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ABSTRACT

This study analyzes the effect of impact fees in urban form and congestion through a combination of methods including econometric analysis, GIS techniques, and interviews with planning officials. The results show that there is some evidence that impact fees might be reducing congestion by creating disincentives for overall development and job creation. However, direct evidence of a negative effect of impact fees in development and job growth was not found. There is no evidence that the difference of impact fees between central cities and outer areas is sufficient to promote more compact urban form. Likewise, there is no evidence that more road impact fees are decreasing congestion through more investment in infrastructure. This might be because impact fees usually finance local roads but congestion is concentrated in freeways and arterials, or because there is a spatial, temporal or financial mismatch between impact fee revenues and the costs of infrastructure. There is a clear, significant and substantial positive relationship between density and congestion suggesting a weak increase in transit use in denser environments or a potential increase in automotive travel through higher trip frequency. However, other urban form variables related to the distribution of that density have a negative effect in congestion indicating that certain urban configurations could decrease congestion. Finally, changes in congestion are negatively correlated with the congestion levels at the beginning of the period suggesting that congestion is increasing faster in those areas that used to be less congested.

EXECUTIVE SUMMARY

This study addresses three research questions: (1) What is the effect of impact fees on residential and employment urban form? (2) What is the effect of urban form on traffic congestion? (3) What is the effect of impact fees on traffic congestion? Based on the literature review specific hypotheses are defined and tested through a combination of methods such as econometric analysis and case studies including GIS techniques and interviews with planning officials.

The econometric models show that there is some evidence of a growth control effect. This suggests that impact fees might be reducing congestion by creating disincentives on residential development and job growth. There is no evidence of a location change effect, which implies that the difference of impact fees between central cities and outer areas is not enough to promote more 'compactness'. Likewise, there is no evidence of a revenue effect, meaning that more road impact fees are not decreasing congestion through more investment in infrastructure. This might be because impact fees usually finance local roads but congestion is concentrated in freeways and arterials, or because there is a spatial, temporal or financial mismatch between impact fee revenues and the costs of infrastructure. There is a clear, significant and substantial positive relationship between density and congestion indicating a weak increase in transit use in denser environments or a potential increase in automotive travel through higher trip frequency. However, other urban form variables related to the distribution of that density have a negative effect in congestion indicating that certain urban configurations could decrease congestion. Finally, changes in congestion are negatively correlated with the congestion levels at the beginning of the period suggesting that congestion is increasing faster in those areas that used to be less congested.

The GIS analysis shows that impact fees are not likely to be an important factor of location since the spatial patterns of residential, commercial, and industrial new developments are not related with areas of low impact fees. This makes unlikely an effect of impact fees in urban form and congestion based on location changes. The interviews with planning officials revealed perceptions that impact fee charges are not high enough to produce a change in development location or a decrease in congestion. In terms of location other factors such as land values or the conditions of the final demand are more relevant. Regarding congestion, other interventions such as transit promotion or traffic management systems are deemed more effective. A modification of local governments' impact fee policies can enhance the effectiveness of impact fees for controlling urban development and congestion. In this sense, it is recommended to define the amount of impact fees based on the actual road construction costs. In addition, to improve the effectiveness of impact fees, inter-governmental coordination and collaboration might be important to minimize the temporal and spatial mismatches in the supply and demand of road infrastructure. Another important consideration is that increases in the compactness of urban form need to be accompanied by more efforts to promote public transit in order to decrease congestion. Therefore, a shift from road impact fees to more flexible mobility fees could be an effective congestion mitigation strategy.

CHAPTER 1 BACKGROUND

1.1. INTRODUCTION

Impact fees can be defined as "a total or partial payment to local governments for the cost of additional public facilities necessary as a result of new development" (Florida Impact Fee Review Task Force, 2006: 2). Impact fees are financial tools to generate revenue to construct or improve public facilities such as roads, water/sewer, parks and schools for serving new development. This tool is now widely used by local governments in Florida. According to the Florida Office of Economic and Demographic Research (EDR), as of 2009, 40 counties and 180 municipalities reported impact fees revenues, almost doubling the number since 1993. Initially, impact fees were seen as an effective way for solving fiscal problems, increasing revenues, and funding public infrastructure (Nicholas, 1987). Indeed, local governments in Florida accumulated more than $11.4 billion in revenues from impact fees from 1993 to 2009. From this accumulated total more than one third corresponded to impact fees related to transportation. Presently, however, impact fees are not only considered an effective tool in urban planning because of their ability to generate revenue but also because of their potential to affect urban growth patterns. In terms of growth management, impact fees could be effective in controlling growth rates and development location. First, impact fees can reduce growth rates by increasing the costs of development in a given region (Skidmore and Peddle, 1998; Burge et al., 2007). Second, impact fees, when properly defined, can increase the relative cost of land development in the urban fringe compared to urbanized areas, thus changing the traditional incentives to urban sprawl produced by the under-pricing of fringe infrastructure and promoting more compact cities (O'Sullivan, 2009). In other words, impact fees could increase densities and encourage compact

city development because they could increase the marginal cost of development in the urban fringe (Bluffston et al., 2008; Turnbull, 2004; Anderson, 2005).

By incentivizing compact development, impact fees could be an effective way to reduce congestion. As some authors suggest, compact cities incentivize transportation alternatives by decreasing the reliance in the automobile (Cervero and Duncan, 2006; Chatman, 2008; TRB, 2009). Accordingly, the increased compactness achieved through impact fees could decrease congestion. However, impact fees could increase the supply of developable land and then promote sprawl because developers can 'buy out' the infrastructure requirements (Burge et al., 2007; Degrove, 1992; Downs, 2003). Also, some researchers argue that compact development does not guarantee the reduction of congestion because of increases in trip frequency and delays per capita (Chatman, 2008; Crane, 1996; Krizek, 2003; Sarzynski et al., 2006; Shiftan, 2008). Therefore, the effect of impact fees on congestion throughout urban form is an open question.

For these reasons estimating the effect of impact fees on urban form and the effect of urban form on congestion are critical elements to analyze the potential of impact fees as a congestion mitigation strategy. This research provides empirical evidence of this potential by analyzing the effects of impact fees in growth management and transportation-related revenue in Florida. To that end, three questions are addressed: (1) What is the effect of impact fees on residential and employment urban form? (2) What is the effect of urban form on traffic congestion? (3) What is the effect of impact fees on traffic congestion? To answer these questions econometric regressions and case studies, including GIS analysis and interviews, are conducted.

