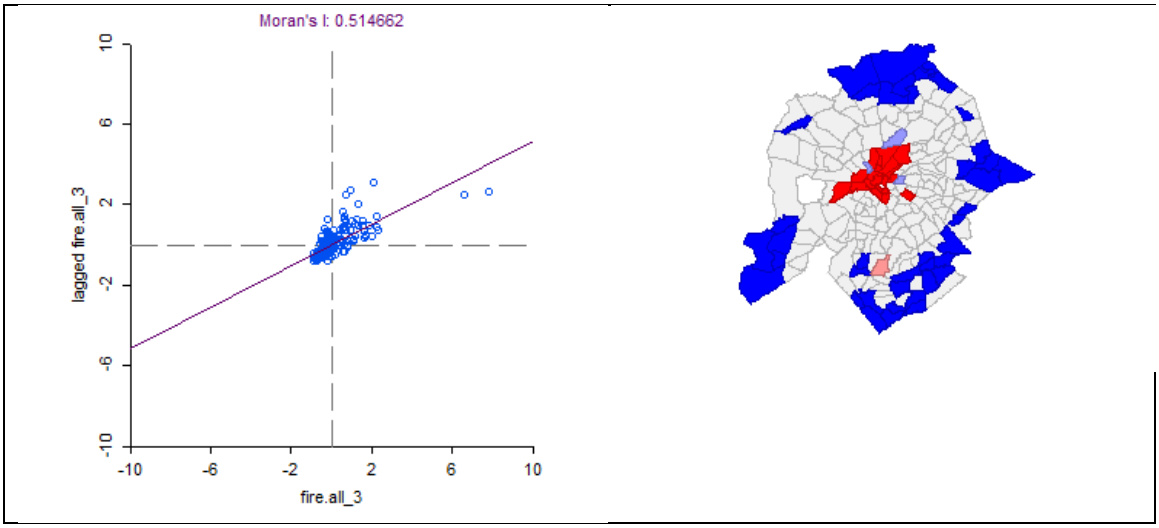

Figure 16: Fire aggregate per capita calls

Similar to the aggregate calls for service, there is a very strong spatial association structure associated with emergency medical calls, but, as seen in Figure 17, it is also distinctly different from the aggregate calls for service. The cluster of high-high areas encompasses more census tracts and expands further to the west. There is also an interesting high-low tract in the northeast and one in the south.

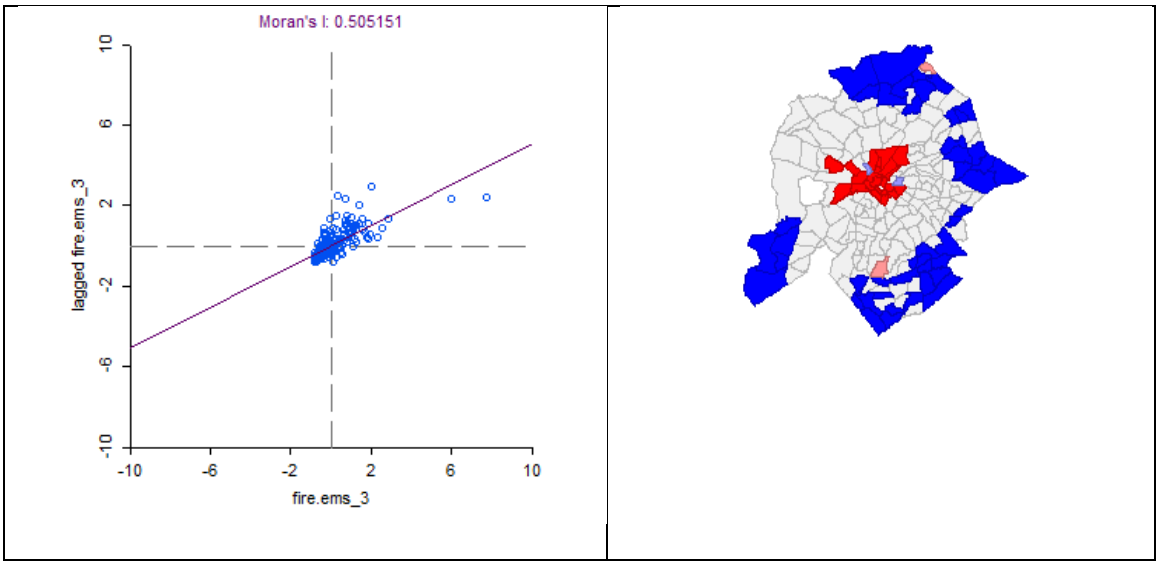

Figure 17: EMS calls per capita

Structure fires, seen in Figure 18, also represent a similar spatial structure as the aggregate calls and the EMS calls, but is again slightly different with some very strong hot spots north of the center part of the city and low spots around the periphery. Again, no census tracts have zero calls for service but there are some that have very low values. The structure fires demonstrate the highest Moran's I calculation for any of the types of calls for service in this study.

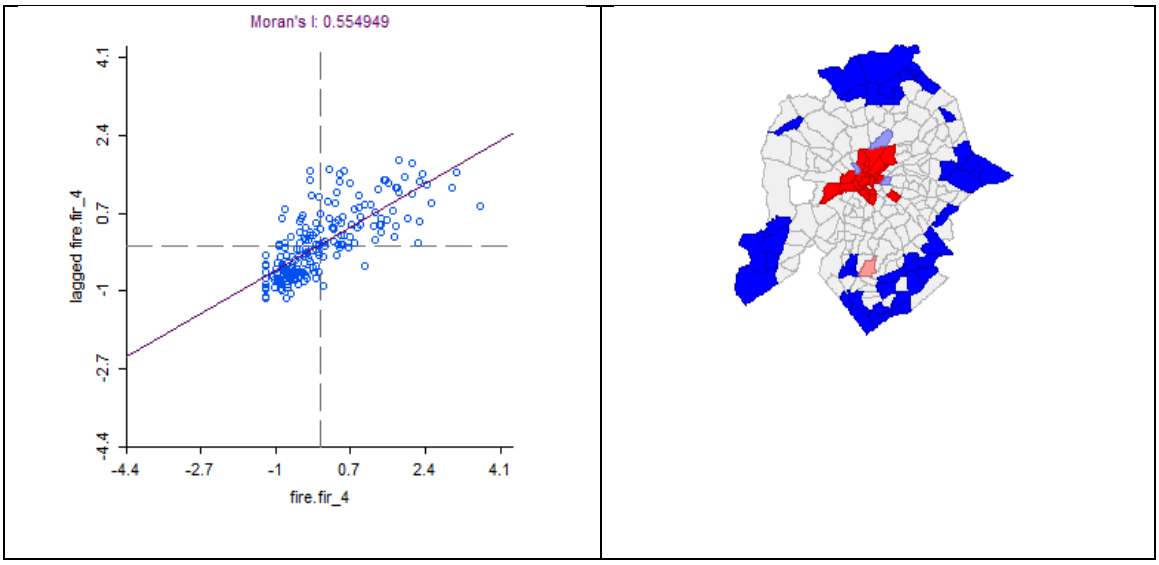

Figure 18: Structure fire calls per capita

Independent Variables: LISA Analysis

Generally, there are some characteristics of the city in which there are similar clustering of socioeconomic characteristics, but those distributions are largely all different. Additionally, every independent variable demonstrates a statistically significant Moran's I, with the exception of the lack of plumbing facilities. This provides some indication that there would be a need to take into account spatial association on the right hand side as well as the left hand side. I examine this issue in a subsequent section of the analysis.

Poverty, shown in Figure 19, appears to be primarily concentrated in the first and second tier rings of census tracts around the center city. There are particularly low levels of poverty in the "wedge" section of the city and to the northeast. This is consistent with typical rhetoric in the media regarding the struggle between the "crescent", which is located generally in the areas of high-high, and the "wedge", which is located in the southern most low-low section. This suggests that poverty in Charlotte is highly concentrated in areas of the city, while it is extremely low in others. This could identify the poverty pocket locations

of the city and is consistent with the theory that suggests poverty tends to be concentrated in certain areas of the city.

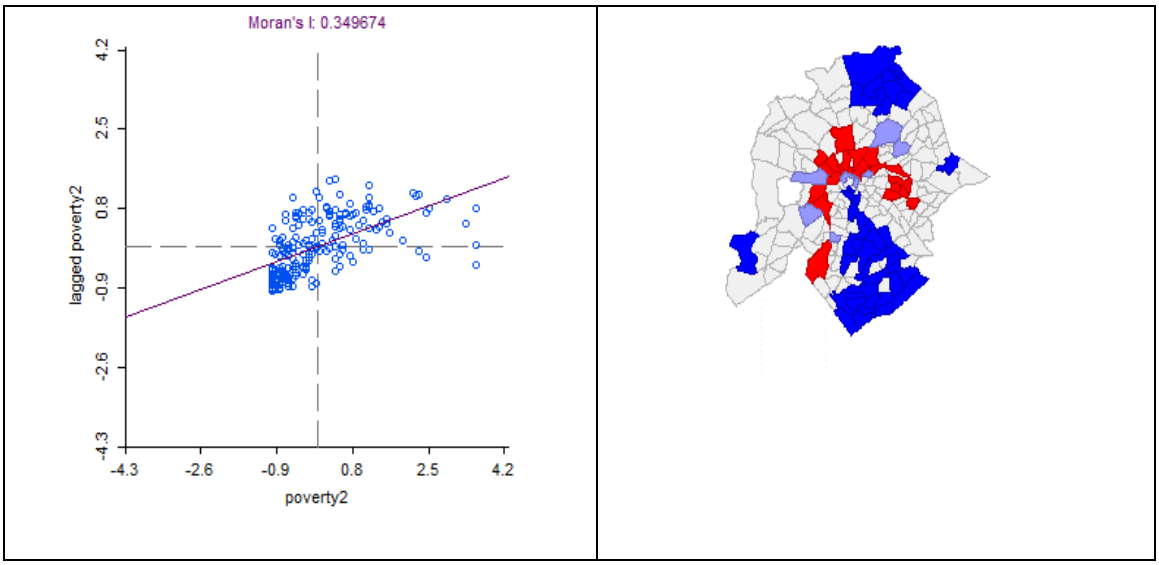

Figure 19: Poverty LISA

The spatial distribution of the population with respect to census tracts appears in Figure 20 to be relatively more random than some of the other variables. This is to be expected because census tracts by their very definition are supposed to be generally similar in population size across the city, but there is still a significant Moran's I, which demonstrates that some of the census tracts are larger and some smaller than others. It appears that the high-high census tracts are relatively larger in geography than the low-low tracts, though that is not always the case.

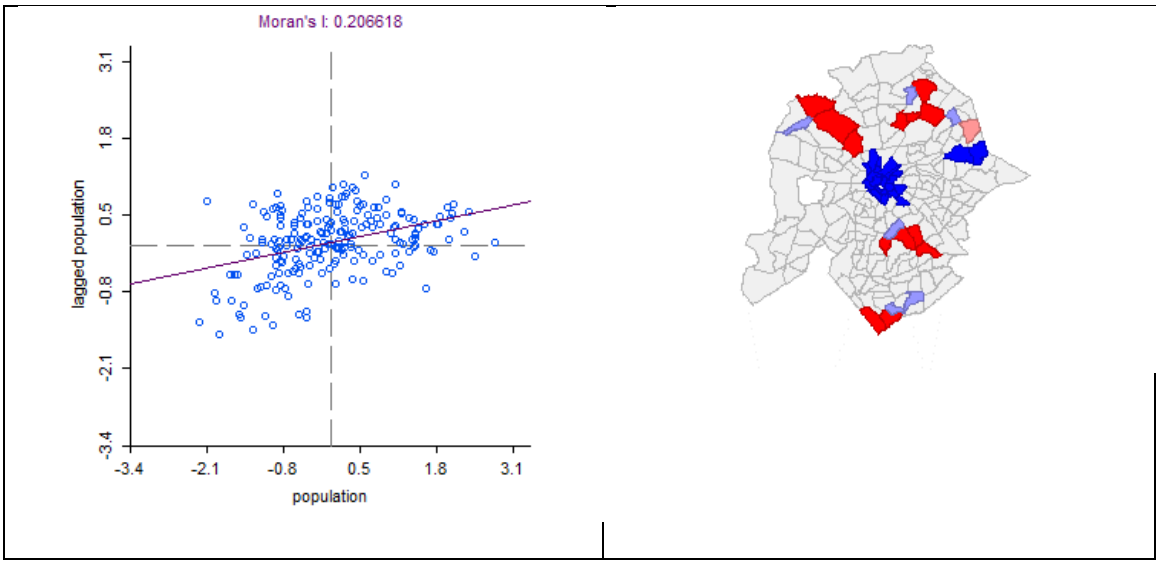

Figure 20: Population LISA

Population density also appears in Figure 21 to be mostly randomly distributed throughout the city, though the western part of the response area is clearly less dense; this is to be expecteded since it is adjacent to the Catawba River. Also, those census tracts are much larger than other areas, geographically. It is important to take note of the locations of high-high population densities on the east side of center city, which will correlate with some other variables.

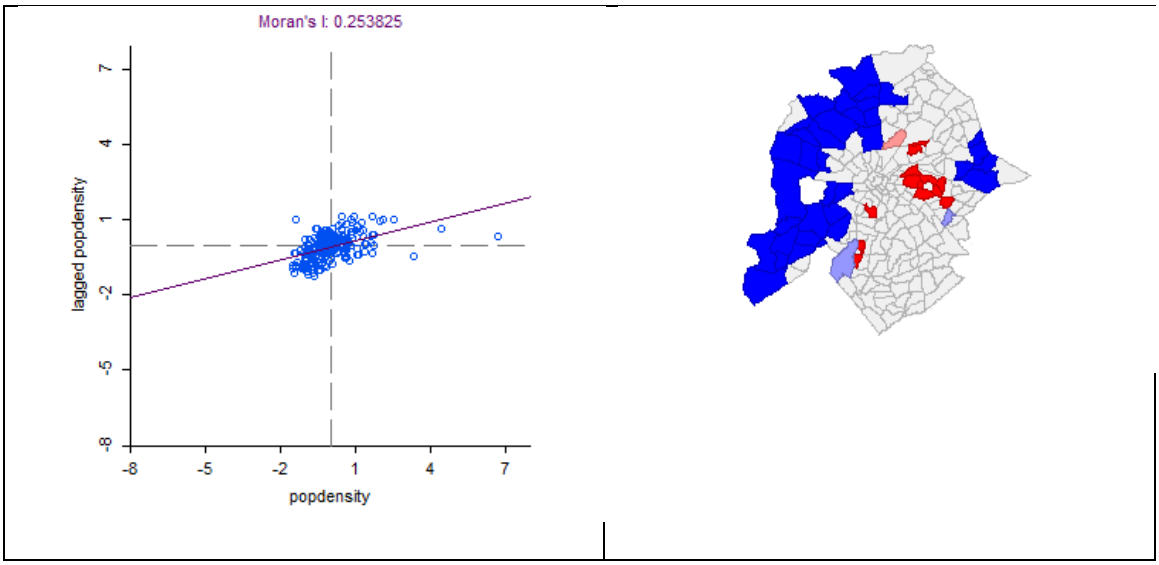

Figure 21: Population density LISA

The percentage of single parent households, shown in Figure 22, presents a similar spatial structure to that of poverty, as well as some of the other subsequent variables that demonstrate relatively more stable characteristics (the "wedge") compared to the rest of the city, the "crescent". However, the spatial structure is not nearly as strong as, for instance, the bachelor's degree below in Figure 23. The existence of a higher concentration of single parent households would suggest that those neighborhoods would have great difficulty supervising the youth in a neighborhood and the residents might experience less social organization. The social disorganization that is created as a result of single parent households limits the amount of social ties that are possible in the neighborhood.

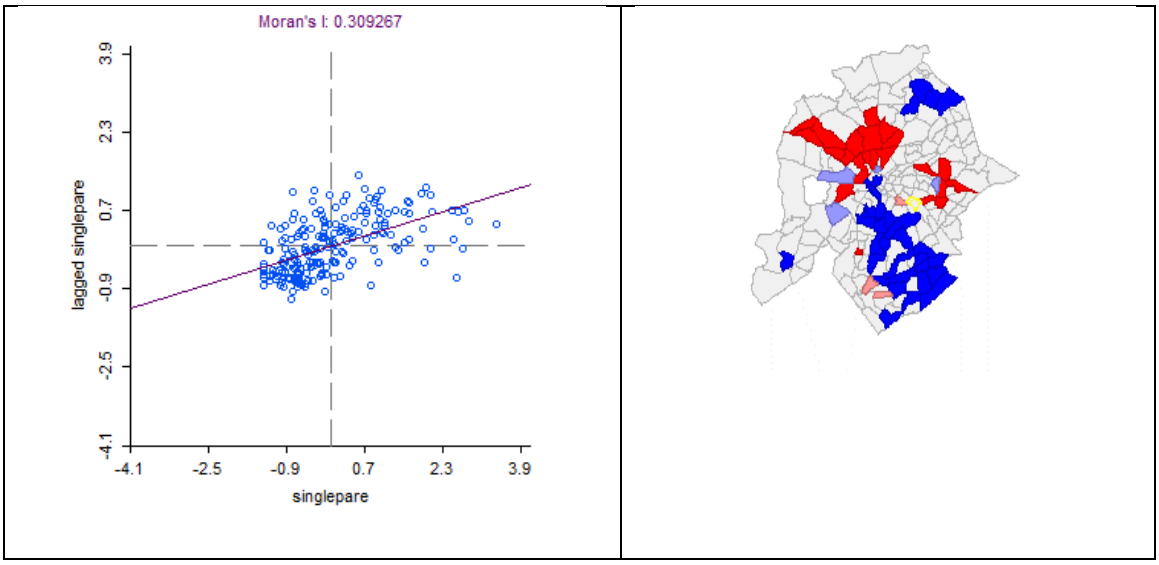

Figure 22: Single parent household LISA

The concentration of residents who have attained at least a bachelor's degree demonstrates one of the strongest degrees of spatial association. In Figure 23, there is a clear distinction between the "crescent" section of the city and the "wedge" section, with some high-high clustering located near the University area, which is to be expected. This will become even more telling as additional variables are discussed, but it is clear that certain areas of the city dominate the education attainment, and, thus, likely the social organization of the city. Socially disorganized neighborhoods should be less likely to have higher concentrations of people with bachelor's degrees. The increased socioeconomic status that is found with additional education would theoretically be related to increased social organization.

