Density, Population Growth and Local Government Finance

by

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(Under the direction of Deborah A. Carroll)

Abstract

Contemporary literature in the fields of public finance, economics, planning and regional science have acknowledged the importance of the built environment (sprawl) and growth issues to the study of local public finance. However, this literature largely focuses on only a small segment local public finance outcomes, primarily per capita expenditures. The contribution of this study is to extend these analyses to include a larger list of outcomes using the State of Georgia as a case study. In addition to per capita expenditures, the impact of the built environment and growth on local fiscal conditions and revenue diversification is examined. These three analyses are undertaken, econometrically, using a panel of county governments in Georgia from 2000 to 2008. To summarize, 1) sprawling type development in Georgia increases the per capita expenditures on average and these results are dominated by per capita capital expenditures, 2) residential growth increases per capita expenditures in a quantitatively small and non-linear fashion, 3) sprawling type developments in Georgia have better fiscal conditions on average, 4) moderate levels of residential growth (0% - 6% annually) are associated with a worsening of local fiscal conditions on average; however, the results are non-linear and u-shaped, 5) sprawling type development patterns are associated with lower levels of revenue diversification, and 6) increased residential growth is associated with lower levels of revenue diversification on average. The results of these analyses suggest that the influence of the built environment and growth is not uniform across local public finance outcomes. Instead, sprawl and growth are both positive and negative factors for communities. As such, there is no "one size fits all" policy recommendation as to how to deal with sprawl and growth. Communities in Georgia (and to the extent these results are generalizable, across the nation) should be careful to weigh the positive and negative attributes of different styles of development before choosing a course of action.

Index words: Urban growth, Urban sprawl, Residential density, Residential growth, Local government expenditures, Local fiscal conditions, Revenue diversification

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Dedication

To Lindsey

Acknowledgments

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Chapter 1

Introduction

The spatial development of cities, specifically the speed at which new residents are added and the density at which those residents live, can have profound effects on the finances of local governments. Most commonly understood as population growth and sprawl, these issues are commonplace for a large number of local governments. Over the past decades, the empirical literature in public finance, regional science, urban economics and urban planning have attempted to estimate the influence of these two issues on the finances of local governments. These efforts have produced a large variety of potential impacts of residential growth and residential density on the public finance systems of local governments. This dissertation seeks to extend this literature by introducing panel data analysis to the question. Additionally, this dissertation explores two new areas of research currently lacking in the literature. Three primary research questions are addressed. Specifically, the influence of residential density and residential growth on per capita local expenditures, local fiscal conditions and revenue diversification is ascertained.

This chapter begins with a brief introduction to the issues that are potentially the result of population growth and sprawl. The second section lays out the primary research questions for this dissertation. The organization of this dissertation is presented in the final section.

1.1 Introduction to Sprawl and Growth

Conceptually, urban sprawl is a nebulous notion. An exact definition of sprawl is highly debated in the academic and applied literatures. Overall, sprawl can be thought of as low density, scattered development patterns. These patterns can be brought about by a number of influences. The literature is rife with potential explanations of sprawl. Urban economic theory, government policies, local government fragmentation, and land characteristics have all been identified as potential drivers of sprawl. Finally, sprawl has been blamed on a variety of outcomes public finance related and otherwise. Sprawl has been shown to increase the cost of public service provision. Additionally, sprawl may lead to adverse environmental outcomes, specifically excess land consumption and air pollution. Sprawl may also lead to negative health outcomes for those living in sprawling areas and may be driving income segregation. These issues will be further explored in the chapters to follow; however, a brief introduction is necessary.

Urban growth is a similarly interesting concept.[1] Recent literature indicates that urban growth is the outcome of knowledge spillovers and positive urban amenities. Increases in human capital can lead to knowledge spillovers making certain urban areas more attractive and conducive to growth. Additionally, positive aspects of the city such as cultural or aesthetic amenities can lead to increased growth. Growth can potentially lead to a number of undesirable conditions. High levels growth can lead to increased traffic congestion, increased school enrollments, and increased need for infrastructure spending. As such, many communities have sought to limit growth to avoid these adverse effects. On the public finance side, the fundamental question is whether growth, specifically new growth, pays its own way.

[1]For the purposes of this dissertation, urban sprawl and urban growth constitute the built environment. These two concepts are but a small part of what constitute the built environment at large. More broadly, the built environment is the "products and processes of human creation" (Bartuska, 2007, pg. 4).

The result of this question, empirically, is mixed with some studies showing growth poses no burden on communities while others show the opposite.

1.2 Research Questions

As the brief discussion in the previous section has illuminated, the built environment can have significant effects on local governments. The purpose of this dissertation is to more fully examine the influence of growth and sprawl on local public finance. Specifically, the influence of sprawl and growth on per capita expenditures will be reexamined in a panel data setting. Additionally, the influence of sprawl and growth on local fiscal conditions as well as revenue diversification will be investigated. Previous empirical literature has largely focused on the influence of growth and sprawl on the cost of service provision. However, it is argued here that the effects of growth and sprawl percolate through local fiscal systems via demand and cost mechanisms.

The influence of sprawl and growth on per capita local expenditures is, perhaps, the most straight forward; however, there is significant disciplinary disagreement over the expected effects. The urban planning field is a large proponent of "Smart Growth" as a mechanism to reduce the cost of local service provision. According to this line of research, sprawl is more expensive to provide public services to because this type of development pattern fails to capitalize on economies of scale (Carruthers and Úlfarsson, 2002, 2003), often fails to optimize the location of costly capital facilities (Carruthers and Úlfarsson, 2002, 2003), and leads to duplicative service delivery (Real Estate Research Corporation, 1974). The economics and public finance fields believe that there is either a positive or u-shaped relationship between sprawl and the cost of local service provision. At lower levels of density, increasing proximity of residents to each other allows local governments to realize economies of density leading to lower levels of per capita expenditures. However, as density continues to rise, urban "harshness"[2] prevails driving per capita expenditures upward (Bradbury et al., 1984; Ladd, 1992, 1994).

The question with regard to population or residential growth is whether new residents impose a burden on existing residents. The popular literature is replete with stories of the harm of rapid population growth. These anecdotal experiences are often held up as reasons to limit population growth in certain jurisdictions. While there are certainly other concerns besides fiscal in growth management, the question, in terms of expenditures, is whether the influx of new residents leads to an increase in average per capita expenditures. Stated differently, is the influx of new residents placing a fiscal burden on existing residents who must now pay a partial share of public services provided to these new residents? If so, new development is not "paying its own way" and should be made to internalize some or all of the costs imposed on existing residents. If new residents are not imposing higher expenditure burdens on existing residents, the need to extract concessions from new residents may not exist.

The influence of sprawl and growth on local fiscal conditions is equally as important as per capita expenditures, and the method of transmission is similar. Local fiscal conditions generally refers to the gap, or lack thereof, between a locality's ability to provide public services at an average level of quality with similar revenue effort. If sprawl increases the cost of service provision for local government, this semi-exogenous shock to the public finances of the local government will likely have some effect on local fiscal conditions. The predicted effect is somewhat ambiguous since sprawl can influence both the cost of service provision and revenue generation. Therefore, this dissertation examines the influence of sprawl on local fiscal conditions.

[2] Defined as increased cost of providing public services at an average quality due to unique aspects of urban areas. For instance, providing free flowing streets in urban areas require more traffic control devices relative to less dense areas. The increased cost of providing traffic control devices makes the urban area "harsh."

The influence of growth on local fiscal condition works through demand and cost shocks. If a local government experiences rapid growth, both demand for public services and the cost of providing those services can change. *A priori*, it is difficult to predict the change in the mix of services demanded and the cost of those services. However, this question is of interest to those communities experiencing rapid positive or negative growth.

Finally, the influence of sprawl and growth on local government revenue diversification is examined. Rising revenue diversification is, at least at the local level, largely driven by a movement away from the property tax as a primary means of revenue generation (Bowman, 1987; Carroll, 2005, 2009). It is unclear if sprawl and growth stimulate property tax revenues through higher assessed values or if sprawl and growth depress property tax revenues. In the latter case, increased sprawl and growth may lead local governments to diversify their revenue stream as a way to keep revenues relatively constant in the face of lagging property tax revenues.

As mentioned above, the contribution of this dissertation to the literature is a further extension of the influence of the built environment on local public finance outcomes. While the cost of public services is the most obvious, there are likely further effects of the built environment on fiscal outcomes. This dissertation explicitly tests for three of these. In addition to the scholarly contribution of this dissertation, there are practical implications as well. The connection between local development policy and local public finance is not fully understood. Given that local governments engage in a large amount of development and/or land use policymaking, either implicitly or explicitly, the potential linkages between development and public finance have tangible, real world implications. Better informing local policy makers can potentially lead to better fiscal outcomes for local governments and taxpayers.

1.3 Organization of Study

This dissertation is organized as follows. The next chapter provides an in depth examination of the issues surrounding population growth and urban sprawl that face individuals, local governments and society as a whole. This review of the literature focuses primarily on the public finance outcomes brought about by growth and sprawl, but it also briefly highlights other aspects as well. The third chapter more fully develops the research questions outlined above and develops hypotheses from these questions. The third chapter also contains a description of the data used in this dissertation. Chapters four through six provide research findings for the three research questions outlined in chapter three. Finally, chapter seven discusses conclusions, policy implications and further directions for this line of research.

Chapter 2

Literature Review

This chapter begins with an in depth overview of urban sprawl. Attempts to qualitatively and quantitatively define sprawl are examined. Potential causes of sprawl are identified and explored. Finally, influences of sprawl on local fiscal outcomes and other revenant issues are discussed. The second section of this chapter focuses on population or residential growth. How and why cities grow are examined and the influence of growth on local fiscal outcomes are discussed. In the final section, the interplay between growth and sprawl is examined.

2.1 Sprawl

Urban sprawl is the "dominant urban form" in the United States (Glaeser and Kahn, 2006). In yesteryears, cities were characterized as dense and largely vertically growing. However, beginning after World War II,[1] many families moved out of cities into large suburbs and cities grew horizontally. Even with this pattern of growth, many continued to commute into a central city for work. Over time, jobs moved outward from the city leading to the low density, decentralized pattern of urban development we see now. The movement out of

[1]Though there is some evidence that suburbanization of American cities began well before the post-war era. See Mieszkowski and Mills (1993) for a further explanation. Also see Fogelson (2001, Chap. 1) for discussion of the segregation of commercial and residential uses in early American urbanization.

dense, compact cities into suburban areas over the last century has certainly had an impact on a variety of topics. In this section, the concept and measurement of sprawl is discussed, the causes of sprawl are explored, and the influences of sprawl on local areas are examined.

2.1.1 What is Sprawl?

Sprawl is a complicated concept. Numerous attempts have been made to define sprawl (both technical and non-technical). Fulton et al. (2001) explain that some characterize sprawl much like Justice Potter Stewart characterized pornography in the Jacobellis v. Ohio (378 U.S. 184, 1964) decision: they know it when they see it. Fulton et al. (2001) go on to explain that others characterize sprawl as "auto-oriented suburban development," "low density residential development on the urban fringe," or "suburban style growth." Downs (1999) suggests that sprawl is not mere suburbanization, but suburbanization of a particular kind. Specifically, Downs (1999) references *The Costs of Sprawl – Revisited* (Burchell et al., 1998) for an inductive definition of sprawl. They cite ten different dimensions of sprawl: (1) unlimited outward extension of development, (2) low-density residential and commercial settlements, (3) leapfrog development, (4) fragmentation of powers over land use among many small localities, (5) dominance of transportation by private automotive vehicles, (6) lack of centralized planning or control of land uses, (7) widespread strip commercial development, (8) great fiscal disparities among localities, (9) segregation of types of land use in different zones, and (10) reliance mainly on the trickle-down or filtering process to provide housing to low-income households. Duany et al. (2000) suggest that sprawl is composed of five parts: housing subdivisions, shopping centers, office parks, large and infrequent civic institutions, and roadways. While this definition provides more descriptive information than the definitions above, Duany et al. (2000) provides little in the way of quantifying these dimensions. None of these non-technical definitions is satisfactory in understanding exactly what sprawl is or how one could measure it.[2]

While many of the non-technical definitions of sprawl leave one with a vague idea as to what sprawl actually means, there have been numerous technical attempts at explaining exactly what sprawl means. By far, the most common operational definition of sprawl is low-density, scattered development (Bruegmann, 2005; Burchell et al., 1998; Burchfield et al., 2006; Carruthers and Úlfarsson, 2003, 2008; Glaeser and Kahn, 2006; Hortas-Rico and Solé-Ollé, 2010; Lopez and Hynes, 2003; Williamson, 2010). This definition has practical appeal since it is simple and relatively easy to compute using available data. In addition to low-density residential development, sprawl can be characterized by low-density job density (Carruthers and Úlfarsson, 2003, 2008; Galster et al., 2001). However, Galster et al. (2001) note that employment or job density is likely to be lumpy because of agglomeration effects making average densities unreliable. Burchfield et al. (2006, pg. 15) offer a more technical definition of sprawl as "the percentage of undeveloped land in the square kilometer surrounding an average residential development." This definition is operationalized using remote sensed data. Additionally, Lopez and Hynes (2003) offer a relational definition comparing the percentage of a metropolitan area that lives in low density census tracts to the percentage that live in high density tracts.[3]

However, others have argued while low-density development is a dimension of sprawl; it is certainly not the only dimension. One of the most comprehensive definitions is posited by Galster et al. (2001) and contains eight dimensions that collectively compose sprawl. Specifically, Galster et al. (2001, pg. 685) define sprawl as: "Sprawl (n.) is a pattern of land

[2]Brueckner (2001) defines sprawl as "spatial growth of cities that is excessive relative to what is socially desirable." This definition is both technical and non-technical since spatial growth can be measured, but the socially desirable amount may be quantitatively unknown.

[3]Specifically, Lopez and Hynes (2003) define their sprawl index as $SI_i = (S_i\% - D_i\% + 1) * 50$ where SI is the sprawl index, S% is the percentage of the population living in low density tracts, and D% is the percentage of the population living in high density tracts.

use in a UA [Urbanized Area] that exhibits low levels of some combination of eight distinct dimensions: density, continuity, concentration, clustering, centrality, nuclearity, mixed uses, and proximity." Galster et al. (2001) further define each dimension with density defined as the "average number of residential units or the average number of employees per square mile of developable land in a UA." Continuity is defined as "the degree to which developable land has been developed in an unbroken fashion throughout the UA." Concentration is defined as "the degree to which housing units or jobs are disproportionally located in a relatively few areas or spread evenly in the UA." Clustering is defined as "the degree to which development within any one-mile-square area is clustered within one of the four one-half-mile squares contained within (as opposed to spread evenly throughout)." Centrality is defined as "the degree to which observations of a given land use are located near the CBD of a UA." Nuclearity is defined as "the extent to which a UA is characterized by a mononuclear pattern of development." Mixed uses is defined as "the degree to which substantial numbers of two different land uses (e.g. housing units and employees) exist within the same area and this pattern is typical throughout the UA." Proximity is defined as "the degree to which a particular land use or pair of land uses are close to each other across the UA." Per the original definition, scoring low on any combination of these dimensions would make an area more "sprawl-like."

In addition to Galster et al. (2001), others have suggested that sprawl is multi-faceted. Burchell et al. (2005) suggests that in addition to low density, scattered development, sprawl may also be characterized by segregation of housing and commercial development caused by construction of standardized development types, automobile dependence, and fragmented planning and governance. Burchell et al.'s (2005) definition combines the one dimensional definition discussed above with many of the aspects of the non-technical definitions offered by Fulton et al. (2001) or Duany et al. (2000). In many ways, Burchell et al.'s (2005) definition is a simplification of the more complicated versions found in *The Costs of Sprawl – Revisited*

(Burchell et al., 1998). Ewing (1994) also offers a multi-faceted definition, arguing that sprawl is suburban development combined with poor accessibility between land uses and a lack of functional open space. Clearly, as the previous discussion has shown, there is much disagreement as to the proper definition and operationalization of the concept of sprawl.

2.1.2 Causes of Sprawl

Much like the definition of sprawl, there is a multitude of potential drivers of sprawl. While causes abound, none appear to be particularly satisfactory on their own. Certainly, a variety of economic forces, government policies, and social conditions brought about the decentralization of urban areas. This examination is not meant to be exhaustive or definitive, as that is not the purpose of this discussion, but the following section will outline many of the major themes in the literature.

From a purely theoretical point of view, the monocentric city model developed by Alonso (1964), Mills (1967) and Muth (1969) predicts decentralization from the urban core, a primary component of urban sprawl. Assume individuals have identical tastes for housing (s) or lot size; identical tastes for a composite, private good (z); and all individuals earn all income (Y) in the central business district (CBD). Housing (s) is available for rent at $R(r)$ where land rent depends on the distance from the CBD, r. The individuals choice of residence can be expressed as:

$$\begin{aligned} &\underset{r,z,s}{\text{Max}} && U(z,s) \\ &\text{subject to} && z + R(r)s = Y - T(r) \end{aligned} \tag{2.1}$$

Where T equals the cost of transportation per mile and $T(r)$ is the total cost of a round trip to the CBD at distance, r. As Brueckner and Fansler (1983) note, the spatial variation in $R(r)$ allows each individual to reach the same level of utility, u, regardless of distance, r.

Without discussing the supply of housing,[4] the equilibrium land use conditions are

$$R(\bar{r}, T, Y, U) = R_A \tag{2.2}$$

$$\int_0^{\bar{x}} 2\pi D(r, T, Y, U)\mathrm{d}x = N \tag{2.3}$$

Where R_A is agricultural rents, D is population density, N is the urban population size and $\bar{r}$ is the distance to the urban fringe. According to Brueckner and Fansler (1983), Equation 2.2 suggests that land rents and agricultural rents are equal at the urban fringe and Equation 2.3 suggests that urban population, N, must fit within $\bar{r}$.

Assuming a closed city,[5] numerous comparative statics can be derived from the monocentric city model. Fujita (1989) demonstrates the following:

$$\frac{\partial \bar{r}}{\partial R_A} < 0, \frac{\partial \bar{r}}{\partial N} > 0, \frac{\partial \bar{r}}{\partial T(r)} < 0, \frac{\partial \bar{r}}{\partial Y} > 0 \tag{2.4}$$

Wheaton (1974) and Brueckner and Fansler (1983) echo these comparative statics results. The first outcome from Equation 2.4 suggests that an increase in agricultural rents will limit the distance from the CBD and the urban fringe, essentially reducing the spatial size of the city. Conversely, an increase in the total population of a city will induce an expansion of the spatial extent of the city as evidenced by the second term of Equation 2.4. The third term of Equation 2.4 suggests that a marginal increase in transportation costs (excluding fixed costs) will decrease the spatial extent of the city or, conversely, a marginal decrease in transportation costs will increase the spatial size of the city. Finally, an increase in individual income will increase the distance from the CBD and the urban fringe. While this is a limited summary of the monocentric model and ignores other, possibly more relevant, models such

[4]See Brueckner and Fansler (1983) for a mathematical description of the supply of housing.

[5]The city need not be "closed" (i.e. population is fixed exogenously). See Wheaton (1974) for the "open city" analogue.

as polycentricism or edge cities, it does provide a basic theoretical understanding as to how sprawl can develop organically, over time.

Empirical testing of the propositions offered by the monocentric model have largely demonstrated that, while somewhat dissimilar to the current pattern of development, the monocentric model explains the dispersion of residential housing from the urban core fairly well. Brueckner and Fansler (1983) put the monocentric model to the test using a cross section of urban areas contained in a single county. Brueckner and Fansler (1983) find that, consistent with theoretical prediction, population (N) and income (Y) both increase the size of the urban area. Also consistent with theory, higher agricultural rents (R_A) reduce the size of the urban area. Theory would indicate that higher commuting costs ($T(r)$) would decrease the size of the urban area, but Brueckner and Fansler (1983) are unable to find a statistical relationship in their analysis.[6] In a follow up analysis, McGrath (2005), using panel data, finds a similar relationship to that found by Brueckner and Fansler (1983). However, McGrath (2005) finds that transportation costs, as measured by the regionally adjusted private transportation consumer price index, are indeed negatively related to city spatial size. This relationship does not emerge in the analysis until the effects of a time trend are partialled out. In an analysis estimating multiple causes of sprawl, Burchfield et al. (2006) largely confirm many of the concepts outlined above though less theoretically derived. They find that, consistent with theoretical predictions, more centralized employment in the city center leads to less urban sprawl. Additionally, metropolitan areas that are less friendly to cars tend to sprawl less, and fast population growth tends to slow sprawl as well. Finally, uncertainty about future development, ultimately, leads to more sprawl.

Also, using the monocentric model as a base, scholars have examined the potential for the property tax to be a significant driver of urban sprawl. As Brueckner and Kim (2003)

[6]The insignificance of commuting cost related proxies is possibly the result of imprecise proxies or limited variation in the sample of cities.

explain, the connection between the property tax and sprawl may seem tepid until one considers the land value tax. At its heart, the property tax is an equal tax on land and capital improvements. The portion of the tax that falls on land does not distort the market; however, the portion of the tax that falls on capital improvements (structures) tends to decrease the equilibrium level of improvements (Brueckner and Kim, 2003). This result is opposed to the outcome of a land value tax where the tax rate on capital improvements is zero leading to no distortion of the market. Comparing the two outcomes and assuming a fixed population size, the property tax scenario would lead to a spatially larger urban area with more dispersed development and the land value tax scenario would lead to the market efficient outcome outlined in the monocentric model. While this argument has an intuitive appeal, the theoretical modeling by Brueckner and Kim (2003) shows that there are two potential influences of the property tax: depressed improvements leading to a spatially larger city and smaller homes leading to a spatially smaller city. Which effect dominates is ambiguous. Assuming that the elasticity of substitution between housing and a composite good is larger than one, both Brueckner and Kim (2003) and Song and Zenou (2006) find, theoretically, that influence of smaller dwellings dominates; increasing property taxes reduce the spatial size of the city. Additionally, Song and Zenou (2006) find, empirically and after controlling for numerous monocentric model variables, that an increase in property tax burdens reduces city size.

In addition to the spatial size analyses derived from the monocentric model, there have been numerous studies attempting to measure the density gradient of a metropolitan area using the monocentric model as a base. Much of this work is outlined in Mieszkowski and Mills (1993). Mieszkowski and Mills (1993) propose that density gradients can be flattened (a sign of suburbanization) either through the standard monocentric city variables (population, income, agricultural rents, commuting costs) or a flight from blight set of variables using theoretical propositions from Tiebout (1956) or a combination of the two. Mieszkowski and

Mills (1993) show that many have found that the standard set of monocentric variables is influential in flattening the density gradient. However, many of the flight from blight variables are insignificant with the exception of racial share of population. Concentrations of African Americans in central cities largely flatten the density gradient. Additionally, based on a hypothetical situation in Mills (1985), integrating the suburbs by moving 50,000 black residents to the suburbs from the urban core and replacing them with 50,000 white residents has the effect of increasing central city employment by 54 percent to 65 percent of total metropolitan employment.

Partially derived from the Muth-Mills model, some scholars have attempted to show that sprawl is largely perpetuated by the proliferation of cars and highway infrastructure. While some use anecdotal evidence to suggest that cars and highways increase sprawl (Burchell et al., 1998; Duany et al., 2000; Ewing, 1994; Williamson, 2010), others have attempted to demonstrate empirically and through simulations that cars or highway infrastructure has an impact on urban sprawl. A pair of papers by Baum-Snow (2007a,b) attempts to demonstrate the importance of highway infrastructure in the decentralization of metropolitan populations. In the empirical piece in the pair, Baum-Snow shows that a one ray[7] increase has a substantial impact on the population decentralization of a city. Depending on the specification and the dataset used (single year or panel), Baum-Snow finds that a one ray increase leads to approximately a 9 to 15 percent decrease in the population of the central city of a metropolitan area. In the theoretical/simulation piece, Baum-Snow finds very similar results to the empirical piece. By applying the average 2.5 highway rays per metropolitan area in the preferred model, "counterfactual central city population estimates imply that nearly the full decline of 28 percent in average city population can be explained by highway construction" (Baum-Snow, 2007b, pg. 420). Separate from an analysis of highway infrastructure, Glaeser

[7]Defined as a highway that connects the central business district of a city to a region outside that city. If a highway passes through a city's CBD, it would count as two rays.

and Kahn (2006) argue that there are forces that make car ownership attractive to individuals. Despite being costly, automotive transport has a significant time advantage over various forms of public transport. As time becomes more valuable to individuals, the commuting time savings of a personal automobile become more pronounced leading more individuals to commute by car. Additionally, Glaeser and Kahn (2006) show through a cross-national analysis that there is a negative relationship between high gas taxes[8] and sprawl. In countries where it is more difficult to own a car, cities are less sprawling.

In addition to the monocentric model derived explanation of sprawl, numerous scholars have offered a wide variety of other explanations for the proliferation of sprawl in cities. Market failures have been cited in numerous explanations as a potential cause of sprawl. Brueckner (2001) outlines three specific market failures that can lead to sprawl: a failure to take into account the social benefits of open space (this is echoed by Ewing (1994)), the failure on the part of an individual commuter to take into account the social cost of his own commuting behavior, and the failure of real estate developers to take into account the full infrastructure costs generated by their projects. Local government fragmentation through a process close to Tiebout (1956) sorting has been blamed for the spread of sprawl (Brueckner, 2001; Carruthers and Úlfarsson, 2002; Carruthers, 2003; Mieszkowski and Mills, 1993; Pendall, 1999; Úlfarsson and Carruthers, 2006; Williamson, 2010). Additionally, various federal programs such as the mortgage interest deduction (Burchell et al., 1998), cheap federally backed mortgage loans (Burchell et al., 1998; Duany et al., 2000; Williamson, 2010), infrastructure grants (Ewing, 1994), and road subsidies (Burchell et al., 1998; Ewing, 1994; Williamson, 2010) have been identified as causes of sprawl. Local zoning policies have also bore the brunt of blame for sprawl (Burchell et al., 1998; Duany et al., 2000; Ewing, 1994; Glaeser and Kahn, 2006; Williamson, 2010). Finally, Burchfield et al. (2006) argues that there are land characteristics that serve to propagate sprawl. Specifically, access to aquifers,

[8] A proxy for the expense or difficulty of owning a car.

rugged terrain in the metropolitan area, and temperate climates increase sprawl. Also, mountains on the urban fringe act as a natural limitation to urban growth and decrease sprawl. Each of these potential causes of sprawl has received varying levels of support in the literature.

Clearly, the preceding exploration of the potential causes of sprawl leads one to a conclusion that sprawl is multi-faceted and extremely complex. While definitively determining the cause of sprawl in cities is not the purview of this analysis, a solid foundation in the arguments of why sprawl has occurred can inform future analyses. Certainly, a one dimensional measure of sprawl is inappropriate to capture all of the intricacies of demonstrated by this exploration of the literature.

2.1.3 Influences of Sprawl on Local Areas

As the predominant urban form, suburban style development[9] is often blamed for many ills that plague society. Rightly or wrongly, scholars in a variety of fields have become convinced that physical attributes of the urban landscape are influential on a variety of outcomes. This section focuses primarily on public finance outcomes of sprawl, as that is the focus of this analysis; however, other influences are briefly overviewed as well.

There is somewhat of a disciplinary divergence between the planning and economics professions with regard to the fiscal benefits/detriments of urban sprawl. Of particular interest to both groups is the influence of the built environment on the per capita cost of public services. The planning community is generally in agreement with the smart growth community in asserting that per capita costs of public service increase as sprawl increases. That is to say, sprawling, suburban style development is more costly to service than more compact, urban development (Bosch et al., 2003; Carruthers, 2002; Carruthers and Úlfarsson, 2003, 2008; Hortas-Rico and Solé-Ollé, 2010; Real Estate Research Corporation, 1974; Speir

[9] A necessary, but not sufficient condition for urban sprawl.

and Stephenson, 2002). The argument is made that sprawl is more costly to provide public services because this type of development pattern fails to capitalize on economies of scale (Carruthers and Úlfarsson, 2002, 2003), often fails to optimize the location of costly capital facilities (Carruthers and Úlfarsson, 2002, 2003), and leads to duplicative service delivery (Real Estate Research Corporation, 1974).

Recent empirical (both regression based and simulation based) research appears to support this proposition. Both Bosch et al. (2003) and Speir and Stephenson (2002) use simulation based approaches to ascertain the influence of residential density on local government costs. Bosch et al. (2003) find that more compact development offers higher revenues than more evenly dispersed development and lower costs through lower capital costs. Additionally, Speir and Stephenson (2002) find that more compact lot sizes[10] decreases the costs associated with providing public water and sewer services by a significant amount. Reduced tract dispersion[11] and reduced distance from central facilities also reduce the cost of providing public water and sewer services but not as much as smaller lot sizes. The regression based work of Carruthers and Úlfarsson (2003, 2008) and Hortas-Rico and Solé-Ollé (2010) sheds additional light on the planner's view of sprawl and cost of public services. Carruthers and Úlfarsson (2003, 2008)[12] find in both of their analyses a negative relationship between density (measured as person per urbanized acre) and per capita local expenditures after taking into account the spatial extent of urbanized land and property values. This trend is persistent across expenditure categories (Carruthers and Úlfarsson, 2003) and after taking into account potential spatial dependencies (Carruthers and Úlfarsson, 2008). Similarly, Hortas-Rico and Solé-Ollé (2010)[13] find that land per person is positively associated with

[10]0.25 acre lots instead of 1 acre lots

[11]Smaller distances between housing tracts

[12]Carruthers and Úlfarsson (2003, 2008) estimate a strictly linear relationship of density and per capita expenditures.

[13]Hortas-Rico and Solé-Ollé (2010) estimate a piecewise relationship of density and per capita expenditures. As such, density does not enter into the model as a continuous variable. Rather, density enters as a series dummy variables measuring individual segments on the overall trend.

per capita costs of public services. Specifically, they find that per capita local costs have increased on average by 2.3 percent due to the impact of urban sprawl (Hortas-Rico and Solé-Ollé, 2010, pg. 1534).

In contrast to the planner's view of sprawl, economics scholars are somewhat skeptical that increased density will lead to lower per capita local expenditures. The reasoning for this is twofold: economies of density could indeed lower per capita local costs and, therefore, per capita expenditures; however, the increased harshness of the urban environment associated with increased development could lead to increased per capita costs and expenditures (Ladd, 1994). The intuition behind economies of density is simple; as average density rises, the average cost of providing public services falls because residents are grouped closer together allowing for economies of density. The result of this would be falling per capita expenditures. Alternatively, per capita expenditures can rise due to the "harshness" of the urban environment. Urban areas are "harsh" because costs are higher to provide the same level of public output than lower density areas (Bradbury et al., 1984; Ladd, 1992, 1994). A particularly useful example highlighted in Ladd (1994) is that dense, urban areas will likely require more stop lights and traffic control officers to generate the same level of traffic safety or traffic flow when compared to lower density areas. Similarly, denser areas may be more conducive to crime or require a higher level of public sanitation due to the physical proximity than less dense areas, leading to higher expenditures for the same level of service provision. Additionally, denser areas have higher land prices and, to the extent that public services rely on land in their production function, these higher land prices will translate into higher expenditures (Ladd, 1994). Urban "harshness" has been considered to be an environmental cost as envisioned by Bradford et al. (1969) in numerous studies (Bradbury et al., 1984; Ladd and Yinger, 1989; Ladd, 1992, 1994).

Given the somewhat indeterminate theoretical guidance above, the influence of density on per capita expenditures has been largely an empirical question in the economics literature.

The typical finding in the economics literature is that increased density increases per capita public service costs at all or most levels of density. Bradbury et al. (1984) find a positive and significant relationship between population density and per capita expenditures. In more recent literature, Ladd (1992, 1994, 1998), modeling a piecewise regression, finds that population density has a U-shaped relationship with per capita expenditures. Rising density first lowers per capita expenditures to a point, after which, per capita expenditures rise with population density. This relationship is persistent across different expenditure types including current expenditures, capital expenditures, and interest costs (Ladd, 1992). Additionally, Holcombe and Williams (2008) find, allowing population density to be endogenously determined, that density is only positive and significantly influential on per capita expenditures for municipalities with populations above 500,000 residents. However, when sewer expenditures are considered alone, there is a negative relationship between density and per capita expenditures.

In addition to the focus on per capita costs of public services, the relationship between sprawl and other public finance related phenomenon has been assessed. Specifically, there is much curiosity as to the influence of sprawl on fiscal disparities between urban and suburban areas. The narrative is similar to the "flight from blight" argument posited by Mieszkowski and Mills (1993); however, the direction of the relationship is opposite. While there is little doubt that flight from blight is a contributing factor for some portion of suburban sprawl, there is also evidence that this same phenomenon is contributing to fiscal disparities. As commuting costs decline, high income individuals and families will tend to leave the urban core for the suburbs. This loss of high income individuals in the urban core will increase (decrease) the tax revenues of the suburbs (urban core) (Wu, 2007). Similarly, this movement of high income individuals from the urban core to the suburbs will decrease public service quality in the urban core and increase public service quality in the suburbs. As Wu (2007) explains, this process is recursive with higher quality public services attracting ever more high income individuals from the urban core. This process will continue until all high income individuals reside in the suburbs. This result is conditioned on the cost of commuting to the urban core. If commuting costs fall, high income individuals are incentivized to move to the suburbs. However, if commuting costs increase, there is less incentive for high income individuals to move out of the city and fiscal disparities are lower as a result. Cigler (1996) supports this assertion. She argues that intraregional migration from cities to suburbs can diminish city tax bases, making much needed upgrades of deteriorated urban infrastructure even more difficult to finance.

The topic of local government fragmentation and the influence of sprawl on fragmentation has received some recent attention in the literature. Though not explicitly a public finance topic, the creation of new taxing jurisdictions is indeed an important potential side effect of sprawling development. Úlfarsson and Carruthers (2006) examine this potential relationship and find that past attributes of the built environment[14] influence local government fragmentation. Low density development leads to increased fragmentation, possibly the result of sorting. Razin and Rosentraub (2000) also find this result in an analysis of urbanized areas above 500,000 residents in the United States and Canada. Úlfarsson and Carruthers (2006) find the relationship between urbanized land and fragmentation to be negative. This result suggests that in spatially expansive urban areas, a dominant city is likely actively annexing land in an effort to avoid regional fragmentation. Úlfarsson and Carruthers (2006) also find that higher property values are associated with increased local government fragmentation. They postulate that this is due to homeowners wanting to insulate their homes from the real estate market (through zoning ordinances) or as part of a "land grab." Both Úlfarsson and Carruthers (2006) and Razin and Rosentraub (2000) find population to be a positive force on local government fragmentation. Finally, there is some disagreement on the influence of housing stock age on fragmentation. Úlfarsson and Carruthers (2006) find that a higher

[14]Density, urbanized land, property value per acre, population, and aged housing stock.

proportion of housing stock built before 1940 leads to more fragmentation, and Razin and Rosentraub (2000) find just the opposite with a higher proportion of housing stock built before 1940 leading to lower levels of fragmentation.

