Does State Growth Management Change the Pattern of Urban Growth? Evidence from Florida

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Abstract. This paper examines a policy question of acute interest in the fields of urban and regional economics and urban planning: if a state government wanted to alter the spatial pattern of growth, could it? The analysis uses a bidirectional growth model to examine equilibrium densities of people and jobs throughout the Atlantic Southeast, which includes Florida — a state having one of the nation’s best-known pieces of growth management legislation. The results suggest that Florida’s policy has had two sets of countervailing effects: (*i*) a lower population density at equilibrium and a slower process of adjustment toward that equilibrium; and, more tentatively, (*ii*) a lower employment density at equilibrium and a faster process of adjustment toward that equilibrium. Focusing on the population density results, which are more robust than the employment density results, the paper concludes that Florida’s growth management program may have produced more residential sprawl, even as it slowed the transition toward that outcome.

1. Introduction

In the United States, state land use law — from the most basic form of enabling legislation to far more complex “growth management” and “smart growth” mandates — has a fundamental influence on urban economies, but, despite this, key questions regarding the actual effectiveness of various policy frameworks remain open to debate. This paper examines what is possibly the most fundamental policy question of all: if a state government wanted to alter the spatial pattern of urban growth, could it? There is little in the way of empirical evidence on the matter, and the evidence that does exist is mixed. The analysis that follows responds to this gap in urban and regional economic and urban planning research by using a bidirectional model of population and employment growth to specify straightforward, testable hypotheses about whether or not the State of Florida’s growth management legislation has altered the spatial pattern of development. As such, the research presented in this paper is as much about how to study land use regulations as it is about Florida’s unique circumstances.

The analysis reveals evidence that examining land use regulation within a spatial equilibrium framework is helpful, and that, on net, Florida’s growth management program has changed both population and employment densities. Specifically, the statewide growth management effort there has had two sets of countervailing effects: (*i*) a lower population density at equilibrium and a slower process of adjustment toward that equilibrium; and (*ii*) a lower employment density at equilibrium and a faster process of adjustment toward that equilibrium. This combination of findings raises compelling questions related to the extent to which the public at large notices the changed adjustment speeds and/or is aware that growth management is also associated with changes in the equilibrium density, plus what the mediating role of growth spillovers from tight to lax regulatory environments is. These and other issues are raised in the conclusion, but it is noted upfront that, while the evidence that growth management has influenced population density in Florida seems clear, policy implications of this work are necessarily tentative — mainly because it asks what happened without pursuing questions of welfare analysis or preferred policy goals. Still, an assessment of the impact of Florida’s growth management program is vital for understanding its spatial outcomes — and the spatial outcomes of land use regulation more generally.

2. Background Discussion

The American system of land use governance is based almost entirely on "home rule" authority, which means that local governments are the primary agents of regulation (Ulfarsson and Carruthers 2006). That having been said, an underappreciated wrinkle in this authority is that local land use regulation is always derived from state-level enabling legislation — much of which is based on the *Standard State Zoning Enabling Act* (SZEA) that was produced by the federal government for use by state legislatures in 1924.[1] Though they are mostly free to do as they choose, local governments throughout the United States ultimately remain beholden to their state governments, which are the sole source of their ability to carry out zoning and all other projections of the police power. While state growth management and smart growth efforts are commonly characterized as necessarily involving a greater degree of land use regulation, in some ways the opposite is true because state efforts typically involve rolling back some of local governments' autonomy by setting policy parameters aimed at creating more consistency in the regulatory landscape (Burby and May 1997). The end result can be that a less volatile mix of regulations is at play.

State governments first began moving in this direction in the early 1970s. Before then, with the exception of Hawaii, local governments had basically unchecked authority to regulate land use and state governments were simply uninvolved. The earliest state attempts at growth management were generally focused on narrow environmental issues and/or developments of regional impact but, over time, the motivation has broadened to include to a wide range of other land use concerns (see Bollens 1992, 1993). At approximately the same time as state growth management programs were developing, the local growth control movement materialized as a recognizable phenomenon and, so, the two concepts are often — and rather mistakenly — conflated with one another (see Carruthers 2002a). Glickfeld and Levine (1992) document several techniques used by California localities to restrict growth within their boundaries, but, unlike more comprehensive state-level growth management strategies, these have no ability to affect the overall tide of growth in the surrounding region (Downs 1999).

As the growth management and growth control movements evolved, the two became very different. On the one track, growth controls were often a reaction to population growth — including growth in the region surrounding the growth controlling community — and the problem

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[1] Specifically, the SZEA was developed by an advisory commission that was appointed by Herbert Hoover, the Secretary of Commerce (and eventual President) in 1921; a complete edition of the 1926 version of this document is available online at: *http://www.planning.org/growingsmart/enablingacts.htm.*

of maintaining appropriate levels of infrastructure and public services in the face of rapid growth. On the other track, growth management evolved to focus more on accommodating growth via consistent, coordinated land use planning, instead of just restricting it outright (Bollens 1992, 1993). While the two movements are not the same, both growth control and growth management raise the general question of whether or not land use regulation can, in fact, have a substantive impact on development patterns.

Early empirical research by members of the urban planning discipline focused mainly on the effects of growth control. For example, in a comparison of seven paired "growth-control" and "pro-growth" cities in California during the 1980s, Landis (1992) found little evidence that growth controls had an appreciable effect. In particular, the analysis revealed no convincing evidence that growth control cities had slower population growth, added new housing at slower rates, or had faster increases in house prices compared to pro-growth cities. In the end, Landis (1992) was led to conclude that the growth control regulations in the seven study cities were "…largely irrelevant to the management of urban growth." Similarly, Glickfeld and Levine (1992) found little evidence that local growth controls in California reduced residential or non-residential construction. On the other hand, Shen (1996) and Pendall (1999, 2000) have more recently found that locally implemented growth controls have a big influence on spatial patterns of development — but, mainly, by displacing it to outlying areas at the urban fringe. These findings are directly in line with the kind of price effects uncovered by economists during the 1970s and 1980s (see Fischel 1990, 1991 for reviews) because they are the result of households getting displaced from highly regulated housing markets.

More recent economic research has examined the influence of land use regulation on both house prices and growth patterns, often using variation at either the metropolitan statistical area or state level. For example, Glaeser et al. (2005, 2006) have found evidence that highly regulated metropolitan areas have higher housing price appreciation in the presence of productivity shocks that include increases in labor demand and increases in the fraction of the populace with a bachelors degree.[2] Similarly, Ihlanfeldt (2007) used a sample of home sales in Florida from 2000 – 2002 to show that more restrictive land use regulations are associated with higher house prices.[3] Carruthers (2002b), in a regression analysis of growth management in several states, found that

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[2] The interaction terms for labor demand and high regulation and for proportion with a bachelors degree and high regulation were both significantly positive in the regressions for housing price change in Glaeser et al. (2006), while the direct effects of labor demand and proportion with bachelors degree were not significant, suggesting that in metropolitan areas with high land use regulation the housing stock is less able to respond to those shocks.

[3] In both the Glaeser et al. (2006) and Ihlanfeldt (2007) studies, the measures of land use regulation were from indices of regulatory restrictiveness and from surveys of planning officials, which asked those officials to report on the use of regulation and to rate the restrictiveness of regulations.

growth management in Florida was associated with larger urbanized areas, or, in other words, more land consumption. Wassmer (2006) used a regression analysis to explain the size (land area) of 452 U.S. urbanized areas and found that the establishment of a statewide growth management program, other things being equal, is associated with urbanized areas that are 15.9 percent smaller in land area.

The motivations for the present analysis, which is focused on evaluating Florida's growth management legislation, are several. With the exception of Carruthers (2002b) and Wassmer (2006), recent research on land use regulation has dealt mainly with house or land prices. While those are important outcome variables, the intent of most land use regulation is to influence aggregate development patterns and, for that reason, it is important to directly test the influence of growth management programs on the character of urban growth itself. Florida's growth management program is a stable, long-lived, statewide effort that presents an excellent opportunity to do this. Moreover, there is some disagreement about whether land use regulation in general — and Florida's program in particular — leads to more (Carruthers 2002b) or less (Wassmer 2006) land consumption. A reexamination of the impact of Florida's legislation on population and employment densities is needed in order to develop a clear understanding of the relationship. And, the measure of land use regulation used here is a measure of local compliance with the state growth management program — that is, a direct measure of the implementation of state-mandated regulation, and a useful addition to a literature that has often been forced to rely upon coarse metrics to gauge regulatory restrictiveness. Last but not least, this paper examines Florida's program via a bidirectional growth model that enables testing of separate hypotheses about the effect of growth management on equilibrium population density and employment density levels, plus the process of adjusting to those equilibrium levels.