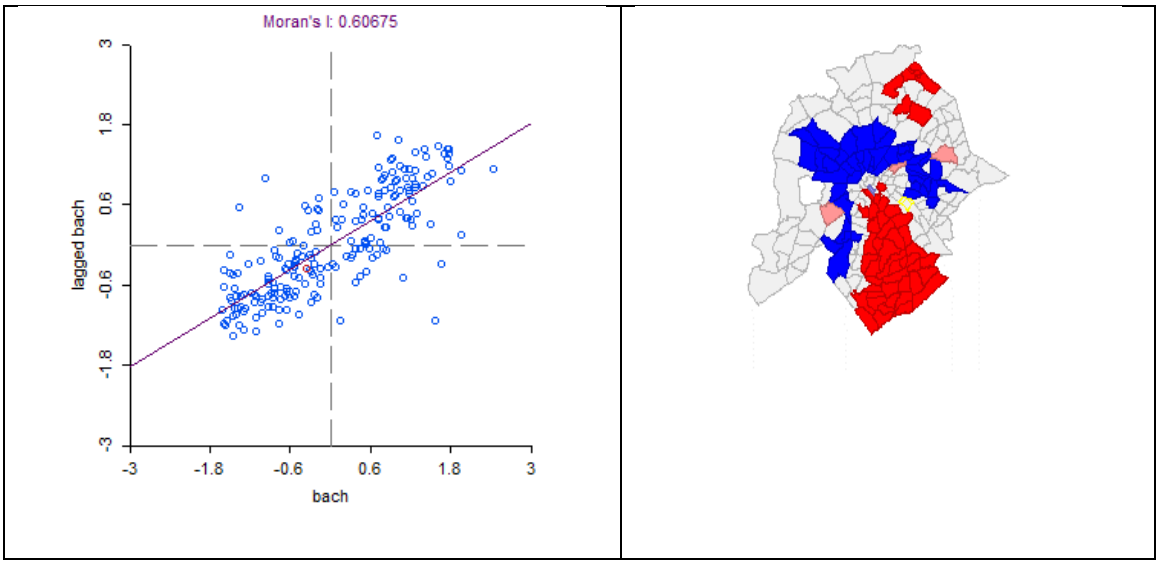

Figure 23: Percentage of people with at least Bachelor's LISA

Interestingly, in Figure 24, the highest concentrations of foreign-born persons are not within the traditionally defined "crescent" section of the city, but are rather in enclaves on the periphery of both the wealthier and the more impoverished areas of the city. Certainly, the east side and west side of the city are areas of concern, given the poverty variable discussed above, but they are generally outside of typical crescent area. This is not all that surprising, though, because many times immigrants will tend to locate among others with similar circumstances. The east side of the city as well as the on the west side, generally south of the airport might be the gateway neighborhoods. This variable is included because of the theoretical explanation that people who are foreign-born may be concerned about how fairly and they will be treated by police, particularly when the time period from immigration is longer. It is clear that there are certain locations of the city that house foreign-born residents, which is consistent with theory.

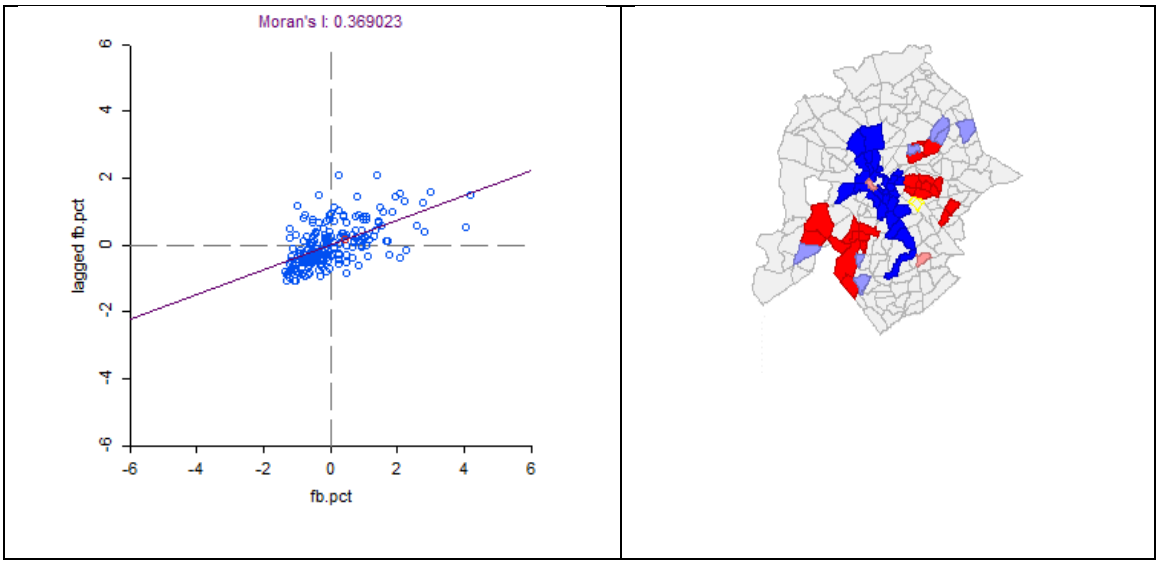

Figure 24: Foreign-born population concentration LISA

Not surprisingly, the limited English speakers concentration in Figure 25 appears to have similar spatial distribution to that of the foreign-born population. This makes sense because it is logical that foreign-born residents are probably the most likely to have limited English skills. Because the hot spots and cold spots in this case are somewhat linear in nature, this might be due to the structure of the road network. This could be another area of research.

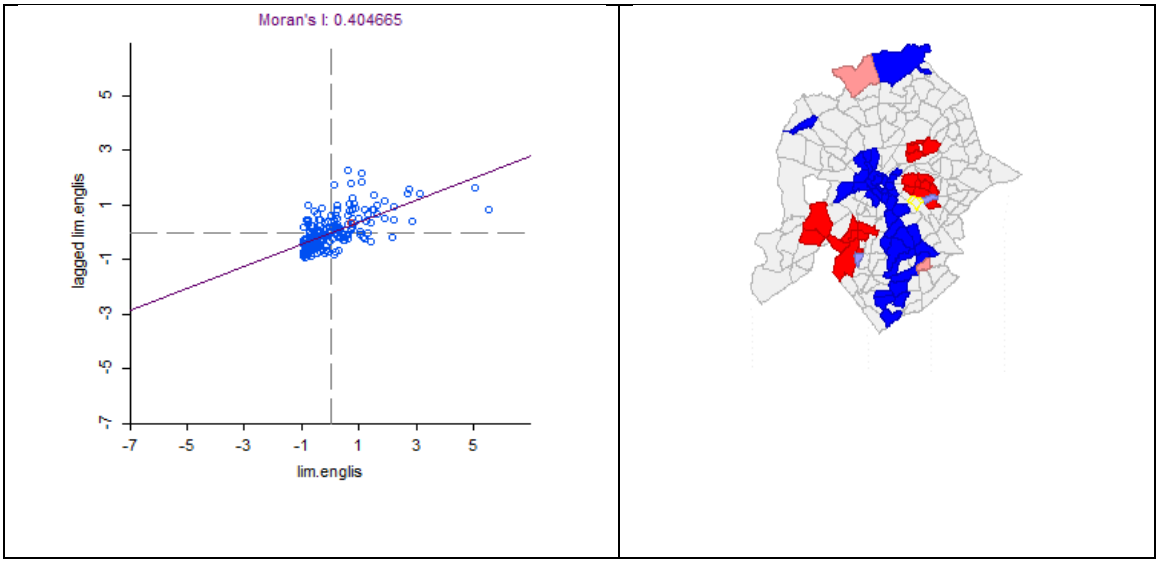

Figure 25: Limited English Population LISA

The concentration of management occupations in Charlotte has a similar spatial structure to the "crescent" and "wedge" characteristics that is apparent in Figure 26. In addition to the wedge area, in the University area (to the northeast), there are additional management concentrations. This demonstrates relatively strong spatial association. This variable is used as a means to examine the socioeconomic status of various neighborhoods. Social disorganization Theory would suggest that those in management positions, because they make more money, are less likely to live in neighborhoods that experience social disorganization.

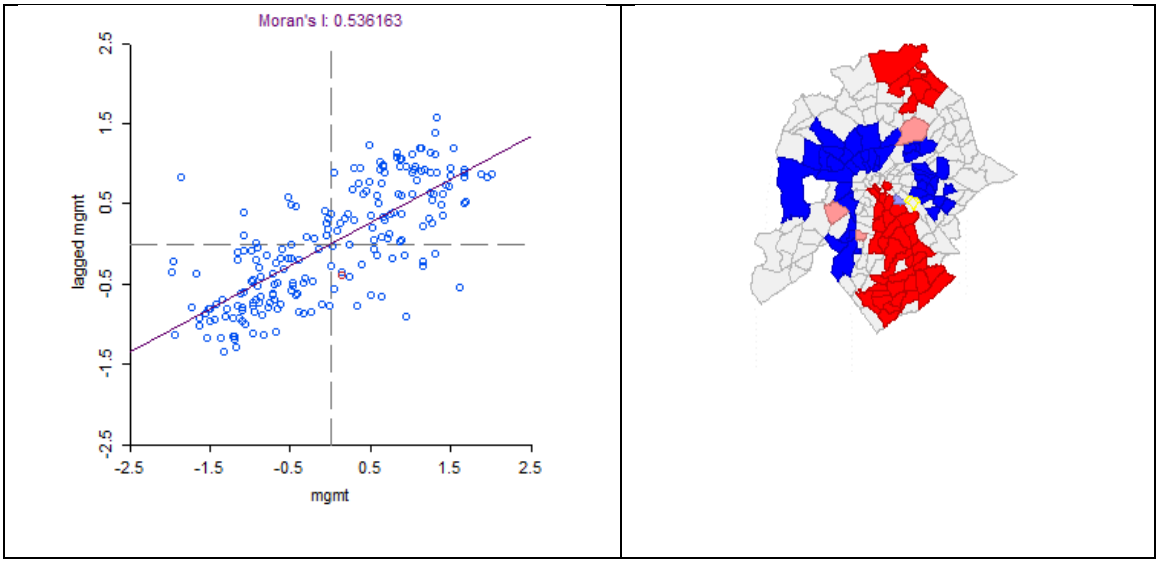

Figure 26: Management occupation concentration LISA

The concentration of renter occupied residences in the city, shown in Figure 27, is particularly strong in the second city ring to the east and west, which are incidentally similar to the foreign-born population, as well as the poverty concentrations. This is to be expected, of course, because generally if someone has the means, they will be more likely

to purchase a residence. But, renter occupancy is an important variable in the models presented below because it demonstrates an important part of the Social Disorganization Theory's view of the connection that residents have with the neighborhoods they live in. Obviously, if someone owns a residence, they will be more likely to be invested in the neighborhood.

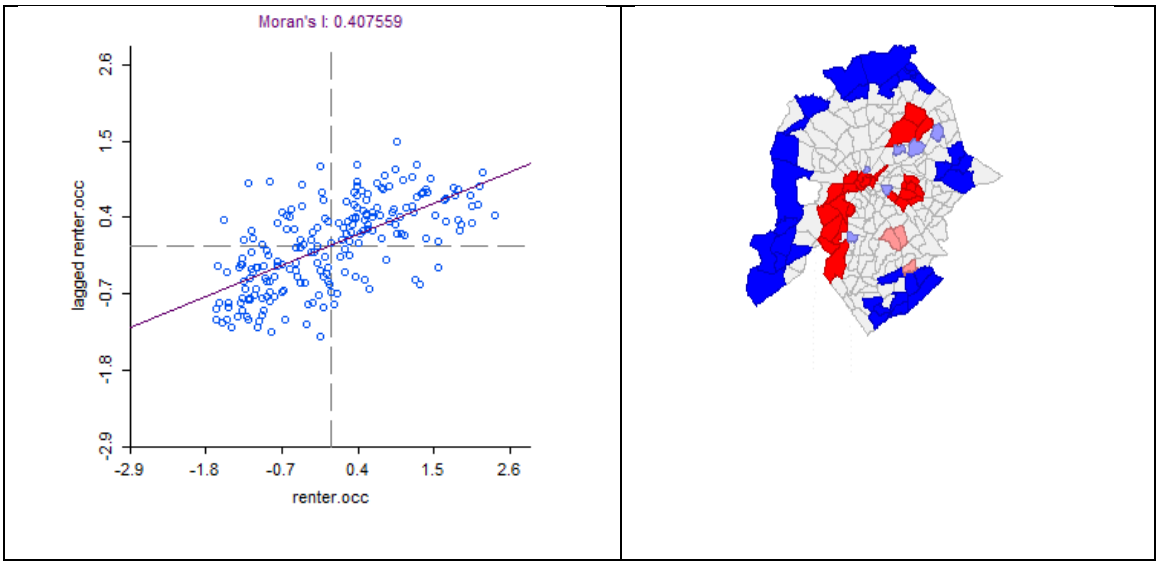

Figure 27: Renter occupied concentration LISA

As shown in Figure 28, the lack of vehicle availability in the city has a similar crescent and wedge appearance to its distribution, though it is not exactly the same. Generally, the high-high location of lack of vehicle availability occurs in the crescent area, but is not as wide-spread as some of the other crescent characteristics, such as poverty and a lack of college education. Appropriately, the outer areas of the city experience very low clusters of lack of vehicle availability. To some extent, a person would not choose to move to those areas if they did not have a vehicle. Lack of vehicle availability is an indication of

lower socioeconomic status and, thus, is an indication of the propensity for a census tract to be socially disorganized.

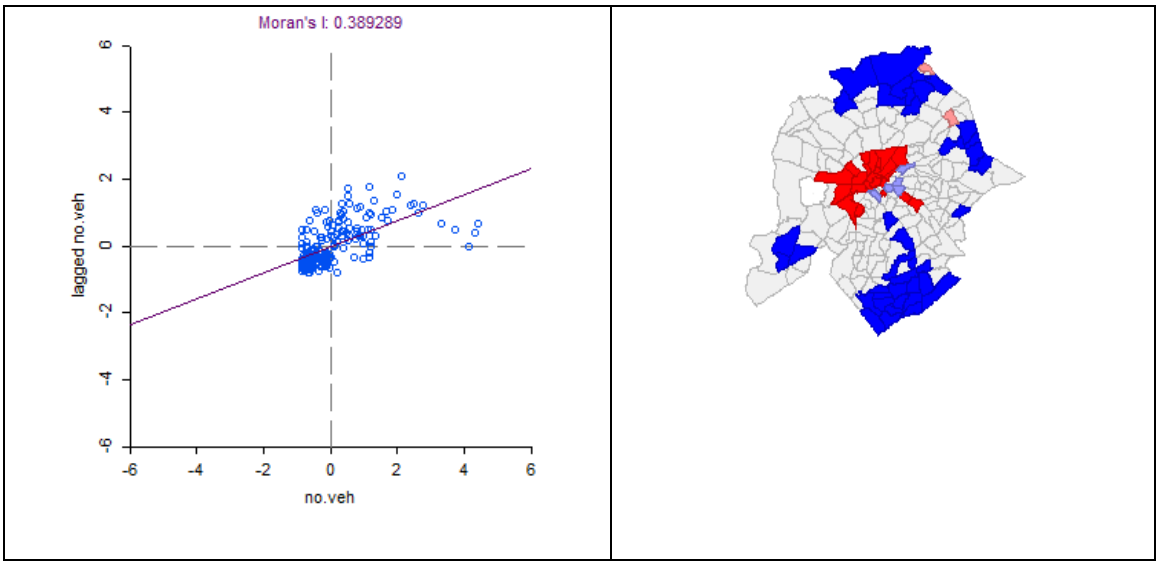

Figure 28: No vehicle concentration LISA

In Figure 29, the spatial distribution of the lack of plumbing availability is relatively random and the Moran's I calculation is not significant. There are two local hot-spots, though, one of the west end and one on the east side of center city. Plumbing availability was included in order to assess socioeconomic status of the census tract.

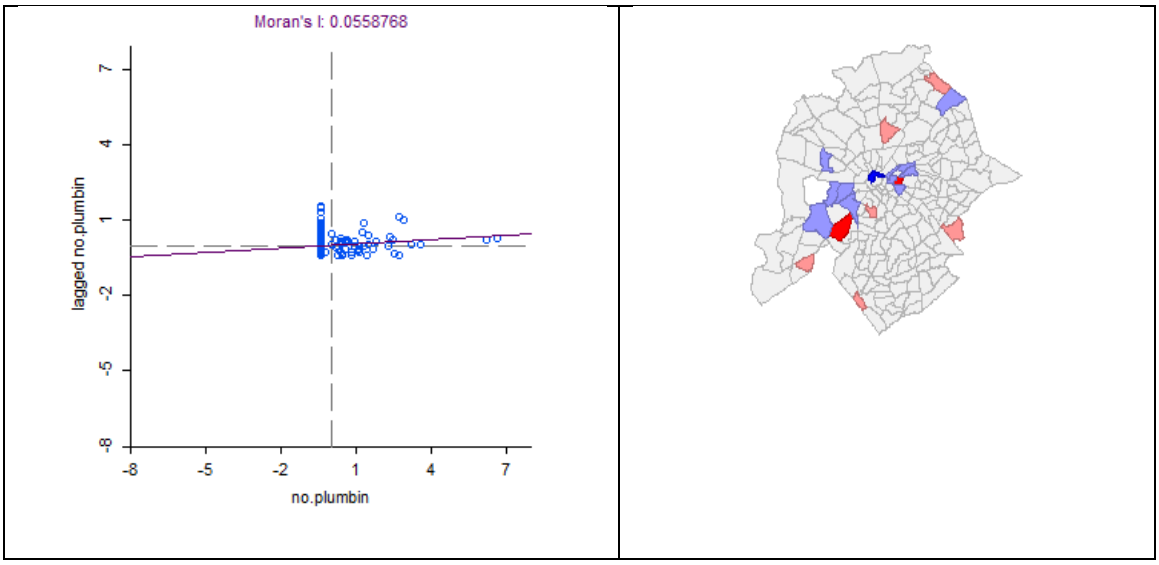

Figure 29: No plumbing LISA

The locations in which there are higher levels of new residences, shown in Figure 30, are distinctly different from the crescent areas than social disorganization would suggest. The western side of the city, where there are higher rates of foreign born residents, and the University area both experience higher rates of short housing tenures. The University area makes good sense because people are coming to the University for a few years and then leaving (renters). Generally, though, there is a modest Global Moran's I, though there are a few hot spots of lower housing tenure. A shorter time frame of housing tenure would suggest that people have not lived in their neighborhoods as long and, as a result, do not have strong social ties, resulting in the neighborhoods being less socially organized.

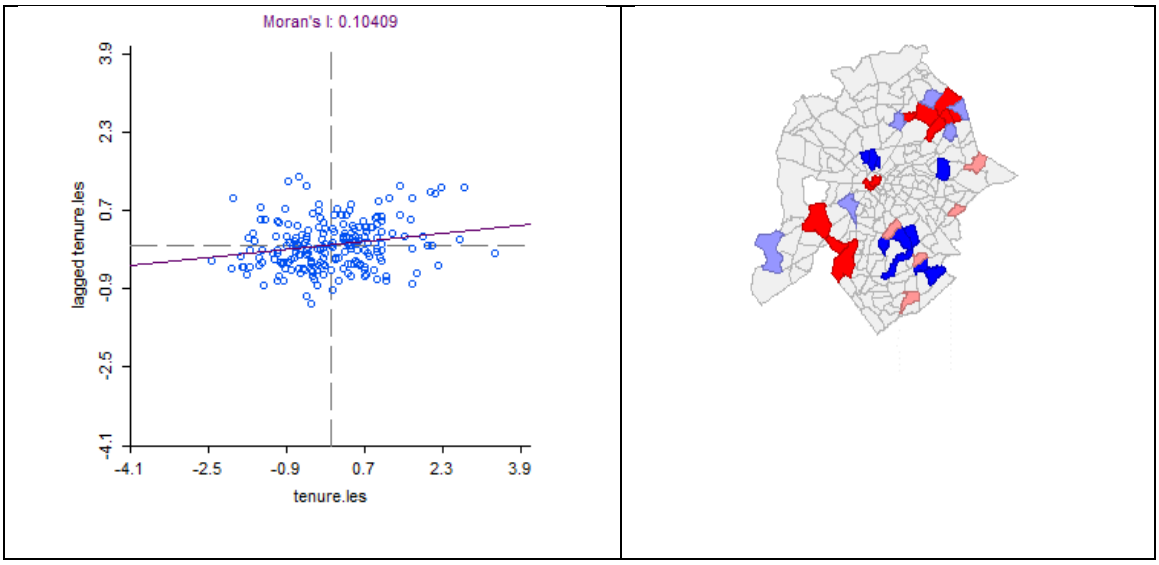

Figure 30: Less than 5 year housing tenure LISA

The concentration of African Americans in Charlotte is highly spatially correlated and demonstrates a strong similarity to the crescent and wedge area. Interestingly, in Figure 31, the southern wedge area is distinctly non-African American, exemplifying the racial overtones of the wedge and crescent discussion. Also, the cluster of African American concentrations is similar to that of the lack of higher education, poverty, and non-managerial occupations. The concentrations of African Americans that are so strong in certain areas would suggest that there is a lack of ethnic heterogeneity and, as a result, there should improve social organization.