Sprawl has been linked with numerous other non-public finance related phenomenon. These range from environmental costs, public health concerns, and many others. While there are far too many potential non-public finance related outcomes from sprawl and the literature on these issues is too vast to outline adequately here, an overview of a few prominent fields will be given. Possibly the most prominent non-public finance related outcome of increased sprawl is potential environmental degradation (Glaeser and Kahn, 2006). Glaeser and Kahn (2006) outline three possible influences of sprawl on the environment: (1) large scale land conversion from forest and farmland to other uses, (2) increased car related pollution due to increased driving, and (3), also from increased driving, increased supply of greenhouse gasses. These three are not exhaustive of potential environmental issues;[15] however, they present three interesting cases of environmental issues.

As Glaeser and Kahn (2006) note, the definition of sprawl necessarily leads to an increased usage of land per individual. Indeed, Kahn (2000) demonstrates that nationally and across individual metropolitan areas, suburban homeowners consume larger amounts of housing (in terms of home size), and these homes are on larger lots when compared to their urban counterparts. Camagni et al. (2002) echoes this finding using Milan, Italy as a case study. They find that in areas considered to be sprawling, land consumption is much higher than more compact developments. In addition to pure land consumption, it is argued that sprawl uses up important farmland on the urban fringe. To this point, Kahn (2000) finds that

[15] See Radeloff et al. (2005) for an overview of additional potential environmental issues associated with the urban fringe or Bockstael and Irwin (2000) for issues dealing with land use types and ecological impacts.

growing populations tend to see decreases in farmland with an approximate elasticity of -0.2.[16]

While these results are illustrative that suburban or exurban development generally consumes more land than urban development, these outcomes need to be put into perspective. Both Glaeser and Kahn (2006) and Kahn (2000) note that while land conversion is increasing, it is only consuming a very small portion of the total land area of the United States. Glaeser and Kahn (2006) explain that 95 percent of the land area in the United States remains undeveloped. At the same time sprawl is increasing, forest cover is also increasing (Glaeser and Kahn, 2006). However, these forests and open areas may not be in areas that people desire them to be. Glaeser and Kahn (2006) note that this is a call for increased parks or private sector solutions such as green belts rather than limits on sprawl.

The final two environmental impacts are derived from the increased car usage associated with spatially larger urban areas. Indeed, suburban residents drive 31 percent more than their urban counterparts (Kahn, 2000). Additionally, Brownstone and Golob (2009) find, using California as a case study, that a reduction in residential density of 1000 housing units per square mile leads to an increase of 1200 miles traveled. With largely stagnant average fleet fuel economy over the last 20 years (Glaeser and Kahn, 2006), this increase in vehicle miles traveled translates into increased consumption of gasoline and increased production of greenhouse gases. However, as Glaeser and Kahn (2006) note, air pollution levels have been falling in most metropolitan areas. This is largely due to increased fuel economy in newer cars (Kahn, 2000). So as vehicle miles traveled has increased over time, fuel economy of new cars has decreased leading to an overall reduction in air pollution. As Glaeser and Kahn (2006) note, this does not provide a reason to not force drivers to internalize their negative externality. There is certainly room for targeted interventions to reduce green house gases

[16]In more sophisticated analyses, Brueckner and Fansler (1983) and others find that high agricultural land prices tend to retard the spatial expansion of cities. This is an empirical confirmation of outcomes of the Muth-Mills model demonstrated by Wheaton (1974).

further; however, the environmental impacts of sprawl related to increased vehicle miles traveled may be overstated.

In addition to environmental costs, there is interest in the proposition that the characteristics of the built environment effects physical activity levels and the wellbeing of individuals (Booth et al., 2005). The proposition has been that the largely car dependent lifestyle associated with sprawling developments negatively influences an individual's health outcomes. Popular dependent variables for these analyses are obesity (defined multiple ways) and minutes walked. The literatures in the public health and medical fields tend to confirm the assertion that low density, suburban sprawl tends to be positively correlated with increased levels of obesity and decreased levels of walking (Ewing et al., 2003; Frank et al., 2004). However, others have argued that these outcomes are the result of endogeneity in the analyses. Instead of sprawl causing increased levels of obesity, individuals who are likely to be obese tend to sort into more sprawling communities (Eid et al., 2008). Once this factor has been taken into account, there is no statistical relationship between sprawl and obesity (Eid et al., 2008). Much like the research on environmental costs, there appears to be some disagreement in the literature as to the impact of sprawl on health related issues.

The final non-public finance related outcome of sprawl to be discussed here is income segregation. The evidence that white residents have, historically, been moving out of core, urban areas to the urban fringe, at least partially, drives the interest in this line of reasoning. The assumption is that affluent, white individuals and families have fled the urban core to areas on the urban fringe that reinforces socioeconomic homogeneity (Carruthers, 2003; Pendall and Carruthers, 2003). Since Smart Growth names the reduction of income segregation as one of its goals (Talen, 2002), empirical evidence that a sprawling built environment encourages income segregation would provide evidence that Smart Growth policies are prudent public policy. However, if there were little connection between sprawl and income segregation, this would limit the persuasiveness of the Smart Growth argument. The results of sprawl's influence on income segregation are mixed. Pendall and Carruthers (2003) find no direct evidence that sprawl increases income segregation. Instead they find that low density development areas have lower levels of income segregation than areas of higher density. Indeed, higher density areas exhibited higher levels of income segregation leading to the conclusion that higher density may contribute to higher levels of income segregation. Using a slightly broader measurement of income segregation, economic segregation, Yang and Jargowsky (2006) find that multiple measures of suburbanization contributed to increased levels of economic segregation in metropolitan areas. Although levels of economic segregation have been falling, Yang and Jargowsky (2006) argue that the pattern of suburban development dominant in the United States has prevented levels of economic segregation from falling even farther.

Overall, this section has demonstrated that developing a comprehensive definition of sprawl that captures all of the intricacies of the concept is nearly impossible. And if possible, it would be difficult to replicate over a large area. Additionally, this section has demonstrated that sprawl can organically develop over time as evidenced by the monocentric city model. Furthermore, empirical testing of the monocentric city model has largely confirmed the theoretical propositions made. Empirically, the relationship between sprawl and a wide variety of outcomes are examined in the literature. Most relevant to this analysis, the relationship between sprawl and local public finance is broken into two distinct factions. Those analyses that subscribe the the "Smart Growth" hypothesis that sprawl is expensive to service effectively and those analyses that subscribe to the Economist's perspective that sprawl isn't necessarily as harmful as the other faction would suggest. Additionally, the influence of sprawl on a variety of other outcomes such as the environment, income segregation and health outcomes are touched on. All these analyses suggest that sprawl is an important factor in understanding a wide variety of outcomes.

2.2 Growth

Population growth is an important consideration for local governments to keep in mind, especially in urban and suburban areas. The U.S. Census Bureau expects national population to grow by more than 100 million residents to almost 440 million residents by 2050. Many of these new residents, possibly up to 90 percent, will likely reside in or migrate to urban areas (Porter, 2008). While this growth is likely to be uneven across urban areas, all areas will experience some level of growth either positive or negative. The question remains how local governments will respond to this changing landscape.

2.2.1 Why Cities and Urban Areas Grow

Since growth, especially urban growth, is largely inevitable[17] in the U.S. context, it is important to understand the theoretical development on the growth of urban areas. First, a point of clarification is necessary. Growth can take numerous forms. Most often, when individuals speak or write about growth, they are talking about population growth. This is likely the most tangible or real concept to individuals. Indeed, most scholarly work on growth deals with population growth. However, growth need not be synonymous with population growth. Growth in housing units, residential acreage, the spatial size of a city,[18] or a variety of other measures can be used. Nevertheless, population growth is the typical measure as it fits with the standard toolkit for microeconomic analysis in a more straightforward manner than other measures of growth.[19]

Numerous scholarly fields have attempted to develop theoretical models explaining why particular urban areas develop or grow and others languish. While the theoretical debate

[17]Immigration and births in excess of deaths keep population on the rise.

[18]A sprawl measure. The interplay between growth and sprawl will be discussed in the next section.

[19]Most micro economic models focus on the individual. As such, it is easy to incorporate changes in population into these models. It is somewhat harder to incorporate other measures of growth who are absent from standard models from the beginning.

over the reasons for urban growth is not the subject of this analysis, an understanding of the important potential influences on urban growth can be helpful in building a well informed model of the impacts of urban growth on fiscal outcomes. This overview focuses on the more recent theoretical and empirical thinking on the subject of urban growth. While former models[20] are still useful, the focus on the most recent models in urban economics and regional science provides a review of the most cutting edge and active parts of the literature.[21]

The motivation for much of this line of research is the dramatic population migrations away from the old, dense urban areas of the northeast to the southern and western regions of the United States. As manufacturing jobs moved out of urban cores and moved either to suburban areas or offshore, many of the traditional models in urban growth were no longer applicable. The focus of much of the recent literature on urban growth is human capital and urban amenities. Since the late 1980s and early 1990s, research on the growth of cities has largely been focused on the influence of human capital accumulation. This line of reasoning is predicated on the assumption that there are knowledge spillovers in urban areas leading to positive externalities (Glaeser et al., 1992). In a string of papers, Glaeser and numerous co-authors attempt to explain urban growth using a theoretical model laid out in Glaeser et al. (1992) that posits that population growth is based on business conditions (specialization, local monopoly, and diversity) and a set of initial conditions of the city. Although, Glaeser et al. (1992) largely focus on the business condition aspects of the model, they do provide evidence that human capital increases economic growth. Glaeser et al. (1995) more explicitly test the influence of human capital on population and income growth in cities. Using a set of initial city conditions from 1960, Glaeser et al. (1995) attempt to predict 1990 growth

[20]See the "Growth Machine" of Logan and Molotch (1987) and exogenous and endogenous growth models.

[21]It should be noted there are differences between the model of urban growth presented in this section and the monocentric city model. The monocentric city model is a model of intercity growth and of spatial arrangement internal to the city. The model presented in this section is a model of intracity growth dealing specifically with the spatial arrangement of people across all cities.

rates in cities. Glaeser et al. (1995) find that higher levels of median years of schooling lead to higher levels of population and income growth. This result, defining human capital in multiple ways, is echoed by numerous other studies (Black and Henderson, 1999; Glaeser, 2000; Glaeser and Shapiro, 2003; Lee et al., 2007; Winters, 2011).

As mentioned above, the second recent focus of the urban growth literature is urban amenities. Clark et al. (2002, pg. 497) citing Gyourko and Tracy (1991, pg. 775) define, "a pure amenity is a non-produced public good such as weather quality that has no explicit price." Glaeser et al. (2001) explain that there are four amenities important to urban growth: a rich variety of goods and services, aesthetics and physical setting, good public services, and speed of transport. The evidence from this empirical study suggest that warm winters (Rappaport, 2007), warm summers (Glaeser and Shapiro, 2003), and urban amenities such as restaurants and theatres (Glaeser et al., 2001) all contribute to positive population growth. The combined evidence on human capital and urban amenities suggests that cities grow by attracting smart people and providing those people with their preferred amenities.

2.2.2 The Influence of Growth on Local Areas

As Downs (1999) explains, there are numerous undesirable conditions that result, at least in the short term, from population growth. They include increased traffic congestion, increased school enrollment and potential overcrowding, increased need for infrastructure spending, and increased pressure to develop open spaces (Downs, 1999). In many of the areas that are active in the kinds of growth management policies discussed above, there is broad consensus that these ills should be avoided. However, the actions taken by individual local governments to slow or prevent growth are likely to fail. Instead of slowing or preventing growth, these local governments only succeed in shifting the growth to other areas of the region. In this manner, population growth and development is a regional issue not suited to be tackled by an individual local government. As with the discussion on sprawl, this conversation about the influence of growth on local areas will largely focus on public finance related topics. However, there are numerous other potential influences (outlined above) that may be of interest to readers. These will receive limited attention at the end of this section.

In keeping with the regional focus discussed above, Ladd attempts to theoretically (1994) and empirically (1993; 1994) test how population growth effects local taxing and spending decisions of local governments on a regional scale. Ladd is careful to point out that, unlike the discussion on the influences of sprawl found above, there is little theoretical guidance from the standard microeconomic toolkit to understand the influence of population growth on local government financial systems. However, Ladd (1994) attempts to build an informal theory of how population growth may impact the financial decisions, specifically the per capita expenditures, of a locality. In the simplest of cases, Ladd considers the influence of adding identical individuals to an area. These new individuals are identical in every way; income, preferences, socioeconomic characteristics, and the ratio of jobs to residents are largely the same. In this case, the addition of new residents does not change the demand for public services. However, additional residents may change the cost of providing public services. Since expenditures are the product of the quantity of public services demanded times the price of the public services, an increase in cost (price) will increase the expenditures of a local government. Ladd (1994) suggests multiple ways in which the addition of identical individuals to a community may increase the cost of providing public services. Ladd explains that most public goods are more like private goods and, to the extent that this assertion is true, capital assets are an increasing function of population. Therefore, population growth should have no impact on per capita capital expenditures. Since land is fixed, population growth will necessarily lead to increases in land prices (higher demand with a fixed supply). To the extent that public services in a community are dependent on land, rising land prices will drive up the cost of providing those services leading to higher per capita expenditures. To the extent that growth leads to higher private sector wages, the cost of public services may rise as the public sector increases wages to compete for talent in the labor market. Lastly, Ladd notes that there may be some scale effects that growth could exploit but these are indeterminate, *a priori*.

Ladd (1994) also considers the situation where the new residents associated with population growth are unlike the current residents. The influence of this type of growth is markedly different than the previous case. Unlike the previous situation, both demand and cost issues arise. If new residents have higher incomes than current residents, the demand for public services is likely to rise, leading to higher per capita expenditures. Additionally, if there is no income change, the new residents could have different preferences for public services, leading to higher demand for those services and higher per capita expenditures. An increase in the mix of jobs per resident will likely lead to, in the short term, an increase in congestion in the community and the associated cost of attempting to mitigate this congestion, leading to higher per capita expenditures. Finally, the outmigration of individuals can lead to increasing costs as the local government attempts to deal with declining wealth and population. The potential for increased crime and the potential fire risk associated with vacant property can drive up the cost of public safety services. Additionally, the cost of providing services via fixed assets (water, sewer, and transportation) is largely unchanged once provided. Therefore, with a smaller population, the fixed expenditure on these assets is divided among a smaller group of individuals leads to higher per capita expenditures (Ladd, 1981, 1994). In the circumstance where the population left behind is more "dependent" upon the local government for services, per capita expenditures are likely to rise.

Finally, Ladd (1994) suggests population growth may lead to disequilibrium effects or surge effects. The previous outline of Ladd's informal theory is based on the idea that a local government can satisfy the desires of the residents, old and new, of the locality. It is possible that this may not be the case. Under this situation, Ladd (1994, pg. 669) explains that "observed spending reflects constrained, rather than desired, levels of services" and this constrained spending is likely in states with tax and expenditure limitations. In this situation, actual spending will be lower than desired spending leading to declining per capita expenditures and service quality.

Beyond the theoretical contributions of Ladd, there is research attempting to theoretically connect population patterns (and presumably growth pattens) to local budgets. This analysis begins with an interpretation of Tiebout (1956) original argument. Tiebout's argument relies on, but does not explicitly mention, a theory of clubs (Buchanan, 1965) style analysis of local government behavior (Mills and Oates, 1975; Cornes and Sandler, 1996). Tiebout (1956) postulates there is an optimal municipal size for each bundle of taxes and services that can be produced for the lowest average cost. To allow for an optimal municipal size that is not infinite, some factor in production must be fixed, and Tiebout suggests that this is land area or a naturally limiting factor such as a beach. To ensure that a municipality does not grow larger than its optimal size, land use regulations (zoning) can be used.[22] Rather than proposing that increased population changes the mix of taxes and services provided by local governments, Tiebout (1956) suggests that if a consumer-voter prefers a different bundle of taxes and services, she will move to another municipality that more accurately satisfies her preferences. Therefore, growth (positive or negative) will occur in areas that are attractive (or not) to certain groups of individuals. Poorly run, unattractive cities will wither while cities that offer attractive public services at reasonable tax costs will like grow. Oates (1981) explains that the Tiebout model, in the pure sense, puts too many demands on individuals to be realistic. However, Oates argues that local governments are Tiebout-like and the Tiebout model is descriptively useful.[23]

[22]Tiebout (1956) suggests that regulations against multi-family homes could be an effective method of restricting municipal size.

[23]However, the exact theoretical mechanics of the Tiebout model must be subject to modification for the model to be empirically useful.

Tiebout's explanation of an optimally sized municipality and tax/services bundle is, in essence, a theory of clubs analysis (Mills and Oates, 1975; Cornes and Sandler, 1996). Though Buchanan (1965) published his formalization of the theory of clubs many years after Tiebout, the idea and concept of a theory of clubs had been around since as early as the 1920s (Chapman, 1988; Cornes and Sandler, 1996). Buchanan (1965) proposes an analysis in between a purely private goods analysis and the purely public goods analysis of Samuelson (1954, 1955). Buchanan provides a theoretical analysis where non club members are excluded from benefiting from the provision of the good, yet membership in the club providing the good is voluntary. At the heart of Buchanan's analysis is the simultaneous determination of the optimal membership size for the club and the optimal amount of goods or services the club will provide. Since the good provided is locally congestible, increasing members of the club increase disutility to all members when the amount of good provided is fixed. However, as more members to the club are added, per capita costs for good provision decrease. Under Samuelson conditions that marginal benefits to the individual club member must equal marginal costs and the marginal rate of substitution between the size of club and the good provided must equal the marginal rate of transformation between size of the club and the good provided, the optimal size and the service provision of the club can be determined.

Using the theory of clubs, Chapman (1988) develops a model in which the optimal amount of development and the optimal amount of public service provision are simultaneously determined.[24][25] A principle characteristic of a club is the ability to exclude individuals from membership and this condition is met in Chapman's model through the use of land use regulation. Chapman shows that the theory of clubs can be adapted to find the optimal units

[24]Tiebout (1956) and Chapman (1988) are similar in that they both attempt to determine the optimal size of a locality. However, Chapman (1988) focuses on units of development rather than population.

[25]While not entirely similar, population growth and development growth, as operationalized by housing supply growth, are highly correlated (Glaeser et al., 2006).

of development and services levels for local governments. Given an initial level of service provision, a ratcheting effect occurs with a given level of service provision leading to higher development leading to higher service provision. Ultimately because of crowding, the optimal level of both service provision and development can be determined and the resultant equilibrium is stable. However, the model is sensitive to the ordering of initial assumptions that could easily throw the model into disequilibrium. Politically driven determinations of optimal service provision[26] can lead to the model having an unstable equilibrium in both development and service provision. Additionally, it is assumed that given a stable equilibrium, increases in expenditures required to maintain the optimal service level will be distributed evenly among units of development. Theory assumes this occurs through something similar to an efficient head tax. However, this is not possible in the real world as revenues are unevenly distributed among units of development based upon a variety of variables. This provides strong incentives for local governments to require new development to pay their own way through fiscal zoning or exactions (Altshuler and Gómez-Ibáñez, 1993). Only through this process of requiring new development to be revenue neutral are the Samuelson conditions met. Windsor (1990) generalizes Chapman's model to be less fiscal in nature and incorporates equity-based shortcomings of the original model.

Chapman (1988) demonstrates that rapid, unplanned growth may push the theoretical model into significant disequilibrium. As a result of this disequilibrium, public expenditures may fluctuate in unpredictable ways. Public service quality may decline in a manner explained in Ladd (1994). However, it is also possible that per capita expenditures will rise, potentially uncontrollable, to meet the demand of new development. These results, taken with the theoretical contributions of Ladd (1994) discussed above, establish a clear con-

[26]Beginning with an initial level of development and then determining service provision is considered by Chapman (1988) to be a political process.

nection between population/development growth and local fiscal outcomes. Many of these theoretical propositions are tested empirically in the literature discussed next.

Ladd (1981, 1992, 1993, 1994) provides an empirical investigation of the influence of population growth on per capita local government expenditures. Ladd (1981) lays out a preliminary econometric model by regressing per capita non-school expenditures and per capita non-school property tax level on a median voter-like set of variables and population growth and population growth squared.[27] Ladd (1981) finds, consistent with the theory above, that there is a u-shaped, non-linear relationship between population growth and per capita expenditures and per capita property tax levy. At negative growth levels, per capita expenditures and per capita levies are high. However, as population growth increases, per capita expenditures and levies fall to a minimum level at 17-19 percent population growth for expenditures and 15-16 percent population growth for property tax levies. Beyond this point (considered rapid population growth), per capita expenditures and per capita property tax levies increase. In a later paper, Ladd (1992) uses a similar model to her 1981 paper but estimates population growth in a piecewise fashion rather than as a continuous variable. In this paper, Ladd finds a similar relationship to the 1981 paper. Compared to the base category of no growth, negative growth increases per capita *current* expenditures. However, unlike the previous model, as population growth increases from zero, per capita current expenditures declined continuously. Additionally, compared to the base category of no growth, negative growth increases per capita *capital* expenditures. Unlike the current expenditure model, as population growth increases from zero, per capita *capital* expenditures increase as well leading to a u-shaped relationship. Finally, Ladd (1992) finds the relationship between population growth and per capita public safety expenditures demonstrate the same u-shaped association as capital expenditures.[28]

[27]Population growth measured as 1975 population divided by 1970 population.

[28]There is a kink in the relationship at 5% annual population growth. The relationship here, relative to zero growth, is negative.

In a separate string of papers, Ladd (1993, 1994) examines the dynamic relationship between population growth and per capita expenditures. Rather than focusing on the level of spending like the analyses above do, these two papers focus on the changes in per capita expenditures in response to population growth. Ladd (1993) examines the influence of population growth on percent changes in per capita expenditures, per capita revenues, and tax burdens.[29] In the first model, percent changes in per capita expenditures are regressed onto the percent change in population and the percent change in population squared. Ladd (1993) finds that there is a u-shaped relationship between population growth and per capita expenditures. Moreover, population growth exerts an inverse u-shaped relationship with per capita capital expenditures and per capita interest costs. These relationships hold when additional variables are added to the model to control for economic growth, age distribution, and the local share of state-local expenditures. These relationships are echoed in the findings of Ladd (1994).

Examining percent changes in per capita revenues, Ladd (1993) regresses the percent change in revenues on the percent change in population and the percent change in population squared. Ladd finds a positive relationship between per capita revenues and population growth but no evidence of a non-linear relationship. However, Ladd explains that the growth in total revenues is the result of increases in total taxes per capita and miscellaneous revenues per capita. Regressions with these variables on the left hand side show that there is a u-shaped relationship between per capita total taxes and population growth. Additionally, there is a strong positive relationship between per capita miscellaneous revenues and population growth likely driven by small absolute changes leading to higher percent changes, the importance of interest income to growing communities, and the inclusion of impact fees into miscellaneous revenues. These relationships hold after controlling for changes in jobs, changes in income, and tax and expenditures limitations in California and Massachusetts.

[29] Defined as revenues divided by personal income.

Finally, Ladd (1993) examines the influence of population growth on changes in tax burdens. In the basic model (without controls), Ladd finds a u-shaped relationship between the percent change in total tax burdens and population growth. The same relationship is also found for the percent change in property tax burdens. Additionally, population growth puts upward pressure on own source revenue burdens, sales tax burden, other tax burden, and miscellaneous revenue burden. Population growth puts downward pressure on general charges burden. These relationships largely hold when controls are added to the model. However, the relationship between sales tax burden and population growth and other tax burden and population growth are no longer significant with the addition of the control variables. Overall, the theoretical and empirical evidence of Ladd demonstrates that there is a connection between population growth and local government financial systems. This relationship is largely non-linear.

2.2.3 Fiscal Impact Analysis

There is a largely practitioner focused literature that specifically attempts to demonstrate the influence of land development or population growth on local government service provision and fiscal outcomes. Known as Fiscal Impact Analysis, this type of analysis allows local governments the ability to better understand the impact of land development on their budgets. Fiscal impact analysis, as defined by Burchell and Listokin (1978, pg. 1), is "a projection of the direct, current, public costs and revenues associated with residential or nonresidential growth to the local jurisdiction(s) in which this growth is taking place." At its heart, fiscal impact analysis assigns costs and revenues to different land use proposals. The cost side of the equation is the more difficult to calculate. There are a variety of methods used to accomplish this task; however, as Burchell and Listokin (1978) note, there are two primary methods of cost allocation, average costing and marginal costing. Average costing is the more prevalent method by which costs are allocated on an "average cost per unit of services

. . . times the number of units" of service supplied. Marginal costing takes into account the supply and demand relationships for municipal services in allocating costs. Revenues are far easier to allocate to land uses, though as Burchell and Listokin (1978) note, this is becoming harder to do as local governments diversify their revenue streams away from the property tax.

A more relevant method of fiscal impact analysis to the research at hand is cost of community service (CoCS) studies. Rather than focusing on prospective developments, this method of analysis focuses on existing land uses and was developed by the American Farmland Trust (Kotchen and Schulte, 2009; American Farmland Trust, 1993). CoCS studies are similar to formal fiscal impact analyses; however, they are somewhat simplified. Edwards (2001, pg. 110) explains that CoCS studies compare "annual revenues and expenditures of public services for various land use sectors...[and result in] a set of ratios showing the proportional relationship of revenues and expenditures for different land uses." These ratios, typically calculated for residential, commercial/industrial, and farm/open space land uses, are the ratio of expenditures to revenues (typically for all local governments, together) and show the dollar amount of services expended on that land classification for every one dollar in revenue generated (Edwards, 2001).

The general consensus from CoCS studies and analyses of these studies is that residential properties are typically a "bad deal" for local governments (Kotchen and Schulte, 2009; Edwards, 2001; Kelsey, 1996). That is, residential land uses have an expenditure to revenue ratio of above one; residential properties consume more in services than they generate in revenue. In a meta-analysis of 125 CoCS studies, Kotchen and Schulte (2009) find that the mean expenditure to revenue ratio for residential land use is 1.18 meaning that residential properties consume $1.18 of services for every one dollar generated in revenue. However, commercial/industrial and farmland/open space have mean ratios that are much lower than one. Mean ratios for commercial/industrial were 0.44 and mean ratios for farmland/open space were 0.50.[30] This shows that, on average, commercial/industrial and farmland/open space land uses generate more revenues than services consumed. Specifically, commercial/industrial land uses demand only $0.44 in services for each dollar generated in revenues and farmland/open space uses demand $0.50 in services for each dollar generated in revenues.

Though CoCS studies provide a useful snapshot for local officials regarding the current impact of land use patterns on local budgets, there are some criticisms of these studies. Kelsey (1996) outlines three major problems with CoCS studies. First, the expenditure to revenue ratio is "primarily a reflection of the proportion of local spending going towards schools" (Kelsey, 1996, pg. 85). Since public school services are only consumed by residential properties but all land use classifications contribute to revenues, this criticism is to be expected. Indeed, the meta-analysis conducted by Kotchen and Schulte (2009) find that inclusion of public school budgets in the CoCS study increases the expenditure to revenue ratio for residential properties at a statistically significant level. However, the inclusion of public school services does not influence the ratio for commercial/industrial or farmland/open space land uses. Second, the land use categories in most CoCS studies are averaged over potentially many types of similar land uses. Kelsey (1996) explains that under residential land uses there are many different uses such as single family homes, multifamily homes, mobile homes, and retirement homes. The averaging of these residential land uses may unintentionally bias the results of the study. Finally, the basis used to calculate the expenditure to revenue ratio influences the result. Most expenditure to revenue ratios are calculated using a dollar basis. This basis tends to overstate the value of farmland or open space. However, the results change if the basis of calculation is changed to dollars per acre. In this case, commercial or industrial land uses become much more influential because they generate more revenue per

[30]However, there is significant variation in this measure. Maximum values for both commercial/industrial and farmland/open space land uses were above one.

acre. Additionally, Altshuler and Gómez-Ibáñez (1993) outlines three additional issues with fiscal impact analysis. First, there is significant difficulty in determining the counterfactual to development. Second, there is difficulty in calculating the true marginal costs of development. And, finally, issues with how to deal with redistributive social services in fiscal impact analyses. Also, Ladd (1998, pg. 63) notes that fiscal impact analysis too narrowly defines costs and benefits. As a result, "fiscal impact analysis provides only a partial analysis of how the new development will affect them [local residents]." Furthermore, Burchell et al. (1985) explains that fiscal impact studies and, presumably though not specifically mentioned, CoCS studies are highly context specific. Therefore, attempts to generalize results of these studies is highly suspect. While these studies are useful for local decision makers, attempts to determine the influence of sprawl and growth on local fiscal outcomes in this manner that are generalizable to other communities is not possible. Therefore, while this method of analysis is informative to the analysis at hand, it is not an appropriate method of analysis for the questions presented.

Overall, this section explores the current literature on why urban areas growth and the impact of such growth on urban areas. Urban areas grow, according to recent research, because knowledge spillovers associated with human capital accumulation. Additionally, positive urban amenities such as warm temperatures, cultural attractions and urban nightlife are associated with higher levels of urban growth. The influence of urban growth on local areas is largely focused on the characteristics of individuals moving into the area. The addition of identical individuals into a community only increases the cost of providing services to extent that such growth influences input prices. However, the addition of dissimilar individuals allows for both demand and costs of public services to change. Also considered is the influence of unplanned or non-optimal growth on public services through an analysis of the theory of clubs. Finally, the literature on fiscal impacts studies and their relevance to urban growth is highlighted, and these studies are critiqued.

2.3 Intersections between Sprawl and Growth

Neither sprawl nor population growth take place in a vacuum. The two concepts are deeply connected and understanding how the two function together can inform an analysis involving the two. This section will highlight these connections between population growth and sprawl and a deeply related topic, the spatial extent of cities.

From a purely theoretical point of view, the Alonso (1964), Muth (1969), Mills (1967) model demonstrates how population growth (or decline) will influence the density and spatial extent of a city. Assuming a closed city, numerous comparative statics can be derived from monocentric city model. Fujita (1989) demonstrates the following:

$$\frac{\partial \bar{r}}{\partial N} > 0, \frac{\partial S(r, u^*)}{\partial N} < 0, \frac{\partial u^*}{\partial N} < 0, \frac{\partial R(r)}{\partial N} > 0 \tag{2.5}$$

Where N is the urban population size and $\bar{r}$ is the distance to the urban fringe as defined above. Additionally, u^* is the equilibrium level of utility from the maximization in Equation 2.1 on page 11 and $S(r, u^*)$ is the equilibrium lot size.[31] The first outcome from Equation 2.5 is the result echoed in Equation 2.4 on page 12; an increase in population leads to an increase in the spatial extent of the city, moving the boundary to the urban fringe outward. The second outcome from Equation 2.5 suggests that the bid-max lot size decreases as population increases. This has the effect of increasing the density throughout the city (Fujita, 1989). The final two results from Equation 2.5 suggest that equilibrium utility falls and land rents rise as population increases.

The implications from the comparative statics above are that population both increases the circumference of the monocentric city while, simultaneously, increasing the density of city. Unfortunately, the comparative statics do not indicate which effect will dominate. One could find a city with positive population growth where the city grew very little, spatially, and

[31]Derivations for equilibrium bid-max lot size can be found in Fujita (1989, chap. 2).

density rose a great deal throughout the city. However, the opposite is equally as likely, with the urban fringe moving outward a great deal and density rising only marginally. Equally likely still, some combination of increased density and increased city size could manifest itself. Each of these situations has implications for the outcomes to be analyzed in this dissertation.

Dealing with the relationship in the opposite direction of what is discussed above, Glaeser and Shapiro (2003) find that population growth is occurring in cities that are spatially larger and have lower densities. In this sense, a low density and spatially extensive city environment can be viewed as an amenity that individuals value. Since population growth is a function human capital and amenities and holding human capital constant, it would appear that individuals prefer to reside in lower density, spatially large cities. The above discussion indicates that there is certainly a relationship between population growth and sprawl; however, the relationship is ambiguous and likely endogenous. It also indicates that excluding one of the variables from an analysis may unduly bias the estimation of the remaining variable. Only together can the unbiased estimate of each variable, sprawl and population growth, be made.

To conclude, this literature review has touched on a number of subjects relevant to the analysis at hand. First, the definitional difficulties associated with the complexities associated with sprawl were analyzed. Additionally, the disciplinary conflict between "Smart Growth" and the Economist's Perspective is overviewed. The former suggests that sprawl is costly to service because it fails to capitalize on economies of scale (Carruthers and Úlfarsson, 2002, 2003), often fails to optimize the location of costly capital facilities (Carruthers and Úlfarsson, 2002, 2003), and leads to duplicative service delivery (Real Estate Research Corporation, 1974). The Economist's Perspective suggests there are economies of density as areas begin to urbanize; however, once an area becomes dense, urban "harshness" takes over and drives up costs. On the growth size, the literature on why cities growth was overviewed.

This literature suggests that urban areas growth because of knowledge spillovers associated with human capital accumulation are present and positive urban amenities such as warm temperatures and cultural activities attract individuals. The influence of growth on urban areas is largely dependent on the characteristics of individuals moving into the area. The addition of identical individuals into a community only increases the cost of providing services to extent that such growth influences input prices. However, the addition of dissimilar individuals allows for both demand and costs of public services to change.

Chapter 3

Data Sources & Research Questions

This chapter begins with an explanation of data sources utilized in this dissertation, and the construction of the dataset is outlined. Next, a more in depth explanation of the research questions which are the subject of this dissertation is conducted. Each question will be examined in turn. Finally, common variables across all research questions are discussed and exploratory analysis of these data are conducted through examination of choropleth (quantiles) maps.

3.1 Data Sources

The data for this dissertation is derived from 158 of the 159 counties in the State of Georgia. One county is excluded because of missing data.[1] Instead of relying solely on the financial information of county governments, whose service delivery obligations vary across counties and time, *composite counties* are constructed. Similar to the constructed cities concept in Chernick et al. (2011) and the county area data available from the Census Bureau, *composite counties* are composed of all the general purpose local governments in a county (county

[1]It is the practice of the Department of Community Affairs to drop counties from the Report of Local Government Finances prior to city-county consolidation. Quitman County and the City of Georgetown consolidated in FY2007.

and all municipalities). Additionally, county and city school district data has been added. Specifically, *composite counties (CC)* are constructed as follows:

$$CC_j = county + \sum_{i=1}^{n} w_n municipalities + \sum_{i=1}^{m} w_m school\ districts \tag{3.1}$$

In Equation 3.1, *composite counties* are defined as the county government (and all of its dependent special purpose governments) plus the summation of all municipalities (an all their dependent special purpose governments), n and weighted by w_n,[2] plus the summation of all school districts (county and, if applicable, independent city districts[3]), m and weighted by w_m.[4] This operation is conducted for each county in each year. In instances where a municipality or independent city school district crosses county boundaries, the information for these governments is allocated to a county based upon the percentage of the municipality or city school district contained in the county. An example is helpful. Assume municipality X resides in two counties, A and B, with 25% of municipality X's land area in county A and 75% of municipality X's land area in county B. In this circumstance, 25% of municipality X's information is allocated to county A and 75% municipality X's information is allocated to county B.

Composite counties are utilized for the analyses in chapters four and six. These chapters analyze the influence of sprawl and residential growth on per capita expenditures and revenue diversification. The choice of *constructed counties* for these analyses was not at random. There are a number of theoretical and methodological reasons for using *constructed counties*. First, the extant literature pertaining to both of these analyses would suggest that

[2]This weight is a fractional weight that sums to one based the acreage in the municipality relative to the total incorporated acreage.