Based on the literature review and the theoretical framework, this study hypothesizes that impact fees can decrease congestion through three effects: (1) Growth Control Effect: by

increasing the cost of development in the region, impact fees can hinder growth and decrease congestion. (2) Location Change Effect: if impact fees in the central city are lower than in the rest of the region, they can incentivize compact development, thereby decreasing congestion by promoting less travel and more use of transit. (3) Revenue Effect: by increasing the revenues to invest in transportation infrastructure, impact fees could decrease congestion by increasing the supply of roads. The results of the analysis provide some evidence of growth control effect and no evidence of the location change or the revenue effects. Since decreasing congestion by creating disincentives for development in the region is clearly suboptimal, there is a pressing need to design impact fee policies that can improve the urban form and the transportation infrastructure. Increasing the amount of impact fees and the collaboration among jurisdictions could make this policy an effective mechanism for growth management and congestion mitigation.

In the following section of this chapter the theoretical framework, including the literature review, is summarized. In chapter 2, the research approach is described, including the source of data, the process of operationalization of the main variables, and the methods of analysis. In chapter 3, results and findings of the analyses are summarized and analyzed. Finally, implications and limitations of the study are discussed in chapter 4. In addition, the report includes appendices presenting important additional information for the development of this research.

1.2. THEORETICAL FRAMEWORK

1.2.1. THE EFFECT OF IMPACT FEES ON URBAN FROM

Burge et al. (2007) summarize the theoretical debates regarding the effect of impact fees on housing construction (and by implication on urban form) as follows: on the one hand, impact fees can reduce new housing construction because they increase development costs. On the other hand, impact fees can increase housing production by increasing the supply of developable land since they can increase the probability of project approval and reduce the exclusionary barriers to development (Nelson et. al, 1992).

The idea that impact fees can decrease housing construction is supported by theories that view impact fees as a growth management tool that can help to control sprawl by creating incentives to move development location from the urban fringe to inner areas (Bluffstone et al., 2008; O'Sullivan, 2009). Bluffstone et al. (2008) provide a conceptual microeconomic explanation about the relationship between impact fees and sprawl as described in Figure 1-1. According to these authors, in a free market developers may develop land up to point A, where marginal benefit equals zero because they will get a positive return by doing it. However, at this point the marginal social cost derived from the development is higher than the marginal benefit of the development. Accordingly, sprawl can be defined as the development taking place beyond the optimum point B, where marginal social cost and marginal benefit is the same. The difference between marginal social cost and marginal benefit beyond B point is the negative externality caused by sprawl. The development fees can increase the cost of development (internalizing the negative externality by making the marginal social cost a private cost for the developer), moving the equilibrium point from A to B. As a result, impact fees can reduce sprawl.

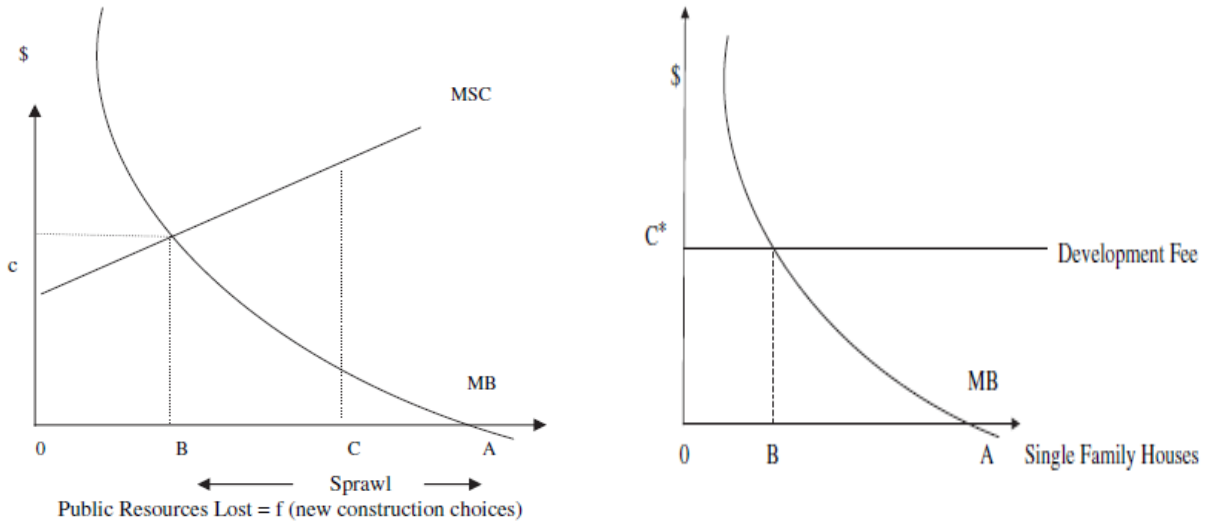


Figure 1-1. Sprawl and Impact fees (Source: Bluffstone et al. (2008, p. 435, 443))

In contrast, the idea that impact fees can increase housing production and stimulate sprawl are supported by theories stating that developers can "buy out" the infrastructure required for their development, specifically for road infrastructure (Downs, 2003). Indeed, even if developers pay the road infrastructure cost to mitigate their developments' impact, the roads are not often constructed due to "high costs or community opposition", so the forced fees to improve road capacity can be considered "legally bribing" in Florida's concurrency system (Downs, 2003:14). In addition, in some cases, impact fees are not a high cost burden to developers. For instance, total impact fees imposed on a single family housing unit in Orange County in Florida are less than $6,000 and this amount is only about 4% of the median sale price. Also, developers can pass the cost burden from the impact fees to buyers of the property in certain market conditions, especially when demand is inelastic (Burge et al., 2007). In sum, if developers can easily buy out infrastructure requirements through impact fees, particularly in the urban fringe, impact fees can aggravate sprawl.