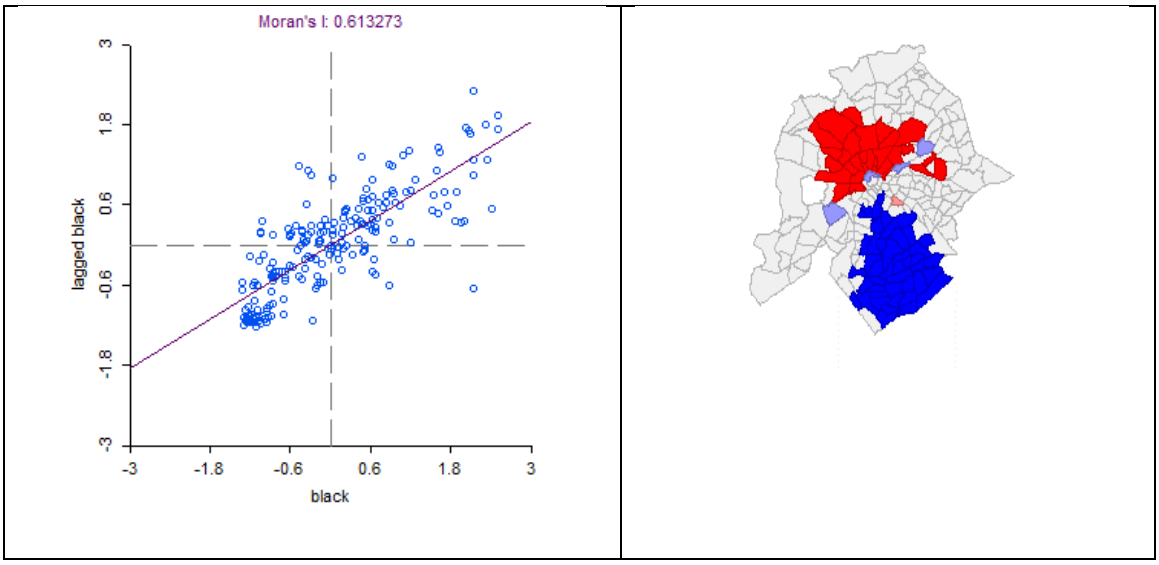

Figure 31: African American concentration LISA

In Figure 32, the areas in which there are high concentrations of Hispanic residents are obviously different from the hot spots of African Americans, but are very similar to that of the foreign-born residents. It could be that new immigrants are either coming to areas where there are either family or familiar people, or that Hispanics are largely the immigrant population. It is likely a mixture of the two. Either way, there are definite hot spots of Hispanic residents, as well as a large cold area, which is addressed in the Simpson's D variable. Areas in which there are high concentrations of Hispanic residents, should experience lower rates of social disorganization.

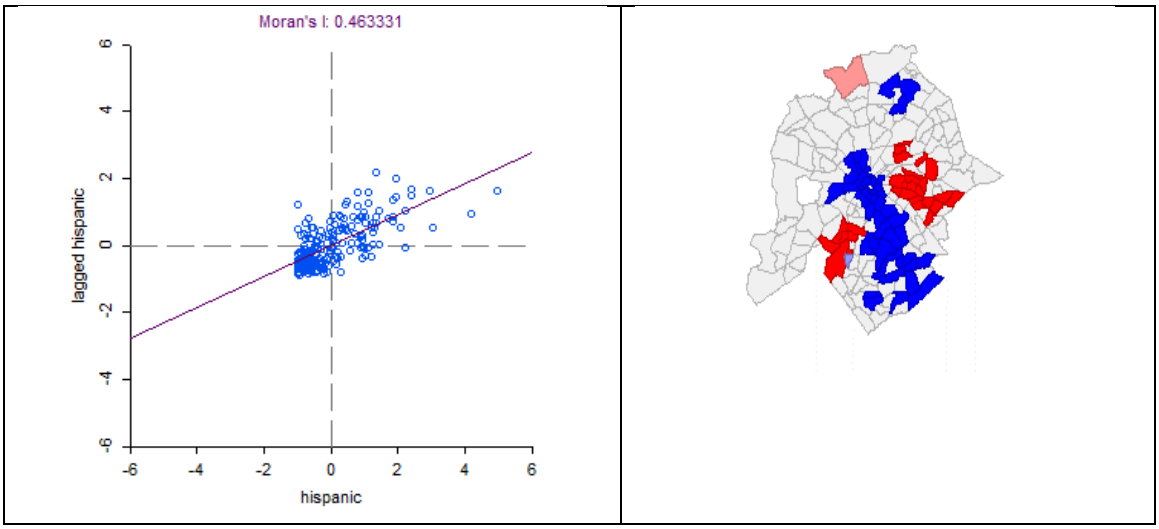

Figure 32: Hispanic concentration LISA

The median age of residents in census tracts also appears to be spatially correlated. In Figure 33, it is clear that the University area boasts a relatively low median age cluster, while the southern end is higher. This is not entirely consistent with the crescent and wedge issue, but certainly in the higher age cluster it is reminiscent of the wedge area. Areas with fewer young people should have less difficulty organizing the social behavior of young people.

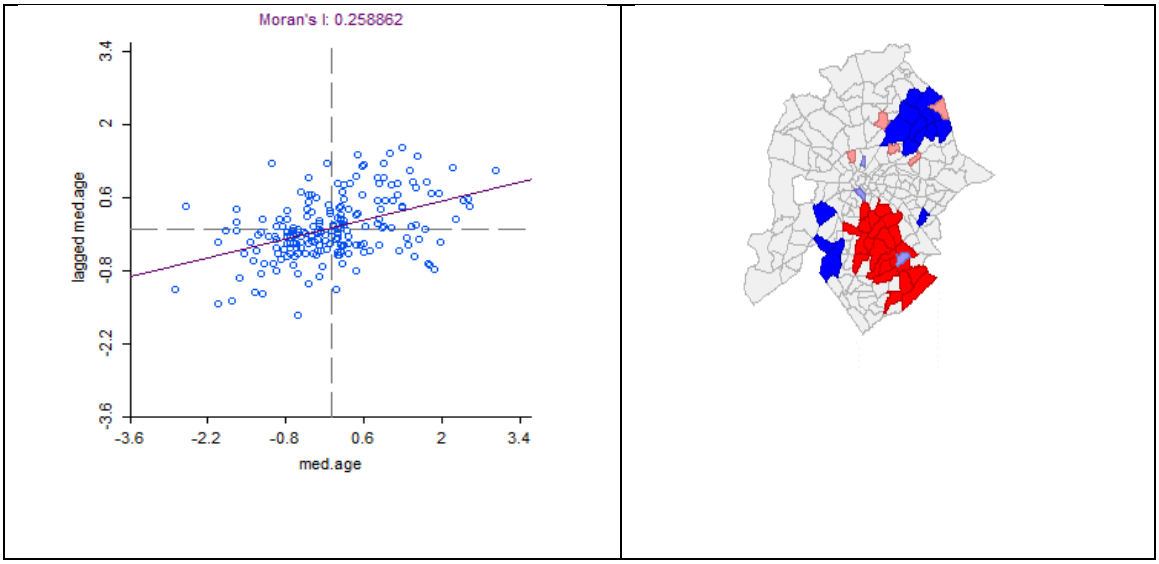

Figure 33: Median age concentration LISA

In Figure 34, the Median Household Income cluster analysis closely mirrors the poverty concentration cluster analysis, as well as some of the other socioeconomic characteristics that have been analyzed here. Interestingly, there is clear similarity between the minority hot spots and the cold spot income cluster that is demonstrated above. This is an additional measure of socioeconomic status. When median household income is lower, social organization is more difficult because of the declined socioeconomic status that is associated with lower income.

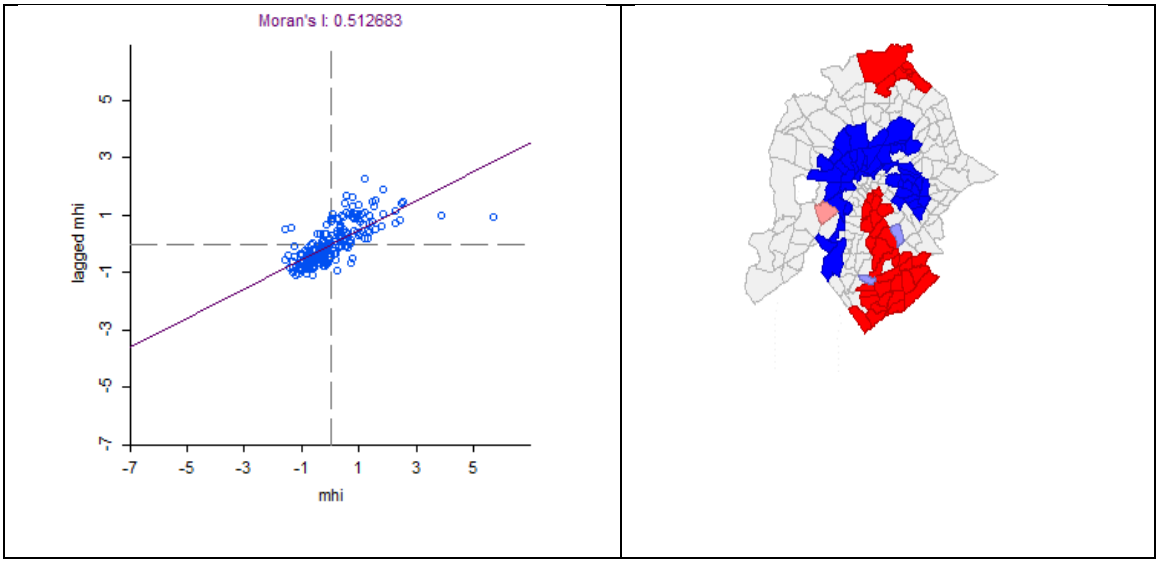

Figure 34: Median household income LISA

The diversity index of the neighborhoods in Figure 35 suggests a relatively similar spatial structure to some of the other variables, but primarily so in the wedge section. Given the knowledge that we now have of other racial groups, it is obvious that the southern wedge is predominantely white and non-diverse, while the univesity area is for more hetergeneous. Ethnic heterogeneity is an indicator of social disorganization. People who

do not hold the same cultural values that in many cases are defined through ethnicity may have a difficult time organizing community within a neighborhood.

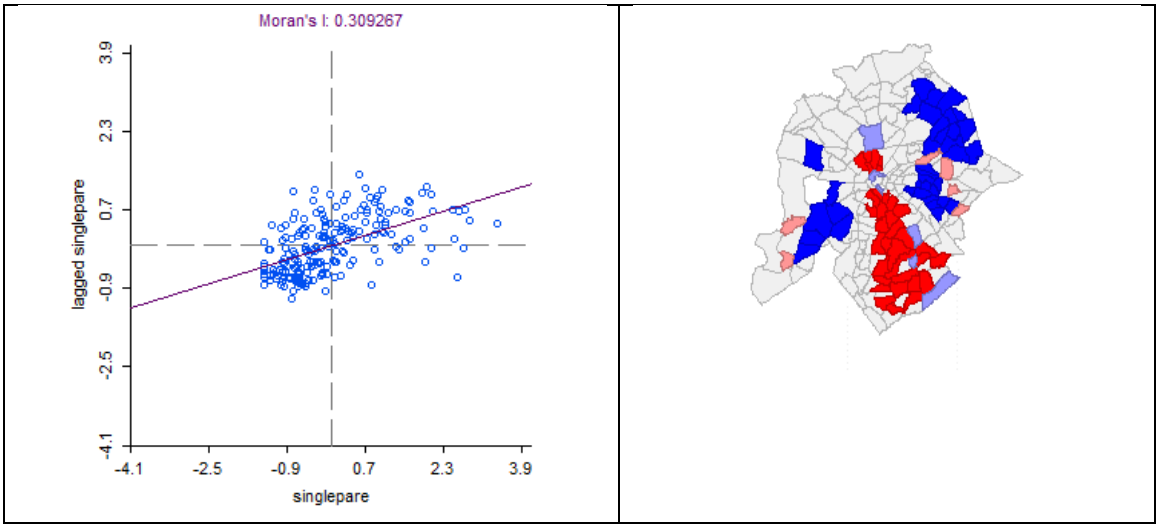

Figure 35: Simpson's D LISA

Econometric Models

The econometric models in this analysis were conducted utilizing the GeoDa software. An important component of this analysis is the comparison of the ordinary least squares model to the spatially lagged dependent variable models that are developed using the queen contiguity weights matrix developed for the calculation of the spatial analysis provided above. The GeoDa software allows data to be uploaded utilizing shape files. The variables are entered into the software as attributes within the shape files allows the creation of a data table that can be used when conducting the analyses. This allows the software to conduct a simple OLS regression model that does not take into account space. Additionally, the shape file allows the utilization of a weight matrix that must be used for the spatial econometric analysis.

This section provides output from the OLS model first, and then the Spatially Lagged Dependent Variable model (Maximum Likelihood Estimation) for each of the models that are addressed in this study. After the presentation of each of the results tables,

the section provides a discussion on the appropriate model to use (spatial or non-spatial) and how the two models differ. Once the appropriate model is chosen, the significant variables are discussed in the model and are interpreted for practical implications in the field. In each of these, a discussion regarding demand for services is provided, and interpreted according to an "average" size census tract of 5,000 residents.

Interestingly, the poverty variable itself is never actually found to be significant, all other variables being held constant. However, there are several other variables that might be somewhat associated with poverty that are significant. This likely indicates that the demand structures and the causal mechanisms are much more complicated than simply being related to people living in poverty conditions. Instead, the processes of poverty are likely to have an effect and, in fact, vary among the different call types. Throughout this section, a discussion of those differences provides an insight into how those processes affect outcomes and practices.

Table 4 and 5 provide an outline of the descriptive statistics of both the dependent and the independent variables. For the dependent variables, I have included a field that translates the per capita calls for service rate to an average 5,000 resident census tract.

Table 4: Independent variables descriptive statistics

Independent Variable	Maximum	Minimum	Mean
Poverty rate (percent persons)	62.2	0	10.88
Population (persons)	8078	327	3838
Pop. Density (person/sq mile	13347	264	2576
Single Parent (percent)	32.7	0	8.95
Bachelors (percent)	59	2	26
Foreign Born (percent)	57	0	13
Limited English (percent)	62	0	9
Management (percent)	73	4	39
Rental Occupancy (percent)	98	1	39
No Vehicle (percent)	50	0	8
No Plumbing (percent)	7	0	0
Tenure <5 (percent)	96	12	47
Black (percent)	100	0	32
Hispanic (percent)	71	0	11
Median Age (years)	50	20	35
Median Household Income (dollars)	219,750	11,063	60,079
Simpson's D (index, 0 to 1)	1.000	0.2774	0.5616

Table 5: Dependent variables descriptive statistics

Dependent Variable	Max	5k Tract	Min	5k Tract	Mean	5k Tract
Police Calls Aggregate	9.60	48,015.00	<.0001	-	0.67	3,348.20
Assault	0.03	157.40	<.0001	-	0.00	14.59
Burglaries	0.19	944.50	<.0001	-	0.02	110.55
Domestic Violence	0.44	2,181.50	<.0001	-	0.05	245.90
Fire Call Aggregate	1.31	6,550.00	0.002	1.02	0.05	226.90
EMS	0.73	3,625.50	0.008	4.08	0.07	372.70
Structure Fire	0.00	23.03	<.0001	-	0.00	8.11

Compared to the fire department data, the police department data in general (outlines in Tables 6 and 7) demonstrates much weaker spatial association. However, there

is still at least some degree of spatial association in the model and, thus, it is necessary to consider using a spatially lagged model. This tends to be the case for much of the police department data, which makes a discussion regarding the appropriate model an important one.

Table 6: Police aggregate calls per capita results[14]

Independent Variables	MLE	OLS
Constant	-1.33	0.0001
	0.855	0.005
Poverty	0.00702	0.005
	0.006688	0.717
Population	-0.00226	-0.0023
	0.0003***	-6.06***
Population density	-0.000098558	-0.0001
	0.00003444***	-2.78***
Single parent	-0.0115	-0.0125
	0.0108	-1.089
Bachelors	-0.02868	-0.0297
	0.00864***	-3.24***
Foreign born	0.006926	0.00547
	0.01332	0.387
Limited English	0.0517573	0.051
	0.01533***	3.138***
Management	0.02269	0.023
	0.006709***	3.24***
Renter occupied	0.009707	0.0103
	0.0049**	1.96**
No vehicle	0.01327	0.0154
	0.0089	1.639*
No plumbing	-0.08509	-0.0922
	0.045*	-1.925*
Tenure <5	0.01707	0.01689
	0.00546***	2.9126***
Black	0.00783	0.00784
	0.0038**	1.92136**
Hispanic	-0.0495	-0.048276
	0.0095***	-4.767***
Median age	0.04728	0.0452
	0.0147***	2.888***
Median household income	0.000000317	0.00048
	0.00000339	0.134
Simpson's D	-0.248	-0.276
	0.288667	-0.9037
lag (Rho)	0.21253	n/a
	0.0966**	n/a

[14] Significance levels: * p<0.1, ** p<.05, *** p<.01

Table 7: Aggregate police calls per capita model characteristics

Statistic	MLE	OLS
Pseudo R-Sqr	0.4163	n/a
Liklihood Ratio Test	4.028**	n/a
Adj R-sqr	n/a	0.345
F Statistic	n/a	7.3345***
Breusch-Pagan	n/a	741.48***
White	n/a	200.4317*

In the case of all calls for service, there is a significant lag rho variable in the maximum likelihood estimation models. However, in the spatially lagged regression, the Pseudo R-Squared is superior to that of the Adjusted R-squared in the OLS model. Although the two are not necessarily comparable in all ways, we can cautiously compare them when determining model fit. For the reasons provided here, it is appropriate to choose the maximum likelihood estimation model (spatially lagged model).