Specifically, this paper evaluates growth management in Florida with an econometric analysis of changes in population and employment densities in the seven states located in the Atlantic Southeast region of the United States between 1982 and 1997. The analysis uses a regional adjustment model — a dynamic, two-equation model that accounts for interaction between population and employment in the growth process — to identify regional characteristics that act on equilibrium densities of people and jobs county-by-county in the 616 counties contained by Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, and Tennessee in the 1982 – 1987, 1987 – 1992, and 1992 – 1997 time periods. It includes spatially explicit measures of growth management compliance to determine whether or not the Florida program changed either the equilibrium densities and/or the speed of adjustment toward equilibrium. The study period covers three critical stages in the evolution of Florida's growth management program: (*i*) the trailing years of the original (1975) Local Government Comprehensive Planning Act; (*ii*) the (1985) adoption of the Florida State Comprehensive Plan and Growth Management Act; and (*iii*) an ensuing 12 years of implementation and revision of that legislation. The empirical model is used to determine whether or not the adjustment process worked differently in Florida than the Atlantic Southeast region as a whole during these three stages of statewide planning. As described in the next section, the influence of growth management is expected to be most evident in the last five-year period because the Florida legislation was significantly strengthened in the late 1980s.

3. Florida's Growth Management Program

As in other so-called "first wave" growth management states (see DeGrove 2005 for a detailed accounting of the first, second, and third waves of the movement), Florida's involvement in land use planning grew out of the environmental activism of the late 1960s and early 1970s. In 1972, an increased consciousness of land use issues led to the formation of the original *Environmental Land Management Study Committee* (*ELMS I*) and then to the adoption of the *Environmental Land and Water Management Act*, which protected state-designated critical areas and regulated developments of regional impact. Next, in 1975, a second committee (*ELMS II*) was formed and the *Local Government Comprehensive Planning Act*, which required local governments to develop land use plans, was adopted. This law was oriented toward process, not substance, so while plans were in place statewide by the end of the decade (DeGrove 2005), it was a rather rudimentary response to rapid growth and land consumption. Nearly 10 years later, in 1984, on the recommendation of *ELMS II*, the *State and Regional Planning Act* was adopted, creating an integrated framework for state, regional, and local planning. As an outgrowth of this step, in 1985, the *State Comprehensive Plan*[4] was adopted along with the *Growth Management Act* (*GMA*). This legislation established a formal requirement that local plans be consistent with regional plans and, in turn, with the state plan — and also mandated that infrastructure investment be concurrent with land development. Table 1 outlines this sequence of events, along with some additional steps prior to, during, and just after the 15-year window of the study period. The Florida *GMA* is generally considered an example of best practices in growth management (Burby and May 1997), so it provides an excellent case for testing the influence of state land use policy on growth patterns.

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[4] In the practice of land use planning, comprehensive plans are documents that spell out intended development patterns; they are "visioning" statements that are intended to guide the application of the regulations, like zoning, that actually act on growth.

A core goal of the *GMA* was to increase the density of urban growth. In implementing the legislation — which was comprehensive in nature and scope — the Florida Department of Community Affairs (DCA) included specific language and requirements that directed localities to plan in ways that were intended to restrain sprawl, a low-density, spatially expansive mode of urbanization that has become "ubiquitous" (Glaeser and Kahn 2004) in the United States. The legislation developed by the DCA included three requirements of local plans: (*i*) consistency with plans of neighboring jurisdictions; (*ii*) elements aimed at limiting sprawl; and (*iii*) language addressing urban redevelopment (Chapin 2007).

The DCA implemented these plan review requirements using the "3Cs" of growth management: (*i*) consistency; (*ii*) concurrency; and (*iii*) compact development (Ben-Zadock 2007). Consistency requires local comprehensive plans to support both state and neighboring cities' plans; concurrency requires growth supporting infrastructure (sewers, roads, parks, and more.) to meet adequate service capacities before new development occurs; and compact development encourages — but does not require — local governments to reduce low-density, spatially expansive modes of land use. To encourage plan consistency, the state utilized both "carrot" and "stick" approaches (Burby and May 1997). The carrot, which primarily consisted of financial and technical support to local governments that adopted plans consistent with state goals, included over $36 million in planning-specific funding for local governments between 1985 and 1993. The stick consisted of a threat to withhold certain sources of funding, such as shared tax revenues provided by the state legislature. This sanction was first implemented in 1989 and continues to be an essential enforcement tool.

Of the "3Cs" of the *GMA*, concurrency most directly impacted the location, timing, and cost of growth. But costs increased enough that most cities and homebuilders could not provide adequate infrastructure for new development (Pelham 1992) and, as a result, new development was pushed into areas with excess infrastructure capacity — areas that were typically in newer suburban and exurban communities on the urban fringe, where development typically consists of larger lot single-family homes (Carruthers 2002b). To help counter this expansion into lower density areas, the DCA implemented compact development requirements. However, these mandates were not adopted until 1999 and, in fact, only one *GMA* amendment, an amendment focused on directing physical and economic development into urban areas, addressed density requirements (Florida Statutes 163.3180; Ben-Zadok 2007). The analysis presented here investigates changes in population and employment over the three five-year time periods between 1982 and 1997 — when compact development was not yet a formal requirement — so the empirical evaluation of Florida's *GMA* is restricted to the consistency and concurrency requirements imposed by the DCA.

Before the *GMA* — that is, before 1985 — the initial growth management policy, enacted in 1975, placed all emphasis on process and little emphasis on outcomes (DeGrove 2005), so it is likely that there were no impacts on development during the 1982 – 1987 time period. In fact, it is quite plausible that development activity actually increased rapidly prior to the implementation of the 1989 sanctions, as a result of developers rushing to circumvent the enforcement of costly concurrency requirements. This is certainly rational behavior, since the concurrency requirement was known in late 1984, when the *GMA* bill was introduced as legislation. The *GMA* greatly strengthened Florida's statewide growth management regime, but Chapin (2007) argues that the legislation was not ready for implementation until 1990 — a sentiment that concurs with other research (see, for example various chapters in Connerly et al. 2007). If the enhanced funding, technical support, and enforcement associated with the program had an early influence, the *GMA* may be observed to take hold as early as the 1987 – 1992 time period, and possibly in the 1992 – 1997 periods due to developer foresight but, overall, its effects, if any, are most likely to be observed in the 1992 – 1997 time period, because enforcement mechanisms were not fully operational until then.

4. Research Approach

4.1 Modeling Framework

The analysis that follows uses a regional adjustment model, specified with data for the 616 counties located in seven states of the Atlantic Southeast, to test the hypothesis that the Florida *GMA* changed the equilibrium pattern of growth and the speed of adjustment toward equilibrium. The dependent variables are population density (people per acre) and employment density (jobs per acre), both of which are calculated using estimates of developed land given by the USDA's National Resources Inventory. The empirical model examines density changes across three five-year intervals, 1982 – 1987, 1987 – 1992, and 1992 – 1997. Because the dependent variables are people and jobs per acre of developed land — as opposed to county land area, which is commonly (and inappropriately) used as a measure of land use — the empirical model directly addresses the spatial pattern of growth. In this way, it can be used to examine whether Florida's growth management program is associated with changes to higher or lower densities, the speed of those changes, and, ultimately, the connection between the growth management program and the transition of undeveloped land into urban uses. Because the data set only contains information on growth management for the State of Florida, state fixed-effects are used to control for other unobserved characteristics — regulatory and otherwise — that might be common among counties within each state.[5]

Regional adjustment models were first developed by Steinnes and Fisher (1974), and then popularized by Carlino and Mills (1987), with spatial econometric extensions developed by Boarnet (1994a, 1994b). The framework implicitly rests on a compensating differentials (Rosen 1979; Roback 1982) foundation, wherein equilibrating processes — namely, population, employment, and wage growth (see Carruthers and Mulligan 2008) — ensure that households end up indifferent among locations, a situation that requires that the value of wages plus the value of quality of life minus the cost of housing is more or less the same across the migration system (see Glaeser 2007). In this way, regional adjustment models characterize migration as a spatial response to both: (*i*) economic opportunity, in the form of employment, higher wages, and/or other means of advancement; and (*ii*) personal preference, for particular amenities, lifestyles, and/or other quality of life improvements. But, because the "ideal" state is a perpetually moving target (Graves and Linneman 1979; Graves and Mueser 1993; Mueser and Graves 1995) the models portray the distribution of activity as always being just out of sync — and, therefore, constantly adjusting toward spatial equilibrium. Over time, variations on this general approach have been used to analyze growth at the metropolitan, sub-national, and national levels (Steinnes and Fisher 1974; Steinnes 1977; Mills and Price 1984; Carlino and Mills 1987; Boarnet 1994a, 1994b; Mills and Lubuele 1995; Clark and Murphy 1996; Bollinger and Ihlanfeldt 1997; Henry et al. 1997, 1999, 2001; Duffy-Deno 1998; Glavac et al. 1999; Mulligan et al. 1999; Vias 1999; Vias and Mulligan 1999; Deller et al. 2001; Liechenko 2001; Boarnet et al. 2005; Carruthers and Vias 2005; Carruthers and Mulligan 2007, 2008; Carruthers et al. 2008). Regional adjustment models have also been widely applied to policy questions that include, for example, the impact of rail transit on employment growth (Bollinger and Ihlanfeldt 1997); the proliferation of sprawl in the Rocky Mountain West region (Carruthers and Vias 2005); the effect of military base closure on local economies (Poppert and Herzog 2003); and the link between plant location and employment growth (Edmiston 2004).

Following Carlino and Mills (1987) and Boarnet (1994a, 1994b), population and employment levels are assumed have the following equilibrium relationships:

$$\begin{aligned} PD^*_{i,t} &= f\ (ICP_{i,t-5},\ ED^*_{i,t}) \\ ED^*_{i,t} &= g\ (ICE_{i,t-5},\ PD^*_{i,t}) \end{aligned} \qquad (1)$$

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[5] Tennessee has since adopted growth management legislation, but that did not happen until 1998, one year after the close of the time period coved by this analysis.