Different empirical studies support both sides of this debate. Some studies show that impact fees can reduce residential development. For example, Skidmore and Peddle (1998) analyze the effect of impact fee on residential development in DuPage County, Illinois between 1977 and 1992. The authors operationalize impact fees using dummy variables at the level of municipalities and show that the adoption of impact fees can decrease rates of residential development. Based on these results, they suggest that impact fees are an effective growth management tool that can reduce the rate of development and ensure the supply of infrastructure. Similarly, Mayer and Somerville (2000) analyze the effect of land regulation, including impact fees on new housing construction between 1985 and 1996, for 44 Metropolitan Statistical Areas (MSAs). They find that impact fees can decrease new housing production, but the effect is relatively small. The results imply that if local governments adopt higher impact fees on urban fringes than in the central city, the residential development on urban fringe -sprawl- can decrease. However, these studies do not consider the actual location of residential developments within the metropolitan areas and how this is correlated to the impact fee policy.

Other studies show that impact fees can increase residential development in certain conditions. For instance, Burge and Ihlanfeldt (2006a,b) consider the location of new housing construction and how it is affected by impact fees. Burge and Ihlanfeldt (2006a) analyze multifamily housing construction between 1995 and 2004 for 33 MSAs in Florida. The authors argue that water-sewer impact fees decrease multifamily housing construction in all areas, but non-water-sewer impact fees such as road impact fees increase multifamily housing construction at inner suburbs.[1] Similarly, Burge and Ihlanfeldt (2006b) analyze single family housing

[1]Burge and Ihlanfelt (2006a,b) divide (non) urbanized areas into four areas: central city, inner suburban, outer suburban, and rural area. Inner suburban is the area of the counties that includes the central city but is located outside of central city. Outer suburban

construction between 1993 and 2003 for 41 counties in Florida. They find that non-water-sewer impact fee could increase the production of all sized single family homes at inner suburban counties and the production of medium and large sized single family housing at outer suburban counties. These results support the theoretical argument that impact fees can increase housing construction in suburban areas by increasing the supply of developable land. However, the geographical definition of development location (such as inner suburbs and outer suburban) is too broad to explain the effect of impact fees on development location. Also, they do not address the difference in impact fee policies among local governments within the same counties or MSAs.

In sum, there is debate over the effect of impact fees on urban form. From a traditional point of view, impact fees can reduce new housing construction by adding additional infrastructure costs. In contrast, recent theories insist that impact fee could increase new housing production by increasing the supply of buildable land and consumer's valuing on infrastructure (Burge et al., 2007). At the center of this debate is the effect of impact fees on the location decision of developers. If they change their decision about the quantity and location of development by considering impact fees, then urban form will be affected by those changes.

1.2.2. THE EFFECT OF URBAN FORM ON CONGESTION

There is a growing body of literature studying the effect of the built environment on travel behavior and congestion. Some authors stress that compact development and high densities can decrease auto use and, by implication, alleviate congestion. Cervero and Duncan (2006) show that mixed land uses, where work places and retail shops are located in proximity to housing, can reduce motorized travel. Chatman (2008) and Crane and Crepeau (1998)

is the area of counties within the MSA that do not contain the central city. Rural area is the area of counties that are not located in MSA.

demonstrate that compact cities generate less trips and less Vehicle Miles Traveled (VMT). Holtzclaw et al. (2002) provide evidence that higher residential densities decrease the average VMT and the number of vehicles per household. TRB (2009) argues that doubling residential density across metropolitan area might decrease VMT by approximately 5 to 12%.

However, as noted earlier, researchers have cast doubts about the potential of compact development to decrease congestion. Shiftan (2008) argues that compact development generates more travel since higher accessibility might create a tendency to commute not only at peak periods but also during other times of the day. Chatman (2008) and Sarzynski et al (2006) also imply that high density development could increase delays per capita depending on the urban configuration. Moreover, increased accessibility could generate more trips (Crane, 1996; Krizek, 2003; Sarzynski et al, 2006; Shifttan, 2008) and even when land use strategies actually decrease automobile use they would do so only by an insignificant amount (Handy, 2005).

Only Sarzynski et al. (2006) directly address the relationship between urban form and congestion. These authors analyze the effect of seven dimensions of urban form -density, concentration, continuity, centrality, proximity, mixed use, and nuclearity- on the change in congestion level between 1990 and 2000 for 50 large MSAs in the U.S. The results show that density and continuity increase ADT/lane and delay per capita. In addition, housing centrality increases delay per capita. In other words, the denser built environments with housing located close to the CBD can increase congestion in terms of traffic volume and delay time. In contrast, more housing-job proximity can reduce commute time because the closeness between jobs and housing decrease physical commuting distance. These results imply that the effect of urban form on congestion varies depending on the dimension of urban form that is being analyzed and the way congestion is measured.

1.2.3. THE EFFECT OF IMPACT FEES ON CONGESTION

To our knowledge there is no study that directly examines the effect of impact fees on congestion. In order to conceptualize this effect our study identifies 3 theoretical hypotheses linking impact fees, urban form, and congestion: the growth control effect, the location change effect, and the revenue effect. Regarding the **growth control effect**, the increased development cost caused by the implementation of impact fees in a given region can decrease growth rates because developers may reduce their investment and move to other regions with relatively lower development costs. If all other things are equal, the decrease in development implies less creation of trip generators, such as housing and shopping malls, and less demand for travel. Therefore, the higher impact fees may decrease congestion level. This effect can be thought as a case of 'throwing out the baby with the bath water' since it is getting rid of something generally considered problematic (congestion) by eliminating something that is not intrinsically bad (development). For this reason, this effect is not considered the optimal way to deal with congestion through impact fees.

In regards to the **location change effect**, as it was suggested in the introduction section, impact fees could decrease congestion by encouraging compact city development. Specifically, impact fees could promote urban infill development and discourage sprawl. This is because impact fees can increase the relative costs of development in the urban fringe compared to the costs in urbanized areas that already have infrastructure. The improved compactness of urban form through impact fees may reduce congestion by decreasing VMT and by increasing the feasibility of alternatives to the automobile. Since this effect is solving congestion by modifying

its underlying cause, the dependency on automotive travel, it is considered the most efficient way to use impact fees to decrease congestion. In addition, this effect is conducive to other benefits commonly associated with dense environments: more economic productivity, less energy consumption, and lower greenhouse emissions. It is important to note that this effect assumes that more compact built environments generate less congestion, something that has been debated in the literature. For this reason, the relationship between urban form and congestion will also be analyzed empirically in this study.