Table 6 indicates there are several independent variables in the model that are significant and have an apparent impact on the outcome of the police aggregate calls for service averaged over five years. Many of the items are consistent with the social disorganization characteristics that are demonstrated within the city, which represents a confirmation of the findings of the many studies that have subsequently studied the phenomenon. However, as will be fleshed-out in the discussion of the individual types of calls for service, those significant variables change, depending on the effects of the social disorganization characteristics.

With regard to the social disorganization characteristics, the one characteristic that appears to have the greatest impact on the aggregate police calls for service is the lack of personal connectedness that a person has with a neighborhood. In this model, a one percent increase in the number of people in the census tract that have lived there less than five years

(Tenure <5) leads to 0.017 more police calls for service per capita. In a census tract with 5,000 residents, this is related to an increase of 85 additional calls for service per year per percentage of people who have a short housing tenure. Similarly, in neighborhoods that have a greater percentage of residents who rent, there also tends to be a higher rate of calls for service. In this model, a one percent increase in the number of people who rent their residence is associated with a 0.0097 increase in aggregate police calls for service per capita. This suggests that in a census tract with 5,000 residents, when there is one more percentage point of renter occupation, there will be 49 more calls for service in a year.

The racial characteristics of the census tract are also interesting. In neighborhoods in which there are higher concentrations of African Americans, there tends to be a higher number of calls for service, all else being equal. On the other hand, in neighborhoods that have higher concentrations of Hispanic residents, there are actually fewer calls for service per capita in the neighborhood. A one percentage increase in the concentration of African Americans tends to lead to 0.0078 more calls for service per capita, while a one percentage increase in Hispanics tends to lead to 0.0495 fewer calls for service per capita. This suggests an increase in 39 more calls for service and 247.5 fewer calls for service in a census tract with 5,000 residents for a one percentage point increase in African American residents and Hispanic residents, respectively.

This is primarily interesting because this it is consistent with the literature on the interactions that various racial groups have with the police. First, it is evident that the experiences across minorities are not consistent. In this model, African Americans and Hispanics have different impacts on calls for service, which is to be expected from the information in the literature. Second, it is consistent with the feeling demonstrated in the

literature that African Americans feel as though they are targeted by police, or at least have more interactions with them. Additionally, it is consistent with the idea that Hispanic residents are less willing to interface with police officers, potentially due to a concern about trusting the police. Also, because the limited English proficiency variable is positive and significant (0.05175, which relates to 258 more calls for service in a 5,000 person census tract annually for a one percent increase in population with limited proficiency), it would be reasonable to suggest that the limited communications capability might be less of a deterrent to coordination with police than concerns about racial bias. These items are consistent with theory in general regarding the experience that various groups have with the police, and confirms an important point that minority groups do not necessarily have the same experiences.

Some of the socioeconomic variables that relate to Social Disorganization Theory are also interesting. First, the percentage of residents with bachelor's degrees has a negative and significant (-0.02868) impact on the aggregate police calls for service. This suggests that in a census tract in which there are 5,000 residents, a one percentage increase in the residents with at least a bachelor's degree, there will be 143.4 fewer calls for police service. This makes sense because it is consistent with the Social Disorganization Theory premise that greater socioeconomic status (theoretically, a college degree leads to a better job with higher pay) leads to less of a propensity to commit crimes. However, in locations with higher concentrations of management professionals, there is actually evidence of higher calls for police service (0.02269, which is related to 113.45 more aggregate calls for police service in a 5,000 census tract neighborhood with a one percent increase in management, which may be because they become targets). This is an odd phenomenon, because given

the social disorganization theories, higher socioeconomic status should lead to less crime. However, this is fleshed-out in more detail in subsequent analysis that disaggregates calls for service.

There are some additional variables in the model that are significant, but are not in the expected direction. First, population and population density are both negative and significant. Theoretically, when there are higher densities of populations, we might expect to see higher demands for services. Simply, people living on top of one another might lead to conflict, which is consistent with Social Disorganization Theory, provided that people are living near one another but not socially organized. However, that appears to not be the case. Even when the variables are transformed (natural log) they are still either not significant, or are still negative. There is not a theoretical explanation for this issue, but could be an opportunity for future analysis. Perhaps a more dense area is easier to patrol, but that is not described in the literature on the subject.

An additional interesting component is that in the aggregate police calls for service models and the rest of the police models, the median age of the census tract is positive and significant. This is inconsistent with Social Disorganization Theory because when there are older citizens it appears that there are more calls for service. Social Disorganization Theory would suggest that when there are younger residents, there might be more crime because the community is unable to supervise the youth and, thus, they get in trouble. In contrast, older residents may be more willing to interact with police compared to younger residents.

In general, the ideas found in Social Disorganization Theory are relatively well supported, with some caveats. Importantly, though, the impacts that these components have varies within the individual call types, which are addressed below.

In consideration of assaults calls to the police department in the City of Charlotte, there is comparable evidence of spatial association. There is a comparably strong spatial association with Moran's I calculations 0.038795. Comparing the MLE estimation with the OLS estimation, the model fits are substantially better in the spatially lagged version (in Table 7). For these reasons, it is appropriate to apply the spatial model to the outcome since we know that in each case there is spatial association that needs to be considered.

In comparison to police calls for service in the aggregate, many of the same variables have significance in the model associated with assaults in the City of Charlotte, as shown in Table 8. Of course, the magnitude of the impact is much smaller in the assaults versus the aggregate calls for service, since assaults are but one component that make up the aggregate. However, even though most of the variables that are significant in the aggregate police calls for service model are also significant in the assaults model, there are some differences in significant variables in the two models which have some interesting implications.

The first variable that is significant in the assaults model, but not significant in the aggregate model, is the percentage of foreign born population. In the assaults model, census tracts that have higher levels concentrations of foreign born residents tend to have lower levels of assaults occurring (-0.0001621, which relates to 0.81 fewer calls for assaults in neighborhoods that have one percent higher foreign born residency in a 5,000 person census tract). Obviously, this is a very minimal impact, but as a point of caution, there are

particular concerns with this statistic because it could be a result of lower reporting rates. If a foreign-born person is less likely to interact with police due to a fear of police, it might make reporting the crime less likely. So, just because the numbers are lower does not mean that it is not occurring.

Table 8: Assaults calls per capita results[15]

Independent Variables	MLE	OLS
Constant	-0.0006	0.00014
	.004	0.005
Poverty	0.0000119	.0000821
	0.0000387	.000041
Population	-0.0000105	-.0000109
	0.00000209***	.0000022***
Population density	-0.00000042125	-000000469
	0.000000199**	0.00000021**
Single parent	-0.00007300	-.0000810
	0.0000627	0.00006654
Bachelors	0.00005244	0.0000480
	0.00005009	0.0000305
Foreign born	-0.0001621	-0.00017
	0.0000772**	.0000817**
Limited English	0.0001737627	0.00017
	0.0000888**	0.000094*
Management	0.0000714	0.00007635
	0.000038994**	0.0000411*
Renter occupied	0.00005863	0.00005544
	0.000028866**	0.0000306*
No vehicle	0.0001182	0.000129
	0.0000517**	.0000545**
No plumbing	0.0000680	0.0000146
	0.0002	0.000277
Tenure <5	-0.00005483	-0.0000484
	0.00003166*	0.0000335
Black	0.00006904	0.0000722
	0.0000223***	0.0000236***
Hispanic	0.00004048	0.0000580
	0.0000554	.0000586
Median age	0.0001417	0.0001332
	0.00008537*	0.0000905
Median household income	0.0000000032618	0.0000000005
	0.00000001963	0.00000002
Simpson's D	-0.00483	-0.0049
	0.001668***	0.0017***
Lag (Rho)	0.2023923	n/a
	0.1011**	n/a

[15] Significance levels: * p<0.1, ** p<.05, *** p<.01

Table 9: Assault calls per capita model characteristics

Statistic	MLE	OLS
Pseudo R-Sqr	0.243352	n/a
Liklihood Ratio Test	3.93**	n/a
Adj R-sqr	n/a	0.152947
F Statistic	n/a	3.15924***
Breusch-Pagan	n/a	104.05***
White	n/a	186.2561*

The lack of a vehicle availability is also related to increased calls for services related to assaults in the police department. This is consistent with the concerns of social disorganization because the decline in socioeconomic status in a neighborhood has tended to lead to more violent crime. With respect to assaults, an increase in one percentage point of a lack of vehicle availability (percentage of people with no vehicle available) will lead to an increase in 0.0001182 more calls for service per capita. This relates to approximately one half of a call per one percent increase for a census tract of 5,000.

Additionally, the diversity index, Simpson's D, is significant in this model, while it is not significant in the aggregate calls for service model. Because the coefficient on the index is negative, as a census tract becomes less diverse, there tends to be fewer call about assaults. This is consistent with the Social Disorganization Theory's assertion that ethnic heterogeneity leads to greater incidence of crime. In this case, the coefficient on the Simpson's D variable is -0.00483, which suggests that in a neighborhood with a complete lack of diversity, there will be, on average, 24.15 fewer call for assaults than in a neighborhood that is highly diverse. Obviously, this statistic is a bit abstract because few if any neighborhoods are completely diverse (Simpson D equals 0) or non-diverse (Simpson's D equals 1), but all are somewhere along the continuum between 0 and 1; those

that are more diverse tend to have more calls for assault. This is consistent with the ideas of Social Disorganization Theory because, even though we like to view ourselves as being a post-racial society, there are still racial tensions that have real tangible impacts on how people interact with one another.

Another interesting point is that the concentration of Hispanic residents is significant in the aggregate calls for police service per capita (negative). This is no longer significant when considering assaults, while African Americans remain significant. Again, this agrees with the idea that the relationship between police and minorities is not consistent across all minority groups. Whether there are truly fewer assaults in certain minority groups or if they are reported less often is a question for future research, but it is important to understand when addressing the demand structure of the police calls for service.

Finally, the percentage of residents that have a bachelor's degree is not significant in this model, while it is significant and negative in the aggregate police calls for service. This is inconsistent with the ideas of social disorganization, but is consistent across the types of police calls for service addressed in this dissertation. Additionally, because the median household income of the census tract is also not significant, there is stronger support for the racial and neighborhood interrelationships components of Social Disorganization Theory as an effect on crime in this model than income and other financial characteristics. This is an interesting finding because it suggests that criminal activity, at least within the context of violent crime such as assault, might be more about the relationships within a neighborhood rather than the economic rational model of criminal activity.

With respect to the models outlining the results from per capita calls for burglaries in the City of Charlotte (Tables 10 and 11), there appears to be a stronger Moran's I than several other police call types in general, with a Moran's I of 0.0385.

Table 10: Burglary calls per capita results[16]

Independent Variables	MLE	OLS
Constant	-0.017	-0.0142
	.0282	0.029
Poverty	-0.000008943	-0.000035
	0.0002217	0.00023
Population	-0.000064205	-0.00006558
	0.0000119***	0.0000125*
Population density	-0.000002408	-0.00000231
	0.0000011413***	0.0000012*
Single parent	-0.0004642	-0.00049
	0.00035	0.00037
Bachelors	-0.000013019	-0.0000289
	0.00025	0.0003
Foreign born	-0.001007	-0.00105
	0.000442**	0.0004**
Limited English	0.001132656	0.00112
	0.0005087**	0.00053**
Management	0.000378774	0.0003
	0.0002232*	0.0002*
Renter occupied	0.0004836	0.0004
	0.000165***	0.00017***
No vehicle	0.000807769	0.000859
	0.000298364***	0.0003***
No plumbing	-0.0009328574	0.0010
	0.001496	0.0015
Tenure <5	-0.0000713883	-0.000481
	0.0001812	0.00019
Black	0.000304	0.000309
	0.0001276**	0.00013**
Hispanic	-0.00006777	-0.0000107
	0.000317	0.0003
Median age	0.0013734***	0.001352
	0.000489***	0.0005***
Median household income	0.000000084014	0.000000088
	0.000000112	0.000000118
Simpson's D	-0.03263539	-0.0329
	0.009***	0.0100***
Lag (Rho)	0.12462	n/a
	0.1049	n/a

[16] Significance levels: * p<0.1, ** p<.05, *** p<.01

Table 11: Burglary calls per capita model characteristics

Statistic	MLE	OLS
Pseudo R-Sqr	0.241266	n/a
Liklihood Ratio Test	1.309720	n/a
Adj R-sqr	n/a	0.1647
F Statistic	n/a	3.367***
Breusch-Pagan	n/a	107.1793***
White	n/a	190.1511

Though this is not a particularly strong indicator of spatial association, it suggests that spatial association exists to some degree, which suggests a spatial model is appropriate to deal with the effects of spatial autocorrelation.

In the case of burglaries in the City of Charlotte, after both the ordinary least squares model and the spatial models are run, there does not appear to be a substantial difference in the outcomes of the models. Also, the rho variables in the spatially lagged model and the Likelihood Ratio Test are both not significant, suggesting that a spatial model likely does not improve the model substantially. Additionally, when comparing the results across the various models presented, the variables that are significant are generally significant across the board and to similar coefficient magnitudes. Finally, when comparing the model fit, the two types of models are comparable, with perhaps a slight improvement with the spatially lagged model. However, comparing the Adjusted R-squared and the Pseudo R-squared must be done cautiously even if there is a slight improvement with the spatial model. Therefore, the spatial model will be used, though it may not be necessary.

The significantly variables that are related to the burglaries are very similar to those that are related to assaults. Of course, there are differences with regard to the magnitude of the number of calls for service per capita, but there are some interesting components, as well.

An interesting finding from the models that are analyzed in this series is the impact of foreign born populations and limited English speaking population on burglaries. In this model, the foreign born population concentration is associated with a declining number of per capita burglaries throughout the census tract. In fact, a one percent increase in the concentration of foreign-born population is related to a 0.001007 decline in the number of calls for burglaries in the census tracts within the City of Charlotte. This translates to the approximately five fewer burglaries per one percent increase of foreign born population. However, in locations in which there are more residents that are limited in their English speaking capability, there is an increase in the number of per capita burglary calls for service in the area. In this case, a one percent increase in the limited English speaking population is associated with approximately 0.0011 more burglary calls for service per capita. This amounts to a similar 5.5 more calls for service with limited English proficiency. There are some concerns here, of course, with the validity of the data that should be addressed. Incidents such as these require that a person calls to report the incident, rather than something like a fire or assault that could be reported by a bystander. While this finding is not consistent with the idea that limited English proficiency will reduce a person's willingness to interact with police, it is perhaps consistent with the idea that those who are newly immigrated to the country may be more willing to interact, perceiving American police to be more competent or less corrupt. This is because those who have limited English proficiency are obviously more likely to be first generation or newly immigrated persons. This might suggest that they would be more willing to call, versus the assimilated foreign-born person who may have had bad experiences with

American police. It is interesting that these components are in opposite directions and should be a direction for future research.

Another interesting point to note is the substantive impact that diversity has on burglaries in the city. In comparison to assaults, burglaries appear to occur more frequently and are impacted to a greater degree by diversity in the census tract. In this case, moving toward complete diversity will be, on average, 150 more burglaries in a census tract than having complete ethnic homogeneity in the area. Again, a census tract that is either completely homogenous or completely heterogeneous is largely theoretical, but there is a continuum of the diversity index. With respect to the diversity index, there is additional evidence that a lack of connection between residents will lead to further criminal activity since in more diverse neighborhoods, there may be fewer racial connections between groups.

With respect to the social disorganization characteristics, it appears that the primary determinant is the lack of connection that individuals might feel with the neighborhoods that they inhabit. In census tracts with higher renter occupations, there also tend to be greater occurrences of burglaries (0.0004, which results in approximately two more burglaries per percent increase in the renter rate). That does not seem like a lot, but in a census tract with 50 percent rental occupancy, there will be nearly 80 more burglaries than a census tract with a ten percent rental occupancy rate. Interestingly, though, housing tenure is not significant in this model.

The domestic violence calls for police service per capita has a comparable spatial association structure to burglaries, as shown in Tables 12 and 13. Though the Moran's I calculation for each of the three models provides evidence that there is spatial

autocorrelation in the dependent variable, when the spatial models are run, there is minimal difference between the ordinary least squares models and the spatially lagged models.

Table 12: Domestic violence calls per capita results[17]

Independent Variables	MLE	OLS
Constant	-0.033	-0.0241
	0.068	0.072
Poverty	0.000263	0.000212
	0.00053	0.00056
Population	-0.0001631091	-0.0001685
	0.00002906***	0.0000305***
Population density	-0.000007387094	-0.00000773
	0.0000027705***	0.00000292***
Single parent	-0.001014063	-0.00108
	0.00087333	0.0009
Bachelors	0.0005373131	0.000501
	0.0006965	0.00073
Foreign born	-0.002340574	-0.0025
	0.0010742**	0.001**
Limited English	0.003114441	0.00309
	0.00123489**	0.0013**
Management	0.001219622	0.001283
	0.00054**	0.00056**
Renter occupied	0.001151725	0.00113
	0.0004014***	0.000423***
No vehicle	0.0015959	0.001745
	0.0007217**	0.00075**
No plumbing	0.00060047	0.000006
	0.0036	0.0038
Tenure <5	-0.0006536	-0.00057
	0.00044	0.00464
Black	0.000995	0.0010314
	0.0003***	0.00032***
Hispanic	0.000002028892	0.000212
	0.00077	0.00081
Median age	0.002624987	0.0025
	0.001187**	0.001254**
Median household income	0.00000009914557	0.00000113
	0.000000272	0.000000288
Simpson's D	-0.0740809	-0.07609
	0.02320132***	0.0244***
Lag (Rho)	0.1678	n/a
	0.10239	n/a

[17] Significance levels: * p<0.1, ** p<.05, *** p<.01

Table 13: Domestic violence calls per capita model characteristics

Statistic	MLE	OLS
Pseudo R-Sqr	0.258865	n/a
Liklihood Ratio Test	2.602844	n/a
Adj R-sqr	n/a	0.1771
F Statistic	n/a	3.5849***
Breusch-Pagan	n/a	95.27131***
White	n/a	186.2078

Additionally, the log likelihoods are comparable between the two types of models. Finally, the significant variables are the same for both the ordinary least squares models and the spatially lagged models. In addition to the comparability of the outcomes in these models, the rho variable in the spatial model is not significant and the Likelihood Ratio Tests are also not significant, which suggests that spatial autocorrelation is not an issue of concern. However, because we recognize that there is at least some degree of spatial association in these models, it is appropriate to consider the spatial models since they do control for spatial association that is present in the dependent variable. However, because there are not substantial differences in the various coefficients in the model, an ordinary least squares model might appropriately address the questions in a manner without the coefficients and significant variables being biased.

The incidence of domestic violence in the City of Charlotte appears to have a similar characteristics of the demand structure for service structure as that of assaults and burglary. Again the magnitudes are different, but it appears that these violent crimes tend to have a similar set of characteristics, some of which are consistent with the social disorganization theoretical understanding of the phenomenon. There are some interesting components to this model.