[3]The creation of new city or "independent" school systems in Georgia was prohibited in 1945. However, the number of independent school system has ebbed and flowed because of consolidations and actions of legislature. The current number is 22 (Boex and Martinez-Vasquez, 1998).

[4]This weight is a fractional weight that sums to one based the acreage in the school district relative to the total school district acreage.

a composite measure of public spending or revenue diversification is necessary. Ladd (1992) and Carruthers and Úlfarsson (2008, 2003) utilize a composite measure of public expenditure in their analyses of the influence of growth and density/sprawl on public expenditure patterns. Furthermore, the theoretical predictions of the influence of sprawl on per capita expenditures explicitly mentions the influence of overlapping jurisdictions and duplicative service delivery (see the discussion above and in Real Estate Research Corporation (1974)). Additionally, the early work on revenue diversification by Shannon (1987) and Ladd and Weist (1987) suggested that a composite measure of revenue diversification was necessary. More recently, Chernick et al. (2011) suggest that by not measuring revenue diversification across all local governments, the results of any analysis pertaining to revenue diversification may be biased. Therefore, theoretically, it would be in appropriate to utilize anything other than a composite measure of per capita expenditures or revenue diversification.

Second, while counties, municipalities, and school districts in Georgia have uniform rules governing the types of services that may be provided and the types of revenues that may be raised, there is significant heterogeneity in the actual service delivery and revenue raising patterns in Georgia between the metropolitan counties (largely in the Atlanta area) and rural counties. In creating *composite counties*, the service delivery obligations of the complex web of counties, authorities and municipalities are normalized across space.[5] In doing so, service delivery obligations are held constant and make *composite counties* comparable across space and time. This is necessarily because of a feature of the Georgia Constitution. Art. IX, § 2, para. 3 grants cities and counties in Georgia the ability to provide the full complement of urban services generally afforded only to municipalities.[6] As a result, there is significant variation as to how county areas delivery local public services. In some counties, municipal-

[5]Over the time period of this analysis, school districts are relatively static. The relationship between city and county school districts are the same in terms of service delivery with only the number and location of students changing (if they change at all).

[6]The authority to plan and adopt a zoning ordinance is considered separately in Ga. Const. art. IX, § 2, para. 4.

ities provide the bulk of public services while the county provides only the services required by the Georgia constitution.[7] However, in other counties, municipalities and the county provide the same or similar services. Additionally, the relationship between the county and municipalities in terms of service delivery arrangements is not fixed across time. As a result, these relationships may change over time making consistency impossible to judge.

In addition to the theoretical and methodological issues discussed above, using *composite counties* allows the results of these two analyses to approximate the effect of the built environment and residential growth on the individual. As defined, the results of a regression model using *constructed counties* as the unit of analysis can be thought of as the influence of the built environment and growth on the expenditures burden or the mixture of revenue sources the "average" individual will face. As a result, these two analyses more focused on the effect of the built environment on the individual taxpayer rather than any individual government.

In contrast to the analyses in chapters four and six, the analysis in chapter five pertaining to local fiscal conditions does not utilize the *constructed counties* concept. Analyzing local fiscal conditions with a single classification of local government is common in the academic literature (Bradbury et al., 1984; Ladd and Yinger, 1989; Ladd, 1999; Bradbury and Zhao, 2009; Wallin and Zabel, 2011). Each of these analyses cited use a method similar to that used here to calculate local fiscal conditions and do so using one layer of local governments. While there is some dissent about this in the literature (see Bradbury (1982) as an example), analyzing local fiscal conditions using one layer of local government is the norm. Additionally, in contrast to the two previously discussed analyses, local fiscal conditions are not something faced by the individual. Rather, local fiscal conditions, as constructed, are faced by a local government and are context specific. It is likely that a county face different local fiscal

[7] "The clerk of the superior court, judge of the probate court, sheriff, tax receiver, tax collector, and tax commissioner, where such office has replaced the tax receiver and tax collector," Ga. Const. art. IX, § 1, para. 3.

conditions than a municipality contained within the county borders. Differences in the size, scope and make up of the local economy is driving these differences between counties and municipalities. It is possible that a county face favorable local fiscal conditions while a municipality contained within the county face poor local fiscal conditions. Any number of variations of these conditions are possible. Given the norm in the extant literature and the differences in local fiscal conditions among classifications of local governments, it would in inappropriate to merge these different jurisdictions into a single composite. Therefore, an alternate data set, containing all of the same information as the *composite counties* data set is utilized. This data set contains information on county governments only.

There are implications for policymakers by designing this study in this manner. The analyses of per capita expenditures and revenue diversification may not be directly applicable to local policy makers as the unit of analysis is not an actual government. However, these results will likely be quite useful to policymakers at higher levels of government (regional or state) who have the ability to craft policy pertaining to local governments, en masse. If the results of this analysis suggest more or less coordination between local governments or new laws would be helpful in alleviating problems, these state or regional level actors will find this analysis helpful in crafting policy. Indeed, Georgia has experience crafting state level policy with the consensus of numerous local level stakeholders in the Georgia Planning Act of 1989 (DeGrove, 2005) so the precedent is not unheard of in the Georgia context. Local policy makers will likely find the analyses in chapter four on local fiscal conditions the most applicable to their work. However, as mentioned before, local fiscal conditions are context specific. Therefore, it is possible that only county level officials will find these results applicable.

The primary dataset for finances on general purpose city and county governments in Georgia is the Report of Local Government Finances collected by the Department of Community Affairs. The Report of Local Government Finances is a detailed survey of city and county financial variables including revenues, expenditures and debt. It is utilized to fulfill reporting requirements of the U.S. Census Bureau and is used by Georgia policy makers to inform decision making.[8] This survey is conducted on an annual basis and timely response is required by law (O.C.G.A § 36-81-8).[9] Therefore, response rates are high. In instances where responses are inconsistent over time, particularly with small cities, information is extrapolated by the author using a linear time trend. School district data are derived from the Public Elementary-Secondary Education Finance Database maintained by the U.S. Census Bureau. These data are collected by the U.S. Census Bureau through the Annual Survey of Government Finances authorized by Title 13, U.S. Code, Section 182.[10] Land use data are derived from the Tax Digest Consolidated Summary compiled by the Tax Commissioner of each individual county and confirmed by the Georgia Department of Revenue on an annual basis (O.C.G.A. § 48-5-1). Remaining data are complied from various state and federal statistical agencies. The time period for this analysis is from FY2000 to FY2008. This time period is approximately peak to peak in business cycle (Q1 2004 - Q4 2007).[11] Therefore, this time period contains the full range of economic circumstances including both improving and deteriorating economic conditions. While this dataset allows for the examination of effects over one time period, it does not allow inference over a longer time period containing multiple business cycles. As such, this is a short to medium term analysis. While the dataset contains information on 158 counties, not all governments responded to each survey in every year or were missing data for specific years. This results in an unbalanced panel of 1,245 observations for the *composite counties* data set and 1,214 observations for the county only data set.

[8] `http://dca.state.ga.us/development/research/programs/downloads/RLGF_Instructions.pdf`

[9] Failure to submit a response to this survey results in the withholding of state funds allocated through the Department of Community Affairs.

[10] `http://www2.census.gov/govs/school/09f33pub.pdf`

[11] `http://www.nber.org/cycles.html`

Table 3.1: Georgia Compared to the Southeast and the United States

Year	Population			Per Capita GDP			Per Capita Personal Income			Unemployment		
	Georgia	Southeast	National	Georgia	Southeast	National	Georgia	Southeast	National	Georgia	Southeast	National
2000	8,230,161	5,569,194	5,478,836	$40,362.91	$32,437.05	$39,139.66	$32.196.28	$28,621.42	$32,817.01	3.467%	4.032%	3.883%
2001	8,419,594	5,627,616	5,533,239	$39,956.48	$32,826.48	$39,524.09	$32,372.98	$29,139.05	$33,332.01	3.942%	4.865%	4.514%
2002	8,585,535	5,689,119	5,584,368	$39,721.55	$33,279.88	$40,075.87	$32,052.64	$29,203.11	$33,274.84	4.817%	5.642%	5.359%
2003	8,735,259	5,750,043	5,631,823	$39.495.22	$34,044.35	$41,041.08	$31,940.48	$29,417.25	$33,555.57	4.767%	5.877%	5.603%
2004	8,913,676	5,825,316	5,682,641	$39,782.51	$34,986.88	$42,316.37	$32,164.60	$30,051.18	$34,298.69	4.733%	5.389%	5.196%
2005	9,097,428	5,906,768	5,785,263	$39,819.32	$36,023.06	$43,228.06	$32,775.00	$30,503.64	$34,659.90	5.225%	5.320%	4.896%
2006	9,330,086	5,964,382	5,785,263	$39,599.26	$36,695.76	$44,028.35	$32,986.46	$31,383.94	$35,701.56	6.717%	4.812%	4.426%
2007	9,533,761	6,045,839	5,840,923	$39.503.70	$36,510.00	$44,622.87	$33,274.04	$31,935.16	$36,433.07	4.675%	4.726%	4.318%
2008	9,697,838	6,1136,30	5,893,540	$38,473.29	$36,131.44	$44,662.12	$33,016.99	$32,472.56	$37,286.93	6.350%	5.973%	5.317%

Year	Per Capita Own-Source Revenue			Per Capita Total Expenditures			Per Capita Current Expenditures			Per Capita Capital Expenditures		
	Georgia	Southeast	National	Georgia	Southeast	National	Georgia	Southeast	National	Georgia	Southeast	National
2000	$2,149.79	$1,641.12	$2,020.56	$3,547.71	$3,115.04	$3,664.24	$2,699.18	$2,497.35	$2,900.31	$651.24	$423.56	$529.80
2001	-	-	-	-	-	-	-	-	-	-	-	-
2002	$2,212.60	$1,703.59	$2,099.15	$3,907.31	$3,260.19	$3,935.32	$2,999.50	$2,633.02	$3,089.46	$717.73	$423.35	$604.70
2003	-	-	-	-	-	-	-	-	-	-	-	-
2004	$2,124.34	$1,751.12	$2,190.07	$3,892.21	$3,377.11	$4,039.33	$2,997.53	$2,744.71	$3,219.91	$711.92	$424.33	$574.00
2005	$2,133.86	$1,795.80	$2,248.91	$3,805.42	$3,404.42	$4,058.68	$3,005.99	$2,795.72	$3,263.29	$638.71	$426.13	$570.55
2006	$2,351.78	$1,881.93	$2,331.22	$3,925.71	$3,538.43	$4,154.03	$3,086.46	$2,897.92	$3,333.55	$673.45	$465.09	$598.54
2007	$2,477.81	$1,976.53	$2,438.86	$4,172.67	$3,657.22	$4,306.91	$3,246.59	$2,995.91	$3,437.26	$765.42	$485.28	$643.10
2008	$2,494.05	$1,999.53	$2,480.26	$4,457.93	$3,723.60	$4,488.24	$3,481.66	$3,031.99	$3,565.96	$815.54	$506.38	$689.06

Source: U.S. Bureau of Economic Analysis; U.S. Bureau of Labor Statistics; U.S. Census Bureau, State and Local Government Finances

As a Georgia specific case study, there must be some note about the potential generalizability of the results using these data. Table 3.1 compares Georgia to the average of the southeast[12] (excluding Georgia) and to the U.S. as a whole (excluding Georgia) on eight dimensions.[13] These dimensions are largely economic or government related. In terms of population, the State of Georgia is significantly larger than the average southeastern state and the average state, nationwide. As shown in the 2010 Census, Georgia is the ninth most populous state in the nation and is the second most populous state in the southeast behind Florida.

While Georgia is a populous state, two indicators of economic activity measured on a per capita basis demonstrate that Georgia is lagging behind the southeast as well as the nation. Per capita GDP in Georgia is higher than the average of the rest of the southeast; however, as Table 3.1 shows, growth in per capita GDP in Georgia has been almost nonexistent. Meanwhile, per capita GDP has been growing in both the southeast and nationally. On a per capita personal income basis, Georgia and the rest of the southeast have been on similar trajectories. Per capita incomes have been rising, but the growth in the southeast has been much larger in magnitude. Overall, per capita income growth in Georgia and the southeast has been overshadowed by more robust growth nationally.

Turning next to local government fiscal data,[14] per capita own-source revenues, per capita total expenditures, per capita current expenditures, and per capita capital expenditures are examined. Dealing first with per capita own-source revenues in Table 3.1, Georgia appears to act more like the average U.S. state rather than the states who compose the southeastern region. Per capita own-source revenue ranges from about $2,150 dollars in 2000 to almost

[12] The southeastern region is defined as Alabama, Arkansas, Florida, Georgia (excluded), Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia and West Virginia. This is the definition of the southeast as outlined by the Bureau of Economic Analysis.

[13] All dollar values are in 2005 adjusted dollars.

[14] To maintain consistency across the states, Census of Governments local government financial data is used for this analysis rather than dataset outlined above.

\$2,500 in 2008. This pattern tracks nicely with the pattern seen at the national level; however, it is much higher than the average southeastern state. Similarly, per capita total expenditures for Georgia track more closely with the national average than the average southeastern state. From 2000 to 2008, per capita total expenditure in Georgia grew from approximately \$3,550 to \$4,460, respectively. This trend is mirrored almost exactly at the national level. Per capita total expenditures grew more slowly in the southeast and are uniformly lower than those found in Georgia. Deconstructing per capita total expenditure into its components, Georgia spent, on average, more on current and capital expenditure per capita than the average southeastern state. However, while spending less than the national average on per capita current expenditures and higher than the national average on per capita capital expenditures, the growth and trajectory of per capita spending tracks nicely with the national average.

The preceding discussion is meant to highlight that Georgia may be somewhat unique in the southeastern region; however, it is much more like the average state in the United States. Georgia is a large, fast growing state. It is dominated by a single, massive metropolitan area while the rest of the state is largely agrarian or rural. This makes Georgia similar to a number of other states in south and west with comparable geo-political arrangements. Therefore, generalizability of this study may be somewhat limited; however, the results are likely to be limitedly applicable to these similar states.

3.2 Research Questions

3.2.1 Per Capita Expenditures

To understand the influence of residential density and residential growth on per capita expenditures in Georgia counties, the following theoretical model is discussed. This model, originally developed by Ladd (1994), explicitly incorporates density and growth into an analysis of per capita expenditures. From this model, hypotheses are developed as to the influence of residential density and growth on per capita expenditures.

As Ladd (1994) explains, per capita public expenditures can be defined as

$$EXP = S \times C_s \times SR \tag{3.2}$$

where EXP is per capita expenditures, S is service levels defined by citizen voters, C_s is the cost per resident of providing public services, and SR is the division of service delivery responsibilities between state and local government. Ladd (1994) stresses that S is the goods and services that citizens desire. An example of this is the protection from crime. However, often we only observe direct, or intermediate, outputs of local governments. Keeping with the crime example, these direct outputs could be viewed as the number of police patrols. As such, S can further be defined as

$$S = f(X, N, E) \tag{3.3}$$

where X is total amount of direct outputs, N is population and E is environmental factors in the vein of Bradford et al. (1969). Equation 3.3 is important for this question because environmental factors often explicitly mean population density (Bradbury et al., 1984; Ladd and Yinger, 1989; Ladd, 1992, 1994). Additionally, Ladd (1994) explains that population could easily be incorporated as an environmental factor rather than a separate consideration.

The cost of public services can be defined as

$$C_s = f(C_x, N, E) \tag{3.4}$$

where C_x is the cost per unit of output (i.e. land costs, labor costs, capital costs) and N and E are defined as they are above.

Therefore, in this simple theoretical construct, Ladd (1994) suggests that population (and changes in population, presumably) and density enter into the model in two ways: (1) through demand for public services and (2) through the costs of providing those services. Dealing first with density, there are potentially two mechanisms through which density can work. First, increasing density can increase the number of direct outputs needed to provide a given level of service delivery. Second, increasing density could generate economies of density leading to lower costs of providing public services to residents. The second point hits at the heart of the "Smart Growth" hypothesis and is largely the position advocated for by the urban planning community. To the first point, planners are quick to point out that density may very well pay for increased demand stimulated by the "harshness" of the urban environment through higher land values (Ewing, 1997). However, increased urban land prices enter into the cost equation (3.4) as well. Overall, there is *a priori* disagreement about both the influence of density on public service costs as well as theoretical disagreement. In addition to density, a key provision of sprawl is a spatially expansive development pattern. One could imagine a larger urban service area being an environmental factor much like density. Therefore, one might expect that a larger service area would drive up public service costs, ultimately leading to increase per capita expenditures.

As for the influence of population growth on per capita expenditures, the key consideration is the publicness of the good and services provided (Ladd, 1994). If public goods and services provided by a local government are particularly public, the costs to provide S should decline. For fixed direct outputs, an increase in the population should decrease per capita expenditures since a fixed cost is spread across a larger number of residents. If the goods and services provided by the local government are more like private goods, we should expect expenditures to rise as demand rises.

The implications of the simple theoretical construct presented above provide for an interesting set of research questions. First, it is ambiguous as to the influence of density on per capita expenditures. The model predicts multiple potential outcomes without clear guidance as to which force dominates. Determining which influence dominates in the theoretical model is ultimately an empirical question. This analysis seeks to inform the theoretical predictions made in the model above as to which force dominates.

Hypothesis 1.1a *If "Smart Growth" is operative, the relationship between residential density and per capita expenditures is hypothesized to be negative.*

Hypothesis 1.1b *If the Economist's Perspective is operative, the relationship between residential density and per capita expenditures is hypothesized to be non-linear and u-shaped.*

The second research question is to what extent is the spatial pattern of development an environmental factor. Previous work on this has suggested that the spatial extent of development is an important factor in determining the costs of public services (Carruthers and Úlfarsson, 2003, 2008).

Hypothesis 1.2a *If "Smart Growth" is operative, the relationship between the spatial extent of developed land and per capita expenditures is hypothesized to be positive.*

Hypothesis 1.2b *If the Economist's Perspective is operative, the relationship between the spatial extent of developed land and per capita expenditures is hypothesized to be insignificant.*

The third question is what is the influence of urban land values on per capita expenditures? The theoretical construct above would suggest multiple possibilities. However, the influence should be uniformly positive though it will enter into different parts of Equation 3.2 depending on if residential land price stimulates demand or is a cost.

Hypothesis 1.3a *If "Smart Growth" is operative, the relationship between residential land price and per capita expenditures is hypothesized to be positive.*

Hypothesis 1.3b *If the Economist's Perspective is operative, the relationship between residential land price and per capita expenditures is hypothesized to be positive.*

Finally, the last question asks what is the influence of population growth on per capita expenditures. Since the publicness of local public services is somewhat unknown, *a priori*, the influence of population growth or residential development is unknown. Therefore, the exact influence of growth on per capita expenditures is an empirical question to be estimated.

Hypothesis 1.4 *If residential growth "pays its own way," the hypothesized influence of residential growth on per capita expenditures will either be negative or insignificant.*

The results from this analysis will help to better inform predictions from the theoretical model presented above. Overall, these four theoretical questions[15] constitute the primary variables of interest to be estimated in Chapter 4.

3.2.2 Local Fiscal Conditions

The influence of residential density and residential growth on fiscal conditions is not as straight forward of a process as per capita expenditures. However, there is a literature that provides important insights on the influence of residential density and residential growth on fiscal condition; the analyses of community adoption of population growth controls in the 1970s and 1980s. The following section will outline this literature and its influence on the research question at hand. In the final part, a conceptual model will be explored integrating population growth and residential density into a model of local fiscal conditions.

It should be noted that local fiscal conditions is a concept that is related to, but separate from, local government fiscal stress. While fiscal stress often refers to the inability of governments to continue to provide public services at current levels, local fiscal conditions

[15]The first three dealing with sprawl and the final question dealing with residential growth.

deal with the underlying environment in which governments operate. Local fiscal conditions generally refers to the gap, or lack thereof, between a localities ability to provide public services at an average level of quality with similar revenue effort (Ladd and Yinger, 1989). The exact definition of local fiscal conditions will be explained, at length, in Chapter 5; however, it largely deals with economic and cost factors that influence the underlying environment in which governments operate. As such, local fiscal conditions are not concerned with government financial management practices or the actions of politicians. Indeed, it is possible for a local government with positive fiscal conditions to be fiscally stressed and a local government with a negative fiscal condition to be financially stable. The remainder of this section is concerned with the influence of sprawl and residential growth on local fiscal conditions.

While the literature on the adoption of population growth limits is not directly associated with the research question at hand, it does provide important logical insights into the potential influence of growth and density on local fiscal conditions. The adoption of these policies can be predicated by three main issues (Dowall, 1978, 1980): avoiding the fiscal impacts of growth, environmental concerns, and changes to the composition or quality of life of the existing community. Of particular interest to this analysis is the fiscal dimension of the adoption. In developing a theoretical framework to understand the fiscal impact dimension, Dowall (1978) utilizes the literature on theory of clubs (Buchanan, 1965) and optimal city size (Arnott, 1979) to more completely understand the ways in which population growth can trigger significantly higher capital expenditure needs. Though theoretical development, Dowall (1978) finds that when a community is at the "public goods threshold,"[16] the entrance of an additional resident necessitates the provision of another unit of the public good. This provision of an additional unit of public good also necessitates public expenditures to be financed through taxation. Since local tax systems largely operate on an average basis

[16]The point at which another unit of the public good must be provided.

(rather than a marginal basis), the new burden is borne by all residents. This process of proving additional units of public goods to be financed by all residents and the adjustment period that follows can be viewed as potentially negatively influencing the local fiscal conditions of a local government. Dowall (1978) uses this finding to advocate for population growth controls.[17] Indeed, Dowall (1978) finds that growth management communities experience rising tax rates and sewer construction, and Dowall (1980) finds that adoption of growth controls is at least somewhat related to fiscal pressures.

This line of research focus on the antecedents of local population growth controls. Implicit in this line of research is the understanding that rapid population growth brought about these antecedents which lead to the control policy. Therefore, concerns about adequate public services and diminished public service capacity leading to population growth limits can be viewed as an argument that rapid population growth lead to these issues. Indeed, Altshuler and Gómez-Ibáñez (1993) explain that demands for infrastructure spending that may be fiscally stressful could arise from rapid population growth. Similarly, concerns that population growth will lead to a change in "small town character," i.e. urbanization, and therefore growth must be limited can be viewed as an argument that urbanization[18] may bring about the same problems as rapid population growth. Therefore, this line of research pertaining to population growth controls provides a basis from which population growth (and density, albeit indirect) can alter local fiscal condition. A more formal exploration of this link will be undertaken next.

As explained by Ladd and Yinger (1989), local fiscal conditions are primarily influenced by two factors, the locality's *economic health* and their *economic structure*. The two concepts

[17] Dowall (1978) argues that population growth controls are a second best policy to marginal taxation. However, marginal taxation is fraught with problems like many first best policy solutions.

[18] In this context, urbanization is synonymous with increasing density. With fixed land area (this is the situation with counties), rising population necessitates rising density. That is, increasing density is a byproduct of population growth. See Ladd (1994) for a more complete explanation of the interplay between growth and density with fixed land areas.

are related; however, they are distinct from each other. *Economic health*, as measured by Ladd and Yinger (1989), is the level of private sector activity in a local area. This is primarily operationalized using total private sector employment per capita. Alternatively, *economic structure* measures the make up of the local private sector. This is operationalized by the proportion of private sector employment in the manufacturing and service sectors. Therefore, local fiscal conditions (LFC) can be conceptualized as

$$LFC = f(EH, ES) \tag{3.5}$$

where EH is economic health and ES is economic structure. These two concepts have been explained above, but Ladd and Yinger (1989) note that they could include anything that generates taxable resources as well as anything that may change the underlying cost structures faced by local governments. As such, urban sprawl and residential growth have a significant possibility of changing these underlying concepts.

As suggested in the previous section, population or residential growth and density are both "environmental" factors contributing to increased costs of public service provision. Localities that are experiencing these problems may face deteriorating local fiscal conditions, at least in the short term, as a result. Indeed, the literature on population growth controls suggest that this potential threat is particularly resonant with local residents and politicians.

Hypothesis 2.1 *It is hypothesized that an increase in residential density leads to a worsening of local fiscal conditions*

Hypothesis 2.2 *It is hypothesized that an increase in residential growth leads to a worsening of local fiscal conditions; however, this result may be non-linear.*

Additionally, horizontal growth of local areas, the spatial extent of development, may also increase the costs of public service provision. This could also adversely affect local fiscal conditions. However, more development, even in a horizontal direction, may stimulate tax base growth through improved land (property taxes) and more plentiful retail development (sales taxes). These factors could improve the local fiscal condition of an area through raising their revenue bases.

Hypothesis 2.3a *If the cost of service provision rises with spatially larger development patterns, it is hypothesized that the relationship between developed land and local fiscal conditions is negative.*

Hypothesis 2.3b *If spatially larger development patterns are associated with higher revenue generate, it is hypothesized that the relationship between developed land and local fiscal conditions is positive.*

Finally, the higher price of land at higher densities is likely to improve local fiscal conditions. The higher price of land contributes to, in a positive manner, property tax base growth allowing local governments to bring in more revenue at lower tax prices.

Hypothesis 2.4 *It is hypothesized that an increase in residential land prices is associated with an increase in local fiscal conditions.*

3.2.3 Revenue Diversification

The issue of diversifying local government revenue streams is one that has garnered much attention in the academic literature. Revenue diversification[19] has been posited as a method of reducing fiscal stress and revenue volatility, but has also been singled out as a way in which governments can conceal how much revenue is being raised from taxpayers, resulting in fiscal illusion. While there is little direct theoretical or empirical literature on the process of revenue diversification at the local level, this section will attempt to provide guidance on how the process of revenue diversification operates and how urban sprawl and residential growth may interact with this process.

[19] Also know in the literature as revenue complexity.

Before engaging in an explanation of potential influences of revenue diversification at the local level, one must explain what revenue diversification is. Since the Great Depression, the property tax has been the "local tax" (Fisher, 1996). Prior to the Great Depression, state and local governments relied heavily on the property tax (Wallis, 2001); however, declining property values during the Great Depression (Ulbrich, 1991) as well as the introduction of less administratively costly taxes (Wallis, 2001) led state governments to all but relinquish their reliance on the property tax by the 1940s. This trend left local governments as, largely, the sole administrator and collector of property taxes in the United States.

As state reliance on the property tax diminished to near zero by the 1940s, local governments were also leaving the property tax as the primary means of revenue collection. Spurred on by the the authorization of local sales and income taxes (Ulbrich, 1991), changes to education finance laws (Raphaelson, 2004), and the tax revolts of the 1970s and 1980s (Fisher, 1996; Raphaelson, 2004; Ulbrich, 1991; Wallis, 2001), dependence on the property tax at the local level has been declining for a number of years. As a result, local governments have increased the portfolio of revenue instruments they utilize leading a more diverse revenue system.

The literature on fiscal illusion[20] provides a valuable starting point from which a more comprehensive understanding of local revenue diversification can be found. As Oates (1988) explains, in attempting to determine if revenue diversification (revenue complexity as it is know in this literature) leads to fiscal illusion (i.e. revenue diversification increasing per capita expenditures or increasing tax effort), a serious simultaneity bias is present. One cannot determine if tax structure has an influence on expenditures because expenditures has an influence on tax structure. Therefore, the results much of the fiscal illusion literature

[20] "The notion that the systematic misperception of key fiscal parameters may significantly distort fiscal choices by the electorate" Oates (1988, pg. 65).

are suspect because of this bias. Additionally, any attempt made in explaining revenue diversification patterns must take into account this potential bias.

To examine the potential simultaneous process between revenue diversification and expenditures, the following prospective models are offered:

$$RD = f(\hat{E}, Y) \tag{3.6}$$

$$E = f(RD, X) \tag{3.7}$$

where RD is revenue diversification, E is per capita expenditures, and $\hat{E}$ is the instrument for expenditures from Equation 3.7. Additionally, Y in Equation 3.6 denotes all other influence on revenue diversification and X in Equation 3.7 denotes all other influences on per capita expenditures. These two equations, 3.6 and 3.7, form the basic foundation from which a more comprehensive theory of local revenue diversification can be built.

As this dissertation is interested in explaining the influence of urban sprawl and residential growth on a variety of local government fiscal outcomes, the variables that make up X and Y will include such influences. Indeed, this two stage model provides an opportunity to assess the direct and indirect influence of urban sprawl and residential growth on revenue diversification. By including both variables in each stage of the equation, the influence of urban sprawl and residential growth filtered through expenditures (similar to the model from the first question of this dissertation) as well as the independent, direct influence of urban sprawl and residential growth on revenue diversification from stage two can be ascertained.

The logic of the potential influence of urban sprawl and residential growth for the first stage equation (expenditures) is laid out in the previous section on the subject (see Hypotheses 1.1 - 1.4 outlined above). However, to recap, it is hypothesized that sprawl and growth can work in multiple directions. Previous literature would suggest either a negative association between sprawl related variables and expenditures (the 'Smart Growth" argument) or a u-shaped relationship between sprawl and expenditures (the public finance argument). The relationship of residential growth to expenditures depends largely on the "publicness" of the goods provided by the local government. While "publicness" cannot be measured directly, higher levels of "publicness" lead to a diminishing influence of residential growth on expenditures.[21] However, if goods provided by local governments are less public (i.e. more like private goods), residential growth will increase per capita expenditures through either congestion in the consumption of a scarce resource or increased expenditure to provide a higher level of service provision.

The logic of the influence of urban sprawl and residential growth on the second stage of the equation is less obvious. The influence of sprawl on revenue diversification is complex. Given the multifaceted nature of sprawl, there are multiple influences on revenue diversification. Increasing density and the spatial extent of development indicate an expansion in potential tax bases. Increased retail sales and business activity provide expansions in the retail sales and selective sales tax bases. The availability of these new tax bases and the legal authority to exploit them will likely result in increased revenue diversification.

Hypothesis 3.1 *An increase in residential density is hypothesized to be associated with an increase in revenue diversification.*

Hypothesis 3.2 *An increase in the spatial extent of development is hypothesized to be associated with an increase in revenue diversification.*

However, the price of residential land acts as a counterpoint to this argument. An elevated property tax base would allow local governments to finance their expenditures needs from the property tax.

Hypothesis 3.3 *It is hypothesized that an increase in residential land price is associated with a decrease in revenue diversification.*

[21] Public goods are not congestible. As a result, increasing the number of consumers of these public goods should not increase the per capita cost of providing the good.

The direct influence of residential growth on revenue diversification draws upon fiscal impact literature. Fiscal impact studies suggest that residential properties will produce limited property tax revenues in relation to expected expenditures. If this proposition is true, local governments experiencing residential growth may attempt to make up for this shortfall by diversifying their revenue sources.

Hypothesis 3.4 *It is hypothesized that an increase in residential growth will lead to an increase in revenue diversification.*

3.3 Variables of Interest

3.3.1 Sprawl

As mentioned in the discussion of the literature on sprawl found in the previous chapter, there is significant disagreement on the proper method of defining urban sprawl. The only real consensus on the measurement of sprawl is that low density, spatially spread out development is indicative of sprawl. Therefore, sprawl will be defined for the purposes of this analysis as low density, spatially expansive development. As such, this concept will be primarily measured using two variables: a horizontal component measuring spatially expansive development and a vertical component measuring the density of development. The measurement of density can be undertaken in a variety of ways (see Table 3.2). First, residential density can be defined as total population divided by residential land. This is known as net population density (McDonald and McMillen, 2011, pg. 121) and is superior to general population density (population divided by land area) in numerous ways. General population density may mask actual residential density because the calculation of general population density utilizes land dedicated to uses other than residential living. Therefore, in a local area with limited land for residential development, but much land for commercial and industrial development, general population density would systematically underestimate the density of residential development. By using net population density, a more accurate measurement of residential density can be ascertained. A similar method to net population density is to measure population density as population divided by urbanized land area (Carruthers and Úlfarsson, 2003, 2008). The Census Bureau defines urbanized land area as containing more than 1.5 persons per acre (U.S. National Archives and Records Administration, 2011),[22] and, alternatively, the National Resource Inventory (U.S. Department of Agriculture, 2000) defines urbanized land area by examining land uses from remote sensing data. In either conception, this method of constructing population density attempts to eliminate the influence of rural land area that can systematically bias estimates of urban population densities downward. Additionally, this measure can be inverted to provide a similar, yet different measure from net population density. Hortas-Rico and Solé-Ollé (2010) utilize urbanized land per capita as their measure of population density. Finally, residential density can be measured as the number of housing units divided by residential land area. This is known as residential structure density (DiPasquale and Wheaton, 1996, pg. 61). This method is similar to the net density definition; however, it puts changes in density in terms of units of development. Many local services such as municipal water and sewer or public safety are largely provided to fixed structures rather than persons. A home, vacant or occupied, is still provided infrastructure and protection from crime or fire. Therefore, a measurement of density that incorporates this may yield more relevant results. Additionally, similar to the construct used by Hortas-Rico and Solé-Ollé (2010), residential structure density can be inverted measuring residential land per housing unit.

For this analysis, net population density is utilized as the preferred measure of density.[23] This variable is constructed as it is outlined in Table 3.2 as population divided by residential land in the county in acres. As such, it is the average residential density across the whole

[22]The exact calculation is 1000 persons per square mile (ppsm) in the urban core. This translates to exactly 1.5625 persons per acre.

[23]Many of the alternative measures of sprawl mentioned were tested during model development.

Table 3.2: Operationalizations of Sprawl

Operationalization	Definition
Net Population Density (McDonald and McMillen, 2011)	Population divided by residential land in acres
Residential Structure Density (DiPasquale and Wheaton, 1996)	Housing units divided by residential land in acres
Urbanized density (Carruthers and Úlfarsson, 2003, 2008)	Population divided by urbanized land
Urbanized land per capita (Hortas-Rico and Solé-Ollé, 2010)	Urbanized land divided by population
Residential land per capita	Residential land in acres divided by population
Residential land per housing unit	Residential land in acres divided by housing units

county. Exact summary statistics for this variable can be found in the empirical chapters that follow. However, this section will briefly describe the data primarily through an analysis of maps. Figure 3.3.1 shows a choropleth (quantiles) map[24] of the total percent change from 2000 to 2008 in net population density.[25] In shades of red are the first two quantiles representing negative changes in net population density. In white is the third quantile representing percent changes centered around zero (both positive and negative). And, finally, shades of blue represent positive increases in net population density. In effect, the red shaded counties are showing potential sprawl and the blue counties are showing rising density. The counties in white are showing, more or less, no change. As can be seen, there is a wide variance, spatially, of change in net population density over the time period. However, it does appear that there is some pattern in these data. In particular, it appears that many metropolitan areas are experiencing both rising and falling residential densities. For instance, counties surrounding Atlanta, the primary metropolitan area in the state, experience this trend. Counties to the northwest of Atlanta (including Fulton County, of which Atlanta

[24]The construction of these quantiles is driven by the data.

[25]The location of large metropolitan areas in Georgia are indicated on the map (as text) as a reference.

is the county seat) demonstrate rising densities while many of the other counties in close proximity to Atlanta are experiencing declining residential densities. This may suggest that counties to the south of Atlanta are sprawling, where the counties to the northwest of Atlanta are becoming less sprawling (or becoming more urban). In contrast, the three counties in the Columbus area all experienced declining net population densities from 2000 to 2008.