In terms of the **revenue effect**, increased revenue by road impact fees could mitigate congestion by increasing the supply of transportation infrastructure in a timely manner. This effect follows the traditional intervention of 'building our way out of congestion'. This strategy has been criticized through what has been termed 'the law of peak hour congestion', which conceptualizes traffic as a self-balancing system where increments in the system capacity induce more traffic from a latent demand (Vickrey, 1969). For this reason, this effect is considered less efficient than the location change effect. Figure 1-2 represents the three hypothesized effects of impact fees on congestion.

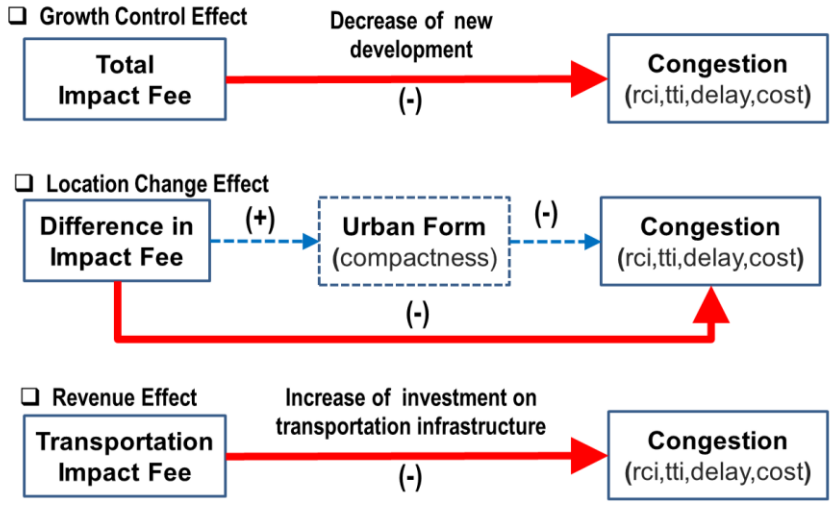


Figure 1-2. Conceptualization of the effect of impact fees on congestion

In addition to the empirical examination of whether these hypothesized effects exist, this study evaluates the hypothesis that impact fees imposed on residential development might have larger effects on urban form than other impact fees imposed on commercial development and industrial development. This hypothesis is derived from the theoretical proposition that the location of commercial and industrial development is more limited than the location of residential development because of their dependence on several location specific factors, such as market conditions, agglomeration economies, delivery costs, and community opposition against non-residential development. From the case studies, these effects of impact fees on different development types are analyzed using GIS techniques.

CHAPTER 2 RESEARCH APPROACH

2.1. METHODOLOGY

2.1.1. DATA

The unit of observation for this study is defined at the level of counties and is restricted to those counties that were part of MSA's in Florida in 2006. Originally, 46 counties were included in the boundaries of MSAs in 2006 but six counties -Baker, Gadsden, Hardee, Hendry, Okeechobee, and Sumter- lack data about congestion.[2] As a result, a total of 40 counties are used in the analyses related to residential urban form. In addition six other counties -Columbia, De Soto, Highlands, Monroe, Nassau, and Putnam- have limitations on the availability of data to operationalize employment urban form.[3] For this reason, 34 counties are used as a sample for the analyses related to employment urban form. The counties in Florida are illustrated in Figure 2-1.

The data for variables representing impact fees, urban form, and congestion from 2000 to 2006 are gathered from different sources and aggregated to county level. The time span - 2000 and 2006 - is defined based on available data sets.[4] The yearly aggregated data for impact fees per municipalities and counties are provided by the Florida Office of Economic and Demographic Research (FEDR) website. For measuring residential urban form and new development between 2000 and 2006, property tax rolls from the Florida Department of Revenue (FDOR) are used. Employment urban form is measured using the number of employee data from

[2] Our indicators for congestion are based on freeways and major arterials and these counties do not have urban arterials.
[3] In these counties, the Census Transportation Planning Package does not provide the information of the number of jobs for some census tracts.
[4] As of 2010, the Florida Office of Economic and Demographic Research (FEDR) provides data for impact fee revenues from 1993 to 2006. Thus, the ending point of the analysis is 2006. Also, the CTPP data is only available at 1990 and 2000 so that the starting point of the analysis is 2000. In March in 2011, impact fee data for 2009 was updated. However, the data measuring congestion was only available up to 2007. Therefore, it was not possible for the research team to use the more recent data on impact fees.

the Census Transportation Planning Package (CTPP) in 2000, and the Longitudinal Employer-Household Dynamics dataset (LEHD). To measure congestion, the information from the research project "The Economic Cost of Traffic Congestion in Florida", funded by the Florida Department of Transportation (FDOT), is used. For the control variables included in the econometric analyses, information from Census 2000, American Community Survey 2006, government expenditure data from the FEDR, and other relevant sources are used.

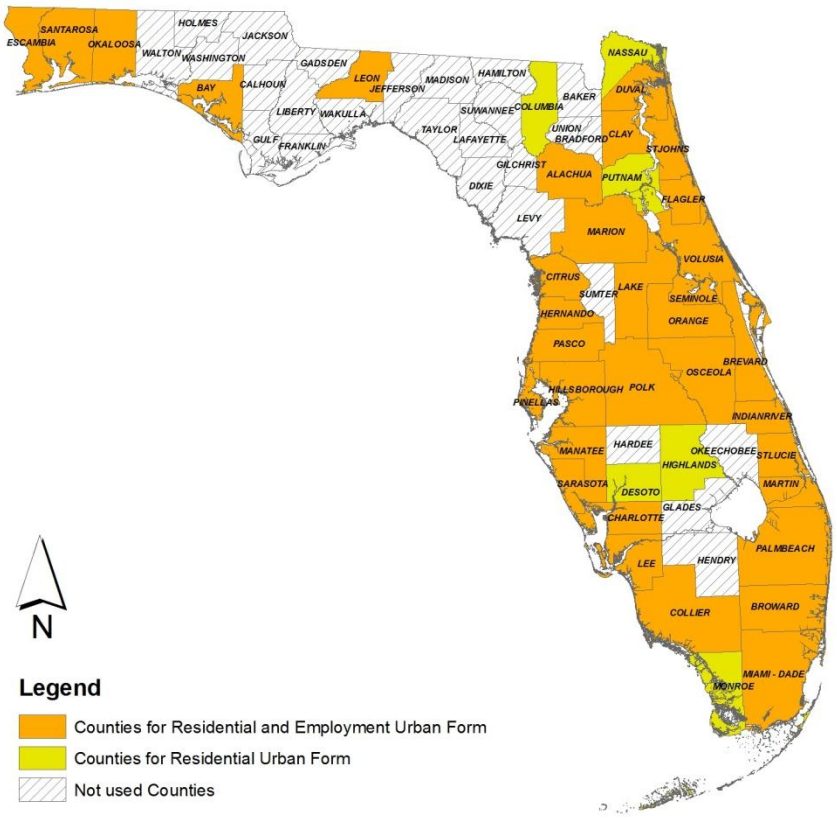


Figure 2-1. A Map of Counties in Florida

2.1.2. OPERATIONALIZATION OF IMPACT FEES

In order to represent the three different hypothesized effects of impact fees on congestion (growth control effect, location change effect, and revenue effect) this study operationalizes

impact fees creating three different indicators: Intensity of Impact Fee (IIF), the Difference of Impact Fee (DIF), and the Transportation Impact Fee Revenue (TIFR)