The first interesting component in this analysis comes from the degree to which the concentration of management professionals in a census tract has a positive relationship with the number of calls for domestic violence received per capita. In this case, a one percent increase in the concentration of management professionals residing in a census tract is associated with a 0.001219 increase in the number of domestic violence calls for service incidents to occur with census tract. That translates to 12.5 more domestic violence calls per percent of management professionals in a 5,000 resident census tract. Though the concentration of management professionals is significant in a number of the other models, it tends to have less of an impact in other models than it does with domestic violence. However, the foreign born population and the limited English speaking population also have relationships to the number of domestic violence incidents that occur within census tracts in the City of Charlotte. This all suggests that perhaps there is an issue with incongruous reporting habits occurring in various neighborhoods. Particularly, there is a relatively substantive negative impact that foreign born populations have with occurrences of domestic violence. It is possible that in neighborhoods having a larger number of residents in management professions (and as a result are more highly educated) might be more likely to report the incident. Particularly if there is a distrust of police, which in theory should be in the foreign born population that has been in the country long enough to speak English well, they may also be less likely to report domestic violence to the police.

It is interesting that the diversity index has a relatively large relationship with the magnitude of domestic violence incidents in the city. Consistent with Social Disorganization Theory, in more diverse neighborhoods, there tends to be far more incidents of domestic violence than in neighborhoods that are less diverse. That could be

attributed to the social ties that neighbors feel with one another. Again, when a neighborhood is more diverse, theoretically there will be fewer social ties and, thus, there is an inability for the neighborhood to organize and prevent some of the violent crime that is occurring.

Domestic violence, though a violent crime like assault and burglary, is a distinctly different crime than the other two types. While there are some definite concerns about reporting, since to a large degree the predictors of police calls for service are similar, it stands to reason that many of the social disorganization characteristics can be easy associated with increased demands for service delivery.

Fire Department Results

When assessing the use of a spatial model, all of the fire department calls for service datasets demonstrate substantial spatial association. This is demonstrated in some cases in the relatively high Global Moran's I in the models that were calculated previously. This is the case for the each of the datasets in the fire all calls set of models, as shown in Tables 14 and 15.

In this case, the significant and positive spatial lag rho variable demonstrates that there is positive and significant spatial autocorrelation occurring in the model, and the significant Likelihood Ratio Test in each of the models for each year demonstrates that the spatial models perform better than their ordinary least squares counterparts. Additionally, the Pseudo R-squared calculated in the spatial model is superior to the Adjusted R-squared values in the ordinary least squares models.

Table 14: Aggregate fire calls per capita results[18]

Independent Vars.	MLE	OLS
Constant	-0.139	-0.149
	0.114	0.13
Poverty	-0.001114232	-0.0018
	0.0009	0.0011*
Population	-0.0000595014	-0.000122
	0.000048884	0.00005897**
Population density	-0.00001262609	-0.000009667
	0.00000463814***	0.000000564**
Single parent	-0.002797706	-0.003411
	0.001467624*	0.0017*
Bachelors	-0.002541265	-0.003411
	0.001166**	0.0014**
Foreign born	-0.0001189481	-0.001338
	0.001797	0.002
Limited English	-0.00164653	-0.00087
	0.00206	0.0025
Management	0.00672087	0.002109
	0.000911	0.001*
Renter occupied	0.001899571	0.003328
	0.0006812***	0.000817***
No vehicle	0.005953488	0.00922
	0.001235246***	0.0014***
No plumbing	-0.004649581	-0.0055
	0.006086122	0.0074
Tenure <5	0.00135889	0.00087
	0.0007374*	0.00089
Black	0.0003130486	0.0008779
	0.00052	0.00063
Hispanic	-0.0005093225	-0.00084633
	0.00128	0.0015
Median age	0.004738038	0.005453
	0.001986**	0.002419**
Median household income	0.0000007314999	0.0000007864
	0.0000004567977	0.00000556
Simpson's D	-0.07842252	-0.08969
	0.038836**	0.0472*
Lag (Rho)	0.553398	n/a
	0.06465***	n/a

[18] Significance levels: * p<0.1, ** p<.05, *** p<.01

Table 15: Aggregate fire calls per capita model characteristics

Statistic	MLE	OLS
Pseudo R-Sqr	0.663921	n/a
Liklihood Ratio Test	48.942***	n/a
Adj R-sqr	n/a	0.504
F Statistic	n/a	13.2045***
Breusch-Pagan	n/a	402.425***
White	n/a	182.2913

For these reasons, in consideration of all fire calls for service, it is appropriate to use a spatially lagged dependent variable model using maximum likelihood estimation to determine the impact that various demographic concentrations have on the demand for fire calls in the aggregate.

There are a number of significant variables in the models that are presented in the all fire calls data. Several of the social disorganization type variables tend to produce the expected outcome, particularly when spatial association is taken into account. However, what appears to be most impactful are the variables that relate to the inability to develop social bonds between community members. The variables that are associated with the socioeconomic characteristics of the community appear to have some impact, but not in all ways.

Probably most interesting is the impact that an increase in renter occupied residences and the impact that a short housing tenure has on the total calls for service outcome variables that are addressed. In these models, a one percent increase in renter occupied residences leads to 0.0019 more aggregate fire calls for service per capita on average. This suggests that in a census tract of 5,000 residents, a one percent increase in renter occupied residences is associated with approximately 10 more aggregate fire calls

for service than the neighborhoods that have less renter occupied status. Similarly, a one percent increase in the short term housing tenures of residents leads to a 0.002 average increase in the number of fire calls in the aggregate per capita, which is similar to the effect that renter occupancy has on calls for service. This would suggest that when neighborhoods lack social cohesion, there will likely be an increased effect on the demand for fire services in the community.

The Simpson's D variable has a negative and significant coefficient, which suggests that as a neighborhood approaches ethnic homogeneity, there will be a reducing number of fire calls for service per capita. In this model, in a census tract of 5,000 persons, a complete lack of heterogeneity will lead to nearly 400 fewer calls for service per year than a completely evenly diverse neighborhood on average. This is consistent with the component of Social Disorganization Theory that suggests that ethnic heterogeneity will lead to an inability for the neighborhood to organize and, thus, will lead to a higher demand for fire calls for service in the area.

Median age is also significant and positive, suggesting that a one year increase in median age in the neighborhood is related to a 0.004 increase in the number of fire service calls. It will become evident from the discussion later about the emergency medical services calls and the structure fire calls that this is likely driven by the number of emergency medical services calls that are required for older persons.

Finally, the bachelor's degree variable has a negative and significant impact on the number of aggregate fire calls for service per capita in these models. This suggests that a one percent increase in the bachelor's degree will lead to 0.003 fewer calls for fire services on average. This would lead to 15 fewer calls for service in a 5,000 per census tract.

Single parenthood and population density are also both significant, but are in the opposite direction than hypothesized. This makes it impossible to reject a null hypothesis related to these variables and can lead us to no determination regarding the applicability of Social Disorganization Theory.

From this information, it appears that social disorganization characteristics tend to have a significant relationship with the demands for services from the fire department. This expands the understanding of the impact that various characteristics have on local government services in general. However, the magnitudes of those impacts are, of course, another point of consideration which we need to address. The specific calls for service have different magnitudes.

When assessing the use of a spatial model, emergency medical services (shown in Tables 16 and 17) requested from the fire department dataset also suggests spatial association. This is also demonstrated in the high Global Moran's I in the models that were calculated in the section addressing spatial association.

The significant and positive spatial lag rho variable demonstrates that there is a positive and significant spatial autocorrelation occurring in the model and the significant Likelihood Ratio Test in each of the models for each year demonstrates that the spatial model performs better than their ordinary least squares counterpart. The impact that space has on this model compared to the aggregate model is less great, which is evidenced by the smaller magnitude of the LRT coefficient and the somewhat smaller coefficient on the rho lagged spatial variable. However, this is to be expected because there are a smaller number of EMS calls than aggregate fire department calls; EMS calls are a subset of the aggregate

calls. Additionally, the Pseudo R-squared calculated in the spatial model is consistently superior to the Adjusted R-squared values in the ordinary least squares models.

Table 16: EMS calls per capita results[19]

Independent Variables	MLE	OLS
Constant	-0.082	-0.088
	0.065	0.076
Poverty	-0.0002795594	-.000567
	0.000510417	0.00060
Population	-0.000027718	-0.0000596
	0.00002773647	0.0000324*
Population density	-0.000005493983	-0.000003867
	0.000002627662**	0.000003103
Single parent	-0.001363856	-0.0014713
	0.0008309231	0.000977*
Bachelors	-0.001314	-0.00182
	0.0006612**	0.00077**
Foreign born	-0.00014579	-0.00065
	0.00101	0.00119
Limited English	-0.0010039	-0.000735
	0.001172202	0.0013
Management	0.0004300992	0.001145
	0.0005169	0.00060*
Renter occupied	0.0007856931	0.001510
	0.0003865335**	0.00044***
No vehicle	0.003836667	0.005415
	0.000700***	0.0008***
No plumbing	-0.0009637	-0.0010
	0.003451	0.004
Tenure <5	0.0008221493	0.00054
	0.0004182029**	0.00049
Black	0.0001477306	0.0004
	0.0002954	0.00034
Hispanic	-0.0002301594	-0.00042
	0.00072	0.0008
Median age	0.002639	0.003054
	0.001125878**	0.00132**
median household income	0.0000006195918	0.00000035147
	0.0000002588541	0.0000003057
Simpson's D	-0.04152826	-0.045627
	0.02200266**	0.0259*
lag (Rho)	0.500925	n/a
	0.067***	n/a

[19] Significance levels: * p<0.1, ** p<.05, *** p<.01

Table 17: EMS calls per capita model characteristics

Statistic	MLE	OLS
Pseudo R-Sqr	0.657930	n/a
Liklihood Ratio Test	39.24645***	n/a
Adj R-sqr	n/a	0.052
F Statistic	n/a	14.2656***
Breusch-Pagan	n/a	418.224***
White	n/a	181.9183

Therefore, it is appropriate to use a spatially lagged dependent variable model, using maximum likelihood estimation to determine the impact that various demographic concentrations have on the emergency medical calls in the city.

There are a number of significant variables in the models that are presented in the emergency medical services calls for service that are similar to the aggregate fire calls. Again, the social disorganization type variables tend to lead to the expected outcome, when spatial association is taken into account. What continues to be most impactful are the variables that relate to the inability of the community to develop social bonds between community members. The variables that are associated with the socioeconomic characteristics of the community appear to have some impact, but not in every way.

The significant variables that have the largest magnitude of impact are the percentage of residents with no access to a vehicle and the percentage of residents who hold a bachelor's degree. In these models, a one percent increase in the lack of vehicle availability leads to 0.0038 more aggregate emergency medical calls service per capita on average. This suggests that in a census tract of 5,000 residents, a one percent increase in lack of vehicle availability is associated with approximately 20 more emergency medical services calls for service than the neighborhoods that have more vehicle availability. It is

possible that this is due to the need for transportation to the hospital, which calling for an ambulance will provide. However, that conclusion is not possible from the data in this model and could be a route of continued research.

Similarly, a one percent increase in the residents holding a bachelor's degree leads to a 0.0013 average decrease in the number of emergency medical services calls per capita. This is related to a reduction in approximately 6.5 emergency medical calls for service per one percent increase of people with a bachelor's degree, suggesting that access to medical care may not be as prevalent for those with less education. This, in addition to the finding regarding vehicle availability, is consistent with the idea that socioeconomic characteristics tend to have an impact on the demand for emergency services.

Median age is also significant and positive, suggesting that a one year increase in median age in the neighborhood is related to a 0.002 increase in the number of fire department EMS calls. This suggests that half of the increase in the aggregate calls for service related to the median age is attributed to the increase in the number of emergency medical calls associated with increasing age. This data suggests that a one year increase in median age will lead to 10 additional calls for service in a census tract of 5,000 people.

In this model, renter occupation percentage is also significant, but the magnitude of impact is far less than the aggregate model. This could also be consistent with the notion about the socioeconomic characteristics, as well as the social cohesion questions of Social Disorganization Theory

The Simpson's D variable in the EMS model also has a negative and significant coefficient, which suggests that as a neighborhood approaches ethnic homogeneity, there will be fewer calls for service per capita. Similar to the aggregate model, in this model, in

a census tract of 5,000 persons a complete lack of heterogeneity will lead to 200 fewer calls for service per year than a completely and evenly diverse neighborhood, on average. This further supports the theory that ethnic heterogeneity will lead to an inability for the neighborhood to organize and, thus, will lead to a higher demand for emergency medical services.

Population density is statistically significant, but is in the opposite direction than hypothesized, making it impossible to reject a null hypothesis related to these variables and can lead us to no determination regarding its applicability of Social Disorganization Theory. Also, the magnitude of impact is quite minimal.

The information provided by the output of the emergency medical services model suggests that the socioeconomic characteristics of the neighborhood have the largest degree of impact on the number of the calls for service, rather than the neighborhood cohesion characteristics found in the aggregate calls for service. This tends to suggest that the hypothesis suggesting that different types of calls will be associated with different characteristics of the social system is supported in principle.

With respect to calls for structure fires within the City of Charlotte, the dependent variable tends to demonstrate very high spatial association compared to the other models, with a Moran's I of 0.486082. That suggests that there is a high degree of spatial autocorrelation in the model and that a spatial correction is necessary in order to accurately fit the models.

The positive and significant coefficient, shown in Tables 18 and 19, on the rho variable in the spatial models, as well as the highly significant Likelihood Ratio Test, suggests that it is necessary to take the spatial characteristics of the model into

consideration. The much higher Pseudo R-squared, compared to the adjusted R-squared found in the ordinary least squares model indicates that the model performs much better when a spatial lag is applied.

Table 18: Structure fires per capita results[20]

Independent Variables	MLE	OLS
Constant	-0.00063	-0.00047
	0.00067	0.0007
Poverty	0.000003864615	0.00000560
	0.000005286229	0.00000601
Population	-0.00000016768	-0.000000331
	0.0000002857723	0.000000323
Population density	-0.0000000436227	-0.0000000337
	0.00000002717989	0.0000000309
Single parent	-0.00000123	-0.000005959
	0.0000085668	0.000009749
Bachelors	-0.0000017827	-0.00004833
	0.0000068619	0.00000777
Foreign born	-0.000000633987	-0.00000539
	0.0000105	0.00001197
Limited english	0.00000198797	0.00000695
	0.0000121316	0.0000138
Management	0.000002600	0.000001521
	0.0000053382	0.00000602
Renter occupied	0.0000116892	0.00001727
	0.00004012***	0.00000448***
No vehicle	0.00002255802	0.00001455
	0.00000701***	0.000007984***
No plumbing	0.0000285575	-0.000001902
	0.00003572386	0.0000405
Tenure <5	-0.0000008913051	-0.0000047077
	0.000004342	0.00000491
Black	0.000009803251	0.0000143
	0.000003143785***	0.000003460***
Hispanic	0.000003614647	-0.0000080464
	0.00000754291	0.000008586
Median age	0.00002113329	0.0000249032
	0.00001164813*	0.0000132*
Median household income	0.00000002440443	0.00000000127
	0.00000000268335	0.0000000030507
Simpson's D	-0.0002150151	-0.0001885
	0.0002275179	0.0002592
Lag (Rho)	0.3986446	n/a
	0.06944***	n/a

[20] Significance levels: * p<0.1, ** p<.05, *** p<.01

Table 19: Structure fires per capita model characteristics

Statistic	MLE	OLS
Pseudo R-Sqr	0.708409	n/a
Liklihood Ratio Test	28.63042***	n/a
Adj R-sqr	n/a	0.6230
F Statistic	n/a	20.8379***
Breusch-Pagan	n/a	68.01618***
White	n/a	177.3615

For this reason, it is appropriate to prefer the findings of the spatial model over the findings of the ordinary least squares model. It can be noted that the significant variables found in the OLS model are similar to those found in the spatially lagged model, but because they fail to take into account spatial autocorrelation, the estimators not being efficient. Therefore, it is necessary to utilize the spatial model in this case.

There are very few significant variables in the model that provide insight into the demographic impacts on structure fires; in fact, the magnitude of the impact is very small for each of these. However, from a financial perspective, one structure fire event is more costly to deal with than even a large number of, for instance, emergency medical calls. For instance, the initial alarm assignment for a structure fire results in multiple engine and ladder companies, a rescue company, and a battalion chief to respond, while an EMS call takes just one engine company from the fire department. Therefore, neighborhoods that have very high rates of the significant variables, the impact on city finances is great. Because the incidence of structure fires is so highly spatially associated, there is a serious fiscal spillover impact from other areas of the city. There are several predictors of higher structure fire rates.

The first characteristics that exerts significant impacts on the rates of structure fires within a census tract is the percentage of renter occupancy (0.0000116892), which is a

small coefficient. However, in a census tract of 5,000, a one percent increase in renter occupancy will result in approximately 0.05 more structure fires. This suggests that in some of the census tracts with more than 80 percent renter occupancy rates, on average there will be approximately 4 more structure fires per year than where there is complete homeownership. In a single census tract, this creates a substantial impact on the resource demand stress.

Another interesting finding is that the lack of vehicle availability is also significantly related to an increase in structure fires in a census tract (0.0000225), which is again a small magnitude compared to the aggregate calls for service or the EMS calls, but a one percent increase in the lack of vehicle availability leads to 0.11 more structure fires per year in a census tract of 5,000 people. Similar to the rental occupancy, this suggests that in a neighborhood that has upward of 50 percent with of households that vehicle availability can lead to nearly 6 more structure fires per year. I suspect that the lack of vehicle availability is really a symptom of socioeconomic status, even though neither the poverty rate nor the median household income are significant. There is also a similar relationship between the concentration of African Americans and the number of structure fires, at a rate similar to that of the rental occupancy, which I also suspect is symptom of socioeconomic status rather than some inherent relationship to race. Importantly, that relationship does not exist with the respect to Hispanic residents, which indicates a difference between the minority groups.

Age is also significant, but not in the direction expected. From a social disorganization perspective, a younger median age of residents might be related to more

fires because the community cannot adequately supervise the youth, but that is not the case in this circumstance.

Table 20 summarizes all of the findings developed in this section, of this study has been provided, indicating all of the significant findings and the coefficient direction. Throughout the models, there are a number of variables that are consistently significant and in the direction that is theoretically expected. First, the concentration of renter occupancy is consistently significant and positive for every model that was analyzed. This indicates that renter occupancy is likely a good predictor of the demands for emergency services. Further analysis of this finding is found in the next chapter, as well as additional policy implications. Secondly, the lack of vehicle availability shows a similar significance, except in the case of the police department's aggregate calls for service. Finally, the Simpson's D index calculation is also significant and negative (as expected), which indicates that ethnic heterogeneity is associated with higher calls for service.

The consistent significance of these variables indicates that the concepts of social disorganization are supported by both the police and the fire departments' demands for emergency services. Though not all variables intended to indicate the existence of social disorganization are consistently found to be significant, these three variables provide strong evidence that social characteristics have a strong relationship with demands for service, and can be used to predict those demands to some extent.