An important aspect of sprawl that is mentioned in the literature reviewed above is the simultaneous influence of density and the spatial extent of development. Low density development, on its own, is not necessarily indicative of sprawling development. However, when combined with spatially expanding development, low density development may move into the realm of sprawl. This specific hypothesis has been advanced most recently by Carruthers and Úlfarsson (2003, 2008) using the percentage of county land area that is urbanized as a measure of the spatial extent of development. Specifically, they hypothesize that as the spatial extent of urbanized land increases in a county area, per capita public expenditures will increase because local governments are unable to capitalize on economies of geographic scope (Carruthers and Úlfarsson, 2003). A local government will need to provide a larger set of fixed assets to serve a given population in a more spatial expansive development pattern than for the same population in a smaller urbanized area (Carruthers and Úlfarsson, 2008). This concept is integrated into this analysis as the natural logarithm of the summation of residential, residential transitional, historic, commercial, industrial and utility lots sold as lots divided by total land area in the county. Finally, the third component of sprawl, residential land prices, are incorporated as the natural logarithm of assessed value of residential properties, less the assessed value of the improved structure on residential properties. This variable is transformed to make the distribution of values look more normally distributed.

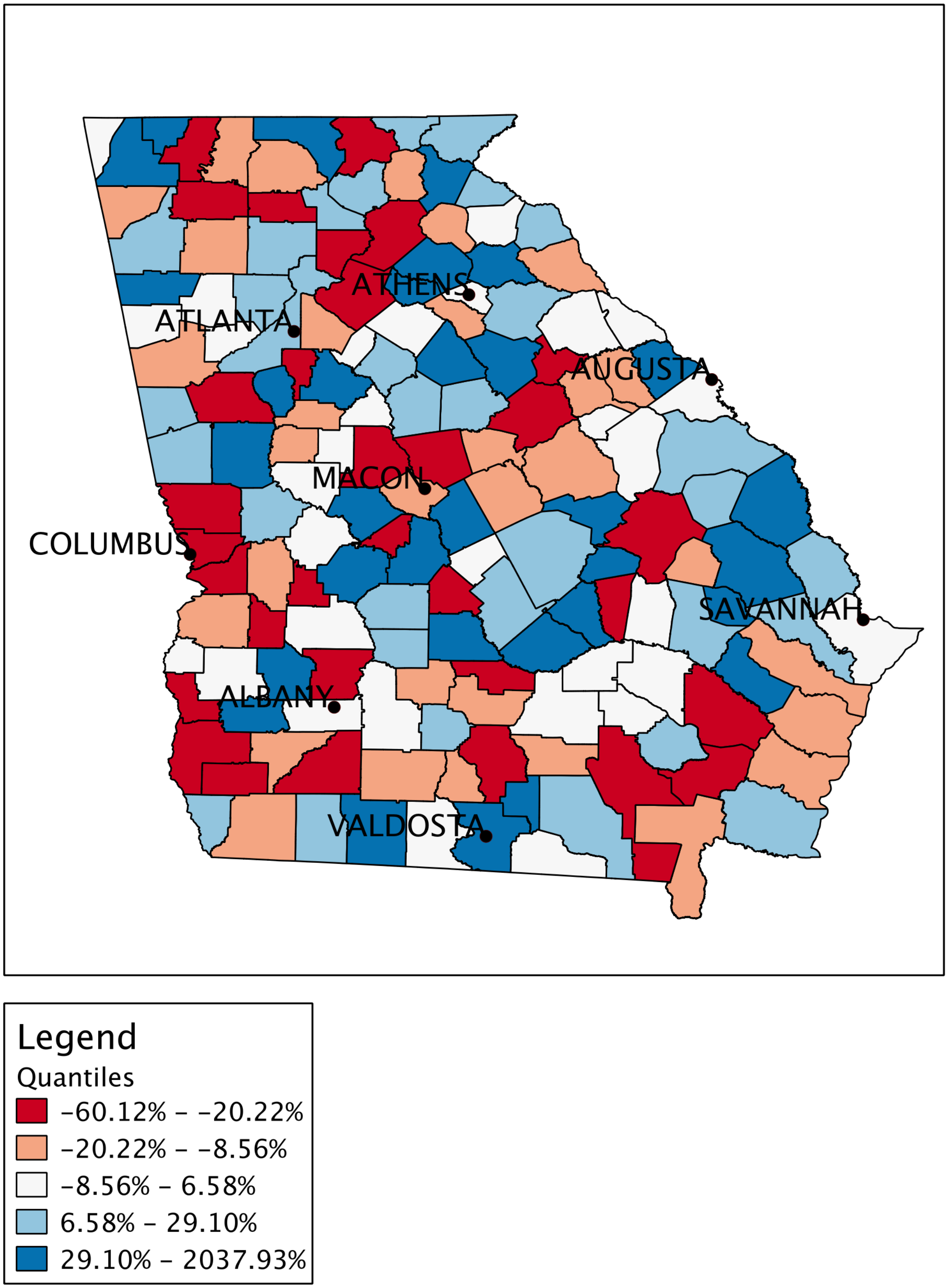

Figure 3.1: Percent Change in Net Population Density, 2000 to 2008

3.3.2 Residential Growth

Residential growth can be measured in variety of ways. The most popular method of measuring residential growth is to measure annual population growth (Ladd, 1981, 1992, 1993, 1994). However, as mentioned above, municipal services are not necessarily delivered directly to individuals but rather are delivered, in large part, to housing units.[26] As such, a measurement of residential growth that does not rely on population may be superior. The most direct representation of growth not based on population is the growth in housing units; specifically, the annual growth in housing units from time $t-1$ to time t. An additional method to measure residential growth could be land conversion. Since county area is largely fixed, land conversion is a zero sum game. Conversion from any land use to residential use necessitates the loss of the previous land use. This method has problems related to fiscal zoning and urban development. In a strictly urban sense, increases in residential land may undervalue residential growth especially if growth is vertical rather than horizontal. In the suburban setting, land conversion may overvalue residential growth because much of the converted land is not utilized by a structure. This result would be especially pronounced with minimum lot sizes or other types of fiscal zoning. For this reason, land conversion is a poor proxy for residential growth and is unsuited for this analysis.

Figures 3.3.2 and 3.3.2 show the spatial pattern of population growth and housing unit growth from 2000 to 2008. The pattern of growth is very similar for population and housing units. In both Figures 3.3.2 and 3.3.2, lighter counties indicate either negative or minimal positive growth (quantile 1), and, as the shading becomes darker, growth is higher (quantiles 2-5). As can be seen, there is significant spatial variation in population growth. If this were not the case, there would evidence, albeit limited, of spatial heterogeneity or autocorrela-

[26] To the extent that local services are funded through the property tax, municipal services delivered to housing units are largely paid for by the property taxes derived from that structure (i.e. a benefits tax). This relationship does not necessarily hold when additional taxes are added.

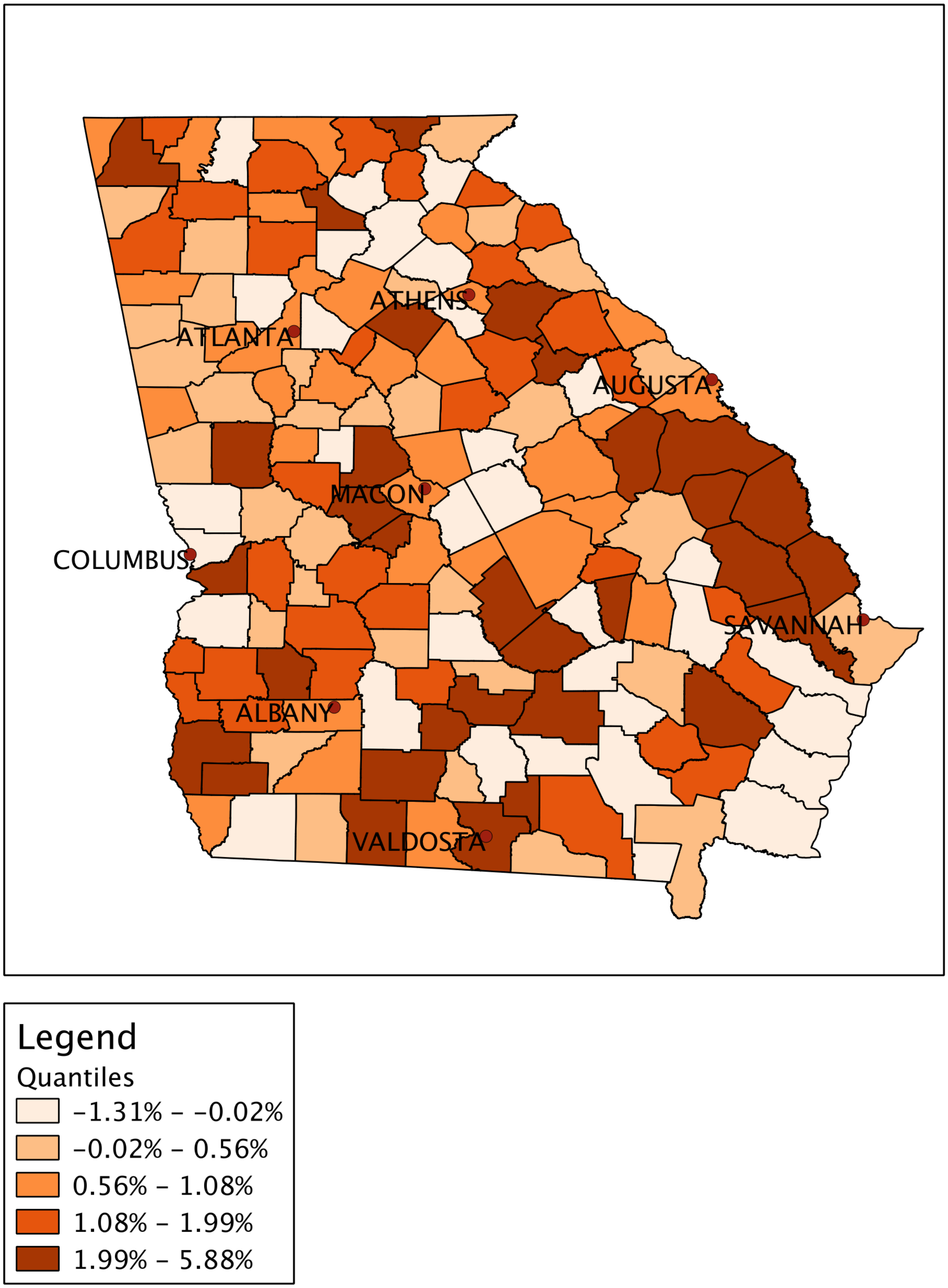

Figure 3.2: Growth in Population by County, 2000 to 2008

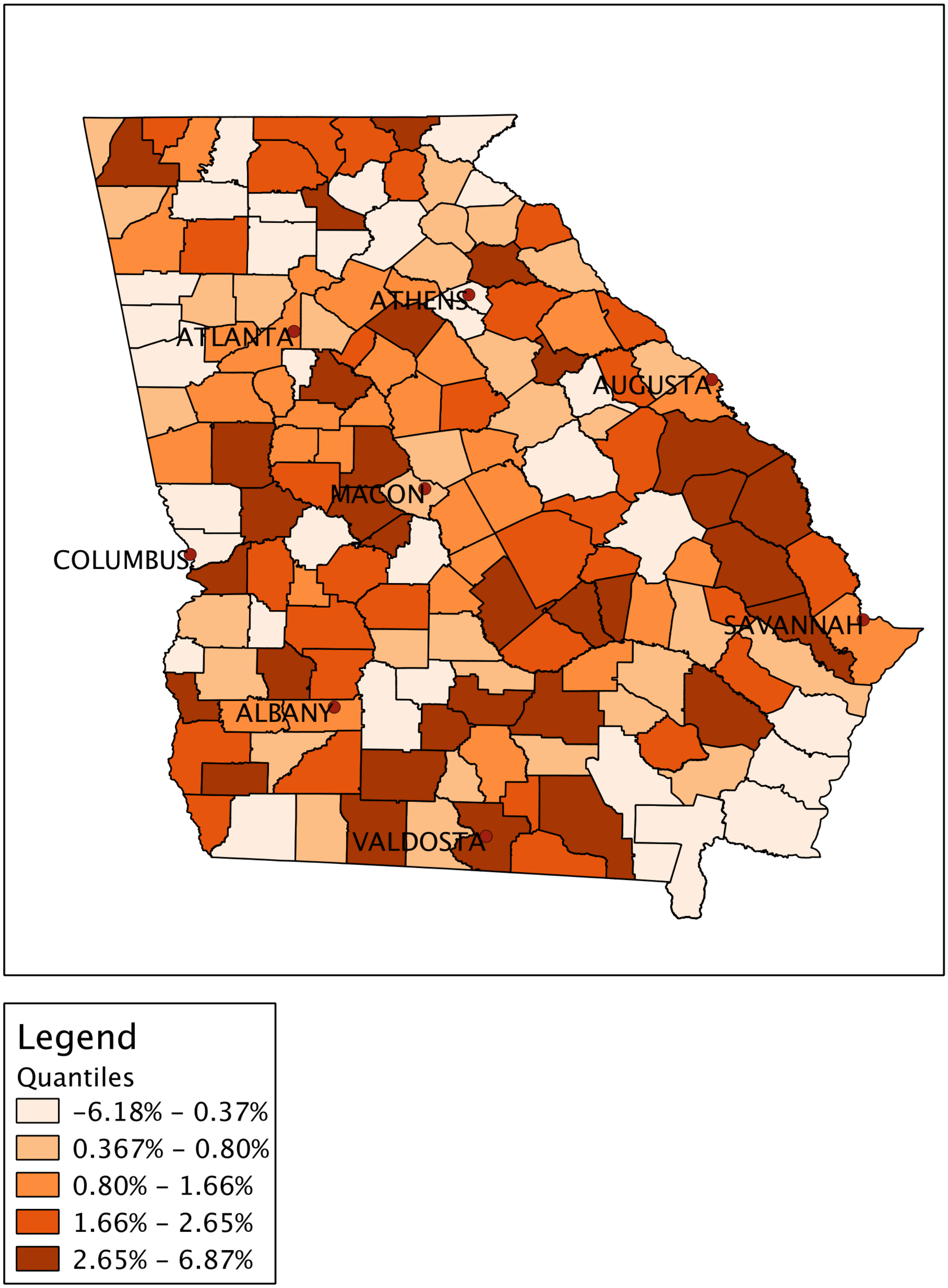

Figure 3.3: Growth in Housing Units by County, 2000 to 2008

tion.[27] However, some trends in the data appear. Most obviously, the growth in population between Savannah and Augusta on the South Carolina border is particularly concentrated. Additionally, the counties in the Atlanta area sustained moderate levels of annual growth. While most counties experienced some growth, there are some concentrations of negative or zero growth. These are largely centered in the southeast and northeastern parts of state. This limited analysis cannot shed light on how the process of population growth is working in Georgia. Clearly, from Table 3.1, individuals are moving from states other than Georgia into the state of Georgia. This is evidenced by large amount of population taking place in the state. However, there may be intra-state migration that these data do not explain. While these patterns of migration are interesting, they are not the focus of this dissertation.

Turning next to housing growth, there are many similarities to the population growth trends found in Figure 3.3.2. The trend of large growth along the South Carolina border is continued as well as the moderate growth in the Atlanta area. Additionally, the areas between Atlanta, Macon, and Columbus experienced large housing growth. The trend of negative or nominal growth in the southeast and northeast parts of the state are somewhat sustained when housing units are concerned; however, the trend is not completely similar. In this analysis, the preferred measurement of residential growth is housing growth. This is for two reasons. First, local government generally provide services to fixed locations. Water, sewer, fire, and policing are provided to structures rather than individuals (i.e. services are provided to these structures regardless if any individuals are inhabiting these homes). Second, measuring residential growth using housing de-couples the measure from net population density. As such, there is not the problem encountered by Ladd (1992) where positive growth necessarily lead to increased density.

[27] Correcting for these problems would require significantly different and more complex models (i.e. spatial econometric) presented here.

The preceding two sections have demonstrated that density and growth in the state of Georgia are not static. Rather, changes in density and housing supply are different across the state. Clearly, some areas of the state are growing faster than others. Additionally, areas are experiencing changing in density at different rates (or directions) than others. This variation across the state makes it clear that Georgia is a dynamic state with the arrangement of individuals and housing units being in flux. This level of variation will allow the models presented next to be identified.

Chapter 4

Findings - Per Capita Expenditures

Presented in the previous chapter, there is significant disagreement as to the influence of sprawl and residential growth on per capita expenditures. This chapter will operationalize the theoretical and conceptual analysis presented in the previous chapter as to the influence of sprawl and residential growth on per capita expenditures. Specifically, the regression model used to analyze this question is introduced and defined. Additionally, variables not defined in the previous chapter will be explored. Finally, results will be presented and discussed.

4.1 Variables and Regression Models

4.1.1 Regression Model

The theoretical and empirical literature on local government expenditures provides a roadmap for the construction of an empirical model of the impact of residential density and growth on local public expenditures. The seminal work of Borcherding and Deacon (1972) and Bergstrom and Goodman (1973) provide the basis for a political economy model using the median voter model (Black, 1948; Downs, 1957) to motivate their analyses. Fischel (2001) argues that, while not perfect, the median voter model does a good job of explaining government outcomes, especially at the local level. Further, Turnbull and Djoundourian (1994) finds that the median voter model is appropriate to explain the actions of general purpose local governments.

Following Ladd (1992), the objective of this analysis is to incorporate density and growth measures into a fully specified model of per capita local government public expenditures. Building upon Borcherding and Deacon (1972) and Bergstrom and Goodman (1973) and incorporating more recent addition to the literature such as Ladd (1992) and Carruthers and Úlfarsson (2003, 2008), a model is specified using the following functional form.

$$\begin{split}\text{exp} = f(&\text{demand tastes and costs; intergovernmental revenues; government}\\&\text{characteristics; built environment; residential growth})\end{split} \tag{4.1}$$

Local public expenditures are the result of service levels defined by citizen voters, the average cost per resident of providing public services and the division of service delivery responsibility between the state and local governments (Equation 3.2 on page 52). In Equation 4.1, the traditional demand variables, price and income, as well as variables measuring costs of public services and tastes of residents, contribute to the service levels defined by citizens. Residential growth and the built environment contribute to the average cost of service provision and the service levels demanded by citizens. On the density side (built environment), rising density could either increase the number of direct outputs needed to provide a given service level, or increased density could generate economies of density leading to lower costs of providing public services.[1] The influence of residential growth depends on the publicness of the good provided. If local governments are providing "pure" public goods, per capita expenditures will decline as more population (i.e. residents) are added. If the goods provided by local government is more private in nature, per capita expenditures will rise as demand for these goods increase. Additionally, government characteristics contribute to the cost

[1]See the discussion of Equation 3.2 on page 52 for a more complete explanation.

of providing public services. The extant literature has identified numerous characteristics of local governments (tax structure, debt, governmental competition) that feed into costs of public services. These variables are not explicitly mentioned in the theoretical model presented in the previous section,[2] but they will be explained in the text to follow. Finally, variables measuring intergovernmental revenues attempts to control for the split in service delivery responsibilities between state and local government. Therefore, the functional form embodied in Equation 4.1 incorporates demand, costs and service responsibility variables to arrive at a fully specified model of local public expenditures.

Following the literature (Borcherding and Deacon, 1972; Bergstrom and Goodman, 1973; Ladd, 1992, 1994; Turnbull and Mitias, 1999), the application of a logarithmic transformation to this equation reveals the estimating equation for this analysis.

$$LEXP_{it} = \beta_0 + LX_{it}\beta_1 + LIGR_{it}\beta_2 + LGOV_{it}\beta_3 + BE_{it}\beta_4 + GROW_{it}\beta_5 + \gamma_i + \delta_t + \varepsilon_{it} \quad (4.2)$$

Where $LEXP$ is the natural logarithm of per capita local government expenditures as described below for composite county i in time t, LX is a vector of demand, taste and cost variables for composite county i in time t in natural logarithms, $LIGR$ is a vector of intergovernmental relation variables for composite county i in time t in natural logarithms, $LGOV$ is a vector of governmental characteristics for composite county i in time t, BE is a vector of variables measuring the built environment for composite county i in time t, $GROW$ is a vector of variables measuring the residential growth rate for composite county i in time t, and ε is the usual composite error term. Additionally, time (δ) and county area (γ) fixed effects are included.

[2] This model focuses on the individual level rather than the governmental level.

4.1.2 Variables

As discussed in the previous section of this dissertation, the dependent variable for this particular analysis is per capita expenditures. To this point, however, the analysis has been agnostic to the functional form of per capita expenditures. There are numerous possibilities that can illuminate the relationship between the built environment and per capita expenditures. In the main analysis, three dependent variables are utilized. These can be found in Table 4.1. In particular, there are three primary dependent variables of interest

Table 4.1: Data Definitions - Dependent Variables

Variable	Description & Data Source
Per Capita Total Expenditures (ln)	Natural logarithm of Total Expenditures divided by population; Source: Georgia Report of Local Government Finances and Census Bureau
Per Capita Current Expenditures (ln)	Natural logarithm of current[3] expenditures divided by population; Source: Georgia Report of Local Government Finances and Census Bureau
Per Capita Capital Expenditures (ln)	Natural logarithm of capital[4] expenditures divided by population; Source: Georgia Report of Local Government Finances and Census Bureau

that highlight the relationship between the built environment and per capita expenditures. First, there is per capita total expenditures. This is calculated as total expenditures divided by population. In this analysis total expenditures is inclusive of all expenditures by local governments including general government administration, courts and public safety, streets, parks and recreation, all enterprise funds, and all school expenditures. Additionally, total expenditures are inclusive of all current and capital expenditures. In this sense, the results from the analysis using this dependent variable is the total impact of the built environment on local government per capita expenditures. The remaining two dependent variables are

[3] Expenditures for salaries and wages, employee benefits, materials and supplies, services purchased, minor parts and maintenance are included in this variable.

[4] Expenditures for the purchase of *capital* assets such as vehicles, construction equipment, computers, structures and land are included. Additionally, expenditures for the construction of new capital assets is included.

per capita current expenditures and per capita capital expenditures. These two variables are inclusive of the same expenditures mentioned above. Current expenditures include those expenditures required to fund current operations. Capital expenditures are those expenditures required for the purchase of equipment, land and structure and construction costs.

The definitions of the independent variables for this analysis can be found in Table 4.2. In this analysis, the preferred operationalization of sprawl can be found through the first four variables in Table 4.2. The density component of sprawl is measured as net population density as defined in the previous chapter. Additionally, the square of net population density is included to explicitly test the non-linear relationship found by Ladd (1992, 1994). The second dimension of sprawl, spatial size, is operationalized as discussed above as the natural logarithm of the proportion of developed land in a county. Developed land is operationalized as residential, residential transitional, historic, commercial, industrial and utility lots sold as lots.[5] Finally, the last potential component of the built environment is land prices. In this analysis, this variable is operationalized as the natural logarithm of assessed land value of residential and residential transitional land (net of structure value) divided by residential and residential transitional acres.[6] This operationalization creates, in essence, the underlying residential land prices for a county. Residential land price, constructed in this manner, is an imperfect measure of price. The preferred measure, market value as measured through sales price, is largely unavailable for a significant portion of composite counties over the time period analyzed. Given these limitations, residential land price, as constructed, is considered a proxy for market value. Together, these three variables more accurately estimates the influence of sprawl than density alone (Carruthers and Úlfarsson, 2003, 2008). In the final component of the built environment, the annual percent change in residential units and the

[5]Specifically, developed land consists of tax classifications of R3, T3, H3, C3, I3, and U3 as defined by the Georgia Department of Revenue. These classifications are outlined in Georgia Department of Revenue Rule 560-11-2-.20 and 560-11-2-.21.

[6]In Georgia, assessed value is 40 percent of market value.

square of the variable are included to more completely understand the influence of residential growth. The squared term is included to test for influences found by Ladd (1981, 1992, 1993, 1994).

Demand, taste and cost variables are operationalized with seven variables.[7] The natural logarithm of per capita personal income is included to estimate potential income effects. An approximation of tax price, the natural logarithm of the proportion of the tax base that is residential, is included to estimate any price effects. The natural logarithm of population is included to control for the "publicness" of public services. Additionally, the inclusion of this variable may help to control for any economies of scale in service provision.. For many of the same reasons, the natural logarithm of school enrollment is included in the model as well. However, school enrollment can also highlight the demand for schooling.[8] The natural logarithm of the proportion of residents age 65 plus is included to control for potential differing demand influences from residents other than the mean or median voter. Similarly, the natural logarithm of the ratio of employment by place and population is included to control for potential demand differences between the daytime (commuter) and nighttime populations of a county. Those composite counties with a ratio of jobs to residents of greater than one likely to cater their public services somewhat to their daytime population (commuters). Those counties with a ratio of one or less than one are likely to provide a different set of public services catering to the demand and tastes of their residential population.[9] Finally, the natural logarithm of the poverty rate is included to control for possible more expensive populations to serve.

[7]Throughout, directional hypotheses for control variables (i.e. variables other than the built environment and residential growth) are identified from the literature. These hypotheses are not being explicitly tested in this analysis; however, it is important to note their direction in order to assess the functionality of the model.

[8]Rather than including the proportion of residents under the age of 18 to control for potential demand for schooling, this variable is included. It is significantly more precise at estimating the demand for public schooling.

[9]These communities could be considered "bedroom" communities where individuals commute to another locale for work. Anecdotally, these communities provide a lower level of public services.

Intergovernmental relations is operationalized using two variables: the natural logarithm of per capita state aid and per capita federal aid. Unfortunately, grants are aggregated by program area eliminating any possibility of determining if there are separate price or income effects (Oates, 1972). Governmental characteristics are measured by four variables: revenue diversification, debt burden and two political fragmentation variables. Revenue diversification is defined using a Hirschman-Herfindahl Index (HHI).[10] This measurement of revenue diversification has been agreed upon in the scholarly literature over a long period of time (Wagner, 1976; Suyderhoud, 1994; Hendrick, 2002; Shamsub and Akoto, 2004; Carroll et al., 2003; Carroll, 2005, 2009; Carroll and Stater, 2009; Carroll and Johnson, 2010). The economic literature would suggest that the influence of revenue diversification on per capita public expenditures is potentially illusionary. Revenue diversification can be a measure of revenue complexity. The public choice literature would suggest that increasing revenue complexity should increase fiscal illusion and lead to higher per capita expenditures (Wagner, 1976). However, recent literature has disputed this finding (Carroll, 2009). Instead of illusionary effects, revenue diversification offers a prudent strategy to managing the downside risks of a variety of revenue sources. To account for potential illusionary effects, revenue diversification is included in this model. Long term debt burden is defined as long term outstanding debt divided by population. Finkler (2005) suggests that this variable is partially symbolic of the long run financial solvency of a local government. Finally, general purpose local governments per 10,000 residents and special purpose local governments per 10,000 residents is a control for the geo-political environment of a local area. If Tiebout (1956) is correct, increased governmental fragmentation, as evidenced by more general purpose local governments, will lead to lower per capita public expenditures via intergovernmental competition for residents. Alternatively, Foster (1997) finds that metropolitan areas that are

[10]Consistent with the recent literature, HHI is defined as $\left(\frac{1-\sum_{i=1}^{n} R_i^2}{1-100\%/n}\right)$ where R_i is the proportion of own source revenue generated from each revenue source and n is the number of revenue sources. There are four revenue sources: Property taxes, sales taxes, other taxes, and non-tax revenues.

more heavily dependent upon special districts to deliver services in specific programatic areas experience higher per capita expenditures in those program areas. Taken together, these two result would suggest that it is likely that increases in general purpose governments will decrease per capita expenditures and increases in special purpose governments will increase per capita expenditures.

Summary statistics for these variables can be found in Table 4.3. The vast majority of variables are in logarithms and therefore are not readily interpretable. However, there are two specific variables that are not logged and important to this analysis. Over the time period and across all all composite counties, the average net population density is 1.611 persons per residential acre. This is approximately the definition of urban land as defined by the Census Bureau and outlined in the previous chapter. Additionally, this variable varies from 0.016 persons per residential acre to 20.178 persons per residential acre. This is some indication that Georgia has the full range of densities present from strictly rural to strictly urban. Turning next to residential growth. Over the time period and across all composite counties, the average annual percent change in residential units is 1.834 percent. While this level appears to be moderate growth, this variable deviated from the mean a great deal with a minimum value of negative 51.6 percent and a maximum value of 78.8 percent.

Table 4.2: Data Definitions - Independent Variables

Variable	Description & Data Source
Built Environment	
Net Population Density	Population divided by residential land in acres; Source: Census Bureau and Tax Digest Consolidated Summary (GaDOR)
Net Population Density, Squared	Population divided by residential land in acres, squared; Source: Census Bureau and Tax Digest Consolidated Summary (GaDOR)
Developed Land (ln)	Natural logarithm of the summation of residential, residential transitional, historic, commercial, industrial and utility lots sold as lots divided by total land area in the county; Source: Tax Digest Consolidated Summary (GaDOR)
Land Price (ln)	Natural logarithm of the summation of the assessed value of residential and residential transitional land divided by summation of residential and residential transitional land in acres; Source: Tax Digest Consolidated Summary (GaDOR)
% Δ in Residential Units	The percent change from time t-1 to t in residential units; Source: Census Bureau
% Δ in Residential Units, Squared	The percent change from time t-1 to t in residential units, squared; Source: Census Bureau
Demand, Tastes and Costs	
Per Capita Personal Income (ln)	Natural logarithm of per capita personal income; Source: Bureau of Economic Analysis
Tax Price (ln)	Proportion of the Property Tax Digest that is residential; Source: Tax Digest Consolidated Summary (GaDOR)
Population (ln)	Natural logarithm of population; Source: Census Bureau
School Enrollment (ln)	Natural logarithm of school district enrollment; Source: Census Bureau
Proportion Age 65+ (ln)	Natural logarithm of the proportion of the population age 65 and over; Source: Census Bureau
Employment Ratio (ln)	Natural logarithm of ratio of total employment (by place) and population; Source: Bureau of Economic Analysis and Census Bureau
Poverty Rate (ln)	Natural logarithm of the Poverty Rate; Source: Census Bureau Small Area Income & Poverty Estimates
Intergovernmental Relations	
Per Capita State Aid (ln)	Natural logarithm of Intergovernmental aid from state sources divided by population; Source: Georgia Report of Local Government Finances and Census Bureau
Per Capita Federal Aid (ln)	Natural logarithm of Intergovernmental aid from federal sources divided by population; Source: Georgia Report of Local Government Finances and Census Bureau
Governmental Characteristics	
Revenue Diversification (ln)	Hirschman-Herfindahl Index (HHI) with four revenue categories (property taxes, sales taxes, other taxes and other revenues); Source: Georgia Report of Local Government Finances and Census Bureau
Debt Burden (ln)	Natural logarithm of total outstanding long-term debt divided by population; Source: Georgia Report of Local Government Finances and Census Bureau
General Purpose Governments per 10,000 Residents (ln)	Natural logarithm of total number of general purpose government divided by population (10,000s); Source: Census Bureau
Special Purpose Governments per 10,000 Residents (ln)	Natural logarithm of total number of special purpose governments divided by population (10,000s); Source: Census Bureau

Table 4.3: Summary Statistics for Equation 4.2

Variable	Mean	Std. Dev.	Min	Max
Dependent Variables				
Per Capita Total Expenditures (ln)	9.240	0.162	8.808	10.131
Per Capita Current Expenditures (ln)	9.114	0.135	8.746	9.618
Per Capita Capital Expenditures (ln)	6.856	0.763	4.387	9.561
Built Environment				
Net Population Density	1.611	1.967	0.016	20.178
Net Population Density, Squared	6.461	29.094	0.000	407.162
Developed Land (ln)	1.044	1.563	-3.815	4.522
Land Price (ln)	8.034	1.048	4.406	11.555
% Δ in Residential Units	1.834%	3.931%	-51.602%	78.811%
% Δ in Residential Units, Squared	18.806%	232.704%	0.000%	6211.117%
Demand, Tastes and Costs				
Per Capita Personal Income (ln)	10.102	0.179	9.218	10.840
Tax Price (ln)	3.881	0.381	2.242	4.495
Population (ln)	10.142	1.140	7.527	13.830
School Enrollment (ln)	8.396	1.157	5.226	11.973
Proportion Age 65+ (ln)	2.478	0.268	1.431	3.332
Employment Ratio (ln)	3.751	0.289	2.646	4.667
Poverty Rate (ln)	2.804	0.375	1.435	3.589
Intergovernmental Relations				
Per Capita State Aid (ln)	8.520	0.167	7.900	9.859
Per Capita Federal Aid (ln)	6.865	0.479	5.080	8.282
Governmental Characteristics				
Revenue Diversification (ln)	-0.170	0.088	-0.755	-0.042
Debt Burden (ln)	6.016	1.084	-2.780	8.909
General Purpose Governments per 10,000 Residents (ln)	0.422	1.063	-2.954	2.782
Special Purpose Governments per 10,000 Residents (ln)	0.139	0.824	-1.906	2.250

n=1,245

4.2 Results of Estimation

The estimation results for Equation 4.2 on page 4.2 can be found in Tables 4.4, 4.5 and 4.6. Table 4.4 shows the results for per capita total expenditures, Table 4.5 shows the results for per capita current expenditures, and Table 4.6 shows the results for per capita capital expenditures. Found in these tables is the baseline, two-way fixed effects model estimated using OLS with White (1980) standard errors (I, II), pooled OLS estimation with Driscoll and Kraay (1998) standard errors (III, IV), and two-way fixed effects OLS estimation with Driscoll and Kraay (1998) standard errors (V, VI). Before conducting the estimation of these models, a variety of statistical tests were conducted to determine the appropriate estimation technique. The nature of these data would suggest that a fixed effects model would be the most appropriate technique. This assumption is confirmed using the Hausman (1978) test. A joint F test on year fixed effects suggests that the inclusion of these variables is warranted. Therefore, estimation will proceed using a two-way fixed effects model.[11] The Wooldridge (2010) test for autocorrelation in panel data suggests that these data suffer from an AR(1) disturbance. Additionally, the Modified Wald test for heteroskedasticity revealed the presence of heteroskedasticity in the model. Finally, to test for potential cross-sectional or spatial dependences, the test outlined in Frees (1995) for cross-sectional dependence in panel models is conducted. This test for cross-sectional dependence is chosen over other potential tests (Pesaran, 2004; Friedman, 1937) because it is robust to the inclusion of time fixed effects. The outcome of this test suggests that there is cross-sectional dependence in this model. To account for autocorrelation, heteroskedasticity and cross-sectional dependence in the error structure, a two-way fixed effects model with Driscoll-Kraay (1998) standard errors, which are robust to these three issues, is utilized. This preferred model is

[11] Columns III and IV are a relaxation of this two-way estimation restriction.

shown in columns V and VI of the tables below.[12] Overall and across the three sets of tables of results, the models perform well. The estimation for per capita total expenditures and per capita current expenditures generally perform better than the estimation for per capita capital expenditures. R^2s for the preferred model (V, VI), for per capita total expenditures and per capita current expenditures, are approximately 60% to 80%. R^2s for the preferred model (V, VI), for per capita capital expenditures, are approximately 25%. It is possible this reduction in explanatory power is due to the "one size fits all" approach to estimating these three models. This technique is somewhat less suited in explaining the patterns of per capita capital expenditures.