Intensity of Impact Fee (IIF) represents the total magnitude of impact fees in a given county. Its objective is to capture the growth control effect by comparing different impact fee charges per county. It is very difficult to operationalize this indicator directly by using the actual rates because they vary not only among counties, but also among municipalities within the same county. In addition, the rates could also be different within the same local government according to the development type and location. Moreover, impact fee policies of local governments are often modified over time. For this reason, this study uses the aggregated impact fee per growth per county. The operationalization of IIF is expressed in equation (1)[5].

$$\mathrm{IIF} = \frac{\sum_{i=1}^{m}\sum_{t=1}^{n}\text{impact fee}_{it}}{\frac{\text{total newly built floor area}}{1000}} \quad (1)$$

Where i = municipalities including unincorporated area
t = 2000 ~ 2006

Where the IIF is the sum of payments from impact fees divided by the number of 1,000 ft^2 of new developments[6] in a given county. In this indicator, all impact fees and newly built floor areas between 2000 and 2006 are aggregated.

[5] All types of impact fees are aggregated into total impact fee. The categories of county and municipality impact fees used in this study are determined by the State Uniform Accounting System Manual (SUASM) in Florida. They are public safety (law enforcement, police, fire), physical environment (water, sewer, storm water, and solid waste), transportation (roads, and transit), economic development (industry development, and housing and urban development), human services (office of public health), culture/recreation (libraries and parks), and others. In addition, school impact fee and impact fee reported from independent special district such as, water control and fire control district, are also used in calculating total impact fee.

[6] Total newly built floor area is measured by aggregating the floor areas of new construction built from 2000 to 2006. If a property is renovated, the property is excluded from the new construction because impact fees are not charged to the renovated property.

The Difference of Impact Fee (DIF) represents the difference of impact fees among local governments within the same county. Conceptually it can represent the location change effect. Figure 2-2 shows the basic rationale behind this indicator. If all other things are equal, and there is no difference in impact fee charges between central areas and outer areas, there are no incentives to change development location (cases 1 and 2 in Figure 2-2). But, if the impact fee charges in the central city are larger than that of the rest of the county, more development may be concentrated outside the central city because there the cost of construction would be lower, all other things being equal (case 3 in Figure 2-2). In contrast, if the impact fee charges in the central city are less than that of the rest of the county, more development may occur in the central city (case 4 in Figure 2-2).

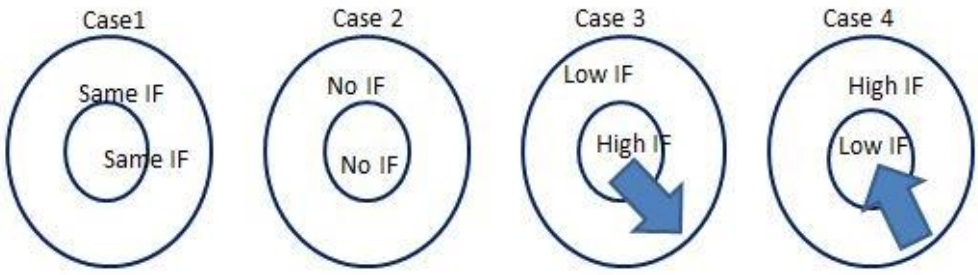


Figure 2-2. Conceptualization of the effect of impact fees on development location

These relative differences in impact fees between local governments within the county could be a driving force for the change in urban form. DIF is operationalized as the difference of the Intensity of Impact Fee between the central city and areas outside the central city. In using this variable, this study assumes that outside areas of central city tend to be suburban or urban fringes compared to the central city. DIF is represented in equation (2).[7] A DIF higher than zero

[7] Unlike aggregated total impact fees used in IIF, school impact fees and impact fee revenue from independent special districts are not applied in calculating DIF. Generally, since school impact fee is gathered throughout county,

means that impact fees are higher outside the central city, thereby representing potential for compact development.

$$\text{DIF} = \text{IIF}_{\text{outside areas of central city}} - \text{IIF}_{\text{central city}} \quad (2)$$

The Transportation Impact Fee Revenue (TIFR) represents the magnitude of transportation impact fees. It is related to the revenue effect because transportation impact fees (road impact fees in particular) are monies earmarked to fund transportation infrastructure. To operationalize this indicator the total revenue from transportation impact fees is divided by the change in number of housing units between 2000 and 2006 in order to normalize the different size and growth among counties. Unlike IIF, in normalizing transportation impact fee, TIFR uses the change in housing units instead of newly built floor areas. This is because trip generation varies depending on land use of new developments, so simply aggregated newly built floor areas are not adequate to explain the potential increase in demand for transportation infrastructure. Increase in the number of housing units can represent the potential demand for transportation infrastructure in a better way because the unit of travel activity is the household (or the person). TIFR is represented in equation (3)

$$\text{TIFR} = \frac{\sum_{i=1}^{m}\sum_{t=1}^{n} \text{transportation impact fee}_{it}}{\text{increase in number of housing units between 2000 and 2006}} \quad (3)$$

Where i = municipalities including unincorporated area
t = 2000 ~ 2006

dividing the school impact fee revenue for central city areas and out-side central city areas is not possible with the available data set. Thus, this study assumes that the amount of school impact fees are same regardless of location (central city areas or outside of central city areas). Also, data for the geographical boundaries of the independent special districts are not available so the impact fee revenue from independent special districts is excluded in calculating DIF.