Table 20: Summary Table

	MLE							OLS						
Independent	PD all	Assault	Burglary	Dom.	FD All	EMS	SF	PD all	Assault	Burglary	Dom	FD All	EMS	SF
Constant	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Poverty	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	- *	ns ns	ns ns
Population	+ ***	- ***	- ***	- ***	ns ns	ns ns	ns ns	- ***	- ***	- *	- ***	- **	- *	ns ns
Population density	+ ***	- **	- ***	- ***	- ***	- **	ns ns	- ***	- **	- *	- ***	- **	ns ns	ns ns
Single parent	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	- *	- *	ns ns
Bachelors	- ***	ns ns	ns ns	ns ns	- **	- **	ns ns	- ***	ns ns	ns ns	ns ns	- **	- **	ns ns
Foreign born	ns ns	- **	- **	- **	ns ns	ns ns	ns ns	ns ns	- ***	- **	- **	ns ns	ns ns	ns ns
Limited English	+ ***	+ **	+ **	+ **	ns ns	ns ns	ns ns	+ ***	+ *	+ **	+ **	ns ns	ns ns	ns ns
Management	+ ***	+ **	+ *	+ **	ns ns	ns ns	ns ns	+ ***	+ *	+ *	+ **	+ *	+ *	ns ns
Renter occupied	+ **	+ **	+ ***	+ ***	+ ***	+ **	+ ***	+ **	+ *	+ ***	+ ***	+ ***	+ ***	+ ***
No vehicle	ns ns	+ **	+ ***	+ **	+ ***	+ ***	+ ***	+ *	+ **	+ ***	+ **	+ ***	+ ***	+ ***
No plumbing	- *	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	- *	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns
Tenure <5	+ ***	- *	ns ns	ns ns	+ *	+ **	ns ns	+ ***	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns
Black	+ **	+ ***	+ **	+ ***	ns ns	ns ns	+ ***	+ **	+ ***	+ **	+ ***	ns ns	ns ns	+ ***
Hispanic	- ***	ns ns	- **	ns ns	ns ns	ns ns	ns ns	- ***	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns
Median age	+ ***	+ *	+ ***	+ **	+ **	+ **	+ *	+ ***	ns ns	+ ***	+ **	+ **	+ **	+ *
Median household income	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns	ns ns
Simpson's D	ns ns	- ***	- ***	- ***	- **	- **	ns ns	ns ns	- ***	- ***	- ***	- *	- *	ns ns
Lag (Rho)	+ **	+ **	ns ns	ns ns	+ ***	+ ***	+ ***	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a	n/a n/a

Explanatory Clustering and the Heteroskedasticity Issue

The assumption of homoskedasticity suggests that the variance of the disturbance is constant for all values of the independent variable (Gujarati and Porter 2009, 365). The absence of homoskedasticity (equal variance) is heteroskedasticity and, thus, the disturbance is not constant for regressors. In the case of heteroskedasticity, coefficients are unbiased and consistent, but are not efficient and the standard errors are biased. In several of the models, heteroskedasticity is present. According to Gujarati and Porter (2009), there are a number of causes of heteroskedasticity, including: error learning models; non-constant choice options as a function of an independent variable (i.e. income discretion); incongruous data collection techniques; outliers; specifications error, particularly missing regressors; skewness of one or several regressors; incorrect data transformation and incorrect functional form. As a result, it is appropriate to explore this issue and determine the extent to which this can be solved through manipulation of the analytical tools employed. The independent variables have already been checked for skewness and functional form. After transforming the few in which there was a concern, there was not an apparent improvement in the models.

Through the LISA analysis provided above, it is apparent that most independent variables are spatially associated with their neighbors, some to a larger degree than others. Of course, spatial autocorrelation is not the same thing as heteroskedasticity, but one of the causes of heteroskedastiscity is misspecification of the model, which is likely a result of the spatial autocorrelation of the independent variables.

In addition to the statistical issue related to spatial clustering of the independent variables, it is interesting to consider how the clustering of various demographic groups

and social issues affect the outcome variable. A further research question can be related to the extent to which the existence of clustering of these effects impacts the outcome variable. While it is possible to map the spatial association of the independent variables used in this model, a traditional spatial lag model, such as the Maximum Likelihood Estimation used above does not account for any clustering of the various circumstances. In order to assess the extent to which pockets of socioeconomic concentrations can have effects overlapping into other areas, a more sophisticated model is necessary.

There are, as we can see, two problems with the models presented above, both of which can be solved and explored with a common approach. A typical spatial lag model, such as the one used above, provides a spatial lag related to the dependent variable *y* in which neighbor's a value of calls for service are accounted for in the model. An appropriate way to deal with spatial clustering of values with respect to the right hand side variables is the use of a Spatial Durbin Model. This model utilizes the Common Factor Hypothesis, which "exploits the property that a spatial error model can also be specified in spatial lag form, with spatially lagged explanatory variables included" (Anselin 2003, 15). In this case, the model will lag the right hand side variables that have statistically significant global Moran's I calculation, utilizing the existing queen's spatial weights matrix developed for the previous analysis. The Spatial Durbin Model is specified as follows:

$$y = \rho W y + X\beta + WX\gamma + \mu$$

Where y is the endogenous variable, X is a matrix of exogenous variables, W is the spatial weights matrix, and γ is the vector of coefficients of the spatially lagged covariates (Bivand et al. 2008). This allows assessment of the effect of larger scale clustering on an individual census tract's calls for service in the various areas. A complete print off of the

regression results for each model is available in the appendix, but I have reported some of the most interesting findings for the lags here.

First, it is important to discuss the interpretation of the output of the Spatial Durbin Model because it is somewhat more complex than the OLS, though not greatly so. Of primary concern is the impact that the concept of *direct* and *indirect* effects have on the way that the output is interpreted. In a spatial model, "if a particular explanatory variable in a particular unit changes, not only will the dependent variable in that unit itself change but also the dependent variable in other units. The first is called *direct effect* and the second an *indirect effect*" (Elhorst 2010, 19). Depending on the type of spatial model that is adopted, there may be different ways in which the indirect and the direct effects are characterized from the output provided by the statistical software. Fortunately, the Spatial Durbin Model's interpretation is straightforward. Elhorst (2010, 21) notes, "If the spatial Durbin…model is adopted, the direct effect of an explanatory variable is equal to the coefficient estimate of the variable (β_k), while its indirect effect is equal to the coefficient estimate of its spatial lagged value (γ_k)." This all suggests that it is possible to compare Spatial Durbin coefficients to OLS coefficients.

In order to determine the effect that spatial clustering around the unit of analysis of a particular variable has on the dependent variable is determined using the indirect effects from the Spatial Durbin Model coefficients, which are the coefficients on the lagged variables. As a result, significant results of the lagged values are reported with respect to the outcome characteristics. This provides some insight into how clustering affects the demands for emergency services. We also know stronger cluster effects will occur when both direct and indirect effects in the Spatial Durbin Model are both significant.

With respect to the fire department[21], there are a number of the lagged variables that have significant indirect effects that may suggest a clustering situation in which the characteristics of neighboring census tracts will have an impact on the unit of interest. This suggests that the concentrated area of concern can potentially have expanding effects, driving the concern of pocketed areas. I specifically do not use the term poverty pockets at this point because, as it become apparent before, the actual poverty rate is not a very good predictor of the emergency services demand, at least in this sample. Instead, there are a number of variables that can be associated with the existence of poverty besides the actual rate itself.

For instance, the lagged lack of vehicle availability has a highly significant and positive impact coefficient with respect to fire calls in the aggregate and EMS calls[22], which suggests that in pockets of the city in which there is a much higher concentration of people with no car, there will also be much higher demands for those two types of calls. If Charlotte were a city like New York in which it is not necessary to own a vehicle to get around, this may not suggest much about the circumstances in which people are living. In Charlotte, though, it is nearly impossible to get around without a vehicle and the lack of vehicle availability likely speaks directly to the socioeconomic status of the area. To some extent, the same can be said of the renter occupancy rates[23], which is positive and significant in both of those models as well. Generally speaking, people who have the means will purchase a home rather than rent if at all possible. In this case, there is a similar direct

[21] Model fit tends to be somewhat better in the Spatial Durbin Model for fire department calls than the spatially lagged model, though that is not the case in the Structure Fire calls, which will be discussed below. The best model improvement in the EMS calls for service.

[22] is 0.01225, p value is 0.00019 for aggregate fire; 0.00698 and 0.0001947 respectively for EMS

[23] is 0.004275, p value is 0.00215 for aggregate fire; 0.00254 and 0.001108 respectively for EMS

effect (the coefficient in the not-lagged variables) for the same independent variables, suggesting a strong clustering effect.

With respect to the EMS calls, there are a couple of other interesting indirect findings that may be of some value. First, the lagged limited English capability variables is both positive and significant, with a γ coefficient of -0.00728 (p value is 0.0097)[24]. This suggests that as the clustering of limited English speakers increases, there will be fewer calls for EMS. This is perhaps due to the unwillingness of a non-English speaker to call for help, possibly because of a fear of not being able to communicate. This is not the case with the concentration of just foreign-born persons, even though non-English speakers are likely mostly foreign-born. Additionally, both the indirect and direct effects of higher levels of bachelor's degree holders leads to a decline in the demand for emergency medical services.

Interestingly, structure fire calls for service do not experience the indirect effects with respect to the independent variables that the aggregate fire calls for service and EMS calls do. This suggests that the individual neighborhood effects are more important with respect to structure fires than the clustering of those issues throughout regions of the city.

Generally speaking, the police models do not experience the indirect effect of spatial clustering of neighborhoods in the same way that the fire department models do. In fact, none of the lagged variables demonstrate statistical significance, except the lagged Hispanic concentration on the burglary outcome variable. I do not have an explanation for that finding that is supported by theory. The fact that the Spatial Durbin model does not present evidence of clustering indirect effects is to be expected, though, because the police model dependent variables exhibit a relatively weak spatial association and there is a more

[24] This direct effect is not significant at the 0.05 level, but is close (p value is 0.09) suggest this clustering effect might be in existence, though with only 91% confidence can that be said to be true.

clear randomness to the distribution of the per capita calls for service. For that reason, it is not possible to address a larger spatial overlap consideration.

An additional point of interest is that there are several instances in which the direct effect variables in this model remove some of the significant independent variables that were found in the traditional spatial lag model. This occurs primarily in the police service models, which suggests that the Spatial Durbin Model may not be entirely appropriate since the spatial characteristics are not nearly as strong in the police calls model. Additionally, this is less of a concern because the model fits are actually better in the traditional spatially lagged model than the Spatial Durbin Model. However, from the perspective of the analysis, if the analysis were replicated in another location or with a different sample, it would be appropriate to at least test the use of the Spatial Durbin Model to deal with these issues if necessary.

With respect to the heterskedastisticty issue, generally speaking, the introduction of the Spatial Durbin Model reduces the extent to which heterskedasticity is in the model, though less so in the police models than in the fire department models. However, there remains some heteroskedasticity in the model and an integration of transformation of the variables with the Spatial Durbin Model resulted in minimal improvement of the model fit.

CHAPTER 6: CONCLUSIONS, POLICY IMPLICATIONS, FUTURE RESEARCH

Between 2006 and 2010, the Charlotte Fire Department responded to over 450,000 calls for emergency service within its response area, and the Charlotte Mecklenburg Police Department responded to approximately 2.1 million calls during the same time period and in the same service area. While responding to the same general areas with similar circumstances, the spatial distribution of demands for emergency services vary greatly between the two departments and the services they provide. The analysis of the large amount of data that was available for this research allows for the development of a number of important conclusions closely related to the research questions and hypotheses of this study. With respect to the demands for emergency services within the City of Charlotte, I am able to identify the following conclusions, make recommendations related to the predictors of the demands for emergency services, and propose opportunities for future research.

Conclusions

The first important conclusion that this research develops is the understanding that the socioeconomic demographics of the city are not equally and randomly distributed. While this is not a particularly surprising finding and literally dozens, if not hundreds, of other scholars have come to the same conclusion regarding the spatial characteristics of demographics within cities, the vast majority of research that has focused on emergency services demands and spending have treated cities as if their socioeconomic characteristics are homogenously distributed (see Pack 1998). This is clearly a simplification of the truth

and is demonstrated throughout the quantitative results chapter of this study. In particular, the spatial characteristics that are quite striking are the comparisons between the concentrations of race and the various economic characteristics. It is clear that not only is Charlotte a racially divided city, it is also economically divided, largely along racial lines. With respect to spatial association of various demographic characteristics, in general, the socioeconomic characteristics that are defined as the independent variables in the various models that are presented, except the lack of available plumbing, all demonstrate a positive and significant Moran's I. This is consistent with the ideas developed in Social Disorganization Theory, which suggest that problematic characteristics of a neighborhood will compound upon themselves. It is also consistent with spillover theory which suggests that those effects are not contained to the problem tract itself. This strongly supports the hypothesis that the socioeconomic characteristics of census tracts within the city are positively and significantly associated with the characteristics of neighboring census tracts. However, demographic characteristics are not the only characteristics that demonstrate spatial association.

The second conclusion that can be developed from this research is that the physical location of the demands for emergency services within the City of Charlotte are not randomly distributed throughout the City. When considering the physical location of these calls for emergency services within the City, it becomes clear that there are certain areas of town that require more services than others. This is, however, not consistent between the two disciplines and the locations are not consistent across the various call types. In general, I find that the fire department's calls for service tend to be far more spatially clustered than police department calls for service. This is particularly surprising since much

of the research on Social Disorganization Theory and the impact of spatial concentration of various demographic group has focused largely on police departments. A key finding of this research demonstrates that perhaps the characteristics that are so widely researched in criminology and general law enforcement-focused literature can also be applied to other areas of emergency services. At a minimum, this research has demonstrated that there may some similar characteristics, and at a maximum has demonstrated that in Charlotte the clustering of fire department calls for service are much tighter and more strongly driven by geography than law enforcement calls for service. Of course, in order to determine the accuracy of that claim, further research from other cities would be necessary to ensure that there is nothing unique to Charlotte's fire department or police department response characteristics. While it is clear from the LISA analysis provided in Chapter 5 that the fire department has relatively strong and positive spatial association characteristics compared to the police department, there are fewer variables that demonstrate statistical significance with regard to the predictors of demands for emergency services. This analysis has identified the effects that various socioeconomic characteristics have on the demands for various types of emergency services within the city. As hypothesized, the effects that each of these items has is dependent upon the types of call for service that is being addressed.

The third conclusion that can be generated as a result of this research is that different socioeconomic processes affect demands for services differently when considering various types of calls for service. There are a number of theoretical implications for the findings that are developed in this analysis. First, several of the factors that have been identified as characteristics associated with social disorganization are consistent with theory. In the models that have been presented, when holding race and

poverty constant, two items that were designed to identify the existence of social disorganization in a neighborhood were consistently significant and positive. The concentration of renter occupied structures and the lack of an available vehicle (with the exception of the police department all types of calls) both demonstrate this circumstance. The renter occupancy is consistent with Social Disorganization Theory's understanding that a lack of ties to neighbors might lead to a declined capability of the neighborhood to socially organize. Inherently, when people are renting residences, they do not have the same commitment to the property or neighborhood as someone who has a vested interest in maintaining a positive and connected social climate in the neighborhood. As such, a neighborhood with a large concentration of rental occupancies will likely have a large number of people who are not interested in getting to know one another or look out for their neighbors, and, as a result, the existence of criminal activity may be more likely. On the fire department side, renters are more likely to experience structure fires and emergency medical services as well. From the structure fire perspective, a person who is renting is much less likely to be concerned with the well-being of the structure and might be more likely to engage in behavior that is not fire safe. In the case of the lack of vehicle availability, this is likely a symptom of a lack of financial resources, which is also an indicator of social disorganization.

In a process similar to that of rental occupancy, the concentration of residents within a census tract that have been in their residence for less than five years is also significant and positive in a number of models (all models except domestic violence and structure fires). When a person has lived in a neighborhood for a short amount of time, it is less likely that the person will be connected to neighbors and, as a result, may not be

likely to be involved in the neighborhood. This increases the degree of social disorganization within a neighborhood.

An additional implication of the findings in the models demonstrates that the racial characteristics of a neighborhood have significant impacts on interactions with emergency services. Theory presented earlier in the literature review suggests that minorities might be less willing to interact with police because of a concern that they will not be treated fairly by authorities. In the case of African Americans, the models suggest that neighborhoods with higher concentrations of African Americans will have a significantly higher demand for all police services, and for the occurrences of structure fires. However, for emergency medical calls and for fire department calls in general, there is not a significant effect. This would appear to be in contrast with the notion that African Americans are less likely to interact with police. Another explanation might be that police officers are spending more time in places with higher concentrations of African Americans trying to "drum up business". So, there may be a problem of endogeneity at work.

In contrast, the concentration of Hispanic residents appears to have either a non-significant impact or a negative impact with respect to calls for service. This may be consistent with the idea that different minorities have different experiences with authority figures and that minorities cannot be lumped into one group with respect to impacts on demands for emergency services. Additional evidence from these models supports this concern with respect to foreign-born individuals. While the concentration of foreign born residents demonstrates a negative relationship between concentration and several call types, the concentration of people with limited English speaking capabilities actually demonstrates a positive relationship. This might suggest, as previous literature has

described, that newly immigrated residents might be more willing to interact with local officials than those who have been here for some time. Those who have limited English capabilities would more likely be newly immigrated. Additional research could focus on how that relationship changes over time.

One of the three major tenets of Social Disorganization Theory is that ethnic heterogeneity is strongly related to the inability of neighborhoods to organize. The literature suggests that this may be the case because people who are living in close proximity to one another but do not share common values, are more likely to conflict with each other. This could be the case when there is substantially higher ethnic heterogeneity, which is one of the characteristics of a socially disorganized neighborhood. This finding is generally supported in the models that have been presented in this study, with Simpson's D heterogeneity index significant in all but the structure fire and the police aggregate calls for service.

In general, the characteristics of socially disorganized neighborhoods are shown in the models to have the effect that might be expected from findings in the literature. While not all variables that are designed to capture the characteristics of neighborhoods (high residential mobility, low socioeconomic status, ethnic heterogeneity) that are socially disorganized are significant for all outcome variables, there are several that are consistently significant. With respect to residential mobility, the concentration of the renter occupied residences variable is consistently significant and positive across all outcome variables. The lack of an available vehicle is also significant across all outcome variables, except police department calls for service in the aggregate. And, Simpson's D, the ethnic heterogeneity variable, is also frequently significant and negative. A primary finding of

this research is that not only do the social disorganization variables predict the occurrence of crime in the city, but they also predict demands for firefighting services. This is consistent with the literature in both the determinants of demands for both fire and police. While it is true that the social processes that lead these variables to impact those services are likely not consistent between law enforcement and firefighting and emergency medical services, the underlying social characteristics of neighborhoods can be consistently assessed in order to determine the demands for emergency services.

It is also important to note that, in general, the spatial models improved the performance of the models, though the spatial models best improved the fire department results. It is apparent in the LISA analysis that the fire department's response demands are far more concentrated in certain areas than the police department's. Further, there was some nominal improvement in the model by the use of the spatial Durbin model, which took into account not only the spatial autocorrelation associated with not only the outcome variables, but also the spatial autocorrelation associated with all of the independent variables as well. The reality that the census tracts are inherently social constructs and are probably not all independent of one another provides justification of the use of spatial models. This study demonstrates how those models can be implemented and how they can affect the outcome of the analysis.

Policy Recommendations

The results from the present research point to several areas of improvement that could have a positive effect on the demands for emergency service delivery, as well as quality of life for residents. The value assumption of these policy recommendations is that it is desirable to reduce the number of emergency calls for service. Should that occur, it

can be assumed that there are fewer emergency problems that citizens are experiencing, reducing government costs. This reduces the burden on taxpayers and improves quality of life for residents of the City of Charlotte. These policy recommendations could be applied to the City of Charlotte, as well as other localities.