Where * denotes unobserved equilibrium values; *i* indexes counties; and *t* indexes time periods, which, in this case are separated by five years. In these functions, *PD* represents population density; *ED* represents employment density; *ICP* represents initial conditions that influence population density; and *ICE* represents initial conditions that influence employment density. Note here that the *IC* vectors vary between the population and employment density relationships, as reflected in the development of the empirical specification below. Next, densities are assumed to adjust to their targeted equilibrium levels via a dynamic process:

$$\begin{aligned} \Delta PD_{i,t} &= PD_{i,t} - PD_{i,t\text{-}5} = \lambda_p (PD^*_{i,t} - PD_{i,t\text{-}5}) \\ \Delta ED_{i,t} &= ED_{i,t} - ED_{i,t\text{-}5} = \lambda_e (ED^*_{i,t} - ED_{i,t\text{-}5}) \end{aligned} \qquad (2)$$

Here, all notation is identical, except that the absence of * denotes actual, observed population and employment densities at times *t* and *t* – 5, and λ_p and λ_e represent the adjustment parameters with both parameters being $\in [0,1]$. Substituting linear versions of equation set (1) into equation set (2), expanding the representation of initial conditions into different vectors of variables, and simplifying the notation by dropping the *i* subscripts yields:[6]

$$\begin{aligned} \Delta PD_t &= \alpha_p + X_{t\text{-}5}B_p + V_{t\text{-}5}\Gamma_p + \eta_p ED_t^{\,*} - \lambda_p PD_{t\text{-}5} + \varepsilon_p \\ \Delta \mathrm{ED}_t &= \alpha_e + X_{t\text{-}5}B_e + Z_{t\text{-}5}\Gamma_e + \eta_e PD_t^{\,*} - \lambda_e ED_{t\text{-}5} + \varepsilon_e \end{aligned} \qquad (3)$$

In these equations, *X* represents a vector of characteristics that affect both equilibrium population and employment densities; *V* represents a vector of characteristics that affect only equilibrium population density; *Z* represents a vector of characteristics that affect only equilibrium employment density; α, η, and λ are estimable parameters that differ between the two equations; B and Γ are vectors of estimable parameters that differ between the two equations; and ε represents a stochastic error term that differs between the two equations.

In equation set (3) population and employment equilibriums are not observable characteristics. After some algebraic manipulation of equation set (2), though, it is possible to replace these equilibrium values with observable densities. Specifically, rearranging equation set (2) yields:

$$\begin{aligned} PD^*_{i,t} &= PD_{i,t\text{-}5} + \frac{1}{\lambda_p}(PD_{i,t} - PD_{i,t\text{-}5}) \\ ED^*_{i,t} &= ED_{i,t\text{-}5} + \frac{1}{\lambda_e}(ED_{i,t} - ED_{i,t\text{-}5}) \end{aligned} \qquad (4)$$

Finally, substitution of equation set (4) into equation set (3) produces the operational specification:

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[6] For a more complete discussion of this model, see Boarnet (1994a; 1994b) or Boarnet, et al.(2005).

$$\begin{aligned}\Delta PD_t &= \alpha_p + X_{t\text{-}5}B_p + V_{t\text{-}5}\mathit{\Gamma}_p + \eta_p ED_{t-5} + \frac{\eta_p}{\lambda_e}(ED_t - ED_{t\text{-}5}) - \lambda_p PD_{t\text{-}5} + \varepsilon_p \\ \Delta \mathrm{ED}_t &= \alpha_e + X_{t\text{-}1}B_e + Z_{t\text{-}5}\mathit{\Gamma}_e + \eta_e PD_{t-5} + \frac{\eta_e}{\lambda_p}(PD_t - PD_{t\text{-}5}) - \lambda_e ED_{t\text{-}5} + \varepsilon_e\end{aligned} \tag{5}$$

These are estimable equations, in which λ_p and λ_e register the fraction of the gap between equilibrium and actual levels that is closed during each five-year time period, or the speed of adjustment toward a spatial equilibrium in the distribution of people and jobs.[7] The model shown in equation set (5) represents the basis of the upcoming empirical tests.

The regional adjustment model framework is ideal for examining the kind of policy questions presented by Florida's growth management program. As Boarnet (1994a) notes, because the model is really a free market, equilibrating model, it is likely to be highly sensitive to regulatory factors that disrupt the adjustment process; in the hypothesis tests that follow, these regulatory factors are measured directly. Plus, the framework is a realistic representation of how contemporary growth and change occur — jobs increasingly follow people, in addition to the other way around, so the it is highly appropriate for applied policy analysis. And, as previous research (Carruthers and Mulligan 2008) has noted, regional adjustment models specified over five-year intervals are sensitive to business cycles and highlight the need for urban policymakers to better understand the nature of the growth process itself, especially when forming regulatory frameworks for managing growth.

4.2 Growth Management Variables

There are two measures of local implementation of the state growth management plan: (*i*) compliance and (*ii*) date of plan adoption. Local municipalities were required to develop and adopt growth management plans and, upon verification that a local plan included all elements required by Florida law, it was submitted to the state Department of Community Affairs (DCA), which would evaluate the plans and determine whether the local plan was in fact compliant with the state *GMA*. In the initial round, local plans were submitted for state review between 1988 and 1991, but some plans were not judged compliant on first submission and were subsequently revised. Accordingly, the focus of the analysis is on the local adoption of the plan and the DCA's determination of compliance as two distinct measures of growth management implementation. Note that a locality might adopt a plan early and, once adopted, that plan can influence local permit decisions — yet the plan still may not be judged compliant based on DCA review, while

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[7] Note that the analysis does not enforce the full parameter restrictions implied by the regression model, and instead only estimates the adjustment parameter from the coefficient on the lagged values of population and employment density. For a discussion of this issue, see Boarnet et al. (2005).

other localities might take longer to adopt a plan that is fully compliant on first submission. While clearly not the only possible combination of outcomes, this example suggests that both the date of local adoption and the plan quality (judged by DCA evaluation of compliance) may affect growth patterns, and so both are used as distinct measures of growth management implementation.

The two dependent variables, population and employment density per acre of developed land, are only available for counties, but land use regulation at the sub-state level in Florida rests with municipal governments or, for unincorporated areas, county governments. In order to accommodate this, the two measures of local land use regulation (compliance and date of plan adoption) were aggregated up to the county level. The following paragraphs describe the two growth management variables.

The initial variable, *GM1*, is a population growth-weighted measure of compliance in each of Florida's 67 counties:

$$GM1_i = \frac{\sum_{j=1}^{n_i} PopGrowth_{92-97,j} \cdot C_j}{PopGrowth_{92-97,i}} \qquad (6)$$

where C_j = 1 if municipality j was compliant with the state growth management program, 0 otherwise; n_i = number of jurisdictions in county i; and $PopGrowth92–97$ = amount of population change in the jurisdiction from 1992 to 1997. This variable was calculated by summing the population growth of all complying local governments, *j*, located within each county, *i,* and then dividing that number by the total population growth of each county. The index measures the proportion of each county's population growth (in the 1992 – 1997 time period) that is subject to a land use plan judged by the Florida DCA to be compliant with the state's *GMA*. Compliance decisions by the DCA are the basis for *GM1*. The pattern of compliance by county is listed in the left-hand panels of Table 2 and mapped in Figure 1. Some counties — fewer than 25 percent of the 67 counties in the state — had no municipalities that were compliant, while others had as much as 83 percent of their municipalities compliant on first submission. Equation (6) reflects the judgment that, for hypothesis tests about growth patterns, it is not only the number of municipalities within a county that comply that is important — but rather whether or not the compliant municipalities are municipalities that actually experienced population growth. Finally, note that *GM1* can lie outside of the range [0,1], because growth in each municipality and county can be either positive or negative.

The second variable, *GM2*, measures the average number of days within the 1988 – 1997 time period that municipal growth management plans were in place, whether or not they were compliant with DCA requirements:

$$GM2_i = \sum_{j=1}^{n_i} \left(\frac{DAYS\ 1988 \rightarrow 1997_j}{DAYS\ 1988 \rightarrow 1997} \cdot \frac{PopGrowth_{92-97,j}}{PopGrowth_{92-97,i}} \right) \tag{7}$$

where $DAYS\ 1988 \rightarrow 1997_j$ = number of days that municipality j had an adopted growth management plan during the 1988 – 1997 time period; $DAYS\ 1988 \rightarrow 1997$ = total number of days in the 1988 – 1997 time period; and, as before, i indexes counties, j indexes municipalities within counties, n_i is the number of municipalities in county i. This variable was calculated by finding the percentage of the total number of days between 1988 and 1997 that each local government, j, located within each county, i, was subject to a locally adopted land use plan and then multiplying that number by the percent of county *i's* population growth that occurred in jurisdictions j. Because the largest effect is expected in the 1992 – 1997 time period, population growth in that period is again used as the weight. This index registers the growth weighted proportion of the 3,653 days from the beginning of 1988 through the end of 1997 that local governments within each county had an adopted a land use plan that had been submitted to the Florida DCA for evaluation under the state's *GMA* — whether or not that plan was ultimately deemed compliant. The pattern of submission by county is listed in the right-hand panels of Table 2 and mapped in Figure 1. The earliest municipality to submit a locally adopted plan for DCA evaluation did so on August 23, 1988, and the latest first-round submission was on January 25, 2001 — while this is outside of the study period, note that the 75th percentile of submission dates is August 6, 1991. Once again, note that some values are outside the range [0,1] because municipal population growth can be positive or negative.