4.2.1 Total Expenditures

Turning first to Table 4.4, the two primary variables measuring sprawl, net population density and developed land, are generally significant across the different specifications. In the preferred estimation technique (V, VI), net population density is negative in both specifications. Specifically in column V, a one person per residential acre increase leads to a 1.5 percent decrease in per capita total expenditures on average. If this is evaluated at the mean (across all composite counties and time), a one person per residential acre increase leads to approximately a \$154.50 decrease in per capita total expenditures (1.5 percent of \$10,300.89). A decrease of \$154.50 may seem small; however, this number is on a per capita basis. When spread across the average sized composite county in 2008 (61,141 residents), this is a savings of near \$9.5 million. This result would be supportive of the planner's perspective that higher densities can lower the cost of public service provision. This result is somewhat larger than the results found in the most comparable analysis (Carruthers and Úlfarsson, 2008). Carruthers and Úlfarsson (2008) finds a one person/job per urban acre (a

[12] It is possible that the relationship between the built environment and per capita expenditures is endogenous. If this were the case, an instrumental variables approach to these models would be necessary. Testing via the Durban-Wu-Hausman test indicates that endogeneity is not a problem in these models.

somewhat different calculation) leads to a 0.649 percent decrease in per capita total direct expenditures on average. While not directly comparable, this result is approximately half of that found in this analysis. The explicit test of the economists perspective can be found in column VI of Table 4.4. The signs of the coefficients are not indicative of a u-shaped relationship between density and per capita expenditures.[13] Rather, rising net population density leads to a decrease at a decreasing rate in per capita total expenditures. While the coefficient on the squared net population term is not statistically significant at the 95% level, this would provide even more evidence of the planner's perspective.

In addition to density, sprawl is measured by the amount of developed land in a county area. In the preferred model, a 10 percent increase in the amount of developed land in a county is associated with a 0.1 percent increase in per capita total expenditures on average. Evaluated at the mean across time and all composite counties, this dollar influence of this result would be a $10.30 increase per capita in total expenditures. This result conforms to the hypotheses made above that the increasing spatial extent of development will lead to rising public service costs; however, the influence is small. The average composite county would likely see a decrease in per capita total expenditures by limiting the spatial extent of development; though, the actual dollar impact on local budgets is much smaller than that of rising density. The influence of developed land is smaller than that found in the comparable literature. Carruthers and Úlfarsson (2008) finds a 10 percent increase in developed land leads to a 0.26 percent increase in per capita total direct expenditures. The result found here is significantly smaller. A final important consideration in the understanding of sprawl's influence on per capita expenditures is the cost of urban land (Ewing, 1997). As can be seen in Table 4.4, a 10 percent increase in the price of urban land is associated with approximately

[13] In the pooled OLS version of this model (III, IV), there is a u-shaped relationship between net population density and per capita total expenditures. While this result is intriguing and requires more thorough exploration, the estimation of the model using within effects (a more appropriate estimation method) changes this result.

a 0.5 percent increase in per capita expenditures. In dollar terms (again at the average over time and across composite counties), this result would yield a $51.50 increase in per capita total expenditures. The significance and magnitude of this result is suggestive that residential land price is an influential factor in understanding the relationship between sprawl and per capita expenditures. Again, Carruthers and Úlfarsson (2008) finds a 10 percent increase in median home price (a similar concept to residential land price) leads to a 0.99 percent increase in per capita total direct expenditures on average. This result from the literature is approximately twice that found in this analysis; however, median home price includes the price of the structure, something that is not found in this analysis.

Turning next to the influence of residential growth on per capita total expenditures, Table 4.4 generally shows that residential growth increases per capita total expenditures at an increasing rate. However, the effect size is rather small with a one percentage point increase in residential units leading to (in levels) a 0.1 percent increase in per capita total expenditures.[14] The top panel in Figure 4.2.3 on page 96 demonstrates that the non-linear effect of residential growth is increasing at an increasing rate. As can be seen, a 10 percentage point increase in residential growth leads to a 1.45 percent increase in per capita total expenditures. A 20 percentage point increase approximately doubles this influence leading to a 3.1 percent increase on average. The rate of increase in per capita total expenditures rises exponentially as the rate of residential growth increases. These results are suggestive that as residential growth increases, average per capita total expenditure burdens rise. Therefore, new growth leads to increasing burdens on all residents, not just new residents.

While the previous paragraphs describes the results for the variables of interest for this analysis, the model also contains a number of controls that provide interesting results. These are grouped into three categories outlined above: demand variables, intergovernmental re-

[14] Ladd (1992) finds a one percent population growth rate is associated with a 1.6 percent *decrease* in per capita current expenditures. While not completely comparable, is does demonstrate that higher effects sizes, regardless of direction, have been found in the literature.

lations variables, and governmental characteristics variables. Dealing first with variables measuring the demand for public services, in the preferred model, income elasticities and tax price elasticities are of the correct sign but neither reach statistical significance (even at the 90% level).[15] The elasticity of population is positive and statistically significant. The positive sign on population is somewhat suggestive that local public goods are more like private goods (Borcherding and Deacon, 1972; Bergstrom and Goodman, 1973; Ladd, 1992, 1994). Had the sign on population been closer to zero or insignificant, this would have been indications that local public goods, in Georgia, are more public in nature. The elasticity of school enrollment is negative and statistically significant, potentially indicating there are some scale economies to school enrollment. The sign on the proportion of residents age 65 plus is positive. This result conforms to the results found in Bergstrom and Goodman (1973). This likely indicates that these residents are demanding more or higher quality local amenities rather than seeking reductions in public good provisions. The final two variables, the employment ratio and poverty rate, do not reach statistical significance; however, they are of the expected signs (Bergstrom and Goodman, 1973; Ladd, 1992; Carruthers and Úlfarsson, 2008). These two groups, whom are unlike the median or average resident, are demanding a higher level of service delivery than the residential population.

The results for intergovernmental relations variables are positive and statistically significant at higher than the 99% level. Specifically, a one percent increase in per capita state aid leads to, on average, a 0.6 percent increase in per capita total expenditures. Evaluated at the average over time, this relationship would increase per capita total expenditures by $61.81. Additionally, a one percent increase in per capita federal aid leads to a 0.11 percent increase per capita total expenditures on average. Evaluated at the average over time, this relationship would increase per capita total expenditures by $11.33. Both results suggest

[15]This may be an artifact of the estimation method. In the pooled OLS estimation of this model, both income and tax price elasticities are of the magnitude and statistical significance suggested in the literature.

that intergovernmental revenues stimulate local government spending, but the relationship is much less than a one to one relationship. Additionally, the results found for intergovernmental revenues are somewhat larger than that found in similar literature, especially for state aid. Ladd (1992) and Carruthers and Úlfarsson (2008) find the elasticity of per capita state aid to be closer to 0.15. These same authors diverge on their findings for per capita federal aid. Ladd (1992) finds results similar to those found here; however, Carruthers and Úlfarsson (2008) finds the elasticity of per capita federal aid with respect to per capita total direct expenditures to be somewhat smaller (0.01). Moving to governmental characteristics, revenue diversification is positive and statistically significant. A one percent increase in revenue diversification leads to a 0.14 percent increase in per capita total expenditures. Debt burden is positive and statistically significant. A one percent increase in debt per capita leads to a 0.01 percent increase in per capita total expenditures. Finally, local government fragmentation offers two differing results. First, a one percent increase in general purpose governments per 10,000 residents leads to a 0.2 percent decrease in per capita total expenditures. Second, a one percent increase in special purpose governments per 10,000 residents leads to approximately a 0.5 percent increase in per capita total expenditures.

4.2.2 Current Expenditures

Turning next to Table 4.5, the results for Equation 4.2 as applied to per capita current expenditures are examined. As with the results in Table 4.4, the two primary variables measuring sprawl, net population density and developed land are generally statistically significant across the various models. In the preferred estimation technique (V, VI), net population density is negative in the strictly linear specification (V) with a one person per residential acre increase leading to a 0.4 percent increase in per capita current expenditures on average. In the nonlinear specification (VI), net population is negative while its square is positive. However, the magnitude of the squared term is small and the *t*-statistic is small. This result indicates, in all practical terms, that the squared term is not adding any predictive power to the model. Therefore, the results from the strictly linear specification are to be used. The second dimension of sprawl, developed land, is positive and statistically significant. A 10 percent increase in developed land is associated with a 0.06 percent increase in per capita current expenditures. These two results are supportive of the hypotheses made above. These results largely conform with the planner's perspective that increases in density and decreases in the spatial extent of development can lead to lower per capita expenditures. The price of land is positive with a 10 percent increase in the price of land leading to a 0.2 percent increase in per capita current expenditures on average. Turning next to the influence of residential growth on per capita current expenditures, as can be seen in Table 4.5, residential growth exhibits, on average, an inverse u-shaped relationship with per capita current expenditures. However, the magnitudes of the coefficients are small and the statistical significance of the squared term is far below any conventional levels. As can be seen, graphically, in Figure 4.2.3 on page 96, the relationship between residential growth and per capita current expenditures is essentially positive and linear.

The results for the three sets of control variables are similar to the results found in Table 4.4. Income and tax price elasticities are of the correct signs (positive and negative, respectively); however, neither reach statistical significance. The elasticity of population is small and insignificant. School enrollment is negative and statistically significant. A 10 percent increase in school enrollment leads to a 2.5 percent decrease in per capita current expenditures. The proportion of residents age 65 plus has a positive influence on per capita current expenditures. Specifically, a 10 percent increase in the proportion of residents age 65 plus leads to a 0.7 percent increase in per capita current expenditures. The ratio of jobs by place to residents is positive and statistically significant. A 10 percent increase in jobs per capita leads to approximately a 1.5 percent increase in per capita current expenditures.

Finally, the poverty rate is positive; however, the coefficient is small and not statistically different from zero.

The influence of intergovernmental aid in Table 4.5 is similar to that found in Table 4.4. Per capita intergovernmental aid is positively related to per capita current expenditures. Specifically, a 10 percent increase in per capita state aid leads to, on average, a 0.7 percent increase in per capita current expenditures. Additionally, a 10 percent increase in per capita federal aid leads to a one percent increase in per capita current expenditures on average. Both are statistically significant at above the 99% level. Turning next to the influence of governmental characteristics, revenue diversification has a much different effects on per capita current expenditures than per capita total expenditures. Rather than providing evidence of potentially illusionary effects, revenue diversification appears to be associated with lower per capita current expenditures. Specifically, a 10 percent increase in revenue diversification is associated with approximately a 0.4 percent decrease in per capita current expenditures at above the 95% level of statistical significance. Debt burden appears to increase per capita current expenditures; however, the result is only marginally statistically significant. The results for the last two variables that compose government characteristics, general purpose governments per 10,000 residents and special purpose governments per 10,000 residents, are similar to that found in the analysis of per capita total expenditures. Specifically, a 10 percent increase in general purpose governments per 10,000 residents leads to a 4.8 percent decrease in per capita current expenditures. Additionally, a 10 percent increase in special purpose governments per 10,000 residents leads to a 3.4 percent increase in per capita current expenditures.

4.2.3 Capital Expenditures

Finally, results for the estimation of Equation 4.2 as applied to per capita capital expenditures can be found in Table 4.6. As Ladd (1992) notes, this model measures the annual investment spending on capital assets, not the annual costs of using capital. As such, it should not be interpreted as an analysis of the annual user cost of capital but, rather, an analysis of annual investment spending.[16]

Turning first to the variables concerned with the built environment and residential growth, the results for the first of two measures of sprawl, net population density, are similar to the previous two specifications. Increases in net population density lead to decreases in per capita capital expenditures. Specifically, a one person per residential acre increase leads to, on average, a 8.7 percent decrease in per capita capital expenditures in the linear specification. This result is statistically significant at above the 99% level. In dollar terms (evaluated at the mean over time and across composite counties), the increase in density is associated with a $110 decrease in per capita capital expenditures. As with the analysis of per capita current expenditures, the results for the non-linear specification of net population density are less convincing with neither variable reaching statistical significance. The second dimension of sprawl, developed land, performs as hypothesized. A 10 percent increase in developed land is associated with a 0.8 percent increase in per capita capital expenditures. In dollar terms, a 10 percent increase in developed land is associated with approximately a $10 per capita increase in capital expenditures. The final dimension of density is the price of urban land. As expected, rising land prices is associated with an increase in per capita capital expenditures. Specifically, a 10 percent increase in urban land prices leads to a 2.4 percent increase in per capita capital expenditures on average. In dollar terms, a 10 percent increase in residential land price is associated with approximately a $30 per capita increase in capital expenditures on average. Finally, residential growth exhibits a non-linear relationship with per capita capital expenditures. Specifically, increases in residential growth are associated with rising per capita capital expenditures at an increasing rate. The bottom

[16]This is a clarification rather than a limitation of this analysis. The research questions presented are explicitly interested in the changes in the provision of capital assets (i.e. investment) as a result of sprawl and growth.

panel of Figure 4.2.3 on page 96 demonstrates the relationship graphically. As can be seen, as the percent change in residential unit increases, per capita capital expenditures rise quite rapidly.

Turning next to the control variables in this model, income is positive, however, statistically, no different from zero. Tax price is also positive but, again, not statistically significant. Population is a positive and statistically significant influence on per capita capital expenditures. Specifically, a one percent increase in population leads to a 3.6 percent increase in per capita capital expenditures. There is no similar effect for school enrollment. As can be seen in Table 4.6, the remaining three demand variables do not reach statistical significance. Turning to intergovernmental relations variables, state aid is a large predictor of per capita capital expenditures. A one percent increase in per capita state aid leads to a 3.5 percent increase in per capita capital expenditures. This result is statistically significant at above the 99% level. Per capita federal aid is much less stimulative with a coefficient of 0.2 that is not statistically significant. Many of the governmental characteristics variables are statistically significant. Revenue diversification is a positive predictor of per capita capital expenditures. Specifically, a one percent increase in revenue diversification is associated with a 1.3 percent increase in per capita capital expenditures. Similarly, a 10 percent increase in debt burden leads to, on average, a 0.5 percent increase in per capita capital expenditures. Finally, the two measures of governmental fragmentation are not statistically significant; however, both are positive.

Table 4.4: Regression Results - Per Capita Total Expenditures

	OLS		Driscoll-Kraay			
	I	II	III	IV	V	VI
Built Environment						
Net Population Density	-0.015	-0.012	-0.016	-0.042	-0.015	-0.012
	(-3.62)	(-1.36)	(-5.74)	(-8.77)	(-10.65)	(-5.19)
Net Population Density, Squared	-	-0.000	-	0.001	-	-0.000
	-	(-0.45)	-	(12.36)	-	(-1.61)
Developed Land (ln)	0.011	0.011	0.010	0.008	0.011	0.011
	(1.83)	(1.85)	(5.58)	(4.73)	(3.10)	(3.19)
Land Price (ln)	0.046	0.045	0.071	0.083	0.046	0.045
	(3.39)	(2.93)	(8.02)	(8.14)	(7.58)	(7.56)
% Δ in Residential Unit	0.001	0.001	0.004	0.004	0.001	0.001
	(2.22)	(2.21)	(2.15)	(2.29)	(7.13)	(7.19)
% Δ in Residential Unit, Squared	0.000	0.000	-0.000	-0.000	0.000	0.000
	(1.11)	(1.11)	(-1.40)	(-1.62)	(2.09)	(2.09)
Demand, Tastes and Costs						
Per Capita Personal Income (ln)	0.060	0.059	0.059	0.087	0.060	0.059
	(1.30)	(1.30)	(1.42)	(2.11)	(1.56)	(1.55)
Tax Price (ln)	-0.007	-0.006	-0.170	-0.187	-0.007	-0.006
	(-0.26)	(-0.23)	(-8.34)	(-8.55)	(-0.69)	(-0.61)
Population (ln)	0.640	0.636	-0.009	-0.000	0.640	0.636
	(2.01)	(1.99)	(-0.55)	(-0.01)	(2.31)	(2.30)
School Enrollment (ln)	-0.198	-0.198	0.012	0.010	-0.198	-0.198
	(-1.62)	(-1.61)	(1.13)	(0.95)	(-2.21)	(-2.21)
Proportion Age 65+ (ln)	0.112	0.115	0.067	0.054	0.112	0.115
	(1.18)	(1.19)	(3.90)	(3.08)	(2.97)	(3.03)
Employment Ratio (ln)	0.134	0.133	0.146	0.145	0.134	0.133
	(1.55)	(1.53)	(8.90)	(8.63)	(1.39)	(1.37)
Poverty Rate (ln)	0.060	0.060	-0.093	-0.071	0.060	0.060
	(1.92)	(1.89)	(-13.75)	(-12.19)	(1.85)	(1.83)
Intergovernmental Relations						
Per Capita State Aid (ln)	0.605	0.604	0.341	0.369	0.605	0.604
	(10.68)	(10.66)	(4.65)	(5.14)	(13.01)	(13.03)
Per Capita Federal Aid (ln)	0.107	0.107	0.143	0.138	0.107	0.107
	(4.40)	(4.38)	(20.51)	(22.37)	(18.32)	(18.55)
Governmental Characteristics						
Revenue Diversification (ln)	0.138	0.137	-0.282	-0.265	0.138	0.137
	(1.57)	(1.56)	(-4.32)	(-3.91)	(2.30)	(2.28)
Debt Burden (ln)	0.007	0.007	0.012	0.013	0.007	0.007
	(1.74)	(1.74)	(6.16)	(6.29)	(2.53)	(2.54)
General Purpose Governments per 10,000 Residents (ln)	-0.213	-0.217	-0.008	-0.010	-0.213	-0.217
	(-2.93)	(-2.94)	(-0.83)	(-1.07)	(-1.58)	(-1.61)
Special Purpose Governments per 10,000 Residents (ln)	0.476	0.478	0.000	0.003	0.476	0.478
	(1.66)	(1.66)	(0.18)	(2.64)	(4.18)	(4.16)
R^2	0.600	0.600	0.509	0.516	0.600	0.600
n	1,245	1,245	1,245	1,245	1,245	1,245
County Fixed Effects	X	X			X	X
Year Fixed Effects	X	X	X	X	X	X

t-statistics in parentheses

Table 4.5: Regression Results - Per Capita Current Expenditures

	OLS		Driscoll-Kraay			
	I	II	III	IV	V	VI
Built Environment						
Net Population Density	-0.004	-0.004	-0.009	-0.017	-0.004	-0.004
	(-1.81)	(-0.87)	(-3.44)	(-3.06)	(-1.90)	(-2.22)
Net Population Density, Squared	-	0.000	-	0.000	-	0.000
		(0.06)	-	(2.69)	-	(0.07)
Developed Land (ln)	0.006	0.006	0.006	0.005	0.006	0.006
	(1.82)	(1.83)	(4.00)	(3.80)	(4.61)	(4.88)
Land Price (ln)	0.020	0.020	0.038	0.041	0.020	0.020
	(3.05)	(2.74)	(3.61)	(3.53)	(2.99)	(3.51)
% Δ in Residential Unit	0.000	0.000	0.002	0.002	0.000	0.000
	(1.51)	(1.50)	(1.43)	(1.45)	(2.14)	(2.09)
% Δ in Residential Unit, Squared	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(-0.11)	(-0.11)	(-1.95)	(-2.06)	(-0.14)	(-0.14)
Demand, Tastes and Costs						
Per Capita Personal Income (ln)	0.012	0.012	0.081	0.090	0.012	0.012
	(0.45)	(0.45)	(1.94)	(2.23)	(0.40)	(0.39)
Tax Price (ln)	-0.009	-0.009	-0.107	-0.113	-0.009	-0.009
	(-0.54)	(-0.54)	(-4.68)	(-4.42)	(-0.75)	(-0.70)
Population (ln)	0.096	0.096	-0.016	-0.013	0.096	0.096
	(0.96)	(0.95)	(-1.72)	(-1.53)	(0.46)	(0.47)
School Enrollment (ln)	-0.252	-0.252	0.010	0.009	-0.252	-0.252
	(-5.10)	(-5.09)	(1.10)	(1.05)	(-7.12)	(-7.11)
Proportion Age 65+ (ln)	0.077	0.077	0.061	0.056	0.077	0.077
	(1.26)	(1.22)	(3.88)	(3.83)	(2.66)	(2.95)
Employment Ratio (ln)	0.145	0.145	0.114	0.114	0.145	0.145
	(2.39)	(2.37)	(12.54)	(12.38)	(8.25)	(7.96)
Poverty Rate (ln)	0.006	0.006	-0.029	-0.022	0.006	0.006
	(0.41)	(0.41)	(-1.75)	(-1.47)	(0.56)	(0.59)
Intergovernmental Relations						
Per Capita State Aid (ln)	0.068	0.068	0.096	0.105	0.068	0.068
	(3.65)	(3.64)	(2.28)	(2.64)	(6.04)	(5.92)
Per Capita Federal Aid (ln)	0.095	0.095	0.164	0.163	0.095	0.095
	(7.41)	(7.34)	(16.29)	(16.84)	(18.30)	(17.01)
Governmental Characteristics						
Revenue Diversification (ln)	-0.038	-0.038	-0.247	-0.242	-0.038	-0.038
	(-0.87)	(-0.87)	(-4.61)	(-4.29)	(-2.49)	(-2.47)
Debt Burden (ln)	0.002	0.002	0.012	0.012	0.002	0.002
	(0.67)	(0.67)	(5.12)	(5.35)	(1.77)	(1.78)
General Purpose Governments per 10,000 Residents (ln)	-0.478	-0.478	-0.012	-0.013	-0.478	-0.478
	(-12.62)	(-12.40)	(-6.06)	(-5.96)	(-7.19)	(-7.69)
Special Purpose Governments per 10,000 Residents (ln)	0.340	0.340	0.007	0.008	0.340	0.340
	(3.85)	(3.84)	(2.40)	(3.09)	(3.09)	(3.06)
R^2	0.794	0.794	0.642	0.643	0.794	0.794
n	1,245	1,245	1,245	1,245	1,245	1,245
County Fixed Effects	X	X			X	X
Year Fixed Effects	X	X	X	X	X	X

t-statistics in parentheses

Table 4.6: Regression Results - Per Capita Capital Expenditures

	OLS		Driscoll-Kraay			
	I	II	III	IV	V	VI
Built Environment						
Net Population Density	-0.087	-0.060	-0.061	-0.163	-0.087	-0.060
	(-3.13)	(-0.93)	(-9.54)	(-7.56)	(-6.91)	(-1.39)
Net Population Density, Squared	-	-0.002	-	0.006	-	-0.002
	-	(-0.63)	-	(5.54)	-	(-0.77)
Developed Land (ln)	0.080	0.081	0.035	0.027	0.080	0.081
	(1.38)	(1.40)	(2.11)	(1.67)	(4.24)	(4.27)
Land Price (ln)	0.249	0.235	0.287	0.337	0.249	0.235
	(2.48)	(2.10)	(13.85)	(12.21)	(7.84)	(5.22)
% Δ in Residential Unit	0.008	0.008	0.018	0.018	0.008	0.008
	(1.83)	(1.82)	(3.64)	(3.98)	(5.58)	(5.85)
% Δ in Residential Unit, Squared	0.000	0.000	-0.000	-0.000	0.000	0.000
	(1.23)	(1.23)	(-0.60)	(-0.86)	(2.21)	(2.19)
Demand, Tastes and Costs						
Per Capita Personal Income (ln)	0.209	0.204	-0.342	-0.228	0.209	0.204
	(0.63)	(0.61)	(-4.55)	(-3.39)	(0.70)	(0.67)
Tax Price (ln)	0.055	0.063	-0.537	-0.604	0.055	0.063
	(0.26)	(0.31)	(-4.57)	(-5.77)	(0.66)	(0.81)
Population (ln)	3.586	3.538	0.032	0.067	3.586	3.538
	(2.07)	(2.03)	(0.32)	(0.64)	(2.69)	(2.61)
School Enrollment (ln)	0.059	0.063	0.090	0.082	0.059	0.063
	(0.08)	(0.08)	(1.81)	(1.61)	(0.10)	(0.10)
Proportion Age 65+ (ln)	0.472	0.507	0.184	0.130	0.472	0.507
	(0.55)	(0.58)	(2.39)	(1.71)	(1.34)	(1.38)
Employment Ratio (ln)	0.159	0.146	0.468	0.466	0.159	0.146
	(0.32)	(0.29)	(4.86)	(4.80)	(0.32)	(0.28)
Poverty Rate (ln)	0.345	0.337	-0.525	-0.437	0.345	0.337
	(1.32)	(1.28)	(-7.86)	(-5.85)	(1.35)	(1.28)
Intergovernmental Relations						
Per Capita State Aid (ln)	3.487	3.484	1.631	1.747	3.487	3.484
	(9.52)	(9.50)	(6.40)	(6.71)	(12.06)	(12.08)
Per Capita Federal Aid (ln)	0.213	0.217	-0.025	-0.044	0.213	0.217
	(1.22)	(1.23)	(-0.28)	(-0.49)	(1.45)	(1.45)
Governmental Characteristics						
Revenue Diversification (ln)	1.304	1.294	-0.190	-0.121	1.304	1.294
	(2.34)	(2.34)	(-0.47)	(-0.31)	(3.13)	(3.10)
Debt Burden (ln)	0.055	0.054	0.029	0.033	0.055	0.054
	(1.84)	(1.84)	(3.21)	(3.34)	(3.51)	(3.55)
General Purpose Governments per 10,000 Residents (ln)	1.594	1.554	0.052	0.043	1.594	1.554
	(2.79)	(2.72)	(0.92)	(0.75)	(1.81)	(1.78)
Special Purpose Governments per 10,000 Residents (ln)	0.695	0.706	-0.100	-0.087	0.695	0.706
	(0.49)	(0.50)	(-5.33)	(-4.94)	(1.10)	(1.10)
R^2	0.257	0.257	0.253	0.253	0.257	0.257
n	1,245	1,245	1,245	1,245	1,245	1,245
County Fixed Effects	X	X			X	X
Year Fixed Effects	X	X	X	X	X	X

t-statistics in parentheses

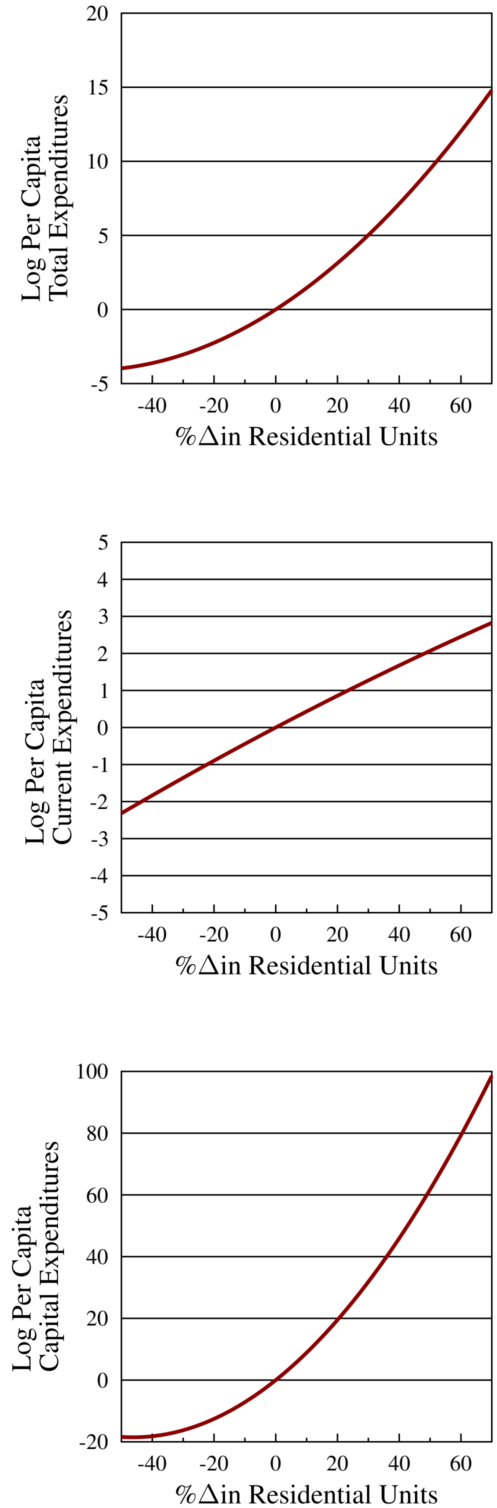

Figure 4.1: Nonlinear Effects of Residential Growth

4.3 Discussion

The results from the three models presented above provide a rich understanding of how sprawl and residential growth can impact local government expenditures on a per capita level. Dealing first with sprawl, as described in the previous chapter, there is a disciplinary disagreement over what the influence of sprawl on per capita expenditures should be. The urban planning discipline largely believes that sprawl almost universally leads to high per capita expenditures. Instead of sprawling development patterns, urban planners advocate for denser, more compact "Smart Growth," partly as a way to keep per capita local government expenditures down. On the other side of this debate, economists, specifically public finance economists, largely believe that the relationship between sprawl and per capita expenditures is not as simple as urban planners would make it out to be. Instead of a strictly linear relationship, economists posit a non-linear, u-shaped relationship between density and per capita expenditures. Density works to lower per capita expenditures at low levels of density; however, as density rises to more urban levels, the "harshness" of the urban environment increases per capita expenditures.

The construction of the models here allows for testing of each hypothesis. For each dependent variable (total, current and capital expenditures), the urban planning perspective and the Economist's perspective are tested. In general, this analysis finds support for the urban planning perspective. On average, an increase in residential density leads to a decrease in per capita expenditures. In testing the Economist's perspective, the results are generally supportive of the urban planning perspective as well. Rising density decreases per capita expenditures at a decreasing rate or the non-linear relationship is statistically insignificant. As a further control for sprawl, developed land is incorporated into the model to control for the spatial extent of urban development. Universally, this variable is positive and significant, indicating that as the spatial extent of urban development increases in a county area, per capita expenditures increase, on average, to service the larger urban area. Taken together, these two variables, density and size of the urban area, indicate that a denser, more compact development pattern can help to keep per capita expenditures down.[17] An additional important consideration to the process of densification is the price of urban land. The process by which density helps to generate higher urban land rents provides a way in which density is made to pay for itself. The analysis presented here demonstrates that higher land prices increase per capita expenditures on average; however, the partialling out of the influence of land prices in the model provides even stronger evidence of the urban planning perspective.[18] As espoused by Carruthers and Úlfarsson (2003, 2008), these three variables (density, developed land and land prices) together more accurately measure sprawl than the univariate approach taken in earlier studies (Ladd, 1992).

The second consideration of these models is the ability to ask whether residential growth "pays its own way." This study allows an elimination of a problem in previous studies. Specifically, population growth and population density were intertwined (Ladd, 1992). Because county land area is fixed, positive population growth necessitated increases in density. In this study, residential density, as defined, allows for both the numerator and the denominator to change. Additionally, operationalizing residential growth in terms of housing units rather than population diminishes the connection between density and growth even further. As such, this analysis can estimate the influence of residential growth apart from its connection to density.

Overall, the findings here are somewhat mixed as to whether residential development pays its own way in Georgia. Examining per capita total expenditures, it would appear that increased development increases per capita expenditures at an increasing rate. However,

[17]As noted earlier, it is possible that this relationship between density and per capita expenditures is endogenous. Testing via the Durban-Wu-Hausman test suggest there is no endogeneity in the relationship.

[18]In more technical terms, the models suffer from an omitted variable bias that depresses the influence of density in the model. Correcting for this bias by including land prices more accurately estimates the influence of density on per capita expenditures.

when that result is deconstructed, it is found that the result is largely driven by per capita capital expenditures. The influence of residential growth on per capita current expenditures is small and linear. The influence on per capita capital expenditures is large and non-linear. This finding somewhat conforms to that found by Ladd (1992, 1994). Ladd finds that population growth leads to declines per capita current expenditures (which she attributes to declining service quality) but finds that population growth increases per capita capital expenditures. In the context of whether new development "pays its own way," it would appear that, in Georgia, new residential development increases the average burden on existing residents (i.e. per capita expenditures increase, an average measure). Therefore, development does not pay its own way, especially with regard to capital expenditures.

Chapter 5

Findings - Local Fiscal Conditions

In Chapter 3, a theoretical model of how the built environment can influence local fiscal conditions was presented. This chapter will build upon that foundation to operationalize the theoretical and conceptual ideas presented in Chapter 3. Fiscal conditions will be empirically defined, and a regression model will be presented to examine the specific influences of sprawl and growth on local fiscal conditions. Variables not previous defined will be explored. Finally, results will be presented and discussed.

5.1 Literature on Fiscal Condition of State/Local Governments

The extant scholarly and practitioner literature on fiscal condition is large and varying. Numerous authors have attempted to understand averse fiscal condition and its impact on state and local governments. While this body of research has been of interest to scholars and practitioners for many years, fiscal crises, such as New York City's in 1975, have increased the need to better understand fiscal condition, how to predict it, and how to remedy it (Aronson, 1984; Benson et al., 1988). The topic of fiscal condition has been debated and numerous definitions offered. This section will overview the diverse measures of fiscal condition as a means to better understand the concept overall.

The term "fiscal condition" or the many other names for fiscally troubled governments has an intuitive appeal. When one references that a local government has an "adverse fiscal condition," readers instantly have a vague understanding of the problems facing that particular government but few completely comprehend the forces at work. While only a limited number of definitions have been offered, there are clearly two schools of thought on the matter (Skidmore and Scorsone, 2009, 2011). The first of which deals specifically with how governmental decisions, such as poor financial management, can lead to poor fiscal condition. This strain of the literature often labels this as "fiscal stress," "fiscal distress," or "fiscal health." The consensus is that this conception, fiscal stress, is an inability to continue to deliver services at current levels (Falconer, 1990; Honadale et al., 2004; Trussel and Patrick, 2009). The other approach focuses on environmental factors outside of the control of local governments such as rising costs or declining intergovernmental support. This line of the literature often labels this "fiscal condition" or "fiscal disparities." Fiscal condition is generally operationalized as a "need-capacity gap" where revenue raising capacity and expenditure needs are estimated (Bradbury et al., 1984; Bradbury and Zhao, 2009; Ladd and Yinger, 1989; Ladd, 1999; Wallin and Zabel, 2011). Of the two, the preference for this analysis is the latter because the built environment is most likely to influence underlying costs and revenue bases.

Historically, much of the early research on fiscal stress was originated by various federal agencies in an attempt to better target grants-in-aid to state and local governments (Advisory Commission on Intergovernmental Relations, 1971). In early research by the U.S. Advisory Commission on Intergovernmental Relations (1973), six "proximate causes" or indicators of fiscal stress were identified:

- Operating fund imbalance (current expenditures significantly exceeding current revenues)
- Pattern of current expenditures exceeding current revenues for several years
- Current liabilities exceeding current assets
- Outstanding short term operating loans at the end of the fiscal year
- High or rising rate of property tax delinquency
- Substantial drop in assessed value

The six indicators outlined in 1973 are informative for diagnosing a single local government with fiscal stress; however, many are not useful in a comparative sense. To provide "meaningful" comparison between local governments, the ACIR developed and refined measures of fiscal capacity and tax effort as a means of equalizing grants-in-aid to state and local governments. The ACIR (1962, pg. 3) defines fiscal capacity as the "resources [from] which a taxing jurisdiction can raise revenue for public purposes." Additionally, tax effort is defined by the ACIR as the extent to which fiscal capacity is used to raise revenue through taxation. The ACIR (1962) utilizes two primary measures of fiscal capacity: personal income and the representative tax system (RTS). While personal income statistics are easily accessible from the Bureau of Economic Analysis, the ACIR (1977) explains that personal income tends to understate the fiscal capacity of governments in a position to export their tax burden and overstate the fiscal capacity of governments who are not. The RTS focuses on tax bases, and the ACIR believes the RTS to be a more accurate measure of fiscal capacity. Tax effort is quantitatively defined as own-source tax revenue divided by fiscal capacity.