The policy recommendations presented herein are interdisciplinary in nature and rely on input and actions from various city government departments, as well as interaction with neighborhood groups in certain circumstances. Of course, this is not an exhaustive list of the solutions that might be available to reduce the need for residents to utilize emergency services, but rather it is set of examples of how city government must break down bureaucratic walls to solve the complex problems that the city faces. This is essentially a holistic approach to solving these issues.

Use Spatial Models for Analysis

When considering the allocation of emergency services resources, the City should utilize spatial models that take into account the clustered demographics of various neighborhoods within the city. While this research has utilized both non-spatial and spatial models, it has demonstrated that not all areas of the City are equal and that social problems are not randomly distributed throughout the City. There is typically some model improvement when utilizing spatial characteristics in this study. As a result, there are hot and cold spots with respect to the demands for emergency services. Building an understanding of the demographic makeup of neighborhoods and their adjacent neighborhood allows for an understanding of the processes by which social problems lead to the need for emergency services. If using a model that treats all of the areas equally, the demands for some resources will be stretched more thinly in some areas compared with

other areas. This could lead to reduced response capability within certain neighborhoods in which resources are more taxed. As human service organizations, development of a strong understanding of the social processes that lead to the need for emergency services will allow the City's Police and Fire Departments to alter their service delivery models in such a way that takes into account actual conditions and provide a stronger predictor of needs. Therefore, a model such as the spatial Durbin model may be used in certain circumstances if independent variables are also spatially autocorrelated. High-low clusters should be monitored closely because they may indicate emerging hot spots (high-high clusters).

Alter the Fire Department Resource Allocation Model

Presently, the Fire Department operates under a consistent geographic model in which fire stations are located approximately 2.5 miles away from one another. The grid of fire stations within the City is consistent with standards set forth by the Insurance Services Organization (ISO), which is the organization that grades fire service delivery. However, it fails to take into account the social processes that lead to higher demands for emergency services. It is clear that in neighborhoods with higher percentages of renters, there are higher levels of demands for both emergency medical services and the occurrences of structure fires per capita than in areas with higher home ownership. The Fire Department should consider continuing this analysis and placing resources throughout the city in a manner that uses historical call data to predict the likelihood of various types of emergency calls for service. For instance, in areas that are more likely to have structure fires, additional engine and ladder companies could be placed. In areas with a high degree of emergency medical calls, service could be improved by placing single-purpose first

response EMS vehicles in service, rather than utilizing full engine and ladder companies to provide first response emergency medical care. This would reduce wear and tear on expensive firefighting equipment and would reduce stress on fire personnel.

Increase Departmental Outreach to Hispanic Neighborhoods

One of the concerns that comes out of the literature on the subject of interaction between neighborhoods and the public service authorities is that there may be an unwillingness for residents of minority status to reach out and interact with local authorities. In the data that were analyzed in these models, it appears that lower call volumes comes from neighborhoods with higher concentrations of Hispanic residents. While it could be that Hispanic neighborhoods have stronger social organization than other groups, the literature reviewed would suggest that there may be a lack of willingness to call for assistance in the time of need, particularly if these are Hispanic neighborhoods in which there are a large number of immigrants who have been in the City for some time. If it is true that the neighborhoods have strong social ties and, as a result, there is just less need for emergency services, that is a good thing. However, if there is a concern regarding the propensity for a resident in a Hispanic neighborhood to reach out to the fire and police departments for assistance, the City should engage in activity that works to endear the agency to the residents of those neighborhoods. By creating a more trusting relationship, the departments may be able to encourage people to call for help when they need it. While I mentioned previously that the driving value of the policy recommendations is to reduce calls for service, it is certainly appropriate to ensure that everyone who needs help is receiving it. Perhaps one day, demands for emergency service will be reduced by increased social organization and less actual need for emergency services rather than an

unwillingness to interact. This can be accomplished by holding neighborhood block parties or meetings and creating a dialogue between local authorities and residents. Certainly, neighborhood leaders must be consulted regarding the best way to do so in each neighborhood, but, it is clear that participation in the 287(g) program likely reduces the willingness of the Hispanic community to work with local government in the Charlotte-Mecklenburg area. Ending this practice is a key component of building the relationship with the Hispanic community, particularly in areas with a high degree of foreign-born residents.

Increase Crime and Fire Prevention Efforts in High Rental Areas

One of the most important predictors of the demands for emergency services within the models that have been presented is the existence of high concentrations of rental residences. This is consistent with the ideas developed in the social disorganization literature and is brought forth in the data that was used for this analysis. This is also consistent with the component of social disorganization in which high residential mobility might lead to greater disorganization. In the models presented, an increase in rental units is consistently associated with greater demands for emergency services per capita. Since this is the case, the police and fire departments should increase the degree of crime and fire prevention activities in neighborhoods in which there are high proportions of rental units. This could occur in a number of different ways, such as working with neighborhoods to build relationships with police so that criminal activity can be heavily discouraged or educating residents on the dangers of certain behaviors that can lead to fire (such as using non-traditional heating sources).

Additional research is necessary to determine if certain types of crime and fire prevention methods are necessary, given various crime and fire trends. Certainly, renter occupancy appears to have a stronger impact on domestic violence incidents than on assaults in the city as a whole, for instance, but that may not be the case in every neighborhood. Proper analysis would provide information on what is necessary in individual neighborhoods.

Encourage Residential Home Ownership and Mixed-Income Development

A key component of the social disorganization discussion is residential mobility that reduces the connections neighbors have with one another. The city government should encourage home ownership among the residents of the city. This could be accomplished by subsidizing home ownership through real property tax abatements for new and first-time home buyers for a period of several years, which could be accomplished for both single family residences as well as individual units within apartment complexes. In addition to subsidizing home ownership, it would be necessary to incentivize present owners of rental properties to places their properties for sale. This could be accomplished by taxing rental properties at a higher rate than owner occupied residences. By encouraging home ownership, the city would be encouraging residents to have a stronger stake in the neighborhood social organization and would be more likely to work to encourage behavior among other residents that allows the maintenance of property values. Strong interactions among residents might encourage everyone to behave in a manner this is less likely to favor criminal activity, as well as encourage fire safety.

Because there are some serious potential externalities associated with this policy recommendation, such as increasing rental prices in locations that are inherently natural

and appropriate for rental housing (such as in the University City and other college housing areas) and reducing the amount of affordable housing available, a substantive analysis of the pricing effects would be necessary. Areas for special taxing districts could potentially be delineated by altering the zoning classifications to include those definitions. This option could potentially require significant cooperation of the North Carolina General Assembly in order to provide the authority to engage in this practice. However, the city can take additional steps to encourage neighborhood connections.

In addition to the encouragement of homeownership, the increase in residential ownership should be created such that there is a diversity of values of homes within neighborhoods, rather than insolating the development of affordable housing from more affluent and from amenities. The City must be sure to ensure that affordable housing development has access to amenities such as transit, shopping, and access to recreational space.

Encourage Mixed-Used Infill Development and Green Space Development

A key concern of social disorganization is that residents are not having opportunities for positive interactions and do not have time to build the long-term relationships that are necessary for a neighborhood to become socially organized. Particularly in large apartment complex neighborhoods with substantial renter residency, the city should enact development policies that encourage mixed-use infill, providing opportunities for residents to interact and get to know one another. In addition to private development, the city should work to increase green space and walkability of neighborhoods to encourage residents to go outside and have opportunities to develop relationships. This investment will require a substantial effort from the city to partner with

private sector stakeholders, such as apartment management companies and potential retailers. These sites should also be close to transit route such as light rail, buses, etc.

Summary of Policy Recommendations

The policy recommendations provided herein demonstrate the need for city government to encourage interaction among residents within neighborhoods and between neighborhoods and city government. Additionally, these policy recommendations represent cooperation between city departments that can lead neighborhoods to opportunities for endogenous social organization. The city will never be able to legislate social organization within neighborhoods, but may be able to create an environment in which neighbors are interested in, and willing to improve, social organization. This should help to improve the atmosphere related to crime and fire safety. Importantly, though, the city's actions must be tailored to the needs of individual neighborhoods. While some neighborhoods may have problems with transience, others may have problems related to lack of work opportunities that lead to incentives for residents to engage in illegal trade. Still others may have problems related to discourse between various races that live in neighborhoods. While the City will never be able to solve all problems, the City can help neighborhoods help themselves.

Future Research

The results of this study provide the opportunity for a number of potentially interesting areas for future research with respect to the City of Charlotte, as well as other metropolitan areas. Each of these items suggest additional qualitative analysis. First, when designing this research, I had hoped to include interview data from service providers to help me understand what processes are evident to service providers and to learn about their

experiences with various neighborhoods in which there are higher demands for emergency services. The idea was that a street-level bureaucrat would be able to provide some insight form their day-to-day interactions with neighborhoods and should be able to provide their thoughts on why certain demands are higher in some places. Unfortunately, both agencies were unwilling to allow me to have access to their employees, which I suspected might occur. A good future research project, should the departments ever allow access to their personnel, would be to conduct a qualitative component in which a more in depth analysis of calls for service hot spots is performed.

In the same vain, an additional opportunity for research would be to conduct interviews of residents living in the areas in which there are higher levels of calls for services per capita. These individuals may be able to provide some insight into the social processes that produce the problems that lead to more dense demands for emergency services. This could be accomplished by interviewing residents, community and neighborhood association leaders, and agents (such as apartment complex managers) that have access to a large number of residents. Mixing this data with the data accumulated in the previous paragraph's future research, as well as the data presented in this dissertation, would provide a meaningful triangulation of social processes that lead to increased demands for emergency services.

A particularly important opportunity for additional research is to determine what, if any, barriers exist for some demographic groups to interface with local government. The results of this study indicate that there is the potential for some concern regarding the willingness for some minority residents to call for emergency services. If that is the case, understanding the causes for such a lack of comfort in interaction will be a meaningful

pursuit, not only for theoretical concerns, but also for local government practice. In a new gateway city such as Charlotte, particular concern needs to be paid to the relationship that local government has with its newly and recently immigrated residents. Particularly, it is necessary to address whether there are in fact fewer concerns in Hispanic neighborhoods, or if residents of those neighborhoods are unwilling to interact with a local government emergency service force that is not seen by the neighborhood as sharing similar neighborhood concerns.

Neighborhood delineations are, of course, social constructs that are developed through some agreed upon definition. In this study, I have chosen to use census tracts as the definition of neighborhoods, but of course there is mobility across census tracts throughout the city. To some extent, this may be an implication of social processes and it is necessary to model how those relationship may change over time. In several of the outcomes variables, the LISA analysis demonstrates that low-high census tracts in which a tract has a particularly low crime or fire level, while its neighbors have a particularly high outcome. It would be meaningful to determine if that relationship exists consistently over time, or if there are changes occurring in neighborhood that lead the two to equalize. That is, are the social problems that lead to the concerns discussed within this study contagious and vice versa?

In addition to the impacts of social characteristics of neighborhoods, additional research is needed to learn about how structural characteristics of the city impact the demands for services within the city. Earlier in this study, I demonstrated that Interstate 85 just north of uptown Charlotte represents a cut-off point in which demands for emergency services drop off substantially. That does not appear to be the case with Interstate 77.

Another future research interest may be to learn about the structural characteristics of the neighborhoods that surround those physical barriers and that might deter expansion of emergency services demand.

Theory suggests that a more dense population should lead to expanding demands for calls for service. In fact, in my discussion with emergency services leaders, there was an indication that they believe that denser areas have exponentially higher demands for service. From this analysis, that does not appear to be the case and, in fact, the negative coefficient indicates the opposite. Additional research is necessary to determine if more dense neighborhoods are easier to patrol or if there is some other processes that is occurring this is not readily evident from the quantitative analysis provided within this particular study.

The final and important next research step is to replicate this study through a series of longitudinal studies to determine if similar factors still predict the demands for service. It is important to specifically study low-high clusters to determine if they eventually turn into high-high clusters (i.e. spillovers), or vice versa, high-low clusters either disappear or turn into low-low clusters, a positive spillover. This will allow confirmation that the effects that have been observed in this study are consistent and have the effects that we believe and if in fact spillover of effects occur. Additionally, it would be useful to conduct a series of cross sectional replications of this study in a number of cities to determine if the effects observed in this study can be found in other cities as well.

As expected, this research opens as many questions as it answers and continuation of this line of research is necessary in order to understand why various services are required in certain areas of cities. In fact, the complexity of service delivery could be better

explained if public managers had a stronger understanding of the social processes that are occurring in the diverse neighborhoods that are present in Charlotte, and in urban environments throughout the United States. While an agency-introspective approach is necessary for properly managing organizations, public organizations have a particularly challenging mandate to develop a strong understanding of the residents for whom services are provided. This dissertation, as well as the future research directions, provide some insight into how public organizations can develop a strong, needs-based approach to policy problems.

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APPENDIX A: CORRELATION MATRIX

	poverty2	population	popdensity	singlepare	bach	fb.pct	lim.englis	mgmt	renter.occ
poverty2	1								
population	-0.1601448	1							
popdensity	0.288263	0.0543629	1						
singlepare	0.6439189	-0.0281998	0.1789323	1					
bach	-0.6651923	0.1040082	-0.1138175	-0.6190317	1				
fb.pct	0.2241282	0.0662687	0.3188924	0.0384973	-0.2787532	1			
lim.englis	0.3804519	0.0441651	0.3733603	0.1953548	-0.4543005	0.9095466	1		
mgmt	-0.7240542	0.0128194	-0.2060716	-0.6689417	0.8644938	-0.3323177	-0.4907176	1	
renter.occ	0.649639	-0.2257702	0.3735932	0.3626136	-0.4137798	0.3176019	0.3676922	-0.4909151	1
no.veh	0.6822401	-0.3092571	0.1676707	0.4697528	-0.5306148	-0.0121478	0.1261884	-0.5063705	0.6461807
no.plumbin	0.0024738	-0.0124168	-0.0018594	-0.0014009	-0.0377561	0.1030884	0.0501925	-0.0407475	0.1386302
tenure.les	0.2410217	-0.0750712	0.208263	0.1245085	-0.0272438	0.3629283	0.3102106	-0.1218296	0.6605215
black	0.5841032	-0.1420293	0.0160348	0.6403048	-0.7505568	-0.1131071	0.03981	-0.687018	0.3923419
hispanic	0.3581354	0.0475073	0.3942181	0.2205368	-0.4633327	0.8259376	0.880871	-0.5330877	0.3112726
med.age	-0.4358316	-0.0859088	-0.2548187	-0.473405	0.3226829	-0.3925036	-0.3970979	0.4254278	-0.4999898
mhi	-0.6478164	0.1663371	-0.1773908	-0.5216734	0.7539889	-0.2558744	-0.3583371	0.7612872	-0.6834618
simpsonD	-0.0379454	-0.0867127	0.0343091	-0.0341915	0.2129278	-0.3604539	-0.2825525	0.204451	-0.0590891

	no.veh	no.plumbin	tenure.les	black	hispanic	med.age	mhi	simpsonD
no.veh	1							
no.plumbin	0.0607173	1						
tenure.les	0.20917	0.1211473	1					
black	0.5718027	0.0480932	0.0342915	1				
hispanic	0.1079904	-0.0360654	0.2148906	0.0275108	1			
med.age	-0.1511039	-0.0930062	-0.5834982	-0.3408354	-0.3701475	1		
mhi	-0.608677	-0.0554612	-0.3174616	-0.6468036	-0.3778289	0.4362854	1	
simpsonD	0.1397928	-0.0067247	-0.1251713	-0.0653647	-0.3058258	0.2415343	0.2446659	1

APPENDIX B: SPATIAL DURBIN MODEL RESULTS

Police Department Aggregate

```
PD ALL

Call:lagsarlm(formula = pd.all.f_1 ~ poverty2 + population
+ popdensity +     singlepare + bach + fb.pct + lim.englis
+ mgmt + renter.occ +
    no.veh + tenure.les + black + hispanic + med.age + mhi
+     simpsonD, data = data, listw = weight.lw, type =
"mixed",     tol.solve = 1e-14)

Residuals:
       Min         1Q     Median         3Q        Max
-2.2235646 -0.3465575 -0.0092088  0.3057091  4.4689870

Type: mixed

                  Estimate  Std. Error z value  Pr(>|z|)
(Intercept)     3.6227e+00  2.3464e+00  1.5439  0.122606
poverty2        7.5351e-03  6.6782e-03  1.1283  0.259188
population     -2.2144e-04  3.4804e-05 -6.3624 1.986e-10
popdensity     -5.0872e-05  3.6650e-05 -1.3881  0.165115
singlepare     -1.1043e-02  1.1264e-02 -0.9804  0.326895
bach           -2.6648e-02  8.8450e-03 -3.0127  0.002589
fb.pct          1.8583e-02  1.2942e-02  1.4358  0.151047
lim.englis      4.0682e-02  1.5345e-02  2.6512  0.008020
mgmt            2.1083e-02  7.0176e-03  3.0043  0.002662
renter.occ     -4.2188e-03  5.0536e-03 -0.8348  0.403823
no.veh          9.8038e-04  1.0379e-02  0.0945  0.924746
tenure.les      1.2504e-02  6.1353e-03  2.0381  0.041540
black           5.2752e-03  4.6228e-03  1.1411  0.253816
hispanic       -4.3606e-02  9.9125e-03 -4.3991 1.087e-05
med.age         1.5062e-02  1.5383e-02  0.9792  0.327496
mhi            -1.4246e-06  3.4343e-06 -0.4148  0.678283
simpsonD       -1.9795e-02  3.2731e-01 -0.0605  0.951775
lag.poverty2   -4.4487e-02  1.9197e-02 -2.3174  0.020480
lag.population  1.8875e-05  9.0983e-05  0.2075  0.835652
lag.popdensity -9.3516e-06  8.6555e-05 -0.1080  0.913962
lag.singlepare  6.5549e-03  2.9273e-02  0.2239  0.822815
lag.bach        1.5782e-03  2.4073e-02  0.0656  0.947731
lag.fb.pct     -3.9852e-03  3.3081e-02 -0.1205  0.904113
lag.lim.englis -2.7172e-02  3.9139e-02 -0.6942  0.487526
lag.mgmt       -2.5585e-02  1.7276e-02 -1.4809  0.138633
```

```
lag.renter.occ  1.1807e-02  1.0576e-02  1.1164  0.264249
lag.no.veh     -5.9168e-03  2.4407e-02 -0.2424  0.808450
lag.tenure.les -1.9456e-02  1.4963e-02 -1.3002  0.193524
lag.black      -9.5936e-03  8.0051e-03 -1.1984  0.230745
lag.hispanic    2.1458e-02  2.5221e-02  0.8508  0.394874
lag.med.age    -4.5860e-02  3.7109e-02 -1.2358  0.216522
lag.mhi         4.0857e-06  9.7913e-06  0.4173  0.676478
lag.simpsonD    3.8856e-01  6.8529e-01  0.5670  0.570710
```