To be clear, *GM1* aggregates information about plan compliance on first submission to the county level, while *GM2* aggregates information about the length of time that municipalities had adopted plans, regardless of whether the adopted plan was judged compliant or not. Alternative, and simpler, measures of both *GM1* and *GM2* were created by using only the county's value — that is, the value corresponding to the unincorporated portion of each county — for compliance and for time under submission. Approximately 81 percent of Florida's population growth from 1982 – 1997 occurred in unincorporated areas, so county planning departments were largely responsible for regulating new development in the state. The right-hand columns of the panels in Table 2 give information on compliance and adoption for county governments only. Throughout the analysis that follows, the two growth management variables (*GM1* and *GM2*) are used, both weighted by municipal growth — and also using only the county value for both. It is important to use both measures, partly because each is imperfect: (*i*) the growth weights might be regarded as endogenous to the growth hypotheses being tested; but (*ii*) the un-weighted county value is not based on realized growth. Using the two variables, *GM1* and *GM2*, weighted and also county values, allows an examination of robustness. Also, both variables are later instrumented to test concerns about endogeneity.

4.3 Hypothesis Testing

Within the context of the modeling framework outlined in the preceding paragraphs, the Florida growth management program could act on either the equilibrium density levels or the speed of adjustment to those levels — the task at hand is therefore to test for both effects. There are three distinct hypothesis tests designed to test for these effects. First, the variables *GM1* and *GM2* are entered into the regressions as part of the *X* vector in equation set (5) and doing this tests the hypothesis that the growth management program influenced equilibrium population and employment densities. Second, the *GM1* and *GM2* variables are also interacted with, respectively, the base year population density in the population equation and the base year employment density in the employment equation in order to test the hypothesis that two adjustment speeds, λ_p and λ_e, differed in Florida from the rest of the Atlantic Southeast in ways associated with the growth management program. Third, Florida-unique effects that are not related to the growth management program are also controlled by entering a Florida dummy variable both as part of the *X* vector, along with other state dummy variables — and by interacting the Florida dummy with base year population density and base year employment density in the two respective equations. Together, these tests are intended to ascertain whether or not Florida's growth management program has impacted equilibrium population and/or employment densities and/or the speed of adjustment to those densities.

Two regression specifications were run: (*i*) a base specification containing only the core variables; and (*ii*) an extended specification containing additional initial conditions. The base specification includes only the core adjustment parameters: current change in employment (population) density, lagged population and employment density, and both *GM1* and *GM2* and their interactions with lagged population (employment) density. The base specification omits the "initial condition" variables in the vectors *X*, *V*, and *Z* in (5). The extended model includes the initial condition variables, vectors *X*, *V*, and *Z* as shown in equation (5). The variables in *X*, *V*, and *Z* are listed in Table 3. The rationale for the two alternative specifications is straightforward: differences between the two models (base versus extended) might indicate the presence of spurious relationships between the core variables and other county characteristics which, in turn, would limit the validity of any results; conversely, similar outcomes across the base and extended specifications would add evidence to support hypothesis tests on the *GM* variables.

Several extensions and diagnostic tests follow the estimation. The regressions in equation set (5) are simultaneous in population and employment density changes, so all specifications are estimated using instrumental variables while treating population and employment density changes as endogenous. Each of the tables discussed below reports over-identification tests of instrument validity, following the approach described and applied in Sargan (1958) and Basman (1960), plus tests for weak instruments (see, for example, Stock and Yogo 2002). The over-identification test were performed using *Stata's* "*overid*" command, which tests the null hypothesis that the excluded instruments are valid — rejecting the null indicates that the instruments are correlated with the error term, and thus not suitable for instrumental variables regression. The tables also report tests (described by Anselin et al. 1996) for spatial correlation — either in the form of spatially correlated error terms or in the form that implies a spatially correlated dependent variable should be included in the model.

4.4 Data

The variables used to implement the empirical model are listed in Table 3, along with descriptive statistics. The dependent variables are population and employment density changes during the three time periods, 1982 – 1987, 1987 – 1992, and 1992 – 1997. The density variables were constructed from population and employment data, by county, available from the Bureau of Economic Analysis and from measures of developed land area from the USDA's National Resources Inventory (NRI). The NRI data is based on a national survey of over 800,000 land use sample points, conducted in five-year intervals in 1982, 1987, 1992, and 1997. The authors have been in touch with NRI officials at the USDA multiple times to assess the appropriateness of using the data for this research. These discussions led to the conclusion that the NRI is the best data source available for this study, though it is willingly acknowledged that it is subject to some sampling error.[8] The NRI is a consistent data set, for multiple states, available for four time periods that correspond to crucial periods in Florida's growth management regulation, which is a considerable advantage over other sources of land use data in the context of this research. A more complete discussion of the NRI data and alternative sources of land cover data, are available in the appendix of the working version of this paper, which is available upon request of from the corresponding author — see also Irwin and Bockstael (2006) and/or Carruthers and Ulfarsson (2008), both of which include extended discussions of the NRI data.

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[8] Comparisons with state error ranges suggest that, in very large, sparsely populated counties, this error can be as much as 10 – 20 percent, but there are no counties of this type in Florida.

The planning data for the State of Florida were acquired from Mr. Ray Eubanks, the Plan Review Administrator for the Division of Community Planning of the DCA. The data set he provided contains detailed information on the first-round plan review outcomes, which includes dates of first submission and approval status, and the inclusion of optional plan elements for all cities and counties in the state. Table 3 summarizes this data, too. Other data required for the analysis was acquired from publicly available data sets: (*i*) county-level government fiscal data was obtained from the Census of Governments; (*ii*) criminal activity data was obtained from the FBI's yearly report on crime via the City and County Data Book; (*iii*) employment data categorized by two-digit SIC codes was obtained from County Business Patterns; (*iv*) the urban, suburban, exurban codes were constructed from USDA's Economic Research Service's Beale code; and (*v*) the amenity score, a combination of six measures of climate, typography, and water area that measure warm winter, winter sun, temperate summer, low summer humidity, topographic variation, and water area, was obtained from the USDA's Economic Research Service.

5. Estimation Results

The regression results are shown in Tables 4 – 7. Tables 4 and 5 show, respectively, regression results for population and employment density, and Tables 6 and 7 show the same while using predicted values for the growth management variables from auxiliary regressions — a process that is discussed later in this section. Each of Tables 4 – 7 is divided into two halves, with the left half using the growth weighted *GM1* and *GM2* variables and the right half using the values for the county. Hence the left half of each tables shows results when *GMA* compliance is measured by aggregating municipal values based on population growth in the 1992 – 1997 time period, and the right half measures *GMA* implementation using only the status of the county itself. (Recall that 81 percent of Florida's growth from the 1982 – 1997 time period was in unincorporated territory, making the counties' compliance and submission status reasonable indicators of *GMA* implementation that would influence growth patterns.) Within each half of Tables 4 – 7, results are shown for base and full specifications, with the full models including the extended set of fiscal, amenity, and industrial structure independent variables. Only the coefficients on *GM1* and *GM2*, lagged population or employment density, and the interaction of *GM1* and *GM2* with lagged (base year) population or employment density are listed — all other coefficients have been suppressed in order to conserve space, but are available upon request from the corresponding author. As already explained Section 4.3, the coefficients listed in the tables address hypothesis tests about: (*i*) the *GMA* program's influence on equilibrium densities (the coefficients on *GM1* and *GM2*); and (*ii*) the speed of adjustment to equilibrium densities (the coefficients on the interaction between the *GM* variables and base year population or employment density.)

The results listed in Tables 4 – 7 are estimated with instrumental variables, with population and employment density changes endogenous. The instruments for the endogenous employment density change variable in Tables 4 and 6 are the four excluded industrial structure variables: percent of employment in the county in (*i*) manufacturing; (*ii*) FIRE; (*iii*) retail; and (*iv*) services. The instruments for the endogenous population density change variable in Tables 5 and 7 are the two excluded racial composition variables and two public service variables: (*i*) percent black; (*ii*) percent white in the county, (*iii*) municipalities per capita, and (*iv*) special districts per capita. In each of Tables 4 – 7, the same regression is estimated for the three time periods — which is necessary because the *GM* variables are hypothesized to have different significance patters in different time periods, with latter time periods hypothesized to register more of an impact of the *GMA*. Also, Carruthers and Mulligan (2008) give evidence of significant structural differences across five-year time periods in adjustment models — a finding confirmed by visual inspection of the results for the three time periods. For those reasons, the three panels are estimated separately instead of as a pool. In the *GM* time periods (1987 – 1992 and 1992 – 1997), population densities appear to be growing slower towards a lower density equilibrium, while employment densities tend to be growing faster towards a lower density equilibrium. The result is more robust for population density, and the diagnostic tests for the population density regression give a higher level of confidence in the results. The following paragraphs elaborate on the estimation results and their interpretation.