2.1.3. OPERATIONALIZATION OF URBAN FORM

As stated above, previous studies have demonstrated that the relationship between urban form and congestion changes according to the dimension that is being analyzed. For this reason, this study applies various measurements of urban form and congestion to examine the effects of compact urban form on congestion. In terms of urban form, this research adopts the methodologies for measuring urban form established by Galster et al. (2001), Cutsinger et al. (2005), and Sarzynski et al. (2006). These authors propose seven dimensions to measure urban form: density, continuity, concentration, clustering, centrality, nuclearity, mixed-use, and proximity. Among those, this study uses four measures that are relevant to the level of 'compactness' of residential and employment urban form: density, concentration, centrality, and proximity for both housing and jobs[8]. In addition to these measures, two other indicators, job-housing ratio and job-housing distance, are used to explain the effect of job-housing balance on congestion.

Defining "urbanized area" is critical in the process of operationalization urban form because not all the land in a county has urban characteristics. Cutsinger et al. (2005) introduce the concept of Extended Urbanized Area (EUA) to capture the actual area that has urban characteristics. They define the EUA as "the Census Bureau-defined urbanized area, as well as each additional outlying square-mile cell comprising the metropolitan statistical area that has 60 or more dwelling units and from which at least 30% of its workers commute to the urbanized area" (Cutsinger et al., 2005: 237). Considering this definition and data availability, this study defines EUA as the Census Bureau designated urban areas and the adjacent square miles cells

[8] In this paper, residential urban form and housing urban form are used interchangeably. Also, employment urban form and job urban form are interchangeably used.

that have over sixty dwelling units[9]. The sixty dwelling units threshold is based on the range between the minimum suburban density, which is 1 unit per 10 acres, and the maximum exurban density, which is 1 unit per 11 acres as defined by Theobald (2001).

Based on the EUA, this study applies the operationalization of urban form measurements developed by Sarzynski et al. (2005) for housing and jobs (separately). First, density is defined as "the degree to which the housing units and jobs within the EUA are developed in an intensive manner relative to land area capable of being developed". Housing (or job) density is operationalized as "the average number of housing units (or jobs) per square miles of developable land in the EUA" (Sarzynski et al., 2006: 613). The following figure represents the concept of density according to Galster et al (2001).

[9] There are several differences in the operationalization of the EUA in this study in relation to previous methodologies to measure urban form in Galster et al. (2001), Cutsinger et al. (2005), and Sarzynski et al. (2006). First, we use different datasets to calculate housing units and jobs for each County. As noted earlier, the residential units for each cell are estimated from property tax rolls of FDOR. With regard to employment, Census Transport Planning Package (CTPP) for 2000 and Longitudinal Employer Household Dynamics (LEHD) for 2006 are used to calculate employment urban form. Second, the observation of this study is counties as opposed to MSAs in Sarzynski et al. (2006). Third, this study uses a different way to distinguish the undevelopable and undeveloped land categories to estimate the actual land area that is used to calculate density. Specifically, this study identifies national and regional water bodies and wetlands as undevelopable land using the data from the Florida Geographic Data Library (FGDL) as opposed to Sarzynski et al (2006) use of the1992 National Land Cover Database (NLCD). This source provides information about thirty-square meter land pixels in which they categorize land into developed land, undeveloped land, and undevelopable land. The undevelopable land contains open water; perennial ice and snow; woody wetlands; and emergent herbaceous wetlands. When defining EUA areas, Sarzynski et al (2006) exclude "undevelopable land".

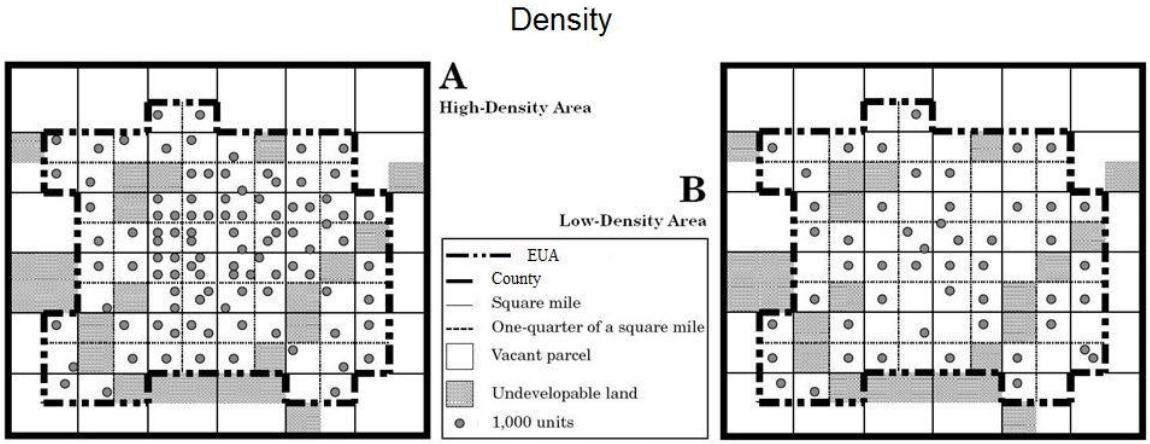


Figure 2-3. Visual representation of density (Source: Galster et al. (2001: 689))

Second, concentration is defined as "the degree to which housing units and jobs are located disproportionately in a few square-mile cells within the EUA". Housing (or job) concentration is operationalized as "the percentage of housing units (or jobs) that would need to move in order to produce an even distribution of housing units (or jobs) within square-mile units of developable l and across the EUA" (Sarzynski et al., 2006: 613). Figure 2-4 represents the concept of concentration.