Assaults

```
ASSAULT

Call:lagsarlm(formula = pd.assau_5 ~ poverty2 + population
+ popdensity +     singlepare + bach + fb.pct + lim.englis
+ mgmt + renter.occ +
    no.veh + tenure.les + black + hispanic + med.age + mhi
+     simpsonD, data = data, listw = weight.lw, type =
"mixed",     tol.solve = 1e-16)

Residuals:
        Min          1Q      Median          3Q         Max
-0.00621479 -0.00244278 -0.00037778  0.00144029  0.01675126

Type: mixed

                  Estimate  Std. Error z value  Pr(>|z|)
(Intercept)     1.3636e-02  1.3490e-02  1.0109  0.312087
poverty2        4.8711e-06  3.8223e-05  0.1274  0.898594
population     -9.7378e-07  1.9985e-07 -4.8726 1.101e-06
popdensity     -9.8032e-08  2.1055e-07 -0.4656  0.641506
singlepare     -6.0666e-05  6.4687e-05 -0.9378  0.348329
bach            6.1393e-05  5.0792e-05  1.2087  0.226770
fb.pct         -1.0132e-04  7.4308e-05 -1.3635  0.172731
lim.englis      1.1698e-04  8.8095e-05  1.3279  0.184204
mgmt            5.5915e-05  4.0304e-05  1.3873  0.165341
renter.occ      1.9229e-05  2.9030e-05  0.6624  0.507727
no.veh          9.2695e-05  5.9587e-05  1.5556  0.119794
tenure.les     -9.5067e-05  3.5277e-05 -2.6948  0.007043
black           2.0579e-05  2.6558e-05  0.7749  0.438404
hispanic        2.9954e-05  5.7029e-05  0.5252  0.599417
med.age         2.8690e-05  8.8348e-05  0.3247  0.745381
mhi            -7.5506e-09  1.9736e-08 -0.3826  0.702031
simpsonD       -1.2171e-03  1.8793e-03 -0.6476  0.517212
lag.poverty2   -1.2243e-04  1.1022e-04 -1.1108  0.266651
lag.population  1.9854e-07  5.1618e-07  0.3846  0.700517
```

```
lag.popdensity -2.6966e-07  4.9657e-07 -0.5430  0.587100
lag.singlepare -1.3188e-04  1.6834e-04 -0.7834  0.433369
lag.bach       -3.3506e-05  1.3737e-04 -0.2439  0.807299
lag.fb.pct     -8.7739e-05  1.8939e-04 -0.4633  0.643160
lag.lim.englis -8.7978e-05  2.2468e-04 -0.3916  0.695379
lag.mgmt       -1.3043e-04  9.9005e-05 -1.3174  0.187710
lag.renter.occ -2.4631e-05  6.0836e-05 -0.4049  0.685565
lag.no.veh     -8.6483e-07  1.4004e-04 -0.0062  0.995073
lag.tenure.les  5.6394e-05  8.5855e-05  0.6568  0.511279
lag.black       2.9332e-05  4.6172e-05  0.6353  0.525249
lag.hispanic    2.1066e-04  1.4323e-04  1.4708  0.141357
lag.med.age    -2.1611e-04  2.1326e-04 -1.0134  0.310882
lag.mhi         8.2312e-08  5.6234e-08  1.4637  0.143264
lag.simpsonD    6.2906e-05  3.9329e-03  0.0160  0.987238
```

Burglaries

```
BURGLARY

Call:lagsarlm(formula = pd.burg._3 ~ poverty2 + population
+ popdensity +     singlepare + bach + fb.pct + lim.englis
+ mgmt + renter.occ +
    no.veh + tenure.les + black + hispanic + med.age + mhi
+     simpsonD, data = data, listw = weight.lw, type =
"mixed",     tol.solve = 1e-14)

Residuals:
        Min          1Q      Median          3Q         Max
-0.04368789 -0.01362998 -0.00088327  0.00878579  0.09783155

Type: mixed

                 Estimate  Std. Error z value  Pr(>|z|)
(Intercept)     5.2106e-02  7.5530e-02  0.6899   0.49027
poverty2       -1.4431e-05  2.1490e-04 -0.0671   0.94646
population     -5.7412e-06  1.1214e-06 -5.1199 3.057e-07
popdensity     -2.8689e-07  1.1819e-06 -0.2427   0.80821
singlepare     -3.5751e-04  3.6284e-04 -0.9853   0.32447
bach            1.0248e-04  2.8498e-04  0.3596   0.71914
fb.pct         -6.3973e-04  4.1689e-04 -1.5345   0.12490
lim.englis      7.6667e-04  4.9457e-04  1.5502   0.12110
mgmt            2.6141e-04  2.2609e-04  1.1562   0.24758
renter.occ      2.6004e-04  1.6285e-04  1.5968   0.11031
no.veh          5.7988e-04  3.3440e-04  1.7341   0.08290
tenure.les     -3.4242e-04  1.9832e-04 -1.7266   0.08424
black           2.0475e-05  1.4904e-04  0.1374   0.89073
```

```
hispanic       -1.0092e-04  3.2079e-04 -0.3146   0.75306
med.age         7.9523e-04  4.9557e-04  1.6047   0.10856
mhi             1.5518e-08  1.1071e-07  0.1402   0.88852
simpsonD       -7.6177e-03  1.0544e-02 -0.7225   0.46999
lag.poverty2   -1.1963e-03  6.1879e-04 -1.9333   0.05320
lag.population  4.0121e-09  2.9164e-06  0.0014   0.99890
lag.popdensity -2.0139e-06  2.7851e-06 -0.7231   0.46963
lag.singlepare -6.1222e-04  9.4425e-04 -0.6484   0.51675
lag.bach       -2.9130e-04  7.6956e-04 -0.3785   0.70504
lag.fb.pct     -5.0832e-04  1.0635e-03 -0.4780   0.63266
lag.lim.englis -1.0381e-03  1.2604e-03 -0.8236   0.41014
lag.mgmt       -7.2922e-04  5.5544e-04 -1.3129   0.18923
lag.renter.occ -9.0619e-05  3.4069e-04 -0.2660   0.79025
lag.no.veh     -1.6279e-04  7.8542e-04 -0.2073   0.83580
lag.tenure.les  5.5244e-04  4.8084e-04  1.1489   0.25059
lag.black       2.1988e-04  2.5828e-04  0.8513   0.39458
lag.hispanic    1.6900e-03  8.0276e-04  2.1052   0.03527
lag.med.age    -9.5135e-04  1.1960e-03 -0.7954   0.42637
lag.mhi         3.8747e-07  3.1550e-07  1.2281   0.21940
lag.simpsonD    8.6313e-04  2.2077e-02  0.0391   0.96881
```

Domestic Violence

```
DOMESTIC

Call:lagsarlm(formula = pd.dom.f_1 ~ poverty2 + population
+ popdensity +     singlepare + bach + fb.pct + lim.englis
+ mgmt + renter.occ +
    no.veh + tenure.les + black + hispanic + med.age + mhi
+     simpsonD, data = data, listw = weight.lw, type =
"mixed",     tol.solve = 1e-14)

Residuals:
       Min         1Q     Median         3Q        Max
-0.0967520 -0.0316060 -0.0043175  0.0213065  0.2188634

Type: mixed

                 Estimate  Std. Error z value  Pr(>|z|)
(Intercept)     1.5606e-01  1.8683e-01  0.8353   0.40353
poverty2        1.9424e-04  5.3020e-04  0.3664   0.71410
population     -1.5026e-05  2.7717e-06 -5.4212 5.918e-08
popdensity     -2.8159e-06  2.9196e-06 -0.9645   0.33480
singlepare     -8.8512e-04  8.9672e-04 -0.9871   0.32361
bach            9.1004e-04  7.0423e-04  1.2923   0.19627
fb.pct         -1.3695e-03  1.0302e-03 -1.3293   0.18374
lim.englis      2.3104e-03  1.2214e-03  1.8916   0.05855
```

```
mgmt            9.3662e-04  5.5890e-04  1.6758   0.09377
renter.occ      4.6521e-04  4.0239e-04  1.1561   0.24763
no.veh          1.1465e-03  8.2627e-04  1.3876   0.16525
tenure.les     -1.2349e-03  4.8904e-04 -2.5252   0.01156
black           2.7450e-04  3.6823e-04  0.7455   0.45599
hispanic       -2.2801e-04  7.9105e-04 -0.2882   0.77316
med.age         7.7125e-04  1.2247e-03  0.6298   0.52885
mhi            -8.4549e-08  2.7356e-07 -0.3091   0.75727
simpsonD       -1.6760e-02  2.6055e-02 -0.6433   0.52006
lag.poverty2   -2.0672e-03  1.5281e-03 -1.3528   0.17612
lag.population -1.7485e-06  7.2357e-06 -0.2417   0.80905
lag.popdensity -4.7417e-06  6.8941e-06 -0.6878   0.49158
lag.singlepare  2.6142e-04  2.3317e-03  0.1121   0.91073
lag.bach        7.5393e-04  1.9054e-03  0.3957   0.69234
lag.fb.pct     -1.0307e-03  2.6249e-03 -0.3927   0.69456
lag.lim.englis -1.0516e-03  3.1178e-03 -0.3373   0.73590
lag.mgmt       -2.2362e-03  1.3730e-03 -1.6286   0.10339
lag.renter.occ -3.2408e-04  8.4220e-04 -0.3848   0.70039
lag.no.veh     -8.0258e-05  1.9409e-03 -0.0414   0.96702
lag.tenure.les  7.0735e-04  1.1900e-03  0.5944   0.55223
lag.black       4.6767e-04  6.4008e-04  0.7306   0.46500
lag.hispanic    3.0863e-03  1.9826e-03  1.5567   0.11954
lag.med.age    -2.3310e-03  2.9550e-03 -0.7889   0.43020
lag.mhi         9.7270e-07  7.7969e-07  1.2476   0.21219
lag.simpsonD   -1.4692e-02  5.4596e-02 -0.2691   0.78785
```

Fire Department Aggregate

```
FD ALL

Call:lagsarlm(formula = fire.all_3 ~ poverty2 + population
+ popdensity +     singlepare + bach + fb.pct + lim.englis
+ mgmt + renter.occ +
    no.veh + tenure.les + black + hispanic + med.age + mhi
+     simpsonD, data = data, listw = weight.lw, type =
"mixed",     tol.solve = 1e-14)

Residuals:
       Min         1Q     Median         3Q        Max
-0.2126393 -0.0383677 -0.0011859  0.0426954  0.5814312

Type: mixed

                  Estimate  Std. Error z value  Pr(>|z|)
(Intercept)    -2.0571e-01  2.9788e-01 -0.6906 0.4898312
poverty2       -1.4576e-03  8.6062e-04 -1.6937 0.0903267
```

```
population     -8.9346e-07  4.4261e-06 -0.2019 0.8400266
popdensity     -1.7972e-05  4.6631e-06 -3.8541 0.0001162
singlepare     -2.6416e-03  1.4332e-03 -1.8431 0.0653165
bach           -2.9082e-03  1.1271e-03 -2.5802 0.0098735
fb.pct          1.2155e-03  1.6461e-03  0.7384 0.4602475
lim.englis     -2.8252e-03  1.9587e-03 -1.4424 0.1491809
mgmt           -4.4050e-04  8.9349e-04 -0.4930 0.6220049
renter.occ      1.4391e-03  6.4678e-04  2.2250 0.0260787
no.veh          3.5303e-03  1.3339e-03  2.6467 0.0081287
tenure.les      1.3261e-03  7.8032e-04  1.6994 0.0892461
black           5.0992e-04  5.8797e-04  0.8672 0.3858053
hispanic       -1.9897e-04  1.2623e-03 -0.1576 0.8747565
med.age         3.6563e-03  1.9560e-03  1.8692 0.0615888
mhi             7.2604e-07  4.3811e-07  1.6572 0.0974756
simpsonD       -9.4737e-02  4.1622e-02 -2.2761 0.0228384
lag.poverty2   -1.1601e-02  2.4952e-03 -4.6492 3.332e-06
lag.population -3.0430e-06  1.1181e-05 -0.2722 0.7855016
lag.popdensity  1.8551e-05  1.0982e-05  1.6893 0.0911639
lag.singlepare  2.0776e-03  3.7327e-03  0.5566 0.5777942
lag.bach       -4.6803e-03  3.1022e-03 -1.5087 0.1313749
lag.fb.pct      3.2025e-03  4.1888e-03  0.7645 0.4445400
lag.lim.englis -1.1122e-02  5.0005e-03 -2.2242 0.0261378
lag.mgmt        8.6565e-04  2.1991e-03  0.3936 0.6938454
lag.renter.occ  4.2782e-03  1.3947e-03  3.0675 0.0021584
lag.no.veh      1.2251e-02  3.2893e-03  3.7245 0.0001957
lag.tenure.les -8.3716e-04  1.9011e-03 -0.4404 0.6596814
lag.black       1.5484e-04  1.0183e-03  0.1521 0.8791429
lag.hispanic    4.8527e-03  3.1714e-03  1.5302 0.1259792
lag.med.age     1.6926e-03  4.7302e-03  0.3578 0.7204715
lag.mhi         2.2496e-06  1.2560e-06  1.7911 0.0732772
lag.simpsonD   -3.1746e-02  8.7227e-02 -0.3639 0.7159001
```

Emergency Medical Services

EMS

```
Call:lagsarlm(formula = fire.ems_3 ~ poverty2 + population
+ popdensity +     singlepare + bach + fb.pct + lim.englis
+ mgmt + renter.occ +
    no.veh + tenure.les + black + hispanic + med.age + mhi
+     simpsonD, data = data, listw = weight.lw, type =
"mixed",     tol.solve = 1e-14)

Residuals:
       Min         1Q     Median         3Q        Max
-0.1337844 -0.0204317 -0.0017044  0.0225871  0.3400238
```

Type: mixed

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-1.4738e-01	1.6799e-01	-0.8773	0.3803079
poverty2	-5.4150e-04	4.8351e-04	-1.1199	0.2627460
population	-1.1787e-07	2.4951e-06	-0.0472	0.9623220
popdensity	-8.0554e-06	2.6296e-06	-3.0633	0.0021888
singlepare	-1.2884e-03	8.0755e-04	-1.5955	0.1106093
bach	-1.6828e-03	6.3614e-04	-2.6454	0.0081597
fb.pct	7.0893e-04	9.2843e-04	0.7636	0.4451161
lim.englis	-1.8224e-03	1.1055e-03	-1.6485	0.0992587
mgmt	-2.0486e-04	5.0362e-04	-0.4068	0.6841774
renter.occ	6.4549e-04	3.6452e-04	1.7708	0.0765952
no.veh	2.5717e-03	7.5236e-04	3.4182	0.0006304
tenure.les	7.3039e-04	4.3989e-04	1.6604	0.0968355
black	2.1246e-04	3.3146e-04	0.6410	0.5215311
hispanic	-9.8177e-05	7.1120e-04	-0.1380	0.8902056
med.age	2.2459e-03	1.1027e-03	2.0368	0.0416715
mhi	3.8260e-07	2.4727e-07	1.5473	0.1217902
simpsonD	-4.9110e-02	2.3468e-02	-2.0926	0.0363841
lag.poverty2	-5.9389e-03	1.3958e-03	-4.2549	2.091e-05
lag.population	-2.9532e-07	6.2970e-06	-0.0469	0.9625941
lag.popdensity	1.0058e-05	6.1898e-06	1.6250	0.1041711
lag.singlepare	9.9826e-05	2.1049e-03	0.0474	0.9621735
lag.bach	-3.7113e-03	1.7501e-03	-2.1207	0.0339491
lag.fb.pct	2.6359e-03	2.3610e-03	1.1164	0.2642360
lag.lim.englis	-7.2895e-03	2.8199e-03	-2.5851	0.0097364
lag.mgmt	6.2771e-04	1.2393e-03	0.5065	0.6125061
lag.renter.occ	2.5410e-03	7.7912e-04	3.2613	0.0011089
lag.no.veh	6.9899e-03	1.8760e-03	3.7259	0.0001947
lag.tenure.les	-3.1455e-04	1.0722e-03	-0.2934	0.7692286
lag.black	1.2023e-04	5.7403e-04	0.2094	0.8340988
lag.hispanic	2.3151e-03	1.7858e-03	1.2963	0.1948554
lag.med.age	1.6435e-03	2.6700e-03	0.6155	0.5381916
lag.mhi	1.5701e-06	7.0756e-07	2.2191	0.0264812

Structure Fires

STRUCTURE

```
Call:lagsarlm(formula = fire.fir_4 ~ poverty2 + population
+ popdensity +     singlepare + bach + fb.pct + lim.englis
+ mgmt + renter.occ +
    no.veh + tenure.les + black + hispanic + med.age + mhi
+     simpsonD, data = data, listw = weight.lw, type =
"mixed",     tol.solve = 1e-17)
```

```
Residuals:
        Min          1Q      Median          3Q         Max
-0.00160052 -0.00031825 -0.00001934  0.00029752  0.00180837

Type: mixed

                  Estimate  Std. Error z value Pr(>|z|)
(Intercept)    -1.3038e-03  1.8577e-03 -0.7018 0.482789
poverty2        5.8993e-06  5.2791e-06  1.1175 0.263786
population     -1.2828e-08  2.7608e-08 -0.4647 0.642179
popdensity     -6.1214e-08  2.9087e-08 -2.1045 0.035335
singlepare      2.7940e-06  8.9346e-06  0.3127 0.754495
bach           -4.0570e-06  7.0167e-06 -0.5782 0.563130
fb.pct         -5.7336e-08  1.0271e-05 -0.0056 0.995546
lim.englis     -3.9985e-07  1.2179e-05 -0.0328 0.973808
mgmt           -3.6419e-06  5.5662e-06 -0.6543 0.512921
renter.occ      4.8529e-06  4.0187e-06  1.2076 0.227205
no.veh          1.2793e-05  8.2360e-06  1.5533 0.120348
tenure.les      5.4436e-06  4.8695e-06  1.1179 0.263615
black           1.1693e-05  3.6677e-06  3.1881 0.001432
hispanic        3.0993e-07  7.8745e-06  0.0394 0.968604
med.age         1.7499e-05  1.2202e-05  1.4341 0.151530
mhi             1.6571e-09  2.7249e-09  0.6081 0.543092
simpsonD       -5.7113e-04  2.5989e-04 -2.1976 0.027978
lag.poverty2   -1.2603e-06  1.5227e-05 -0.0828 0.934038
lag.population -3.2668e-08  6.9629e-08 -0.4692 0.638949
lag.popdensity  7.6198e-08  6.8557e-08  1.1115 0.266372
lag.singlepare -4.8865e-06  2.3254e-05 -0.2101 0.833563
lag.bach       -1.2815e-06  1.8983e-05 -0.0675 0.946177
lag.fb.pct     -1.2474e-05  2.6170e-05 -0.4767 0.633597
lag.lim.englis  3.1701e-05  3.1065e-05  1.0205 0.307508
lag.mgmt        7.0122e-06  1.3673e-05  0.5129 0.608045
lag.renter.occ  1.0106e-05  8.5822e-06  1.1776 0.238956
lag.no.veh      8.7147e-07  1.9528e-05  0.0446 0.964404
lag.tenure.les -2.1187e-06  1.1841e-05 -0.1789 0.857991
lag.black       1.4447e-06  6.5103e-06  0.2219 0.824383
lag.hispanic   -2.5251e-05  1.9758e-05 -1.2780 0.201242
lag.med.age     1.5236e-05  2.9546e-05  0.5157 0.606084
lag.mhi        -3.3558e-09  7.7720e-09 -0.4318 0.665903
lag.simpsonD    8.7420e-04  5.4262e-04  1.6111 0.107165
```