First, consider the results for the growth weighted *GM* variables in the left panel of Table 4. For both the base and full models, the interaction of *GM1* (compliance) with base year population density is positive in the 1992 – 1997 time period. The adjustment parameter in equation (5), λ_p, is the negative of the coefficient on base year population density plus the coefficients on the interaction terms for population density and the *GM* variables. Hence a significantly positive interaction coefficient on *GM1* · *Pop Density* implies a smaller λ_p. Specifically, λ_p is reduced from 0.2029 to 0.0644 (0.2029 minus 0.1385) once the effect of the *GMA* is taken into account. This implies a slower adjustment toward the equilibrium population density in counties with more (growth-weighted) compliant municipalities. During the 1992 – 1997 time period, 55 of the 67 Florida counties experienced decreases in population density, and 78 percent of Florida's population lived in counties with decreasing population density.[9]

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[9] Recall that density is measured relative to developed land, and so density changes reflect changes in the land-use intensity of development, not simply whether a county added or lost population.

Therefore, slower adjustment is, for most of Florida, a matter of slower adjustment toward lower densities.

In the right panel of Table 4, the *GM* variables are the values for the county government, rather than an aggregate of all municipalities in the county. In the 1992 – 1997 time period, the coefficient on *GM2* is negative and the interaction between *GM2* and base year population density is positive, implying that, in counties that submitted early growth management plans, there were two countervailing effects: (*i*) the equilibrium population density was reduced; and (*ii*) the adjustment toward that lower population density equilibrium was slower. The interaction term for *GM1* and base year population density is significant and negative in the earliest time period, 1982 – 1987. There are two possible interpretations of this finding: (*i*) the *GM1* variable is correlated with other county characteristics that influence adjustment in the 1982 – 1987 time period; or (*ii*) developers rushed to build housing before the enforcement of costly concurrency requirements, which went into effect in 1989. Other studies of Florida's growth management program — including Ben-Zadock (2005) and Chapin (2007) — support the latter interpretation. More generally, there is a consistent pattern is visible: the coefficients on the interaction terms for base year population density and the *GM* variables grow larger in magnitude over the three time periods, a result that appears in all cases except for the growth-weighted *GM2* variables in Table 4. This suggests that, on the whole, the *GMA* slowed the adjustment toward the population density equilibrium.

The employment density regression estimates, given in Table 5, yield only one statistically significant result. The county *GM2* variables interacted with employment density is statistically significant and negative in the 1982 – 1987 time period. This suggests that counties that adopted *GM* plans earlier in the 1988 – 1997 period adjusted faster toward equilibrium employment densities in the 1982 – 1987 time period. Once again, the findings can be interpreted in one of two ways: (*i*) *GM2* is correlated with other county-specific characteristics that are associated with faster adjustment in 1982 – 1987; or (*ii*) developers exercised foresight and increased non-residential construction in advance of early implementation of the *GMA*. The more striking result in Table 5 is the general lack of significant *GM* variables, as compared with Table 4. There is little evidence in Table 5 that the *GMA* influenced employment density — a finding consistent with the idea that both the intention and implementation of the Florida *GMA* focused more on residential development than on employment generating land uses.

The diagnostic statistics in Table 4 give little cause for concern. For the two LM statistics and the over-identification test, Table 4 shows the *p*-values for rejecting the null hypotheses of no spatial correlation (in the dependent variable for LM lag and in the error term for LM error) and of valid instruments (for the over-identification test.)[10] In Table 4, the null of no valid instruments for the endogenous employment density change variable is only rejected in the 1987 – 1992 base models in Table 4, and the null of no spatial correlation is rejected in 1992 – 1997 for the full model (growth weighted) and in 1982 – 1987 for the base model (county value). Overall, for the 12 regression results in Table 4, both the LM and over-identification test reject null hypotheses in two of the 12 cases. The first-stage F-statistics in Table 4 and in later tables are near or above the suggested value of 10 (Stock and Yogo 2002) meaning that there little reason to be concerned about weak instruments. Finally, for the employment density regression in Table 5, the over-identification test rejects the null of valid instruments in 6 out of 12 cases, implying that the employment density results might be viewed with less confidence than the population density results.

As a remaining check, the *GM1* and *GM2* variables are tested for exogeneity to changes in population and employment density. This step is carried out even though there is good reason to believe upfront those variables are exogenous. In particular, while the jurisdictions located in a given county might anticipate future growth and therefore decide to comply more quickly or less quickly with Florida's growth management plan, the dependent variable in Tables 4 – 5 is not the amount of growth — but instead land use density measured as the number of people and jobs per acre of developed land. If *GM1* and *GM2* were endogenous, the relationship would imply that counties anticipate not just the amount of population and employment growth, but also the density of that growth over a five-year window, which seems less plausible. Furthermore, the fact that the magnitude of the *GM1* and *GM2* parameters grows progressively larger over the three time periods in Table 4 suggests that causality flows from growth management compliance to changes in population density, rather than the other way around. Last, local governments did not have full discretion about their timeline for compliance — the Florida DCA focused on compliance in stages that emphasized earlier compliance in counties that were more prone to flood-related natural hazards or had significant environmentally sensitive wetlands (Florida Statutes Part II 1985). That emphasis on early compliance for counties based in part on geography provides an opportunity to construct instruments for the *GM1* and *GM2* variables, allowing instrumented versions of *GM1* and *GM2* to be used as robustness tests, and the reminder of this section considers those results.

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[10] The tests for spatial dependence use a neighbor matrix whose elements equal one if counties are within 60 miles, zero otherwise. The 60-mile distance band was chosen because it ensures that contiguous counties are neighbors and because the distance is approximately the scale of metropolitan areas in Florida. While most of the tests imply no spatial dependence, the tests reported in Tables 4 – 5 do suggest both a spatial lag and spatial error model would be desirable in the 1987 – 1992 time period for population.

The *GM1* and *GM2* variables were each regressed on three instruments: (*i*) the percentage of the county's area that is water; (*ii*) the acres of water in a county; and (*iii*) a dummy variable for coastal counties. This produced predicted values of the *GM1* and *GM2* variables,[11] which are orthogonal to factors other than these geographic characteristics which proxy for the state's compliance schedule. The predicted values of *GM1* and *GM2* —*GM1-hat* and *GM2-hat* — were then used in place of *GM1* and *GM2* in the models, and results are reported in Tables 6 and 7. Table 6 shows that the predicted values of *GM1* and *GM2* do not change the pattern of results for the growth-weighted *GM* variables. The results for the county *GM* variables, when using predicted values, are insignificant in the right half of Table 6. It is possible that the instruments are less effective for the county variables, and, hence, the insignificant *GM* variables for county values in Table 6. At any rate, the county value is less likely to be endogenous to population density changes, because it is not a weighted sum based on population growth, and so more confidence is placed in the county value results from Table 4. Overall, the results from the growth weighted *GM* variables give consistent evidence (Tables 4 and 6) that compliance slows adjustment toward the population density equilibrium. The results in Table 4 give further evidence that earlier submission of plans both lowers the population density equilibrium and slows adjustment speeds, but this result does not hold up when the predicted *GM* variables are used in the models shown in Table 6. The results for predicted *GM* variables in the employment density regressions in Table 7 give evidence of faster adjustment speed (the negative coefficients on the growth-weighted *GM1* interaction variable and the county value interaction for *GM2*, both in the 1992 – 1997 time periods.) They also give evidence of a lower equilibrium population density in the form of the negative county *GM1-hat* coefficient in 1992 – 1997. The idea that the *GMA* lowered employment density and increased the speed of adjustment is credible, given the findings of earlier research.

The *GMA*'s concurrency requirements were generally applied to residential development, since these land uses demand more infrastructure than commercial or industrial growth (Ben-Zadock 2005; Chapin 2007). Confronted with costly infrastructure requirements, developers likely revised their development strategy to push through residential development before the implementation of concurrency mandates. After restrictions were enforced, they likely focused more on commercial and industrial complexes, which require less supporting infrastructure. At the same time, these concurrency requirements increased municipal expenditures on infrastructure for new residential development. Faced with greater expenditures and little

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[11] All three of the variables, percent water, acres of water, and coast dummy, were statistically insignificant when included in the structural models for population density and employment density in all time periods except that coast was significant in the population density regression for 1987 – 1992.

additional funding from the state, local governments likely approved more commercial and industrial development to help increase sales tax revenue. To compound the issue, Florida has no state, county, or local income tax — so sales-tax revenue is a key source of funding for local governments. Having said that, it is necessary to reiterate that the employment density results are less reliable than the population density results. (Note that the over-identification test rejects the null of valid instruments in 6 of 12 regressions in both Tables 5 and 7.) So the interpretation from Table 7, while plausible, is also more speculative than the interpretation from Tables 4 and 6. The population density regression results are more consistent and have better diagnostics, and those results suggest that the *GMA* lowered equilibrium population densities (more growth in peripheral areas) while also slowing changes toward the new population equilibrium (slower construction rates).

6. Summary and Conclusion

This paper began by setting out an important research question: if a state government wanted to alter the spatial pattern of urban growth, could it? The evidence indicates that it can, though maybe not in the way that was intended. Specifically, the growth management program in Florida is associated with two countervailing effects for population density. The following paragraphs summarize these results and comment on directions for future research.