The ACIR used fiscal capacity and tax effort as a means to identify governments in fiscal need, not in fiscal stress. Recognizing the difference, the ACIR (1977) modified their existing measures and developed the "fiscal blood pressure" to identify governments under fiscal stress. The fiscal blood pressure consists of two measures: an index of tax effort and an index of the percent change in tax effort. By constructing this two-part indicator, the fiscal blood pressure can show where a government is in relation to other governments in terms of tax effort and where it is heading (increasing or decreasing). Those governments with high and rising fiscal blood pressures are experiencing the highest levels of fiscal stress.

In addition to the significant work done by the ACIR, the U.S. Department of the Treasury (1978) and the Congressional Budget Office (1978) also constructed fiscal stress indicators. Both of these are composite in nature, composed of multiple factors. The Department of Treasury measure was designed to evaluate the fiscal impacts of Economic Stimulus Package (Aronson, 1984). This index (urban fiscal strain) is composed of local government fiscal components including the average weighted (percent weights in parentheses) change in population (37), change in per capita personal income (27), change in per capita own source revenues compared to changes in per capita income (12), change in long-term debt compared to changes in per capita income (12), and the change in full market property values (12). Aronson (1984) explains that the weights were decided upon somewhat arbitrarily. This measure blends governmental characteristics with socio-economic characteristics; however, it is difficult to understand the influence of per capita personal income because it enters into the measure so many times (Aronson, 1984). The CBO measure, Urban Need Index, is an index of four primary components: tax effort, per capita property tax base, and two HUD indices.[1] The index is constructed by standardizing each component.[2] The interpretation of this index is that cities with the greatest need with score a 100 and the cities with the lowest need with score a 0. The composite index is the mean of the four components. Aronson

[1] These two indices take into account community development need, tax effort and fiscal capacity (Aronson, 1984). One index is in multiplicative form and the other is in linear form.

[2] This standardization is achieved using the following formula: $x = \left[\frac{y-y_a}{y_b-y_a}\right] = 100$ where y is equal to the value of a specific component, y_a is equal to the value of y with the least need (lowest rank), and y_b is equal to the value of y with the highest need (highest rank).

(1984) notes a weakness of this approach is the reliance on components that are sensitive to the number of public services the city is responsible for providing.

Further research has taken place in the academic literature as scholars and practitioners have attempted to predict and understand governments under fiscal stress. As Skidmore and Scorsone (2009, 2011) note, many of the indicators that would follow the six "proximate causes" of fiscal stress identified by ACIR (1973) would be a variation on the theme set by the report. Aronson and King (1978) suggest seven measures of fiscal stress. These measures are explicitly debt related including three ratios relating long term debt retired (plus annual interest payments) to own-source revenues, total revenues, and state personal income. Additionally, three more ratios relating long term debt retired, annual interest payments and outstanding short term debt to the same three variables (own-source revenues, total revenues, and state personal income). The final ratio is short term debt to cash/securities on hand. Aronson and King (1978, pg. 155) do not suggest any specific levels of these ratios that would be indicative of fiscal stress; however, they do suggest that rising levels of any of these variables over several fiscal years would be indicative of "increasing fiscal pressure."

Clark and Ferguson (1983, pg. 45) develop a measure of "urban fiscal strain" that relates "fiscal policy outputs of the city government to . . . private sector activities." Fiscal policy outputs are weighted by whether the city engages in certain activities. If a city engages in one of 67 sub-functions, it receives a one (and a zero if it does not engage). This is then multiplied by the weight (the average per capita expenditure on the sub-function across all cities that engage in it) and summed to generate the functional performance index. Private sector activities are measured using population (and the annual percent change), change in median family income, and the City Wealth Index composed of weighted median family income and equalized taxable property value. These two measures are combined to create ratios. These ratios are generated for a sample cities over 50,000 population in between 1960 and 1977. The relationship between these indicators and a variety of precursors (fiscal stress, financial preferences, political culture, and leadership (Hendrick, 2011)) are examined.

Brown's (1993) 10-point test for financial condition (updated by Mead (2006) to incorporate changes in reporting from GASB No. 34) calculates ten "key ratios of financial condition." Given the outputs of those ten ratios, the local government being graded determines which quartile their ratio falls (quartiles are determined from information in the GFOA Financial Indicators Database and are based on population size). Each quartile is associated with a number[3] which a local government sums across all ten ratios to give an overall grade. Local governments with a grade of 10 or more would be considered "among the *best*" relative to their peers, a grade of 5 to 9 would be considered "*better* than most," a grade or 1 to 4 would be considered "about *average*," a grade of 0 to -4 would be "*worst* than most," and a grade of -5 or less would be considered "among the *worst*."

The 10-point scale for fiscal distress developed by Kloha et al. (2005) attempts to do something similar to Brown (1993). Across nine indicators, a one is given if the value of the indicator is undesirable (i.e. for population growth, a one is assigned if population growth is negative, otherwise a zero is given).[4] The value assigned to each indicator is summed to generate an overall score. Similar to Brown (1993), point categories indicate if there are problems (dubbed the "Early Warning System"). A score of 0 to 4 would be considered fiscally healthy, a score of 5 points would indicate a fiscal watch (triggering the local government to be notified of their high score), a score of 6 to 7 would indicate a fiscal warning (triggering a public announcement of this status), and a score of 8 to 10 would indicate a fiscal emergency and an automatic review by the state is triggered.

[3]Numbers are assigned as follows: -1 for quartile 1, 0 for quartile 2, +1 for quartile 3, and +2 for quartile 4.

[4]A value ranging from 0 to 2 is given for prior year general fund operating deficits. A value of one is given for each year with a deficit for up to two years.

Groves et al. (2003) introduce, explicitly, that financial condition can exist in different time frames. That is, financial condition can differ depending on how long term one looks. Specifically, Groves et al. (2003) suggest there are four kinds of fiscal solvency: long-run solvency, service-level solvency, budgetary solvency, and cash solvency. Long-run solvency, as the name suggests, deals with a local governments ability to balance expenditures and revenues over the long-run. Additionally, it speaks to the ability of a local government to deal with an unforeseen fiscal problem at some point in the future. Service-level solvency is the ability of a local government to provide adequate public services to its citizens with current revenue generating resources. Budgetary solvency is the ability of a local government to balance its budget (expenditures = revenues) in the current fiscal year. Finally, cash solvency is the ability of a local government to generate enough cash to pay for expenditures over the next 30 to 60 days.

Rivenbark et al. (2010) suggest a benchmarking process similar to those presented in the paragraphs above; however, rather that exclusively on the government-wide level or the fund level, an approach that combines the two concepts is utilized. Government-wide and enterprise fund level resources, representing economic resources (and accounted for on an accrual basis), and governmental funds, representing financial resources (and accounted for on a modified accrual basis) are used simultaneously. Both approaches attempt to identify ratios that are indicative of resource stock and resource flow. Resource stocks are somewhat indicative of longer term financial condition while resource flows are associated with shorter term financial condition.[5] After these ratios are calculated, they are benchmarked against the average (or median) ratios of similar local governments in a trend analysis.

Additionally, the work of Trussel and Patrick (2009) attempts to empirically predict fiscal stress in Pennsylvania local governments using many of the approaches outlined in the

[5]Carroll and Goodman (2012) suggest that the design of a revenue system that balance the elasticities of various revenue sources can help to decrease the volatility of resource flows.

preceding paragraphs. Overall, Trussel and Patrick (2009) find that the probability of fiscal distress[6] increases with an increased reliance on intergovernmental revenues. As explained, this is likely because of the stress caused by declining intergovernmental revenues or local governments seeking external sources of revenues when already stressed. Additionally, those local governments with higher revenue growth and population growth are at less of a risk of fiscal stress. Those local governments with higher administrative expenditures are less prone to fiscal stress because, as Trussel and Patrick (2009) explains, administrative expenditures are more discretionary and, therefore, easier to cut in light of potential fiscal stress. Finally, the usage of debt is associated with increased risk of fiscal stress. Although Pennsylvania local governments are subject to debt limits, it would appear that the usage of debt, below the limit, is still associated with fiscal stress.

Hendrick (2004) outlines a measure of fiscal health with a focus on governmental environment, balance, and fiscal slack. Each of these concepts is identified with an index. In an updated measure, Hendrick (2011) defines financial condition as a multipart phenomenon. Specifically, financial condition is composed of three types of solvency (long-term, service-level, and cash and budget) across three areas (revenues, assets, and other resources; expenditures and liabilities; and net financial condition or balance). These types of financial condition are measured over both the short and long term; a concept Hendrick (2011) is careful to point out. Clearly, with the multitude of measures of fiscal stress, there is little agreement in the extant literature on the appropriate method of diagnosing fiscal stress.

[6]As measured as three consecutive years of operating deficits from 1998-2006 and a cumulative deficit of more than five percent for those same years.

5.2 Variables and Regression Models

5.2.1 Measuring Local Fiscal Conditions

As the literature above suggests, there are two competing methods of measuring fiscal condition. Fiscal condition can be measured, partly, using the financial decisions of local policy makers. Additionally, fiscal condition can be measured by examining local economic conditions. Finally, some methods combine the two previous methods. For the purposes of this analysis, a measure of local fiscal condition that is as exogenous to local financial management decisions as possible is created. This is for a variety of reasons. As a statewide analysis, it would be nearly impossible to account for all of the varying financial management practices of county governments in the State of Georgia. Also, the purpose of this analysis is to examine how residential development patterns influence local fiscal condition. If fiscal condition were envisioned as including financial management practices, the underlying assumption would be that the built environment somehow influences those practices in some systematic fashion. That assumption is a far stretch and much beyond the argument being made in this analysis. Therefore, this analysis will proceed with the construction of a fiscal condition measure is better able to capture influences from the external environment.

The basis for the operational definition of fiscal stress in this analysis can be found in the work of Ladd and Yinger (1989). Ladd and Yingers definition of fiscal stress is based upon a "need-capacity gap" of local governments. This is the distance, in dollars, between the expenditures needed to provide an average level of service provision and the revenue raising capacity of the local area. Ladd and Yinger (1989, pg. 101) explain that this definition of fiscal health "summarizes the effect of external economic and social factors on its ability to deliver public services." Additionally, measuring fiscal condition in this manner divorces external factors from local decisions. No information on how a local government is managing their public financial system is included. The "need-capacity gap" simply measures the constraints put on local governments by economic and social forces.

Following the lead of Bradbury et al. (1984); Bradbury and Zhao (2009); Ladd (1999); and Wallin and Zabel (2011), the need capacity gap (local fiscal conditions, LFC) is defined as the following:

$$LFC_{it} = RRC_{it} - \hat{E}_{it} \tag{5.1}$$

where RRC_{it} is defined as revenue raising capacity for county i in time t and $\hat{E}_{it}$ is predicted expenditures from a regression where preferences are held constant and only cost related variables are allowed to vary (See below for complete explanation). Accepting that there may be systematic differences between urban and rural counties, the average expenditures are evaluated separately for urban and rural counties.[7]

Following Wallin and Zabel (2011), predicted expenditures, $\hat{E}_{it}$, is constructed using the following method. E_{it} is defined as:

$$E_{itj} = \gamma_{0tj} + EXOG_{it}\gamma_{1tj} + PREF_{it}\gamma_{2tj} + \eta_{it} \tag{5.2}$$

where E_{it} is defined as per capita current expenditures, $EXOG$ is a vector of variables measuring costs exogenous to the local government, and $PREF$ is a vector of variables measuring preferences for local public goods. The index j is for metro or non-metro counties. As such, E_{itj} is estimated for two subsets of counties, metro and non-metro. In predicting $\hat{E}_{itj}$, preferences are held constant and the cost variables are allowed to vary creating a prediction of expenditures solely based on the individual cost variables in the county. $\hat{E}_{ij}$ is defined below.

$$\hat{E}_{itj} = \hat{\gamma}_{0tj} + EXOG_{it}\hat{\gamma}_{1tj} + P\bar{R}EF_{it}\hat{\gamma}_{2tj} \tag{5.3}$$

[7]Urban counties are defined as those included in a Metropolitan Statistical Area.

where expenditures, $\hat{E}_{itj}$, are a function of a vector of cost variables ($EXOG$) and a vector of preference variables ($P\bar{R}EF$), held constant across groups, j.[8]

Revenue raising capacity (RRC) is defined using the method outline in Zhao and Hou (2008).[9] Specifically, RRC is estimated using the Income-with-Exporting (IWE) method (Ladd, 1999) and adjusted to fit Georgia specific conditions. Ladd and Yinger (1989) define RRC_i as

$$RRC_i = KY_i(1 + e_i) \tag{5.4}$$

where revenue raising capacity (RRC_i) is the average burden (K) imposed on residents multiplied by per capita personal income (Y_i) multiplied by one plus the extent to which local taxes are exported (e_i). Specifically, Ladd (1999) suggests that tax exporting (e_i) is difficult to measure. Following Zhao and Hou (2008), RRC_i is defined as

$$RRC_{it} = PCPI_{it} \times BURDEN_t + EXPORT_{it} \tag{5.5}$$

where $PCPI_{it}$ is per capita personal income and $BURDEN_t$ and $EXPORT_{it}$ are defined as below.

$$BURDEN_t = mean[OSR_i/PI_i]_t \tag{5.6}$$

$$EXPORT_{it} = PCSALES_{it} - (PCPI_{it} \times SIRATIO_t \times 0.01) \tag{5.7}$$

$BURDEN_t$ is the average of the ratio of own-source revenues to personal income for each year, t. $EXPORT_{it}$ is, essentially, sales taxes collected minus the potential sales tax collected in the absence of tax exportation (Zhao and Hou, 2008).[10] Specifically, Equation 5.7 measures

[8] Following Wallin and Zabel (2011), Equation 5.2 does not include county level fixed effects. Therefore, this equation is estimated annually and the coefficients retained to estimate Equation 5.3.

[9] This conceptualization is an adaptation of the method used in Ferguson and Ladd (1986).

[10] This measure assumes that only sales taxes can be exported to non-residents. Property tax exportation does occur (See Ladd and Yinger (1989)); however, it is assumed there is zero property tax exportation for the purposes of this analysis.

per capita sales tax revenues minus potential sales tax revenues defined as per capita personal income times average retail sales/personal income times 1 percent. The need-capacity gap (LFC_{it}) is calculated using the method outlined in Equation 5.1 where $\hat{E}_{it}$ is subtracted from RRC_{it}.

5.2.2 Regression Model

Following the conceptualization of Ladd and Yinger (1989) in Equation 3.5 on page 58, the following operationalization of the model is offered.

$$\begin{aligned} LFC = f(&\text{built environment, residential growth,} \\ &\text{economic health, economic structure}) \end{aligned} \tag{5.8}$$

Local fiscal conditions are the result of *economic health* and *economic structure* (Equation 3.5 on page 58). In Equation 5.8, economic health, defined as employment per capita, is likely positively related to local fiscal conditions. However, *economic structure* is more indeterminate where if changes in economic structure influence the underlying cost structures of a local area, the influence could be negative. Alternatively, if the change in economic structure alleviates certain problems, the influence could be positive. The built environment, as a multifaceted construction, influences the cost of service provision. To the extent that these costs are internalized in local fiscal condition, the built environment has the potential to influence local fiscal conditions. The spatial extent of development could lead to increased costs of service provision and a higher expenditure burden; however, it could also lead to a stimulation of tax bases (property and sales) and higher revenues. Similarly, density can work in a similar manner with rising density leading to decreased costs of service provision and increased tax base generation (through a density of economic activity). The combination of these two forces ultimately leads to better local fiscal conditions. Finally, rising residential land prices are likely to lead to improving local fiscal conditions by stimulating the property tax base. The influence of residential growth is discussed in Chapter 3. Anecdotal evidence from the population growth control literature would suggest that the fear of deteriorating fiscal conditions from population growth is a driving factor in the adoption of growth controls. This would suggest that growth leads to deteriorating fiscal conditions. These propositions are empirically tested in the following analysis.

The operationalization of Equation 5.8 below reveals the estimating equation for this analysis. Following Wallin and Zabel (2011),

$$LFC_{it} = \beta_0 + LFC_{it-k}\beta_1 + BE_{it}\beta_2 + GROW_{it}\beta_3 + X_{it}\beta_4 + \gamma_i + \delta_t + \varepsilon_{it} \qquad (5.9)$$

where LFC_{it} is the need-capacity gap outlined in the previous section for county i in time t, LFC_{it-k} is the need-capacity gap lagged an indeterminate number of time periods, k,[11] BE is a vector of variables measuring the built environment for county i in time t, $GROW$ is a vector of variables measuring residential growth in county i in time t, X is a vector of variables affecting local fiscal condition for county i in time t, and ε is the usual composite error term. Additionally, time (γ) and county (δ) fixed effects are included.

5.2.3 Variables

The definitions for the independent variables used in this analysis can be found in Table 5.1. The construction of the dependent variable can be found in the previous section. Similar to the previous research question, the preferred operationalization of sprawl can be found in

[11] It is assumed that local fiscal conditions are highly persistent over time (Wallin and Zabel, 2011); therefore, lags of local fiscal conditions are included on the right hand side of Equation 5.9. Since county level fixed effects are included, this necessitates the estimation of Equation 5.9 using the method outlined in Arellano and Bover (1995) or Arellano and Bond (1991). The number of lags was determined by testing a variety of specifications. Beyond two lags, t-statistics diminished quickly to zero. Additionally, Holtz-Eakin et al. (1989, pg. 415) suggests a one or two year lag is “sufficient to summarize the relevant dynamic interrelationships in local public finance.”

the first four variables defined in Table 5.1. Net population density is defined as outlined in Chapter 3. Additionally, to account for the spatial extent of urban development, the natural logarithm of all county land sold as lots divided by total land area is included. Finally, the price of urban land is included and operationalized as the summation of the assessed value of residential and residential transitional land divided by summation of residential and residential transitional land in acres. As mentioned before, this composite measure of sprawl more accurately estimates the influence of sprawl than density alone (Carruthers and Úlfarsson, 2003, 2008). In addition to the built environment, residential growth and the square of residential growth are included in the model. This is operationalized as the annual percent change in housing units from time $t-1$ to t.

The remaining variables in Table 5.1 attempt to control for the *economic health* of local areas.[12] As suggested by Ladd and Yinger (1989), the natural logarithm of total employment divided by population is included to control for overall economic health. Additionally, the natural logarithm of per capita personal income is included to control for the influence of local personal wealth on local fiscal conditions. Following Wallin and Zabel (2011), the natural logarithm of population and the natural logarithm of population squared are included to control for possible scale effects of local fiscal conditions. Finally, Wallin and Zabel (2011) suggest that demographics on the locality can effect local fiscal conditions in an area. In this analysis, three demographic variables are included: the percentage of the population who is African American, the percentage of the population over age 65, and the percentage of the population under the age of 19.

[12] *Economic structure* was entered into Equation 5.9 using the percentage of the private sector workforce in either the service or manufacturing industries. However, due to small response sizes to the Quarterly Census of Employment and Wages in certain job categories across counties, the Bureau of Labor Statistics does not report data to protect anonymity. As a result of the missing data generated by this protection, number of observations and counties included in this analysis is reduced by an unacceptable level. Additionally, the missing data is concentrated in small, rural counties, potentially introducing a selection bias into the analysis. Due to this issue, service sector and manufacturing sector employment was left out the results presented here.

Summary statistics for these variables can be found in Table 5.2. Predicted expenditures while holding constant preferences ($\hat{E}$) is, on average, \$555.34 per capita. This measure variables substantially with a minimum value of \$348.71 and a maximum value of \$963.96. Over the time period and across all counties, revenue raising capacity is, on average, \$507.64. Again, this measure varies considerably with a minimum value of \$223.88 and a maximum value of \$995.00. The combination of these two variables is the measure of local fiscal conditions utilized in this analysis. Overall, the mean value is negative \$47.70 indicating that the average county has gap between predicted expenditures and revenue raising capacity of almost \$48 per capita and is in somewhat of poor fiscal condition. This measure does vary considerably from a minimum value of negative \$526.87 to a maximum value of \$389.81. Certainly, some counties are in serious fiscal trouble while others are enjoying excellent fiscal conditions.

Net population density and residential growth are similar to the previous chapter's outlining. However, the mean net population density is 1.631 person per residential acre. Additionally, this measure varies from nearly zero at the minimum to more than twenty at the maximum. Similarly, the mean annual percent change in residential units is 1.763% with a minimum value of approximately negative 52 percent and a maximum value of almost 79 percent. Many of the remaining variables in the analysis are in logarithms; however, the three variables measuring county demographics are easily interpretable. Overall, the average percentage of the population that is African American is 27.7 percent; however, this variable deviates from the mean considerably with the minimum percentage at 0.5 percent and the maximum at 76.7 percent. The average proportion of the population who is age 65 or above is 12.422 percent. This measure varies from a low of 2.7 percent to 28 percent on the high end. Finally, the average proportion of the population age 19 or below is 28.8 percent. However, this measure varies considerably from a low of 19.7 percent to a high or 41.7 percent.

Table 5.1: Data Definitions - Dependent and Independent Variables

Variable	Description & Data Source
Dependent Variable	
Local Fiscal Capacity	Revenue Raising Capacity minus Costs; See section 5.2.1 and Appendix B for exact definition and sources
Built Environment (BE)	
Net Population Density	Population divided by residential land in acres; Source: Census Bureau and Tax Digest Consolidated Summary (GaDOR)
Developed Land (ln)	Natural logarithm of the summation of residential, residential transitional, historic, commercial, industrial and utility lots sold as lots divided by total land area in the county; Source: Tax Digest Consolidated Summary (GaDOR)
Land Price (ln)	Natural logarithm of the summation of the assessed value of residential and residential transitional land divided by summation of residential and residential transitional land in acres; Source: Tax Digest Consolidated Summary (GaDOR)
Residential Growth (GROW)	
% Δ in Residential Units	The percent change from time t-1 to t in residential units; Source: Census Bureau
% Δ in Residential Units, Squared	The percent change from time t-1 to t in residential units, squared; Source: Census Bureau
Factors Affecting LFC (X)	
Employment Ratio (ln)	The ratio of total employment (by place) and population; Source: Bureau of Economic Analysis and Census Bureau
Per Capita Personal Income (ln)	The natural logarithm of personal income divided by population; Source: Bureau of Economic Analysis and Census Bureau
Population (ln)	Natural logarithm of population; Source: Census Bureau
Population (ln), Squared	Natural logarithm of population, squared; Source: Census Bureau
Percent African American	Percent of the population who is African American; Source: Census Bureau
Percent Age 65 Plus	Percent of the population who is age 65 or older; Source: Census Bureau
Percent Age 19 and Under	Percent of the population who is age 19 or younger; Source: Census Bureau

Table 5.2: Summary Statistics for Equation 5.9

Variable	Mean	S.D.	Minimum	Maximum
Dependent Variable				
$\hat{E}$	\$555.34	\$84.98	\$348.71	\$963.96
RRC	\$507.64	\$111.13	\$223.88	\$995.00
Local Fiscal Capacity	-\$47.70	\$122.02	-\$526.87	\$389.81
Built Environment (BE)				
Net Population Density	1.631	2.055	0.018	20.178
Developed Land (ln)	1.070	1.562	-3.813	4.426
Land Price (ln)	8.097	1.059	4.406	11.555
Residential Growth (GROW)				
% Δ in Residential Units	1.763%	4.441%	-51.602%	78.811%
% Δ in Residential Units, Squared	22.806%	269.639%	0%	6211.117%
Factors Affecting LFC (X)				
Employment Ratio (ln)	-1.262	0.393	-2.598	-0.200
Per Capita Personal Income (ln)	10.106	0.181	9.219	10.840
Population (ln)	10.155	1.150	7.527	13.830
Population (ln), Squared	104.500	24.273	56.652	191.278
Percent African American	27.670%	17.014%	0.501%	76.660%
Percent Age 65 Plus	12.422%	3.261%	2.676%	27.993%
Percent Age 19 and Under	28.765%	2.687%	19.679%	41.654%

n=926

5.3 Results of Estimation

The estimation results for Equation 5.9 can be found in Table 5.3. This table show the results of a two-way fixed effects model with the dependent variable lagged two periods on the right hand side. Estimating a fixed effects model with lagged dependent variables necessitates the usage of a dynamic panel model. The introduction of lagged dependent variables on the right hand side violates the assumption that right hand side variables be strictly exogenous (Arellano, 2003). By construction, the lagged dependent variable will be correlated with both the fixed effect (δ) and lagged error term (ε_{t-1}). Additionally, the contemporaneous correlation between the lagged dependent variable and ε in the current term is not excluded. Therefore, the lagged dependent variable is considered endogenous with respect to the fixed effect and the error term (Arellano, 2003). In order to remove the effects of the endogenous lagged dependent variable, these results are estimated using the method outlined in Arellano and Bond (1991). To control any potential heteroskedasticity or autocorrelation in this model, robust standard errors are reported. Overall, the joint-F statistic testing that all the variables in the model are jointly equal to zero is 54.33, and the null hypothesis that all the variables in the model are equal to zero is rejected.

As can be seen by the results in Table 5.3, local fiscal conditions are quite persistent over time. An increase in local fiscal conditions in the previous year leads to an increase in local fiscal conditions in the current year. This result is statistically significant at above the 99% level suggesting that a one dollar increase in local fiscal condition in time $t-1$ leads to a 0.27 dollar increase in local fiscal conditions in time, t. Interesting, this same trend does not hold with a two period lag. An increase in fiscal condition in time $t-2$ leads to a decrease, or worsening of, local fiscal conditions. While only slightly missing statistical significant at the 95% level, a one dollar increase in local fiscal condition in time $t-2$ leads to approximately a 0.11 dollar decrease in local fiscal condition in time t. This result could be for a variety

Table 5.3: Regression Results - Local Fiscal Conditions

Variable	Coefficient	S.E.	t	P>|t|
$\text{LFC}_{(t-1)}$	0.272	0.0781	3.48	0.001
$\text{LFC}_{(t-2)}$	-0.113	0.0582	-1.95	0.053
Net Population Density	-19.078	9.2394	-2.06	0.041
Developed Land (ln)	24.635	22.5157	1.09	0.276
Land Price (ln)	82.425	45.9221	1.79	0.075
% Δ in Residential Unit	-0.243	0.4580	-0.53	0.596
% Δ in Residential Unit, Squared	0.036	0.0081	4.49	0.000
Employment Ratio (ln)	18.454	36.7601	0.50	0.616
Per Capita Personal Income (ln)	319.527	72.1701	4.43	0.000
Population (ln)	641.136	607.4341	1.06	0.293
Population (ln), Squared	-28.492	28.7485	-0.99	0.323
Percent African American	4.525	4.8712	0.93	0.354
Percent Age 65 Plus	18.251	9.1140	2.00	0.047
Percent Age 19 and Under	-5.622	2.7442	-2.05	0.042
n	926			
Counties	158			

County and year fixed effects excluded; Robust standard errors reported

of reasons, but the most plausible is, given the short time frame of this study, the model is picking up changes in the business cycle that would not be present in a longer term study. With a recession in Q1-Q4 of 2001 and Q4 2007 to Q2 2009, the $t-2$ time period is never far from a recessionary period. If the time period of the study was longer, something like the 20 years of data in Wallin and Zabel (2011), the influence of business cycle would be smoothed over numerous peaks and toughs.

Turning to the influence of the built environment on local fiscal conditions, as can be seen in Table 5.3, the influence of net population density is negative. A 1 person per residential acre increase in net population density leads to, on average, a 19.01 dollar decrease in local fiscal conditions at higher than the 95 percent level. This result would indicate that, on average, an increase in density leads to a worsening of local fiscal conditions, increasing the gap between revenue raising capacity and expected expenditures. The second component of the built environment, the spatial extent of development, is not statistically significant in this analysis. However, the result is positive suggesting that a one percent increase in the amount of developed land in a county is associated with a 0.25 dollar increase in local fiscal condition. The final component of the built environment, residential land prices, is a positive and statistically significant[13] predictor of local fiscal condition. Specifically, a ten percent increase in residential land price is associated with a 8.43 dollar increase in local fiscal condition on average. This result suggests that increases in a significant component of the property tax base (land) leads to, on average, a narrowing of the gap between revenue raising capacity and expected expenditures.

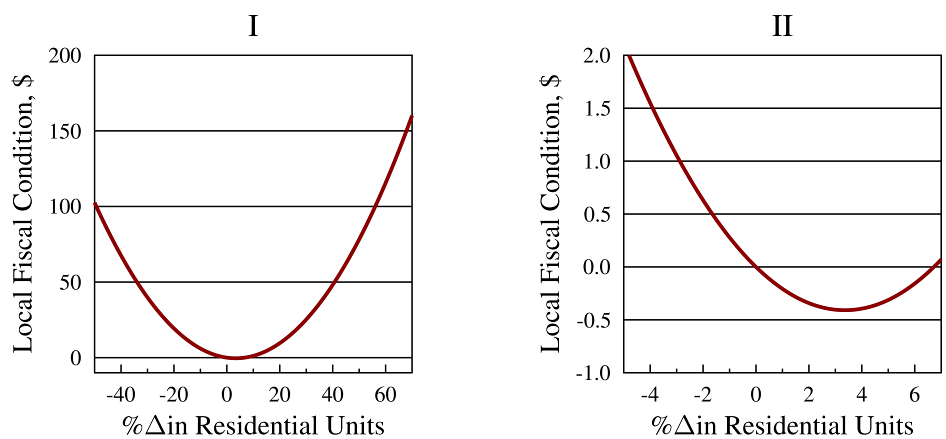

Figure 5.1: Nonlinear Effects of Residential Growth on Local Fiscal Condition

The results of the influence of residential growth on local fiscal conditions is non-linear in fashion. Specifically, the relationship between the change in residential units and local fiscal conditions is u-shaped with the influence approaching zero as residential growth become less negative. Alternatively, positive residential growth leads to a sharp increase in local fiscal

[13] Using a one-tailed test, this variable is significant at above the 95% level. However, using a two-tailed test, this variable is significant at above the 90% level, but below the 95% level

conditions. This relationship can be seen quite clearly in Panel I of Figure 5.3.[14] However, when this relationship between residential growth and local fiscal conditions is restricted to a more reasonable range of residential growth of approximately one standard deviation around the mean growth level (as seen in Panel II of Figure 5.3), an interest relationship emerges. Residential growth, in moderate amounts from zero to approximately three percent annually, leads to, on average, a worsening of local fiscal conditions. However, annual residential growth higher than approximately three percent is associated with improving local fiscal condition. However, the adverse fiscal impacts are small relative to the influence of the built environment and are on the order of less than 50 cents per capita.

The remainder of variables in Table 5.3 demonstrate other influences, beyond the built environment and growth, on local fiscal condition. As predicted by Ladd and Yinger (1989), increased jobs per capita leads to better local fiscal conditions. Specifically, a ten percent increase in jobs per capita leads to a 1.85 dollar increase in local fiscal conditions. While this result is not statistically significant, it does illustrate the assertion made by Ladd and Yinger (1989) that having a healthy economy (i.e. workers commuting to a county) increase local fiscal conditions.. Additionally, a one percent increase in per capita personal income leads to a 3.20 dollar increase in local fiscal conditions. The influence of population or its square is not statistically significant in this analysis. Turning lastly to demographics of the county, the percentage of the population that is African American has no statistical relationship with local fiscal conditions and is similar to the results of Wallin and Zabel (2011). However, the age distribution in the county is associated with local fiscal conditions. Specifically, a

[14]It should be noted that only the squared term in the quadratic specification of residential growth is statistically significant. Additionally, when only the non-squared specification of residential growth is included in the model, it is positive and statistically insignificant. It is also possible that residential growth is correlated with the error term (ε). This would bias the coefficients on these two variables, but they would still be estimated consistently if the correlation is not contemporaneous. This leads to caution in interpreting the results of these variables.

0.1 percentage point increase[15] in the proportion of county residents over the age of 65 is associated with a 1.825 dollar increase in local fiscal conditions on average. This result is at odds with Wallin and Zabel (2011) who find that increases in the proposition of elderly residents leads to declines in local fiscal conditions. Additionally, a 0.1 percentage point increase in the proportion of county residents who are under the age of 19 is associated with a 0.56 dollar decrease in local fiscal conditions.

5.4 Discussion

As noted in the previous section, local fiscal conditions are quite persistent over time. Previous year's fiscal conditions are a strong predictor of current year fiscal conditions. The negative result of a two year lag of fiscal conditions is an interesting anomaly. Given the time period of this analysis, it is entirely likely that the effects of the business cycle are at play. The recession in 2001 and the beginning of the housing and stock market crashes in 2007 play a prominent role in the timeframe of this analysis. Given a longer term study, these effects may change. Recent analyses of local fiscal conditions over the long term in Massachusetts demonstrate this reality (Wallin and Zabel, 2011). Additionally, it may be unique characteristics of Georgia county governments that is driving this result. As a state specific case study, there are generally context specific phenomenon that limit the generalizability of this analysis. Even though the results of previous fiscal conditions on current fiscal conditions may be influenced by the business cycle and these result may be only somewhat generalizable to the broader local government context, their prominence in the model indicates that not controlling for these forces is likely to introduce an omitted variable bias into the model. Therefore, any study of local fiscal conditions, moving forward, should include

[15] A one percent increase would be a abnormally large increase in the elderly population (nearly 1/3 of a standard deviation).

lagged dependent variables on the right hand side to control for the persistence of local fiscal conditions.

As shown in the previous section, the influence of sprawl on local fiscal conditions is somewhat mixed. An increase in net population density indicative of a reduction in one dimension of sprawl actually leads to a worsening of local fiscal conditions. This is not the result predicted in the explanation of hypotheses in this dissertation. It was expected that increases in density be associated with decreased costs (i.e. reduced expenditures) and a stimulated tax base (i.e enhanced revenues capacity). The combination of these two factors lead to a prediction of increased local fiscal conditions as a result of rising density. Contrary to the hypotheses made previously that increased developed land may lead to better local fiscal conditions, the results of Equation 5.9 on page 112 suggest there is no relationship. Finally, rising residential land prices is associated with better local fiscal condition. These results suggest that sprawl may actually improve local fiscal conditions. While this is certainly not the result expected, it is a logical outcome. By demanding a less complicated set of public services, relative to more dense, urban areas and generating a significant amount of revenue through a mix of high property values and significant retail sales, these areas will, on average, be able to meet their public service obligations with little trouble. It is unclear if the results of this analysis would hold for municipalities. In certain ways, older, denser, and potentially poorer urban cores are likely to experience adverse fiscal conditions while newer, potentially less dense, and more wealthy municipalities are likely to enjoy a much better fiscal status. The model presented in Wu (2007) suggests how this process may work as central cities become poorer and suburban cities gain the wealthy former residents of the central city.