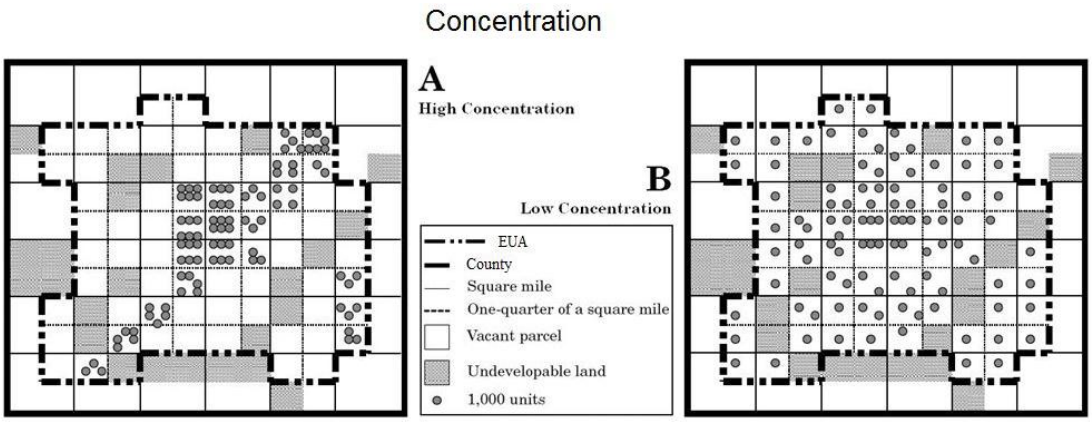


Figure 2-4. Visual representation of concentration (Source: Galster et al. (2001: 692))

Third, Sarzynski et al. (2005: 613) describe centrality as "the degree to which a land use is located near the core of the EUA." and define the core of the EUA as the "location of city hall of major central city for each metropolitan area". Housing (or job) centrality is operationalized as "the ratio of the average distance to city hall from the centroids of the grids comprising the EUA to the average distance to city hall of a housing unit (or a job) within the EUA" (Sarzynski et al., 2006: 613). Figure 2-5 represents the concept of centrality.

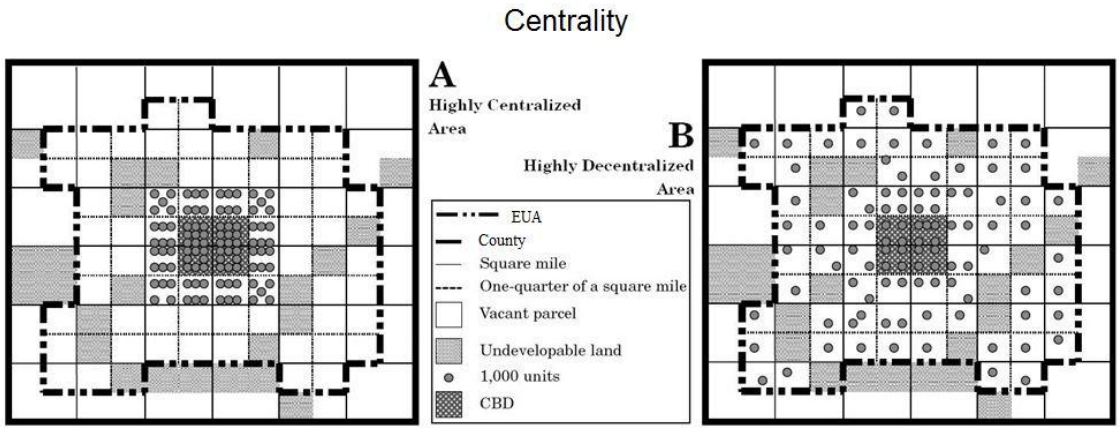


Figure 2-5. Visual representation of centrality (Source: Galster et al. (2001: 695))

Fourth, proximity is defined as "the degree to which housing units or jobs are close to each other across the EUA, relative to the land area of the EUA". (Sarzynski et al., 2006: 614). Housing (or job) proximity is operationalized as "the ratio of the average distance among centroids of square-mile cells in the EUA to the weighted average distance among housing units (or jobs) in the EUA" (Sarzynski et al., 2006: 614). Figure 2-6 represents the concept of proximity.

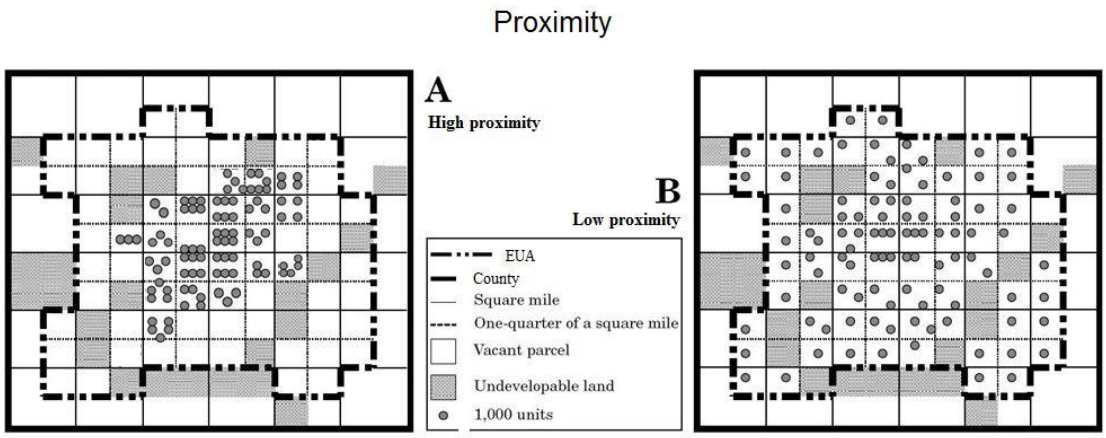


Figure 2-6. Visual representation of proximity (Source: Galster et al. (2001), modified.)

Finally, regarding job-housing balance, two measurements are used: job-housing ratio and job-housing distance. Job-housing ratio is operationalized by dividing the number of jobs within the EUA by the number of housing units within EUA. If the ratio is higher than 1, there are more jobs than housing units. A higher job-housing ratio indicates, all other things being equal, that employees inside the EUA have a higher tendency to reside outside the EUA. Job-housing distance is defined as the average distance between job and housing weighted by the number of commuters. The larger job-housing distance means the less proximity between jobs and housing. In calculating job-housing distance, cases in which a housing unit (origin) is located within the county and job (destination) is located within the MSA where the county is included, are considered. The job-housing distance is measured as the Euclidean distance between the centroid of the origin (housing) census tract and the centroid of the destination (job) census tract. Each distance is weighted by the number of employees between O-D census tracts based on the data from CTPP 2000 and LEHD 2006. Regarding the job-housing distance, the EUA is not

considered because the conversion of O-D data from census tracts to one square mile grids causes an aggregation bias and because most commuting occurs between counties.