First, the regressions give some evidence that the growth management program is associated with a lower population density at equilibrium, a finding that is similar to other research on this topic. A detailed explanation of this finding is beyond the scope of this paper, but possible explanations include growth spillovers from early-complying to later-complying jurisdictions and/or the movement of growth to outlying areas due to the state growth management plan's infrastructure concurrency requirements (see, for example, Carruthers 2002; Song 2007). Second, growth management slows the speed of adjustment toward spatial equilibrium. The evidence on slower adjustment speed is more robust than the evidence for the lower population density equilibrium — see especially Table 4. This result suggests that Florida counties have adjusted to the new, lower density equilibrium more slowly than they would have in the absence of growth management.[12] A possible explanation for this is that concurrency requirements have increased construction costs. These results apply to population density only —

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[12] Note that the equilibrium for population density in Florida during the key 1992 – 1997 time period was toward lower density. During the 1992 – 1997 time period, 55 of the 67 Florida counties had decreases in population density, and 78 percent of Florida's 1992 population lived in counties that moved to lower population densities (measured for the full county) from 1992 – 1997. Recall that the adjustment model posits that the change in actual density has the same sign as the gap between the equilibrium and beginning period density, and one can infer that 78 percent of Florida residents lived in counties where the equilibrium density was below the actual density in 1992.

the connection between growth management and employment density, based on the regressions, is less consistent. When growth management is observed to act on employment density, it leads to lower equilibrium density and faster adjustments toward that equilibrium. This finding is reasonable because land uses conducive to employment, such as commercial and industrial developments, require less supporting infrastructure and therefore are less affected by concurrency requirements, and because developers might also have refocused their projects from residential to commercial and industrial land uses. Additionally, many growth management regulations are motivated by — and are intended to address concerns about — population growth and population density. Planning practice that applies similar motivations and concepts to employment growth is considerably less common. On net, this paper represents another piece of evidence that, instead of limiting residential sprawl, Florida's *GMA* may have contributed to it — with the added dimension that the program may have simultaneously slowed the transition toward a lower population density equilibrium.

These results highlight some general issues that merit further investigation. Foremost, it might be easier for residents and policymakers to observe changes in the adjustment process, since those would be experienced as changes in the speed of development. Thus, people might more easily noticed the slowed adjustment toward a lower-density equilibrium, and might have failed to realize that the lower density equilibrium itself may be due, in part, to the growth management program. In other words, for those who are concerned with increasing the density of development, the favorable evidence related to Florida's growth management (slowed adjustment) might be more easily observed than the unfavorable evidence (lower population density equilibrium). The findings presented here suggest that the spatial impacts of the growth management program are complex and that a full analysis of the program, or, by extension, of land use regulation more generally, is best pursued within the context of a theoretical model that can illuminate the complexity of those impacts. Additionally, there is evidence, albeit indirect, of population growth spillovers that contribute to lower density equilibria. One of the motivations for a statewide program is to coordinate local land use regulation in a way that reduces the possibility of leapfrog and/or spillover growth from one jurisdiction to another. The fact that this paper and others have independently found evidence consistent with spillover growth in Florida suggests that, even under statewide programs, the problem of coordinating local land use decisions remain. Last, there is some evidence that employment adjustments grew faster during the growth management time period, and this countervailing (to the population density effect) impact deserves further investigation.

These conclusions do not imply a judgment about the desirability or undesirability of the Florida growth pattern — that would require a welfare analysis that is beyond the scope of this research. However, any welfare assessment would start by assessing the impacts of the *GMA* on growth patterns, which in-and-of-itself is a tricky matter. A key difficulty in this research area is determining the counterfactual: what would have happened absent the land use regulation? This paper argues that one method for determining that counterfactual, and for researching land use controls, is to adapt regional adjustment models. The results of the analysis suggest that the approach can play a useful role in studying the impacts of land use regulation.

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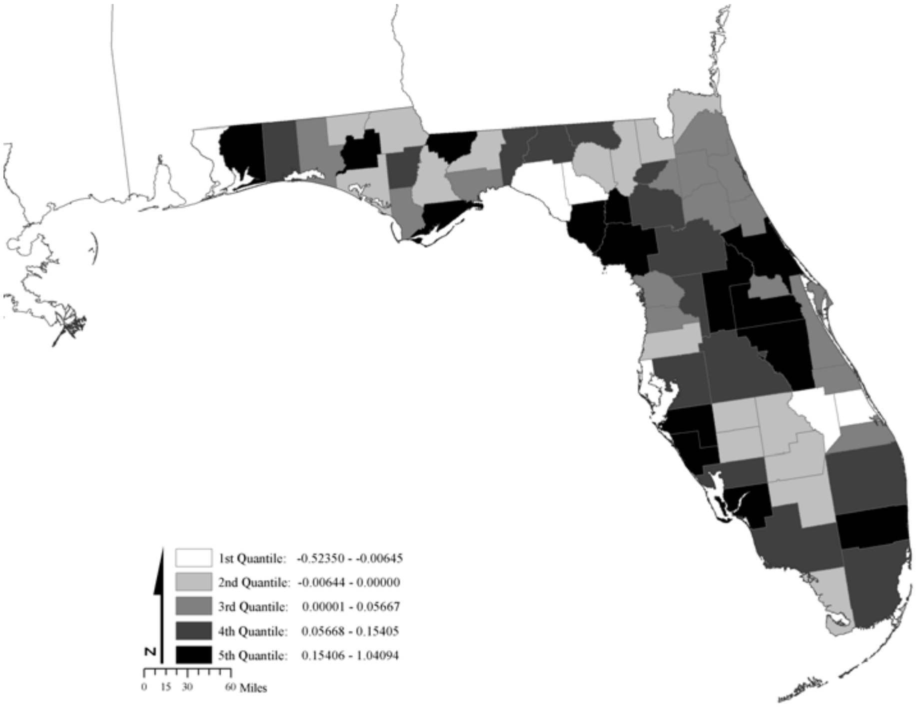

Figure 1. Spatial Distribution of *GM1*, population growth weighted

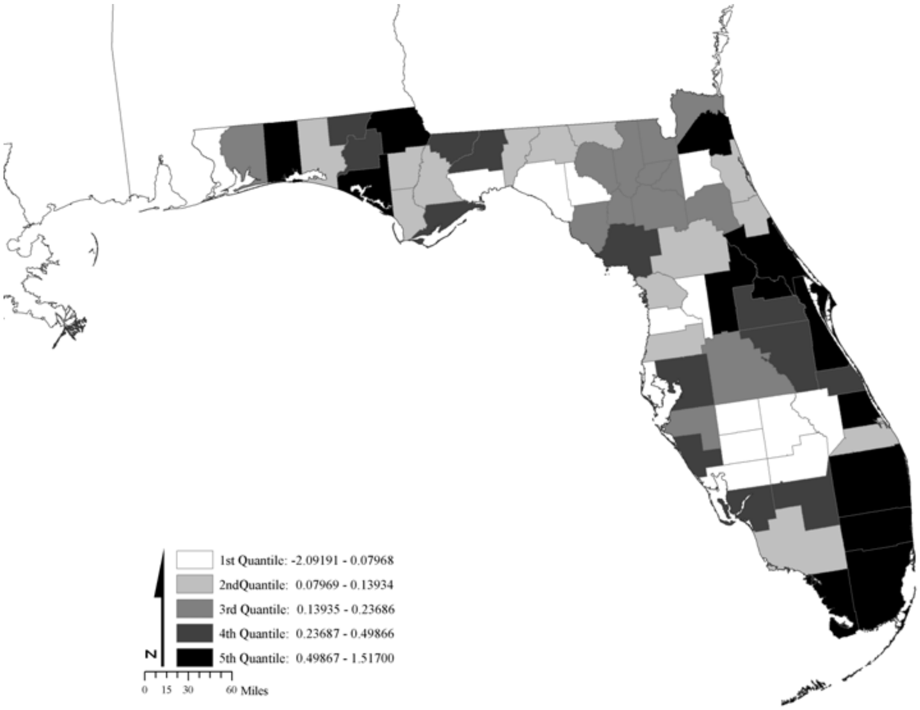

Figure 2. Spatial Distribution of *GM2*, population growth weighted

Table 1. Timeline of State Growth Management in Florida

Year	Event
1972	ELMS I – adoption of the *Environmental Land and Water Management Act*
1975	ELMS II – adoption of the *Local Government Comprehensive Planning Act*
1984	Adoption of the *State and Regional Planning Act*
1985	Adoption of the *Florida State Comprehensive Plan* and *Growth Management Act*
1991	ELMS III – Growth Management added to the *Florida State Comprehensive Plan*
1994	Evaluation of the *Florida State Comprehensive Plan*
1998	Re-evaluation of the *Florida State Comprehensive Plan*

Source: Growth Management Study Commission, *http://www.floridagrowth.org*.