This analysis stops short of endorsing sprawl as a method to generate positive local fiscal conditions. Rather, it suggests that localities that are denser and more urban may need assistance from state and federal governments to equalize disparities between urban and suburban/exurban development patterns. Historically, the literature on fiscal disparities has focused on "need-capacity gap" typified in this analysis as a method to better inform intergovernmental assistance programs, particularly at the state level (Bradbury et al., 1984; Ladd and Yinger, 1989; Bahl, 1994; Ladd, 1999; Bradbury and Zhao, 2009). Though indirectly, this analysis could be seen a contributing to that literature.

The results for residential growth provide an interesting look at how the process of residential development changes local fiscal conditions. In moderate amounts, it appears that residential growth leads to a worsening of local fiscal conditions. However, at higher levels of growth, local fiscal conditions improve. Overall, this may suggest there is a certain amount of residential growth needed to sustain positive fiscal conditions. However, this analysis does not provide overwhelming evidence of this assertion. More research on the relationship between residential growth and local fiscal conditions is needed to better understand the relationship.

The remaining variables in model are suggested by Ladd and Yinger (1989). Overall, per capita employment and per capita personal income are positive predictors of local fiscal conditions. Taken together, these two results suggest that wealthier and areas with more economic activity tend to have better local fiscal conditions. These results make intuitive sense by which wealthier and more economically active areas should have an easier time (relative to the entire distribution of wealth and economic activity) dealing with the demands of the public and financing them from available resources. It is possible that this analysis has gotten the ordering of these variables wrong. Specifically, it is possible that higher local fiscal conditions attract more jobs and wealthier individuals. One method of sorting out this process is through Granger causality. To identify which direction the process is working, a one-way fixed effects regression is run where local fiscal conditions are regressed on lags of local fiscal conditions and lags of either employment or income. This is similar to the analysis presented in the preceding section. A joint F test is conducted on the lags of employment or income. This process is conducted in reverse with employment or income as the dependent variable as well with the same joint F test conducted on lags of local fiscal conditions. If the outcome of the joint F test from the second equation is jointly significant, there is evidence of Granger causality. When this process is conducted on the data used for this analysis, the null hypotheses of the joint F test on the lags of local fiscal conditions cannot be rejected. This provides some evidence that the process is working in way outline in Equation 5.9 on page 112 and not the other way around. These results can be seen as supportive of the assertion made in chapter 3 and by Ladd and Yinger (1989) that having positive *economic health* is a key factor in favorable local fiscal conditions.

Chapter 6

Findings - Revenue Diversification

Presented in Chapter 3, the influence of sprawl and residential growth on revenue diversification is complex. The two influences are largely derived from the tax base expansions or contractions as a result of increasing sprawl and residential growth. In this chapter, the previous literature on revenue diversification will the outlined and the concept of revenue diversification will be defined in more depth than previous. Subsequently, a two stage model of local revenue diversification is offered. Finally, results will be presented and discussed.

6.1 Literature on Revenue Diversification

The previous literature on revenue diversification or revenue complexity is split into two strands. The first strand is derived from the public choice literature and suggests that governments utilize complex revenue structures to increase the size of the public sector. Also known as fiscal illusion, revenue complexity leads taxpayers to misperceive their tax price leading taxpayers to demand an excess amount of public goods. Alternatively, revenue diversification has been posited as a method of decreasing revenue and expenditure volatility. Rather than expanding the size of government, revenue diversification is a prudent financial management technique. The remainder of this section will outline these two strains of research.

The concept of fiscal illusion is not new.[1] Fundamentally, fiscal illusion is "the notion that the systematic misperception of key fiscal parameters may significantly distort fiscal choices by the electorate" (Oates, 1988, pg. 65). Fiscal illusion may arise from numerous sources including debt illusion, the revenue-elasticity hypothesis, the "flypaper effect," renter illusion, and the revenue-complexity hypotheses. Debt illusion is the notion that voters are more likely to be aware of the costs of public services if they are paid for with current revenues. Financing public services with debt hides the "true" cost of public services from the electorate leading to fiscal illusion. Furthermore, this type of illusion can be broken down into two specific types (Dollery and Worthington, 1996). The first is a 'Vickery-type' illusion where "an individuals subjective assessment of debt on future tax liabilities was [is] undervalued" (Dollery and Worthington, 1996, pg. 290). The second is a 'Puviani-type' illusion where "the subjective assessment of the diminution of assets are not treated in the same manner as a lump-sum taxation payment" (Dollery and Worthington, 1996, pg. 290). For either of these types of illusion to hold the subjective assessment must be made in the time of debt issuance and the true costs realized in later time periods (Buchanan, 1967). Evidence of this type of illusion is uncovered via studies of the capitalization of debt in to property values. If debt is visible, full capitalization is expected; however, if debt is illusionary, something less than full capitalization is expected. The evidence of this type of illusion is slim due to problems with adequately specifying a model that teases out the distinction between currently funded activities and debt funded activities. However, the one major analysis (Epple and Schipper, 1981) attempts to uncover debt illusion in house prices. Epple and Schipper (1981) find evidence of little evidence of undercapitalization suggesting debt illusion may be an elusive concept.

[1]See Buchanan (1967) for an overview of the early work on fiscal illusion.

The revenue-elasticity hypothesis posits that revenues sources that are highly income elastic[2] lead to "automatic" increases in revenues. These increases, largely unseen because tax rates stay the same, lead to an increase in the size of government (Oates, 1975). Oates (1975) finds that using his measure of tax elasticity is positively associated with state expenditures suggesting that this revenue-elasticity hypothesis has some merit. However, subsequent analysis has cast doubt on this finding. Most notably, Feenberg and Rosen (1987) find no relationship between a more sophisticated measure of income elasticity derived from a sample of actual tax returns and government expenditures.

The "flypaper" effect is the notion that categorical, lump-sum grants from higher levels of government to lower levels of government increase public expenditures more than an equivalent increase in income (Dollery and Worthington, 1996). The idea is that when public officials are given categorical, lump-sum grants, rather than returning an equivalent amount of local tax revenue to taxpayers, public officials utilize the grant to increase the size of the public budget. Additionally, this expansion, financed through outside revenue, lowers the margin tax price for taxpayers leading to an increase in demand for public services in excess of what they would otherwise be in the absence of the grant. The empirical literature on the "flypaper" effect is vast (too large to outline here); however, this hypothesis enjoys much support in the literature (Heyndels and Smolders, 1994; Dollery and Worthington, 1995). Additionally, Turnbull (1998, 1992) attempts to extend the "flypaper" effect model to a more general model of voter decision making under uncertainty.

Renter illusion is the idea that as the percentage of renters in a locality increases, local expenditures will increase as well. This is because it is assumed that only home owners can correctly perceive their tax price. Since renters do not directly pay property taxes, they are incapable of fully estimating their tax price, and this misperception will bias expenditure

[2] An income elastic revenue source would be characterized by large revenue growth as the result of increases in personal income. For example, a highly income elastic revenue source would be revenues that increases two percent in response to a one percent increase in personal income.

upward. Beginning with Bergstrom and Goodman (1973), empirical evidence of this type of illusion has mounted. Heyndels and Smolders (1994) and Dollery and Worthington (1999a) find significant evidence of renter illusion in their analyses. The results of these analyses hinge on the assumption that renters are not rational in their perception of marginal tax prices. The results in Yinger and Carroll (1994) demonstrating that increases in property taxes are exactly passed through to renters in the form of increased rent suggests that renters are in possession of full information and capable of correctly perceiving the marginal tax price. This potentially decreases the persuasiveness of the renter illusion argument.

The most relevant form of fiscal illusion to this analysis is the revenue-complexity hypothesis. Wagner (1976) is the first to suggest that complex revenue structures may cause taxpayers to misperceive the true cost of public outputs and, therefore, demand higher levels of output. This process would increase the size of government to a level that taxpayers would not ordinarily demand had they known the true cost of public outputs. Indeed, Wagner (1976) finds, empirically, that as revenue complexity increases, so does total expenditures of cities. The results of this first paper are not necessarily robust (Munley and Greene, 1978); the size of the effect of revenue complexity may be overestimated. In addition to Wagner (1976), there have been numerous other works suggesting that fiscal illusion may arise from complex revenue systems. Pommerehne and Schneider (1978), Baker (1983), Breeden and Hunter (1985), Heyndels and Smolders (1994, 1995), Dollery and Worthington (1995), and Misiolek and Elder (1988) all find support for Wagner's argument. Additionally, Dollery and Worthington (1999b) finds limited evidence in support of Wagner's argument; however, Dollery and Worthington are careful to note their results are sensitive to specification. While there is much support for Wagner's argument, the results of these articles may be the result of a simultaneity bias (Oates, 1988). Tax structures and public expenditures cannot be separated from each other, and the failure to take into account the simultaneous relationship of tax structure and public expenditures can lead to biased results. More recent literature acknowledge this “alternative hypothesis”; however, Dollery and Worthington (1999b) determine via a Hausman test that revenue complexity is exogenously determined in their model leading them to reject Oates's assertion.

Traditionally, the property tax has been the “local tax” (Fisher, 1996). State government property tax revenue as a percentage of total revenues has hovered near zero since the 1940s (Wallis, 2001). Even though the property tax is the “local tax,” local reliance on the property tax has been waning. At the local level, reductions in property taxes as a share of total revenues means increased revenue diversification. As mentioned in Chapter 3, the trend of revenue diversification is largely rooted in three phenomena. First, the introduction of local income and sales taxes have reduced reliance on the property tax and increased the diversity of local revenue sources (Ulbrich, 1991). Indeed, during this time, the Advisory Commission on Intergovernmental Relations (1974) formally recommended that states authorize local governments to collect sales and income taxes with proper safeguards. Additionally, user charges were advocated as effective methods of revenue diversification when “specific beneficiaries of particular government programs can be readily or approximately identified” (Advisory Commission on Intergovernmental Relations, 1974, pg. 7). Second, changes in education finance laws, brought about by a multitude of court cases, have mandated primary and secondary education be financed more centrally (Raphaelson, 2004). As a result, the reliance on the property tax to finance education has been reduced leading to more revenue diversification. Finally, the tax revolts of the 1970s and 1980s have lead to a significant reduction in the reliance on the property tax to generate local revenues (Fisher, 1996; Raphaelson, 2004; Ulbrich, 1991; Wallis, 2001). The resultant tax and expenditure limitations from these tax revolts and other sources have shifted revenues away from the property tax and “other” taxes in favor of miscellaneous revenues (Shadbegian, 1999). These reductions in property tax dependence have not, largely, reduced local revenues. Instead, local governments have introduced other tax and non-tax revenues to make up the shortfall (Carroll, 2009).

The origins and complications of the trend of state-local revenue diversification are explored in Shannon (1987) and Ladd and Weist (1987). Shannon (1987) explains that the trend toward more "balance" among the big three taxes can be attributed to two primary causes: the understanding that there is no ideal tax and that fiscal crisis creates an opportunity to diversify revenues out of necessity. The first cause, the understanding that there is no ideal tax, suggests by using a combination of revenue sources, state and local governments can overcome the weaknesses of a single revenue source while gaining the benefits of multiple types of revenues. Additionally, Shannon explains that the adoption of income and sales taxes are generally spurred by either severe revenue shortfalls or significant public demand for property tax relief. While Shannon explains the origins of revenue diversification, Ladd and Weist (1987) take a step back and ask whether diversification is a worthwhile endeavor in the first place. Ladd and Weist conclude that pursuing increased revenue diversification has both good and bad qualities. Policy makers must balance competing policy goals in the process of revenue diversification. Ultimately, pursing revenue diversification for revenue diversification's sake is not enough. Policymakers must have an end goal in pursing a policy of increased revenue diversification.

In addition to literature on the origins and logic of revenue diversification, there have been numerous empirical studies of the influence of revenue diversification on local government outcomes. Much of this literature focuses on how revenue diversification can help state and local government weather fiscal stress in a more effective manner or how to use revenue diversification to reduce revenue volatility. Early work (Suyderhoud, 1994) suggests that more diverse state revenue portfolios are associated with increased revenue stability, a more equitable revenue system, and, to a certain extent, a more efficient tax system. Work in this area continues with evidence mounting that revenue diversification can, indeed, lead to reduced revenue volatility in both public (Carroll, 2009) and non-profit organizations

(Carroll and Stater, 2009) as well as lowered levels of fiscal stress (Hendrick, 2002; Shamsub and Akoto, 2004).

Generally, neither the fiscal illusion or the financial management literature attempt to predict revenue diversification/complexity patterns. The one standout is Carroll (2005) who attempts to predict revenue diversification at the state level. She integrates Oates (1988) argument that expenditures and revenue structures are inseparable. Carroll (2005) estimates a two stage model, estimating per capita general expenditures in the first stage and predicting expenditures from this model to be included in the second stage model predicting revenue diversification. This model provides a tentative road map for explaining revenue diversification patterns at the local level.

6.2 Variables and Regression Models

6.2.1 Regression Model

As mentioned in the previous section, there have been few attempts to predict revenue diversification. However, Carroll (2005) does provide a general road map. Following the general model set forth by Carroll, the following two equations are offered.

$$E_{it} = \beta_0 + RD_{it}\beta_1 + BE_{it}\beta_2 + GROW_i t\beta_3 + X_{it}\beta_4 + \gamma_i + \delta_t + \varepsilon_{it} \tag{6.1}$$

$$RD_{it} = \beta_0 + \hat{E}_{it}\beta_1 + BE_{it}\beta_2 + GROW_i t\beta_3 + ECON_{it}\beta_4 + DEM_{it}\beta_5 + \gamma_i + \delta_t + \varepsilon_{it} \tag{6.2}$$

Where RD is revenue diversification as defined below for county i in time t, E is the natural logarithm of per capita total expenditures for county i in time t, BE is a vector of variables measuring the built environment for county i in time t, $GROW$ is residential growth for county i in time t, X is a vector of variables measuring demand, costs and tastes for public services for county i in time t, $ECON$ is a vector of variables measuring the economic conditions of county i in time t, DEM is a vector of variables measuring the demographic characteristics of county i in time t, and ε is the usual composite error term. for county i in time t Additionally, time (δ) and county area (γ) fixed effects are included.

Stage one (Equation 6.1) is largely based on the analysis in Chapter 4. However, the model presented in this chapter is a reduced form equation as a full estimation is not point of this particular analysis. Overall, as will the shown below, the model performs similarly to the models presented in chapter 4. Stage 2 (Equation 6.2) is based upon Carroll (2005) with some modifications to adapt the model to the local government setting. As can be seen, variables measuring the built environment are included in each stage of the model. This allows for both direct and indirect influences of the built environment on revenue diversification.

6.2.2 Variables

In general, revenue diversification has been measured in the extant literature using some variation of a Hirschman-Herfindahl index (Wagner, 1976; Suyderhoud, 1994; Hendrick, 2002; Shamsub and Akoto, 2004; Carroll et al., 2003; Carroll, 2005, 2009; Carroll and Stater, 2009; Carroll and Johnson, 2010). Consistent with the recent literature, RD is defined as a Hirschman-Herfindahl index (HHI) specifically defined as

$$RD = \left(\frac{1 - \sum_{i=1}^{n} R_i^2}{1 - {}^{100\%}/_{n}} \right) \tag{6.3}$$

where R_i is the proportion of own source revenue generated from each revenue source and n is the number of revenue sources. There are four revenue sources as suggested in the literature (Hendrick, 2002): Property taxes, sales taxes, other taxes, and non-tax revenues. RD is bounded between 0 and 1 with higher scores indicating higher levels of diversification. Perfect revenue diversification (i.e. equal reliance on all four revenue categories) would be indicated by a score of one and reliance on only one revenue source would receive a score of zero. Carroll (2009) makes three important observations about the nature of revenue diversification measured in this way. First, HHI measured in this manner implies that each unit of analysis (composite counties) are equally able to diversify their revenue sources. Second, it implies that each composite county utilizes all four revenue categories. Finally, HHI measured in this way assumes that equal reliance on each of the four revenue categories (i.e. a HHI score of one) is feasible. Given that this analysis utilizes composite counties from the same state, each unit of analysis has access to the same revenue sources as all of the others. Additionally, the constructed nature of composite counties ensures that each composite county utilizes the full complement of local revenue sources and that each composite county has the ability to use them equally.[3] In addition to revenue diversification, the dependent variable for Equation 6.1 is the natural logarithm of per capita total expenditures. This is the summation of current and capital expenditures for the *composite county* divided by county population. Per capita total expenditures are utilized for this analysis rather than per capita current expenditures (as used in Carroll (2009)) because of a somewhat unique aspect of local public finance in Georgia. Two one percent sales tax levies (SPLOST[4] and ELOST[5]) explicitly provide for the provision of capital assets. Therefore, excluding capital expenditures from the expenditure model could potentially bias the results of the estimation since some revenues are explicitly for capital asset provision.

The independent variables for this analysis can be found in Table 6.1. As with the previous two analyses, the built environment is operationalized as four variables: net population

[3]The nature of composite counties allows for all composite counties to have access to the same set of revenue instruments. However, internal to each composite county, the local sales tax rate is limited to 3 percent.

[4]The Special Purpose Local Option Sales Tax is levied to provide capital assets to the community contingent on a popular referendum (O.C.G.A § 48-8-110.1.)

[5]The Education Local Option Sales Tax can be levied by county school districts with independent school districts in their borders for the provision of capital assets for educational purposes or the retirement of general obligation debt. (Ga. Const. art. VII, § 6, para. 4.)

density, developed land, residential land price, and residential growth. These variables are defined the same way as the previous two analyses. Additionally, for the first stage of the analysis, these four variables are hypothesized to exhibit the same signs as predicted in Chapter 4. Specifically, it is expected that net population density will reduce per capita expenditures, developed land and land prices will increase per capita expenditures, and residential growth will increase per capita expenditures. In the second stage, it is expected that more compact, urban development patterns (demonstrated by higher densities and less spatially extensive development) will lead to higher levels of revenue diversification. These types of development patterns are likely to foster the growth of alternative tax/revenue bases, specifically the sales tax, leading to a more balanced revenue portfolio. The influence of residential land price is expected to be opposite from sprawl because increases in residential land price will foster property tax base growth. The potential influence of residential growth is an empirical question. If the fiscal impact study literature is to be believed, revenue growth will lag from residential development, potentially leading to a need to diversify revenues. However, if residential growth stimulates the property tax base, there may be little pressure to diversify revenues.

In the first stage model (Equation 6.1), demand, cost and taste variables are operationalized using seven variables similar to the analysis in Equation 4.2 on page 75. Per capita personal income is defined as the natural logarithm of personal income divided by total population. As mentioned in chapter 4, this variables measure the income elasticity of demand for public services. To measure the price elasticity of demand for public services, the natural logarithm of the percentage of the property tax base that is residential is included. Additionally, the natural logarithm of population and the natural logarithm of school enrollment are included to control for any scale effects as well as the "publicness" of local public services. Debt burden is included in the model and is operationalized as the natural logarithm of total long-term debt divided by population. Additionally, the natural logarithm of the percentage of individuals in a composite county who are above age 65 is included to control for potential differences in demand for public services among the elderly. Finally, the natural logarithm of the percentage of total revenues derived from intergovernmental sources (state and federal) is included in the model.

In the second stage model (Equation 6.2), there are two grouping of variables beyond the built environment. These are economic factors and demographic factors. Economic factors are operationalized using four variables. As with the first stage, per capita personal income is defined as total personal income divided by population. Additionally, tax burden, defined as total tax revenue divided by personal income, is included in the model to approximate a total tax rate. In addition to tax burden, the local sales tax rate is included in the model. Often at the local level, revenue diversification means the introduction or more intensive use of the local sales tax (Sjoquist et al., 2004). It is expected that higher local sales tax rates will lead to higher levels of revenue diversification. Finally, the employment ratio, defined as jobs by place divided by residental population, is included to control for any influences of commuters. Local governments with a large net influx of commuters may attempt to diversify away from the property tax to sales taxes to capture these individuals who consume local public services but do not pay property taxes in the jurisdiction. Demographic factors are operationalized as population in thousands, per capita school enrollment, and the poverty rate.

Summary statistics for all variables discussed here can be found in Table 6.2. Of interest, the average level of revenue diversification is 0.847 indicating that the average composite county is fairly diverse in their revenue usages. Revenue diversification does variable significantly from a low of 0.47 to a high of 0.96. Turning next to the non-logged variables of interest, the mean net population density is 1.611 with the measure varying from a low near zero to a high over 20 persons per residential acre. Additionally, residential growth average 1.834 percent with a low of -51.6 percent and a high of 78.8 percent.

The remainder of variables measure demand, costs and tastes; economic conditions; or demographic variables. Mean per capita personal income is $24,810.20 indicating that the average individual in the average county is not too well off. When compared to national figures, this average is well below the national average. While on average per capita personal income may be low, its variability is high ranging from a low of just over $10,000 to a high of over $51,000. Average population is 57,735 persons; however, this variable also deviates quite significantly from the mean. Population ranges from just over 1,800 residents to slightly over 1 million residents. School enrollments per capita are, on average, 0.198 students per capita. This variable ranges from 0.008 students per capita on the low end to 3.691 students per capita on the high end. The percentage of total revenues composite counties derive from intergovernmental sources is approximately 44 percent on average. The variance on this variable is high so the it ranges from a low of almost 8 percent o a high of nearly 66 percent of total revenue. On average, tax burdens are low in Georgia composite counties with tax revenue just over $50 per $1,000 in personal income. The measure of tax burden varies considerably from a low of $15.56 per $1,000 in personal income to a high of $878 dollars per $1,000 of personal income. The average sales tax rate for composite counties in Georgia is 2.818%. The sales tax rate varies from a low of 1 percent to a high (and legal maximum) of 4 percent in Fulton County (3% for Fulton County and 1% for the City of Atlanta). On average, the employment ratio, measuring jobs per capita, is 0.444 indicating that the average county has almost 1 job per 2 residents. This measure varies from a low of 0.141 jobs per capita to a high of 1.064 per capita. Finally, the average poverty rate is 17.606 percent. This varies from a low of 4.2 percent to a high of 36.2 percent indicating that some counties are well off while other struggle with high poverty.

Table 6.1: Data Definitions - Dependent and Independent Variables

Variable	Description & Data Source
Dependent Variables	
Revenue Diversification	Hirschman-Herfindahl Index (HHI) of revenue diversification of four revenue categories: Property taxes, sales taxes, other taxes, and non-tax revenues; calculated as one minus the sum of the proportions of total own source revenue generated in each category squared and then divided by 0.75; recorded on a 0 to 1 scale with increasing values indicating greater diversification; Source: Georgia Report of Local Government Finance
Per Capita Total Expenditures (ln)	Natural logarithm of Total Expenditures divided by population; Source: Georgia Report of Local Government Finances and Census Bureau
Built Environment & Growth	
Net Population Density	Population divided by residential land in acres; Source: Census Bureau and Tax Digest Consolidated Summary (GaDOR)
Developed Land (ln)	Natural logarithm of the summation of residential, residential transitional, historic, commercial, industrial and utility lots sold as lots divided by total land area in the county; Source: Tax Digest Consolidated Summary (GaDOR)
Land Price (ln)	Natural logarithm of the summation of the assessed value of residential and residential transitional land divided by summation of residential and residential transitional land in acres; Source: Tax Digest Consolidated Summary (GaDOR)
% Δ in Residential Units	The percent change from time t-1 to t in residential units; Source: Census Bureau
Demand, Cost, and Taste; Economic Condition; & Demographic Variables	
Per Capita Personal Income (ln)	The natural logarithm of personal income divided by population; Source: Bureau of Economic Analysis and Census Bureau
Per Capita Personal Income	Personal income divided by population; Source: Bureau of Economic Analysis and Census Bureau
Tax Price (ln)	Proportion of the Property Tax Digest that is residential; Source: Tax Digest Consolidated Summary (GaDOR)
Population (ln)	Natural logarithm of population; Source: Census Bureau
Population (1000s)	Population in 1000s; Source: Census Bureau
School Enrollment (ln)	Natural logarithm of school district enrollment; Source: Census Bureau
Per Capita School Enrollment	School district enrollment divided by population; Source: Census Bureau
Debt Burden (ln)	Natural logarithm of total outstanding long-term debt divided by population; Source: Georgia Report of Local Government Finances and Census Bureau
Proportion Age 65+ (ln)	Natural logarithm of the proportion of the population age 65 and over; Source: Census Bureau
Percent Intergovernmental Revenue	The proportion of total revenues from all sources that is derived from state or federal sources; Source: Georgia Report of Local Government Finances and Census Bureau
Percent Intergovernmental Revenue (ln)	The natural logarithm of the proportion of total revenues from all sources that is derived from state or federal sources; Source: Georgia Report of Local Government Finances and Census Bureau
Tax Burden	Total tax revenue divided by personal income in $1000s; Source: Georgia Report of Local Government Finances and Bureau of Economic Analysis
Local Sales Tax Rate	County sales tax rate; Source: Georgia Department of Revenue
Employment Ratio	The ratio of total employment (by place) and population; Source: Bureau of Economic Analysis and Census Bureau
Poverty Rate	Individual in poverty divided by population; Source: Census Bureau Small Area Income & Poverty Estimates

Table 6.2: Summary Statistics for Equations 6.1 and 6.2

Variable	Mean	S.D.	Minimum	Maximum
Dependent Variables				
Revenue Diversification (HHI)	0.847	0.069	0.470	0.959
Per Capita Total Expenditures (ln)	9.240	0.162	8.808	10.131
Built Environment & Growth				
Net Population Density	1.611	1.967	0.016	20.178
Developed Land (ln)	1.044	1.563	-3.815	4.522
Land Price (ln)	8.034	1.048	4.406	11.555
% Δ in Residential Units	1.834%	3.931%	-51.602%	78.811%
Demand, Cost, and Taste; Economic Condition; & Demographic Variables				
Per Capita Personal Income (ln)	10.102	0.179	9.218	10.841
Per Capita Personal Income	$24,810.20	$4,871.78	$10,081.87	$51,020.69
Tax Price (ln)	3.881	0.381	2.242	4.495
Population (ln)	10.142	1.140	7.527	13.830
Population (1000s)	57.735	123.408	1.857	1,014.932
School Enrollment (ln)	8.396	1.157	5.226	11.973
Per Capita School Enrollment	0.198	0.276	0.008	3.691
Debt Burden (ln)	6.0163	1.084	-2.780	8.909
Proportion Age 65+ (ln)	2.478	0.268	1.431	3.332
Percent Intergovernmental Revenue (ln)	3.757	0.253	2.067	4.189
Percent Intergovernmental Revenue	44.043%	9.661%	7.898%	65.968%
Tax Burden	$50.394	$62.0478	$15.555	$878.269
Local Sales Tax Rate	2.818%	0.422%	1.000%	4.000%
Employment Ratio	0.444	0.128	0.141	1.064
Poverty Rate	17.606%	5.888%	4.200%	36.200%

n=1,245

6.3 Results of Estimation

The estimation results for Equations 6.1 and 6.2 can be found in Tables 6.3 and 6.4, respectively. Given that the first stage of this analysis is based on the analysis conducted in Chapter 4, a similar estimation technique is undertaken. It is assumed that a fixed effects model is the appropriate estimation technique. This assumption is confirmed using a Hausman (1978) test. Additionally, a joint F test on the year fixed effects suggests that the inclusion of the year effects is appropriate. The Wooldridge (2010) text for autocorrelation in panel data suggests that the two models suffer from an AR(1) disturbance. Additionally, a Modified Wald Test for heteroskedasticity suggests the presence of heteroskedasticity in the model. Finally, testing for cross sectional dependence using the test outlined in Frees (1995) suggests there is cross sectional dependence in the two models. Given the outcome of these tests, the results in the two tables referenced above show two-way fixed effects models estimated using OLS with Driscoll and Kraay (1998) standard errors which is robust to the three problems found. Overall, the two models perform well with R^2 values of 0.403 and 0.290, respectively.

Turning first the stage one results in Table 6.3, the four variables that compose the built environment perform as expected. As found in Chapter 4 as well by Carruthers and Úlfarsson (2008), net population density is negatively associated with per capita total expenditures. Specifically, a 1 person per residential acre increase in net population density leads to, on average, a 1.6 percent decrease in per capita total expenditures. This results nearly mirrors the result found in Table 4.4 on page 93 for the same variable. Also as found in Chapter 4 and by Carruthers and Úlfarsson (2008), increasing the spatial extent of development (as operationalized as developed land) is associated with increases per capita total expenditures. A 10 percent increase in developed land leads to a 0.17 percent increase in per capita total expenditures on average. This result is somewhat larger than that found in Table 4.4;

Table 6.3: Regression Results - Expenditure Model (Stage 1)

Variable	Coefficient	S.E.	t	P>|t|
Built Environment & Growth				
Net Population Density	-0.016	0.0017	-8.95	0.000
Developed Land (ln)	0.017	0.0035	4.85	0.000
Land Price (ln)	0.056	0.0050	11.21	0.000
% Δ in Residential Unit	0.001	0.0004	4.09	0.001
Revenue Diversification				
Revenue Diversification (HHI)	0.244	0.0721	3.38	0.003
Demand, Cost, & Taste				
Per Capita Personal Income (ln)	0.131	0.0279	4.68	0.000
Tax Price (ln)	0.002	0.0156	0.16	0.875
Population (ln)	0.711	0.1314	5.41	0.000
School Enrollment (ln)	-0.501	0.0731	-6.86	0.000
Debt Burden (ln)	0.011	0.0029	3.97	0.001
Proportion Age 65+ (ln)	0.284	0.0338	8.42	0.000
Percent IGR (ln)	0.438	0.1115	3.93	0.001
Constant	1.928	1.2274	1.57	0.132
R^2	0.438			
n	1,245			

County & year fixed effects excluded; Driscoll and Kraay (1998) standard errors reported

however, given the reduced form nature of the present analysis, these small anomalies are to be expected. Similar to the results found in Chapter 4, a 10 percent increase in residential land prices is associated with a 0.56 percent increase in per capita expenditures. Again, this result is somewhat larger than that found in Table 4.4. Finally, residential growth is positively associated with per capita total expenditures at above the 99% level. Specifically, a one percent change from the previous year in residential units leads to a 0.1 percent increase in per capita total expenditures on average. The similarity of these results to the findings in Chapter 4 are suggestive that the reduced form modeling presented here is a valid estimation technique.

The remaining variables in this first stage model are estimates of demand, cost and taste variables. Additionally, the measure of revenue diversification, the Hirschman-Herfindahl index, is included. This variable is statistically significant at the 99% level. The coefficient is positive and indicates potential illusionary influences. Beginning with per capita personal income, this variable is positively associated with per capita total expenditures at greater than the 99% level of significance. Specifically, a one percent increase in per capita personal income leads to a 0.13 percent increase in per capita total expenditures. This result is similar of results found in the analysis in Chapter 4 as well as in the literature (Bergstrom and Goodman, 1973; Borcherding and Deacon, 1972). Similar to the results found in Chapter 4, tax price fails to achieve statistical significance. The two measures of scale and/or "publicness," population and school enrollment, are associated with per capita total expenditures at above the 99% level of statistical significance. However, the direction of the influence is opposing. A one percent increase in population is associated with a 0.71 percent increase in per capita total expenditures; however, a one percent increase in school enrollment is associated with a 0.5 percent decrease in per capita total expenditures. Increased debt burden is associated with an increase in per capita total expenditures. Specifically, a one percent increase in debt burden leads to a 0.01 percent increase in per capita total expenditures. This result is similar to, though slightly larger than, the effect found in Chapter 4. Turning next to the elderly population, an increase in the proportion of residents age 65 or above is associated with increases in per capita total expenditures. Specifically, a one percent increase in the proportion of residents age 65 or above is leads to, on average, a 0.28 percent increase in per capita total expenditures. Finally, a one percent increase in the proportion of total revenues derived from intergovernmental sources is associated with a 0.44 percent increase in per capita total expenditures on average. Again, this result is similar to that found in Chapter 4.

Table 6.4: Regression Results - Revenue Diversification (Stage 2)

Variable	Coefficient	S.E.	t	P>|t|
Built Environment & Growth				
Net Population Density	0.008	0.0014	5.64	0.000
Developed Land (ln)	-0.008	0.0018	-4.54	0.000
Land Price (ln)	-0.033	0.0042	-7.83	0.000
% Δ in Residential Unit	-0.000	0.0002	-2.80	0.011
Economic Factors				
Predicted Expenditures ($\hat{E}$)	0.435	0.0958	4.54	0.000
Per Capita Personal Income	-0.000	0.0000	-3.71	0.001
Tax Burden	-0.001	0.0005	-2.39	0.027
Local Sales Tax Rate	0.026	0.0012	22.27	0.000
Employment Ratio	0.039	0..0215	1.81	0.085
Percent IGR	-0.005	0.0012	-3.94	0.001
Demographic Factors				
Population (1000s)	-0.000	0.0001	-4.56	0.000
Per Capita School Enrollment	0.827	0.3496	2.37	0.028
Poverty Rate	0.001	0.0003	2.31	0.032
Constant	-2.756	0.8197	-3.36	0.003
R^2	0.290			
n	1,245			

County and year fixed effects excluded; Driscoll and Kraay (1998) standard errors reported

The second stage regression results can be found in Table 6.4. Turning first to the influence of the built environment, all four variables are statistically significant at the 95% level or higher. Overall, the influence of these variables is exactly opposite of that found in stage one. A one person per residential acre increase in net population density is associated with a 0.008 point increase in revenue diversification (measured on a 0 to 1 scale). This would indicate that composite counties with rising residential densities also see increasing levels of revenue diversification. This result is also supportive of the hypothesis made previously that increased density will likely lead to growth across multiple tax bases. Growth in these areas will likely lead to increased levels of revenue diversification. The influence of developed land, residential land prices, and residential growth are all negative with respect to revenue diversification. Specifically, a 10 percent increase in the developed land in a county leads to a 0.0008 unit decrease in revenue diversification (measured on a 0 to 1 scale) on average. This result is in contrast to the hypothesis made in Chapter 3. An increase in developed land is expected to increase revenue diversification through the stimulation of multiple tax bases. However, it appears that more compact development is indicative of higher levels of revenue diversification. Additionally, a 10 percent increase in residential land prices is associated with a 0.0033 unit decrease in revenue diversification. The result for residential land price is supportive of the hypothesis made in Chapter 3; stimulation of the property tax base is associated with reductions in revenue diversification. Finally, a one percent annual change in residential units leads to a 0.0005 unit decrease in revenue diversification. This result is somewhat in contrast to the hypothesis made in Chapter 3. It is hypothesized that increases in residential growth would lead to increases in revenue diversification if growth reduces the efficacy of the property tax. The results of this analysis would suggest that assertion is incorrect; however, the effect size is small potentially indicating no relationship at all.

As suggested by Oates (1988), per capita total expenditures is a positive influence on revenue diversification. Specifically, a ten percent increase in per capita total expenditures is associated with a 0.044 point increase in revenue diversification (measured on a 0 to 1 scale). The remaining variables composing economic factors largely exhibit statistically significant influences on revenue diversification. A $1,000 increase in per capita personal income leads to a 0.0034 unit decrease in revenue diversification (measured on a 0 to 1 scale) on average. Additionally, a one percent increase in tax burden leads to a 0.001 unit decrease in revenue diversification. As predicted, a one percentage point increase in the local sales tax rate leads to, on average, a 0.026 unit increase in revenue diversification. The employment ratio, a crude measure of commuting patterns, is not statistically significant. Finally, the relationship between the percentage of intergovernmental revenues received by a composite county and revenue diversification is negative. Specifically, a one percentage point increase in the proportion of revenues from intergovernmental sources is associated with a 0.005 unit decrease in revenue diversification.