Table 2. Summary Statistics on Submission and Compliance

Submission Dates and Compliance Status

Submission Dates

	Date	Municipality and County
Earliest Submission	8/23/88	Indialantic Town, Brevard County
25th percentile	8/31/89	Palm Beach County
Median Submission	7/19/90	Jefferson County
75th percentile	8/6/91	Tavares City, Lake County
Latest Submission	1/25/01	Islamorada, Monroe County

Percent of Municipalities Compliant, by County

	% Compliant	County
Minimum	0%	Several
25th percentile	15%	Seminole, Volusia
Median	40%	Clay, Duval, Flagler, Lee
75th percentile	50%	Several
Maximum	83%	Sumter

Empirical Measures of Compliance and Submission

GM1 — Compliance

	Growth Weighted		County Value
	Value	County	
Minimum	–0.524	Okeechobee	0
25th percentile	0.000	Several *	0
Median	0.043	Seminole	0
75th percentile	0.145	Miami-Dade	0
Maximum	1.041	Broward	1

GM2 — Submission (proportion of 1988-1997 time period with submitted plan)

	Growth Weighted		County Value	
	Value	County	Value	County
Minimum	–2.090	Hardee	0.566	Calhoun
25th percentile	0.090	Citrus	0.649	Jackson, Lake
Median	0.203	Gilchrist	0.723	Escambia
75th percentile	0.430	Gadsden	0.794	Indian, St. Lucie
Maximum	1.517	Broward	0.932	Brevard

Notes: Brevard, Broward, Jefferson, Manatee, Okeechobee, Pinellas, Sarasota, Seminole, Sumter, Taylor, Volusia, Washington Counties were compliant* counties with no compliant jurisdictions have zero value for growth-weighted GM1. Those counties are Baker, Bay, Columbia, DeSoto, Glades, Hardee, Hendry, Highlands, Holmes, Jackson, Leon, Liberty, Monroe, Nassau, Pasco, and Suwannee.

Table 3. Descriptive Statistics

	1982 – 1987				1987 – 1992				1992 – 1997			
	Mean	Std. Dev.	Min.	Max.	Mean	Std. Dev.	Min.	Max.	Mean	Std. Dev.	Min.	Max.
ΔPD	–0.19	0.38	–3.8	0.89	–0.16	0.30	–4.40	0.92	–0.18	0.21	–1.50	0.54
ΔED	0.00	0.17	–1.20	0.76	–0.05	0.26	–5.80	0.48	–0.04	0.15	–2.00	1.61
$PD_{t\text{-}5}$	0.93	0.70	0.10	10.39	0.93	0.72	0.10	10.83	0.88	0.58	0.08	5.02
$ED_{t\text{-}5}$	2.26	1.15	0.41	12.06	2.07	0.99	0.33	9.09	1.91	0.86	0.33	7.86
Natural Amenity Score	0.46	1.42	–2.90	6.05	0.46	1.42	–2.90	6.05	0.46	1.42	–2.90	6.05
Urban	0.29	0.46	0.00	1.00	0.29	0.46	0.00	1.00	0.29	0.46	0.00	1.00
Suburban	0.29	0.45	0.00	1.00	0.29	0.45	0.00	1.00	0.29	0.45	0.00	1.00
Exurban	0.30	0.46	0.00	1.00	0.30	0.46	0.00	1.00	0.30	0.46	0.00	1.00
Expenditure Per Student ($1,000)	2.10	0.84	0.24	15.17	3.08	0.92	0.62	10.61	4.53	3.74	0.20	86.72
General Revenue Per Person ($1,000)	0.82	0.03	0.07	4.32	1.18	0.42	0.13	5.64	1.61	0.55	0.22	6.10
Total Direct Expenditure Per Person ($1,000)	0.80	0.09	0.06	4.96	1.13	0.45	0.12	6.74	1.57	0.56	0.22	0.58
Total Taxes Per Person ($1,000)	0.20	0.09	0.02	0.73	0.30	0.14	0.04	1.31	0.45	0.21	0.07	1.70
Property Tax Per Person ($1,000)	0.15	0.08	0.01	0.67	0.22	0.12	0.01	1.12	0.32	0.19	0.02	1.55
Violent Crime Incidents Per Person	2.81E-03	2.70E-03	0.00	0.02	3.20E-03	3.05E-03	0.00	0.02	4.52E-03	3.98E-03	0.00	0.02
Property Crime Incidents Per Person	0.02	0.02	0.00	0.09	0.03	0.02	0.00	0.11	0.03	0.02	0.00	0.11
Per Capita Income ($1,000)	8.02	1.51	4.85	15.44	11.22	2.34	6.50	23.11	14.82	2.87	9.35	31.41
Percent Black	0.25	0.19	0.00	0.84	0.24	0.19	0.00	0.85	0.24	0.19	0.00	0.85
Percent White	0.75	0.19	0.15	1.00	0.75	0.19	0.14	1.00	0.72	0.20	0.01	1.00
Percent Manufacturing	0.43	0.18	0.02	0.88	0.39	0.17	0.02	0.91	0.37	0.17	0.02	0.89
Percent FIRE	0.05	0.02	0.01	0.28	0.05	0.03	0.01	0.49	0.04	0.02	0.01	0.14
Percent Retail	0.20	0.07	0.01	0.56	0.21	0.07	0.00	0.49	0.22	0.07	0.02	0.48
Percent Services	0.15	0.08	0.00	0.64	0.17	0.08	0.00	0.56	0.21	0.10	0.00	0.74
GM1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.18	0.24	0.00	0.91
GM2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.40	0.19	0.00	0.85

Notes: *PD* represents population density; *ED* represents employment density; GM1 represents the first growth management variable (see equation 6); GM2 represents the second growth management variable (see equation 7); and n/a denotes not applicable. Variables that are in levels are measured at the beginning of each five-year time period.

Table 4. Population Density Regression Results

Estimates												
	Growth-weighted *GM* Variables						County *GM* Variables					
	Base Model			Extended Model			Base Model			Extended Model		
	82 – 87	87 – 92	92 – 97	82 – 87	87 – 92	92 – 97	82 – 87	87 – 92	92 – 97	82 – 87	87 – 92	92 – 97
GM1	0.090	–0.168	–0.269	0.489	–0.119	–0.307	0.057	–0.087	–0.109	0.210	–0.065	–0.095
	(0.390)	(0.820)	(1.440)	(1.330)	(0.590)	(1.630)	(0.660)	(1.120)	(1.520)	(1.520)	(0.850)	(1.330)
GM2	0.032	–0.006	0.010	–0.176	–0.033	0.032	0.048	–0.220	–0.686	0.550	–0.263	–0.768
	(0.280)	(0.070)	(0.100)	(0.960)	(0.340)	(0.330)	(0.120)	(0.680)	(2.260)	(0.860)	(0.750)	(2.380)
Pop Density, t-5	–0.160	–0.185	–0.200	–0.264	–0.195	–0.203	–0.161	–0.189	–0.202	–0.263	–0.200	–0.206
	(7.460)	(10.900)	(13.770)	(5.020)	(8.820)	(11.960)	(7.430)	(11.290)	(13.940)	(5.030)	(8.920)	(12.270)
Pop Density · FL	0.114	0.051	0.096	0.143	0.029	0.099	–0.052	–0.143	–0.267	0.257	–0.106	–0.307
	(4.400)	(2.590)	(4.610)	(3.510)	(1.500)	(4.040)	(0.400)	(1.510)	(2.780)	(1.140)	(1.100)	(3.110)
GM1 · Pop Density	–0.050	0.055	0.127	–0.215	0.036	0.139	–0.057	0.025	0.042	–0.091	0.030	0.033
	(0.750)	(1.000)	(2.410)	(1.930)	(0.650)	(2.550)	(1.950)	(0.960)	(1.660)	(2.020)	(1.160)	(1.180)
GM2 · Pop Density	0.006	0.001	–0.019	0.087	0.015	–0.027	0.216	0.234	0.442	–0.111	0.172	0.506
	(0.130)	(0.020)	(0.530)	(1.210)	(0.400)	(0.750)	(1.400)	(1.960)	(3.750)	(0.420)	(1.390)	(4.150)
Observations	616	616	616	616	616	616	616	616	616	616	616	616
R^2	0.818	0.768	0.629	0.610	0.786	0.644	0.817	0.774	0.632	0.611	0.790	0.649
Diagnostics												
Robust LM — Lag	0.059	0.511	0.105	0.281	0.075	0.022	0.018	0.685	0.480	0.223	0.119	0.388
Robust LM — Error	0.903	0.014	0.580	0.365	0.792	0.142	0.793	0.009	0.821	0.268	0.953	0.817
Over-ID *p*-value	0.078	0.703	0.448	0.945	0.760	0.742	0.056	0.717	0.407	0.955	0.799	0.654
First-Stage F-test	9.670	54.020	11.650	9.650	47.750	8.270	9.740	54.370	12.180	9.090	43.590	7.790

Notes: Coefficients on other variables not shown — full results are available upon request from the authors; absolute values of t-statistics are shown in parentheses below coefficients.