Finally, the results are mixed on the influence of demographic factors on revenue diversification. A 1,000 person increase in population leads to a reduction in revenue diversification of 0.0005 units (measured on a 0 to 1 scale). However, an increase of 0.1 students per capita leads to a 0.083 unit increase in revenue diversification (measured on a 0 to 1 scale). Additionally, a one point increase in the poverty rate is associated with a 0.001 increase in revenue diversification.

6.4 Discussion

The results of the analysis presented above attempts to model local revenue diversification patterns with a specific interest on the influence of the built environment. The two stage nature of the model presented allows for both direct and indirect effects of the built environment on revenue diversification to be ascertained. The first stage model (per capita expenditures) is hypothesized to work similarly to the analysis presented in Chapter 4 of this dissertation. Indeed, a reduced form specification of Equation 4.2 outlined in Equation 6.1 finds similar results to that of the analysis in Chapter 4. Specifically, net population density was expected to exhibit a negative influence on per capita expenditures, the spatial extent of development was expected in increase per capita expenditures, residential land price was expected to increase expenditures, and residential growth was expected to increase expenditures.[6] These indirect influences filter through predicted expenditures in the second stage model. The direct influence of the built environment in the second stage, revenue diversifica-

[6]This is based on the analysis done in Chapter 4; not necessarily the predictions from previous literature.

tion model are more complex. The potential influences of the built environment are largely concerned with the potential for influencing tax bases. If any of the four variables that compose the built environment promote alternative tax/revenue bases, they should, *a priori*, increase revenue diversification. However, if these built environment variables increase the property tax base, there should be little incentive to diversify.

The first stage model (per capita expenditures), specified in a reduced form, demonstrates the same results presented in Chapter 4. Rising density is associated with decreasing per capita expenditures while increasing development, residential land prices, and residential growth all lead to increasing per capita total expenditures on average. These results confirm the "Smart Growth" hypothesis explored in Chapter 4 utilizing a similar empirical specification. As discussed previously, the limiting sprawl can be an effective method of keeping costs low, thereby limiting increases in per capita expenditures. Additionally, limiting residential growth to moderate rates will, on average, increase per capita expenditures; however, the influence is somewhat small.

The second stage results (revenue diversification) provide for the direct effects as well as the indirect effects of the built environment to be ascertained. On the indirect side, increasing predicted per capita expenditures is associated with an increase in revenue diversification. This is the exact result observed by Oates (1988) that governments with higher expenditures generally have more diverse revenue portfolios. In addition, this result suggests that components of the built environment can either help to increase or decrease revenue diversification, indirectly. Specifically, a rise net population density is associated with a decrease per capita expenditures which would, indirectly, decrease revenue diversification on average. The opposite is true for the remaining built environment variables. Increases development, residential land prices, and residential growth are associated with increases per capita expenditures, and indirectly increases revenue diversification on average. These indirect effects are countered by the direct effects of these same variables. In all circumstances, the direction of the influence is opposite of that found in the first stage model. Rising net population density is a contributing factor to increased revenue diversification. This result suggests that more compact, urban counties are diversifying their revenue sources. Similarly, counties with a smaller spatial extent of development are associated with higher levels of revenue diversification. One can only speculate as to the potential explanations for these results. It is possible that the density of economic activity in spatially smaller areas is indicative of higher levels of revenue diversification. A comprehensive theoretical model of local revenue diversification coupled with a more precise measurement of revenue diversification may be able to uncover more exact explanations. As such, this analysis should be considered a first step in the building of a more complete understanding of the fiscal interactions leading to revenue diversification patterns at the local level.

Overall, this model shows that sprawl, indirectly through expenditures, reduces revenue diversification; however, these reductions are offset, at least partially, by the direct effects of the same variables on revenue diversification. Similarly, residential growth is shown to indirectly increase revenue diversification; however, the direct effect is to reduce revenue diversification. The results from this analysis demonstrate that the relationship between the built environment and revenue diversification is complicated with the direct and indirect influences often pulling in opposite directions. A more complete theoretical model of local fiscal interactions is needed to better understand how these direct and indirect effects compete with each other.

Chapter 7

Conclusions

Overall, these three questions addressing per capita expenditures, local fiscal conditions and revenue diversification have attempted to examine the relationship between the built environment, residential growth and public finance outcomes. These three outcomes, per capita expenditures, local fiscal conditions and revenue diversification, are important issues for local governments. Each examines a different aspect of the environment in which local governments operate or the decisions they make. This concluding chapter will provide an overview of the results and attempt to distill policy implications of this analysis.

7.1 Expenditures

Local public expenditures are at the heart of local governments. Public monies must be expended to fund public programs that provide a wide variety of public services that individuals and business have come to rely upon on a daily basis. The level of public expenditure may be the only indicator of public services (not public service quality or individual public programs) that an individual from afar may observe. Additionally, the local budget, giving legal authority to expend public monies, is an extremely visible document and is the subject of public hearings in most jurisdictions. Understanding how any force influences the level of public expenditure at the local level is warranted given the primacy of the local budget to local governments.

The analyses presented in Chapter 4 examine the influence of the built environment, specifically sprawl, and residential growth on per capita expenditures. Theoretically, the influence of sprawl on per capita expenditure can be divided into two distinct factions: "Smart Growth" and the Economist's Perspective. Each suggest different potential influences of sprawl on local budget. Smart Growth suggests that limiting sprawl by encouraging denser, more spatially compact cities will yield lower per capita public expenditures. The Economist's Perspective suggests that sprawl, operationalized through density, will lead to a u-shaped relationship with per capita public expenditures. Increasing density will, on average, lower per capita expenditures at low levels of density; however, as density becomes large, urban "harshness" overtakes these economies and leads to higher per capita expenditures. Additionally, an important point noted in the literature is the importance of land prices in the process of densification (Carruthers and Úlfarsson, 2003, 2008; Ewing, 1997). Rising land prices closer to the urban core (i.e. more dense), predicted by the monocentic city model, can potentially allow local governments to cover the increased costs of dense development patterns.

The influence of residential growth on per capita expenditures fundamentally asked the question "does new growth pay its own way?" More to the point, does residential growth increase the average expenditure burden in a local area? Theoretically, the answers to these questions are unclear. The potential influence of residential growth depends, largely, on the characteristics of the individuals who are moving to an area. If the new individuals are similar to current residents, the effect is likely to be small. However, if new individuals are different than existing residents, there is the potential for an increase in average burdens.

The results contained in this dissertation suggest, pertaining to the sprawl argument, that "Smart Growth" largely prevails in Georgia. On average, increasing density leads to lower per capita expenditures and spatially smaller development patters lead to lower per capita expenditures. These two results, a negative sign on density and a positive sign on developed land, mirror the results in recent literature on the effects of sprawl on per capita expenditures (Carruthers and Úlfarsson, 2003, 2008). The final component of the built environment, land prices, are found to have a positive influence on per capita expenditures on average. The partialling out of residential land prices in the model allows an unbiased estimation of the influence of density and spatial development patterns. This result suggesting that land price is an important factor in the relationship between sprawl and per capita expenditures conforms to the predictions made in the literature (Carruthers and Úlfarsson, 2008; Ewing, 1997).

The potential policy implications from this analysis for Georgia are important to note. Local governments who promote sprawl, knowingly or unknowingly, could potentially be faced with rising expenditures. The theoretical literature outline in Chapter 3 would suggest that the influence of sprawl on per capita expenditures is largely a cost of public services problem. Promoting sprawl is likely to lead to increased costs for local governments. To the extent that local governments are reliant on own-source revenues to fund local expenditures, taxes will necessarily need to rise to fund the higher level of expenditure. Alternatively, if a local government faced with higher per capita expenditures due to the influence of sprawl choose to not increase taxes, the quality of public services is likely to decline for individuals and businesses in the jurisdiction. While this possibility is not explicitly tested in this analysis, Ladd (1994) suggests that this is a likely outcome. The influence of sprawl on the quality of public services provided is an important research question to be addressed in the future. While objective measures of public service quality are allusive, work in this area would likely provide policy relevant results for local officials.

On the growth side of this question, the potential influences of residential growth were theoretically ambiguous. Overall, the underlying question is whether new development pays its own way. The influence of population growth on per capita expenditures largely depends on the characteristics of the new individuals locating in the area. Previous literature (Ladd, 1992) found that the influence of population growth on current expenditures was u-shaped; however, the influence of population growth on capital and interest on debt expenditures was inversely u-shaped. These results suggest that population growth allows for economies to be realized at moderate levels of growth for current expenditures; however, moderate levels of growth dramatically increase expenditures on capital assets and debt service.

The method of analysis used in this study to examine the question of whether growth increases average burdens contradicts the previous research. Instead of focusing on population growth, this analysis focuses on residential unit growth. This is a more appropriate measure of new growth as population growth could be absorbed by vacant housing. A large number of municipal or local services are delivered to broad areas rather than to specific individuals. Policing, fire protection, and water and sewer service ares provided to domiciles regardless of whether individuals reside in those homes. Therefore, individuals moving into these vacant homes are unlikely to change the expense of providing municipal services to those home. However, if municipal services must be extended to a new area, as is the case with the building of new homes, expenditures are likely to change as government behavior is changed. By focusing on housing unit growth, this issue is resolved and a truer measure of new development is obtained. At the per capita total expenditure level, the influence of residential growth is positive and increasing (see Figure 4.2.3 on page 96). However, when deconstructed into current and capital expenditures, it can be seen that the influence of residential growth on per capita capital expenditures is what is driving the per capita total expenditure results. Even moderate levels of residential growth substantially increase per capita capital expenditures. This finding makes intuitive sense. Growth in residential units is likely to lead to an increased provision of capital intensive public services such as roads and water and sewer lines/facilities.

These results suggest that growth, even at moderate levels, is like to have fairly significant impacts of local government finances. These impacts are likely to be on the capital expenditure side of public expenditures. Given this information, local governments in Georgia can more adequately plan for new development and attempt to make new development pay its own way. There are numerous tools available to local governments in Georgia that would help reduce the burden on existing residents from new development. Tools like special assessments and impact fees can be utilized to help pay for the provision of new capital assets required by new development. By extracting revenues from new development[1] to pay for new services, the burden to existing residents is minimized. The potential affect of these tools is somewhat unclear; however, there has been some effort expended to understand the affects. Yinger (1998) explains that development or impact fees increase the burden on landowners or developers, and only some of the burden is passed through to the homeowner. If the point of an impact fee is make the resident of the home, not the builder of the home, pay for increased service provision, impact fees fall short. Additionally, the imposition of impact fees in one area tend to lower the price of undeveloped land since there is an assumption a similar fee will be imposed when it is developed (Yinger, 1998). Therefore, impact fees do a poor job of making those who will most benefit from new infrastructure pay for these improvements (i.e. homeowners). Special assessments are a much better method in which homeowners are made to pay for the benefits they receive from improved infrastructure provision. Special assessments do not distort the land market as is the case with impact fees. Additionally, the entire burden of the assessment falls on new homeowner who are the beneficiaries of the provision of new infrastructure.

[1] Special assessment is a one time property tax payment (based on lot frontage or some other characteristic of the home) in order to pay for increased provision of capital assets. Similarly, impact fees are charged to developers in an amount sufficient to pay for increased service provision.

7.2 Local Fiscal Conditions

Local fiscal condition is a topic that is related to, but somewhat separate from, local fiscal stress. While fiscal stress is often operationalized as an inability of local governments to continue to provide public services at current levels, local fiscal condition is concerned with the gap between the costs of providing public services and the revenue capacity of the local area (Wallin and Zabel, 2011). As such, local fiscal condition[2] has little to do with decisions made by governments. Rather, it deals with the underlying conditions of an area. The literature on local fiscal conditions has yet to examine the influence of the built environment and residential growth. Most literature is interested in examining trends in local fiscal conditions and devising state aid formulas to correct for any potential fiscal disparities (Bradbury and Zhao, 2009).[3] As such, there is little direct theoretical guidance as to the potential influence of the built environment and residential growth on local fiscal conditions. However, it is argued here that any potential influence that could change the latent conditions under which local governments operate can potentially be influential on local fiscal conditions.

The analyses presented in Chapter 5 posit that local fiscal conditions are persistent over time and are influenced by a variety of variables including the built environment and residential growth. The results are consistent with the results of Wallin and Zabel (2011) that local fiscal conditions are persistent over time. Previous years' fiscal conditions are significant predictors of current term fiscal conditions. The results of the influence of the built environment are mixed. Net population density (a vertical measure of sprawl) is negatively related to local fiscal conditions. This would suggest that more dense areas have a large spread between the cost of public services and revenue capacity. The horizontal component

[2]It should be noted that local fiscal conditions are a separate concept from financial condition. The former is concerned with economic conditions underlying the provision of public services. The latter is concerned with the balance sheet of a local government.

[3]A notable exception is Wallin and Zabel (2011) who examine the influence of Proposition 2 1/2 on local fiscal conditions.

of sprawl, developed land, is not statistically significant. Finally, residential land price is positively related to local fiscal conditions. This result indicates that areas with higher residential land prices experience a better overall fiscal condition than areas with lower land prices. Finally, there is limited information about the relationship between residential growth and local fiscal conditions. While the non-squared variable is not significant in the estimated model, the square is highly significant. When these results are graphed (see Figure 5.3), the graph demonstrates that those localities experiencing moderate levels of growth see a small reduction in their fiscal condition; however, these results change as growth becomes larger.

The policy implications derived from this part of the analysis are complicated as there are multiple ways to interpret these results. First, these results could be seen as an indication that local areas with more sprawling, more expensive residential properties have a better fiscal condition. Consequently, interpretation in this manner could be seen as an argument for developing in this manner to avoid negative fiscal conditions. Alternatively, these results could be interpreted as an indication that areas that are more urban are more likely to have adverse fiscal conditions relative to other types of development patterns. As a result of these findings, higher levels of government could step in to ameliorate these inequities or disparities. Equalizing aid, as these interventions are know as, are argued to be justified on efficiency (Ladd and Yinger, 1989) and equity (Ladd and Yinger, 1994) grounds. The first argument would appear to ignore the findings from Chapter 4 of this dissertation suggesting that sprawl is expensive to provide public services to. While it is likely the case that revenue capacity on a per capita basis is higher in sprawling areas than in urban areas, this is not an appropriate argument for the perpetuation of sprawl. Rather, the second argument is more persuasive. Knowing that more dense areas are likely to experience adverse fiscal conditions, higher levels of government should consider intervening to correct these inequities. More broadly, the results from this question coupled with the results from the pervious question pertaining to per capita expenditures highlight a theme that there are tradeoffs between sprawl and more traditional (i.e. denser) development patterns. On the one hand, denser and more compact development in Georgia yields cost savings from local governments on average; however, it would appear that denser and more compact developments experience higher levels of adverse fiscal conditions. At the very least, this is an indication that local fiscal systems are complex machines prone to contradictions.

7.3 Revenue Diversification

In the last few decades, the topic of revenue diversification and its potential ability to cause or alleviate local fiscal problems has been the subject of large amounts of scholarship. Numerous scholars have posited that revenue diversification could either cause fiscal illusion, leading to an increase in per capita expenditures, or allow local governments to more adequately and effectively manage their revenue streams. Evidence has mounted on both sides of the argument, but neither has satisfactorily explained, empirically, why a government would diversify their revenues. Additionally, as Oates (1988) notes, there is a simultaneity bias present in the process. Governments who have higher revenues also tend to have higher levels of revenue diversification.

Carroll (2005) develops a model attempting to explain revenue diversification patterns at the state level while specifically integrating the objections of Oates (1988). The process of revenue diversification is explicitly modeled using a two-stage procedure where per capita expenditures are estimated in the first stage, predicted, and incorporated into the second stage estimating revenue diversification. This same approach is taken in this analysis looking at the local level. Expenditures are predicted in a first stage model, retained, and integrated into the second stange model attempting to determine revenue diversification patterns. In both the first and second stages, the influence of the built environment and residential growth are determined. In this way, both indirect and direct effects of these two influences are determined.

Similar to the results from Chapter 4, net population density exerts a negative influence of per capita expenditures and the spatial extent of development leads to a positive influence on per capita expenditures. The final component of sprawl, residential land price, had a strong, positive influence on per capita expenditures. Residential growth exerts a positive influence on per capita expenditures. The results on the sprawl variables largely conform to the "Smart Growth" hypothesis outlined in Chapter 4 where denser, more compact development patterns are associated with reduced per capita expenditures. Additionally, this model provides more evidence that residential growth may not pay its own way and increases average burdens on all residents. In the second stage, predicted expenditures from the first stage exert a positive influence on revenue diversification as predicted by Oates (1988). Sprawl related variables as well as residential growth all exert a statistically significant influence on revenue diversification. Higher net population density, on average, leads to higher revenue diversification. Additionally, spatially smaller cities leads to higher revenue diversification. Finally, higher land prices lead to lower levels of revenue diversification, a result that makes intuitive sense as the property tax will be more productive with higher land prices. Higher residential growth leads to lower levels of revenue diversification.

The policy implications of this analysis are twofold. Indirectly, policies promoting "Smart Growth" limit per capita expenditures which can, when filtered through expenditures, also limit revenue diversification. However, the direct effect of certain parts of "Smart Growth" policies work in the opposite direction. Denser cities tend to have higher levels of revenue diversification. Additionally, more spatially compact counties tend have higher revenue diversification. Residential land prices work in the negative direction. Higher land prices encourage higher per capita expenditures, indirectly encouraging higher levels of revenue diversification. However, higher land prices directly lead to lower levels of revenue diversification. Residential growth similarly works in two different directions, indirectly and directly. Residential growth simulates per capita expenditures leading to higher levels of revenue diversification; however, directly, positive residential growth leads to lower levels of revenue diversification. If revenue diversification is an explicit goal of a local government, encouraging a denser and more compact city may be a path to this goal. However, these endeavors may be offset by the influence of "Smart Growth" on per capita expenditures. Alternatively, residential growth may reduce efforts to encourage revenue diversification; however, these effects may be offset by the indirect, positive influence of growth. Overall, the policy implications of the influence of sprawl and growth on revenue diversification is a balancing game. Direct and indirect effects often offset each other. More comprehensive theory is needed to better understand the implications of these findings.

7.4 Concluding Remarks

Overall, this dissertation attempts to more completely understand the influence of the built environment and residential growth on a variety of important local government fiscal outcomes. So much of the responsibilities of local government revolve around land. In almost every instance, local governments have the power to regulate the development of land through zoning laws. Additionally, local governments have the power through incentives, business regulations, building regulations, and other regulatory powers to encourage or discourage different types of developments in their jurisdiction. Finally, local governments in a large number of states have the power to tax land as part of the property tax. Land and issues surrounding it at certainly at the heart of local government operations. Although there is significant evidence of the connection between land/development and local governments, there is little scholarship that deals directly with the connection between how areas develop and utilize land and local government operations. This dissertation seeks to change the conversation in a limited way about the this connection. By taking this topic seriously and examining it critically, a better understanding of the local government fiscal environment can be ascertained.

The first overarching concept this dissertation is sprawl. The literature surrounding sprawl is vast. It spans multiple disciplines with research questions ranging from measurement of sprawl, antecedents of sprawl as well as implications of sprawl at the macro and micro levels. Each of these concepts has been touched on in this dissertation. The contribution of this dissertation to the literature is the implications of sprawl to local public finance. Only limited research as been conducted on sprawl as it relates to local government fiscal systems. The first research question dealing with per capita expenditures examines two potential relationships: "Smart Growth" and the Economist's Perspective. The results of this analysis suggest that "Smart Growth" is the dominant paradigm. Specifically, denser, spatially compact development patterns are associated with lower levels of per capita expenditures. When decomposed from aggregate levels, this analysis shows that sprawl is more influential in decreasing per capita capital expenditures than per capita current expenditures. The second research question examines the relationship between sprawl and local fiscal conditions, the need-capacity gap. The results of this analysis suggest that counties that would be considered sprawling are also those in the best fiscal condition. This result is consistent with the literature that more urban areas have difficulties balancing expenditure demands/rising costs with stagnant or inadequate revenues. Finally, the relationship between sprawl and revenue diversification is examined. In this two stage model, sprawl increases the cost of service provision (i.e. per capita expenditures) in the first stage; however, sprawl is associated with lower levels of revenue diversification. Conversely, a denser, more compact development style is indicative of lower per capita expenditures, but also higher levels of revenue diversification. Overall, the impact of sprawl on local public finance is mixed. Sprawl is associated with higher per capita expenditures and lower levels of revenue diversification. Both of these outcomes would be considered “bad” in some contexts. Higher than optimal expenditures could be considered inefficient and lower than optimal levels of revenue diversification could open local governments to undue risk of revenue volatility (Carroll, 2009). Alternatively, sprawl is associated with better local fiscal conditions. While this would be considered a “good” outcome, it may be the result of a number of “bad” policies. Maintaining good local fiscal conditions through the usage of fiscal zoning, exclusionary policies and other less than savory tactics is not something to be replicated. In the absence of these government interventions, sprawl may very well be associated with worsening local fiscal conditions.

The second overarching theme is residential growth. The literature on influences of growth, residential or otherwise, is more limited than the literature of sprawl. The current literature would suggest that cities grow because they attracted talented individuals and provide consumers amenities that individuals value. The literature on influence of growth on local public finance is sparse. What limited literature there is suggests that the characteristics of new individuals is the key component in understand the potential impacts of growth. The first question of this dissertation asks whether new residential growth pays its own way or if it increases average burdens on existing residents. The analysis conducted here suggests that residential growth in Georgia does not pay its own way. Instead, growth increases per capita expenditures, though the impacts are quantitatively small. The second question dealing with residential growth and local fiscal conditions presents a similarly negative connotation. Increases in residential growth at low levels (0%-6%) leads to worsening fiscal conditions; however, the results are nonlinear. Again, the results are quantitatively small compared to other influences of local fiscal conditions. Finally, the influence of residential growth on revenue diversification is ascertained. Indirectly, residential growth appears to increase revenue diversification through expenditures. However, the direct influence of residential growth on revenue diversification is negative and quantitatively small. Overall, it would appear that residential growth is not necessarily a good thing in Georgia. This may vindicate the results found in the growth management literature suggesting that growth above the optimal level is a bad thing. However, more research is necessary to completely understand the relationship between growth and local public finance. The situation in Georgia is likely the most optimistic case as Georgia is a fast growing state. There are numerous other states/areas experiencing low levels of growth or nonexistent/negative growth.

Overall, this dissertation seeks to incorporate the built environment and growth into models of local public finance. This has been accomplished for three specific models: per capita expenditures, local fiscal conditions, and revenue diversification. The local governments in the State of Georgia from 2000 to 2008 provide a case study for these interactions. While it is possible that the results found here are Georgia specific, the analysis conducted in Chapter 3 would suggest that Georgia is similar to the "average" state in the United States. Still, further work is necessary to support and extend the research conducted here. As demonstrated here, the interaction between land/development and local public finance is too important to ignore.

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Appendices

Appendix A

Statistical Techniques

A.0.1 Specification Tests

While it is standard practice in the applied economics literature to automatically assume heteroskedasticity in the error term, inappropriately applying the typical fix, clustering errors on the panel unit, may lead to inference that is unnecessarily conservative. In order to more adequately test for the presence of heteroskedasticity, the Modified Wald statistic for groupwise heteroskedasticity in fixed effect models is utilized. This test is adapted from Greene (2008). Following Baum (2001), the null hypothesis for this specification test is that "$\sigma_i^2 = \sigma^2$ for $i = 1, \ldots, N_g$, where N_g is the number of cross sectional units." Baum (2001) further defines $\hat{\sigma}_i^2 = T_i^{-1} \sum_{t=1}^{T_i} e_{it}^2$ to be the estimate of the ith cross-sectional unit's error variance. Additionally, the estimated variance of $\hat{\sigma}_i^2$ is defined as

$$V_i = T_i^{-1}(T_i - 1)^{-1} \sum_{t=1}^{T_i} (e_{it}^2 - \hat{\sigma}_i^2)^2 \tag{A.1}$$

It then follows that the test statistic for the modified Wald test is defined as

$$W = \sum_{i=1}^{N_g} \frac{(e_{it}^2 - \hat{\sigma}_i^2)^2}{V_i} \tag{A.2}$$

Equation A.2 is distributed $\chi^2[N_g]$. Therefore, we can reject the null hypothesis of $\sigma_i^2 = \sigma^2$ for $i = 1, \ldots, N_g$ if $W > \chi^2[N_g]$. Baum (2001) cautions that this particular test statistic is sensitive to large N, small T data. Given that this is the exact type of data that is being utilized here, this test is taken with some caution. However, the estimated values of W are so large that there is little cause for concern. Overall, all of the models estimated have some level of group wise heteroskedasticity in their error terms. Therefore, estimation will proceed with an attempt to eliminate this bias.

To test for autocorrelation, the Wooldridge test for serial correlation in panel-data models is utilized. This test statistic is proposed in Wooldridge (2002). The Wooldridge test takes the standard cross section, time series model (A.3) as the starting point and first differences the model to eliminate any individual level effects ($\mathbf{Z}_i\beta_2$) (Drukker, 2003).

$$y_{it} = \alpha + \mathbf{X}_{it}\beta_1 + \mathbf{Z}_i\beta_2 + \mu_i + \varepsilon_{it} \tag{A.3}$$

$$y_{it} - y_{it-1} = (\mathbf{X}_{it}\beta_1 - \mathbf{X}_{it-1}\beta_1) + \varepsilon_{it} - \varepsilon_{it-1} \tag{A.4}$$

The test is then conducted on the residuals from Equation A.4. Equation A.4 is estimated and the predicted residuals, $\hat{e}_{it}$, are obtained. As Drukker (2003) explains, if there is not serial correlation, then $Corr(\Delta\varepsilon_{it}, \Delta\varepsilon_{it-1}) = -0.5$. The test proceeds by regressing $\hat{e}_{it}$ from Equation A.4 on the lag of $\hat{e}_{it}$. The coefficient on the $\hat{e}_{it-1}$ variable is then tested to see if it is equal to -0.5.[1] To the extent that the coefficient on the $\hat{e}_{it-1}$ term differs from -0.5, serial correlation is present in the initial model. In all of the models tested, there is significant serial correlation. Estimation will proceed using a method that is robust to this problem.

[1]As Drukker (2003) explains, the second regression controls for within group heteroskedasticity by cluster the errors on the panel unit.

To test for cross sectional dependence, three primary tests are available.[2] The tests suggested by Pesaran (2004) and Friedman (1937) are not robust to the inclusion of year fixed effects.[3] Throughout the following three empirical chapters, year fixed effects are necessary for proper identification of the models. Therefore, the third test, suggested by Frees (1995) and robust to the inclusion of time fixed effects, will be utilized. The test statistic is examined below.

Following Frees (1995) and De Hoyos and Sarafidis (2006), the test statistic is "the sum of the squared rank correlation coefficients" which can be found below.

$$R^2_{ave} = \frac{2}{N(N-1)} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{r}^2_{ij} \tag{A.5}$$

where $\{r_{i,1}, \ldots, r_{i,T}\}$ is the ranks of $\{\varepsilon_{i,1}, \ldots, \varepsilon_{i,T}\}$. The distribution from which critical values for this test are derived can be found in A.6.

$$\begin{aligned} FRE \; &= N\{R^2_{ave} - (T-1)^{-1}\} \rightarrow Q = a(T)\{x^2_{1,T-1} - (T-1)\} \\ &+ b(T)\{x^2_{2,T(T-3)/2} - T(T-3)/2\} \end{aligned} \tag{A.6}$$

The null hypothesis of no cross sectional dependence is rejected if $R^2_{ave} > (T-1)^{-1} + Q_q/N$ where Q_q is the appropriate quantile of the Q distribution (De Hoyos and Sarafidis, 2006). This test draws from two independently drawn χ^2 distributions and depends on the size of T. When T is large, it becomes computationally difficult to compute the correct quantile of

[2]The standard Breusch and Pagan (1980) test for cross-sectional dependence is appropriate when $T > N$. However, when $N > T$ this test displays significant size distortions (Pesaran, 2004). In these data, N is always much greater than T resulting in the standard Breusch-Pagan LM test to be inappropriate. Given that the correction for cross-sectional dependence (Driscoll and Kraay (1998) standard errors) is highly sensitive to the existence of cross-sectional dependence, this distinction is non-trivial. OLS clearly dominates Driscoll and Kraay's method when cross-sectional dependence is inappropriately assumed.

[3]Time demeaning will limit the ability of these tests to detect cross sectional dependence even if there is considerable cross sectional dependence left in the error term.

Q. Therefore, Frees (1995) suggests that when T is not small, the normal distribution can be used as an approximate.[4]

A.0.2 Estimation Technique

To deal with all of the specification problems outlined above, consider the following general cross sectional, time series model.

$$y_{it} = \mathrm{x}_{it}'\theta + \varepsilon_{it}, \quad i = 1, \ldots, N, \quad t = 1, \ldots, T \tag{A.7}$$

where y_{it} is a scalar, x_{it} is a $(K+1)\times 1$ vector of independent variables, θ is a $(K+1)\times 1$ vector of unknown regression coefficients. If Equation A.7 is put in stacked form, we assume that x_{it} is uncorrelated with ε_{it} $\forall$ i and t and the error term ε_{it} is allowed to be heteroskedastic, autocorrelated and spatially correlated, θ can be estimated consistently via OLS yielding Equation A.8

$$\hat{\theta} = (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'y \tag{A.8}$$

While $\hat{\theta}$ will be estimated consistently, the standard errors will be biased. Therefore, any inference about the significance of the relationships will be unreliable. To overcome this problem, Driscoll and Kraay (1998) standard errors are used and can be "obtained as the square roots of the diagonal elements of the asymptotic (robust) covariance matrix" (Hoechle, 2007, pg. 287),

$$V(\hat{\theta}) = (\mathbf{X}'\mathbf{X})^{-1}\hat{\mathbf{S}}_T(\mathbf{X}'\mathbf{X})^{-1} \tag{A.9}$$

[4]Following De Hoyos and Sarafidis (2006), as T becomes large, $\frac{FRE}{\sqrt{Var(Q)}} \approx N(0,1)$ where $Var(Q) = \frac{32}{25}\frac{(T+2)^2}{(T-1)^2(T+1)^2} + \frac{4}{5}\frac{(5T+6)^2(T-3)}{T(T-1)^2(T+1)^2}$

where $\hat{\mathbf{S}}_T$ is defined by Newey and West (1987) as:

$$\hat{\mathbf{S}}_T = \hat{\mathbf{\Omega}}_0 + \sum_{j=1}^{m(T)} w(j,m)[\hat{\mathbf{\Omega}}_j + \hat{\mathbf{\Omega}}_0'], \quad w(j,m) = 1 - [j/(m+1)] \tag{A.10}$$

$m(T)$ denotes the number of lags that the residuals are allowed to be autocorrelated.[5] Additionally, the second term of Equation A.10 ensures that $\hat{\mathbf{S}}_T$ is positive, semi-definite and the weights decline as j increases.

The $(K+1) \times (K+1)$ matrix $\hat{\mathbf{\Omega}}_\mathbf{j}$ is defined as

$$\hat{\Omega}_j = \sum_{t=j+1}^{T} \mathbf{h}_t(\hat{\theta})\mathbf{h}_{t-j}(\hat{\theta})' \quad \text{with} \quad \mathbf{h}_t(\hat{\theta}) = \sum_{t=1}^{N(t)} \mathbf{h}_{it}(\hat{\theta}) \tag{A.11}$$

In Equation A.11, cross sectional averages of $\mathbf{h}_{it}(\hat{\theta})$ are utilized in the Newey and West (1987) calculation of robust standard errors (A.10) to eliminate the influence of cross sectional dependence.

Estimation of a fixed effects cross sectional, time series model proceeds in two steps. First, as opposed to the pooled OLS estimation above (Equation A.7), the data $z_{it} \in \{y_{it}, \mathbf{x}_{it}\}$ are demeaned using the following method:

$$\tilde{z}_{it} = z_{it} - \bar{z}_i + \bar{\bar{z}}, \quad \text{where} \quad \bar{z}_i = T_i^{-1} \sum_{t=t_{i1}}^{T_i} z_{it} \quad \text{and} \quad \bar{\bar{z}} = \left(\sum T_i\right)^{-1} \sum_i \sum_t z_{it} \tag{A.12}$$

Once demeaned, estimation can proceed using the pooled OLS method outlined in Equation A.7 on the data demeaned using the method in Equation A.12. This is accomplished using Equation A.13

$$\tilde{y}_{it} = \tilde{\mathbf{x}}_{it}'\theta + \tilde{\varepsilon}_{it}, \tag{A.13}$$

[5] For this analysis, the number of time lags that the residuals will be correlated is determined automatically by Stata ®. Specifically, the following formula is applied to the data as suggested by Newey and West (1994). $m(T) = \text{floor}[4(T/100)^{2/9}]$

Estimation of Equation A.13 is both unbiased and consistent to the extent that x_{it} is uncorrelated with ε_{it}. The Driscoll and Kraay (1998) standard errors are robust to heteroskedasticity, autocorrelation and cross-sectional dependence.

Appendix B

Cost Index Variables

Table B.1: Data Definitions

Variable	Description & Data Source
Local Cost Variables	
Employment Ratio (ln)	The ratio of total employment (by place) and population; Source: Bureau of Economic Analysis and Census Bureau
Population (ln)	The natural logarithm of population; Source: Census Bureau
Population (ln), Squared	The natural logarithm of population, squared; Source: Census Bureau
Unemployment Rate	Average annual unemployment rate; Source: Bureau of Labor Statistics
Preferences Variables	
Per Capita Personal Income	Personal income divided by population; Source: Bureau of Economic Analysis and Census Bureau
Per Capita Residential Assessed Value	Total residential assessed value divided by population; Source: Georgia Department of Revenue and Census Bureau
Per Capita Retail Sales	Total retail sales divided by population; Source: Georgia County Guide (Center for Agribusiness and Economic Development, University of Georgia) and Census Bureau
Per Capita State Aid	Intergovernmental aid from state sources divided by population; Source: Georgia Report of Local Government Finances and Census Bureau
Per Capita Federal Aid	Intergovernmental aid from federal sources divided by population; Source: Georgia Report of Local Government Finances and Census Bureau
Percent African American	Percent of the population who is African American; Source: Census Bureau

Table B.2: Summary Statistics

Variable	Mean	S.D.	Minimum	Maximum
Local Cost Variables				
Employment Ratio (ln)	-1.260	0.401	-2.759	-0.073
Population (ln)	10.130	1.137	7.527	13.830
Population (ln), Squared	103.910	23.971	56.652	191.278
Unemployment Rate	5.205%	1.439%	2.400%	15.700%
Preferences Variables				
Per Capita Personal Income	$24,763.11	$4,887.62	$10,081.87	$51,758.32
Per Capita Residential Assessed Value	$23,081.32	$12,127.06	$2,606.28	$104,694.60
Per Capita Retail Sales	$9,704.47	$8,083.44	$149.23	$242,702.50
Per Capita State Aid	$45.88	$52.92	$0	$937.08
Per Capita Federal Aid	$9.93	$32.48	$0	$739.25
Percent African American	27.556%	17.042%	0.139%	77.707%

n=1,409