Table 5. Employment Density Regression Results

Estimates	Growth-weighted *GM* Variables						County *GM* Variables					
	Base Model			Extended Model			Base Model			Extended Model		
	82 – 87	87 – 92	92 – 97	82 – 87	87 – 92	92 – 97	82 – 87	87 – 92	92 – 97	82 – 87	87 – 92	92 – 97
GM1	0.067	0.070	–0.139	0.101	0.090	0.124	0.020	0.069	–0.064	0.054	0.034	–0.061
	(0.620)	(0.520)	(0.710)	(0.600)	(0.810)	(0.510)	(0.470)	(1.280)	(0.820)	(1.060)	(0.730)	(0.720)
GM2	–0.026	–0.019	0.027	–0.037	–0.066	–0.049	0.227	0.112	0.248	0.196	–0.092	–0.249
	(0.530)	(0.340)	(0.400)	(0.500)	(1.230)	(0.740)	(1.310)	(0.530)	(1.030)	(0.960)	(0.450)	(0.720)
Emp Density, t-5	0.068	–0.279	–0.107	0.063	–0.329	–0.216	0.068	–0.284	–0.108	0.062	–0.337	–0.236
	(5.540)	(12.770)	(4.560)	(3.130)	(8.670)	(8.020)	(5.530)	(13.480)	(4.420)	(4.090)	(9.220)	(8.140)
Emp Density · FL	–0.030	0.012	0.117	0.078	0.009	–0.028	0.329	0.231	0.390	0.354	0.067	0.240
	(0.980)	(0.410)	(1.410)	(1.180)	(0.390)	(0.230)	(3.000)	(1.930)	(2.630)	(2.760)	(0.590)	(1.190)
GM1 · Emp Density	–0.050	–0.094	0.120	–0.130	–0.090	–0.144	0.001	–0.068	0.125	–0.026	–0.055	0.157
	(0.830)	(1.420)	(0.760)	(1.200)	(1.650)	(0.630)	(0.030)	(1.880)	(1.610)	(0.690)	(1.750)	(1.720)
GM2 · Emp Density	0.010	0.017	–0.044	0.034	0.039	0.028	–0.446	–0.264	–0.399	–0.413	–0.045	–0.128
	(0.250)	(0.440)	(0.770)	(0.560)	(1.010)	(0.400)	(3.310)	(1.630)	(1.760)	(2.670)	(0.280)	(0.390)
Observations	616	616	616	616	616	616	616	616	616	616	616	616
R^2	0.818	0.829	0.328	0.460	0.889	0.516	0.738	0.831	0.371	6915.000	0.888	0.187
Diagnostics												
Robust LM — Lag	0.816	0.187	0.222	0.161	0.842	0.010	0.720	0.271	0.470	0.296	0.842	0.188
Robust LM — Error	0.336	0.250	0.303	0.396	0.800	0.254	0.286	0.234	0.578	0.573	0.582	0.372
Over-ID *p*-value	0.000	0.242	0.040	0.002	0.163	0.306	0.000	0.270	0.020	0.012	0.129	0.417
First-Stage F-test	32.820	28.540	21.780	24.420	18.270	12.910	32.710	29.230	21.940	23.300	20.370	12.060

Notes: Coefficients on other variables not shown — full results are available upon request from the authors; absolute values of t-statistics are shown in parentheses below coefficients.

Table 6. Population Density Regression Results — Predicted GM Variables

Estimates												
	Growth-weighted *GM* Variables						County *GM* Variables					
	Base Model			Extended Model			Base Model			Extended Model		
	82 – 87	87 – 92	92 – 97	82 – 87	87 – 92	92 – 97	82 – 87	87 – 92	92 – 97	82 – 87	87 – 92	92 – 97
GM1-hat	0.974	0.460	0.333	0.147	0.783	0.241	–0.773	0.046	0.109	–0.176	0.013	0.016
	(1.230)	(0.650)	(0.500)	(0.120)	(0.980)	(0.340)	(1.120)	(0.080)	(0.190)	(0.170)	(0.020)	(0.020)
GM2-hat	–0.159	–0.046	–0.038	–0.017	–0.147	0.009	0.255	0.008	–0.030	0.125	0.041	–0.003
	(0.570)	(0.190)	(0.160)	(0.040)	(0.530)	(0.040)	(1.380)	(0.050)	(0.190)	(0.460)	(0.250)	(0.020)
Pop Density, t-5	–0.160	–0.185	–0.199	–0.261	–0.195	–0.198	–0.162	–0.188	–0.198	–0.258	–0.202	–0.203
	(7.430)	(10.910)	(13.540)	(5.070)	(8.790)	(11.240)	(7.550)	(11.360)	(13.420)	(5.190)	(9.230)	(11.600)
Pop Density · FL	0.092	0.040	0.105	0.143	0.030	0.108	0.095	0.007	0.087	0.173	0.005	0.086
	(3.850)	(2.300)	(4.660)	(3.550)	(1.770)	(3.680)	(2.990)	(0.310)	(3.420)	(3.170)	(0.240)	(2.700)
GM1 · Pop Density	–0.291	0.373	0.662	–0.844	0.053	0.760	–0.011	0.342	0.353	–0.545	0.253	0.368
	(0.770)	(1.140)	(2.170)	(1.450)	(0.160)	(2.370)	(0.040)	(1.420)	(1.470)	(1.180)	(1.030)	(1.390)
GM2 · Pop Density	0.139	–0.019	–0.139	0.192	0.041	–0.162	0.032	0.060	–0.009	0.006	0.045	–0.003
	(1.310)	(0.210)	(1.610)	(1.210)	(0.430)	(1.850)	(0.540)	(1.220)	(0.170)	(0.070)	(0.890)	(0.040)
Observations	616	616	616	616	616	616	616	616	616	616	616	616
R^2	0.819	0.771	0.620	0.631	0.789	0.633	0.817	0.777	0.616	0.633	0.796	0.639
Diagnostics												
Robust LM — Lag	0.016	0.515	0.383	0.292	0.056	0.253	0.017	0.584	0.436	0.390	0.098	0.185
Robust LM — Error	0.478	0.016	0.966	0.277	0.705	0.601	0.522	0.018	0.937	0.386	0.895	0.485
Over-ID *p*-value	0.096	0.732	0.366	0.936	0.766	0.677	0.081	0.774	0.341	0.934	0.822	0.668
First-Stage F-test	9.270	54.580	11.930	8.970	43.820	20.700	9.400	54.870	12.050	9.020	43.680	8.040

Notes: Coefficients on other variables not shown — full results are available upon request from the authors; absolute values of t-statistics are shown in parentheses below coefficients.

Table 7. Employment Density Regression Results — Predicted GM Variables

Estimates	Growth-weighted *GM* Variables						County *GM* Variables					
	Base Model			Extended Model			Base Model			Extended Model		
	82 – 87	87 – 92	92 – 97	82 – 87	87 – 92	92 – 97	82 – 87	87 – 92	92 – 97	82 – 87	87 – 92	92 – 97
GM1-hat	–0.536	–0.750	–1.038	–0.752	0.460	0.413	0.316	–0.130	–0.283	0.418	–0.562	–1.152
	(1.230)	(1.390)	(1.820)	(1.180)	(0.730)	(0.750)	(0.820)	(0.280)	(0.560)	(0.940)	(1.230)	(2.070)
GM2-hat	0.167	0.210	0.512	0.220	–0.180	–0.172	–0.052	0.028	0.164	–0.073	0.091	0.217
	(1.120)	(1.130)	(2.470)	(0.980)	(0.880)	(0.910)	(0.510)	(0.220)	(1.220)	(0.640)	(0.790)	(1.610)
Emp Density, t-5	0.069	–0.278	–0.117	0.065	–0.326	–0.231	0.069	–0.279	–0.112	0.063	–0.337	–0.239
	(5.620)	(12.550)	(6.010)	(3.470)	(8.880)	(10.060)	(5.590)	(12.930)	(5.490)	(4.200)	(9.120)	(9.690)
Emp Density · FL	–0.002	0.024	0.144	0.090	0.017	0.085	0.022	0.058	0.125	0.080	0.037	0.140
	(0.060)	(0.940)	(2.140)	(1.490)	(0.770)	(1.160)	(0.690)	(2.170)	(2.090)	(1.690)	(1.680)	(2.330)
GM1 · Emp Density	–0.086	–0.209	0.113	–0.527	–0.325	–1.108	–0.288	–0.524	0.519	–0.656	0.096	0.826
	(0.210)	(0.420)	(0.170)	(0.790)	(0.790)	(2.080)	(0.910)	(1.430)	(0.960)	(1.770)	(0.240)	(1.390)
GM2 · Emp Density	–0.132	–0.047	–0.280	–0.017	0.069	0.129	–0.097	–0.055	–0.190	–0.052	–0.076	–0.264
	(1.200)	(0.360)	(1.580)	(0.100)	(0.570)	(0.920)	(1.560)	(0.750)	(2.240)	(0.730)	(1.220)	(2.900)
Observations	616	616	616	616	616	616	616	616	616	616	616	616
R^2	0.736	0.828	0.386	0.520	0.889	0.597	0.737	0.829	0.388	0.694	0.887	0.476
Diagnostics												
Robust LM — Lag	0.737	0.177	0.269	0.188	0.796	0.049	0.773	0.297	0.558	0.235	0.551	0.463
Robust LM — Error	0.461	0.197	0.453	0.300	0.799	0.568	0.351	0.290	0.874	0.460	0.934	0.900
Over-ID *p*-value	0.000	0.201	0.031	0.014	0.954	0.276	0.000	0.245	0.040	0.010	0.116	0.153
First-Stage F-test	32.410	29.280	20.670	24.590	21.870	12.020	32.360	29.740	20.610	23.200	20.600	11.360

Notes: Coefficients on other variables not shown — full results are available upon request from the authors; absolute values of t-statistics are shown in parentheses below coefficients.