After completing the calculation of each urban form for 2000 and 2006, the changes of urban form are measured by the ratio of the values of each one of these dimensions in 2000 and in 2006. They are used to capture the change in residential and employment 'compactness' per county. This represents how much the urban form changes between 2000 and 2006. Higher changes in density, concentration, centrality, and proximity imply that the county is becoming more compact. Changes in the job-housing ratio variable do not have a direct relationship with the compactness of urban form. Higher changes in job-housing distance imply less compactness in terms of job-housing proximity.

2.1.4. OPERATIONALIZATION OF CONGESTION

As noted earlier, congestion for 2000 and 2006 are operationalized using the methodology that Blanco et al. (2010)[10] adapted from the Texas Transportation Institute (TTI)[11] to measure congestion from traffic volumes. The equations for four measurements - Roadway Congestion Index (RCI), Travel Time Index (TTI), Delay per capita (DELAY), Congestion cost per capita (COST)- at county level are as follows:

$$RCI = \frac{FreewayVMTperLn.Mi.* FreewayVMT + ArterialsVMTperLn.Mi.* ArterialsVMT}{14{,}000 * FreewayVMT + 5{,}000 * ArterialsVMT} \quad (4)$$

[10] See: Blanco, A., Steiner, R., Peng, Z., Wang, R., and Shmaltsuyev, M. (2010) "The economic cost of traffic congestion in Florida". Final Report. Florida Department of Transportation. 225 pages. Available at http://www.dot.state.fl.us/research-center/Completed_Proj/Summary_OP/FDOT_BDK75_977-19_rpt.pdf

[11] See: TTI (2009). *The 2009 Urban Mobility Report.* Texas Transportation Institute. Available at http://tti.tamu.edu/documents/mobility_report_2009_wappx.pdf. TTI (2007). *The 2007 Urban Mobility Report.* Texas Transportation Institute. September 2007. Available at http://tti.tamu.edu/documents/mobility_report_2007_wappx.pdf

$$TTI = \frac{Delay\ Time + Free\ Flow\ Travel\ Time}{Free\ Flow\ Travel\ Time} \quad (5)$$

$$DELAY = \frac{Annual\ Persons{-}hours\ of\ delay}{nubmer\ of\ population} \quad (6)$$

$$COST = \frac{Annual\ Cost\ due\ to\ congestion\ inluding\ vehicle\ delay\ cost, fuel\ cost, and\ congestion\ cost}{number\ of\ population} \quad (7)$$

RCI, TTI and DELAY measure the intensity of congestion based on the comparison of the speeds estimated from actual traffic density with the ideal 'free-flow conditions'. COST quantifies the monetary economic loss per capita caused by congestion. Only urban freeways and principal arterials are considered for these estimations. The changes in RCI, TTI, DELAY, and COST between 2000 and 2006 are calculated by dividing the value in 2006 by the value in 2000. A higher change in any of these variables means that the county is becoming more congested.

2.1.5. METHODS OF ANALYSIS

To answer the research questions in a comprehensive way, different methods, such as econometric analysis and case studies including GIS analysis and interviews are combined. For the econometric analysis, this study applies Seemingly Unrelated Regressions (SUR). The SUR model consists of several regression equations which have their own dependent and independent variables. The dependent variables are assumed to be correlated with each other because, in general, they are often constructed from the same data sources to explain similar characteristics. If the dependent variables are highly correlated, SUR estimators are more efficient than Ordinary Least Squares (OLS) estimators. In this study, a set of dependent variables are highly correlated with each other as summarized in Table 7 and 8 in the next section. For this reason, the SUR method is applied. For all models, the multicollinearity, heteroscedasticity, and autocorrelation

problems[12] are evaluated using the OLS estimator before SUR. In all cases the tests are satisfactory.

2.1.6. MODEL ABOUT THE EFFECT OF IMPACT FEES ON URBAN FORM

The first SUR econometric model is used to identify the relationship between impact fees and urban form. The regression model can be expressed as the following equation (8).

$$\Delta UF_i = \alpha_i + \beta_0 * UF_{2000i} + \beta_1 * \mathbf{IIF_i} + \beta_2 * \mathbf{DIF_i} + \beta_3 * \Delta POP(\text{or } \Delta JOB)_i + \beta_4 * DPOPGROW_i + \beta_5 * \Delta AMI_i + \beta_6 * ROADEXP_i + \varepsilon_i \quad (8)$$

Where, ΔUF indicates change in urban form, UF_{2000} is the urban form at the beginning of the period, IIF is Intensity of Impact Fee, and DIF is Difference of Impact Fee. As control variables for the model, the change of population (or number of jobs) between 2000 and 2006 (ΔPOP or ΔJOB), the difference in population growth rate from 2000 to 2006 between central city and other areas (DPOPGROW: $\Delta POP_{\text{other areas}} - \Delta POP_{\text{central city}}$), the change of Area Median Income (ΔAMI) between 2000 and 2006, and the amount of government expenditure on road construction per capita from 2000 to 2006 (ROADEXP) are used.

The population (or job) growth rate (ΔPOP or ΔJOB) is expected to decrease the compactness of urban form because the supply of land in U.S. cities is not heavily restricted (Evans, 2004). Also, land developments to accommodate increases in population on the urban fringe are in general easier than those in already urbanized areas, both in terms of land preparation cost and regulation (Farris, 2001). For these reasons, higher increases in population can cause more sprawl. In this regard, Fulton et al. (2001) calculate that the elasticity of urban

[12]Multicollinearity is tested with Variance Inflation Factor (VIF). All independent variables have a value under 5. That means low possibility of multicollinearity. In testing heterosedasticity, the White (1980) test is used. In all estimations, the null hypothesis that residuals are homoscedastic is not rejected. Durbin-Watson test for auto-correlation also shows that there is no auto-correlation.

land with respect to urban population is 2.76 for the United States, indicating that when population increases by 1% urban land increases by 2.76%. The difference of population growth between the central city and the outskirts is expected to have negative effects on the compactness of urban form because the higher value in DPOPGROW leads to a greater concentration of developments in suburban areas rather than in the central city. Regional income (ΔAMI) is also expected to have a negative effect on compactness since the demand for land increases as income increases. For instance, the income elasticity of the demand for housing area is 0.75 (O'Sullivan, 2009). Finally, it is expected that more road construction expenditure (ROADEXP) increases sprawl because it makes it easier to commute from residential suburban areas to employment central areas (Bruegmann, 2005; Burchfield et al., 2006).

2.1.7. MODEL ABOUT THE EFFECTS OF URBAN FORM IN CONGESTION

The second SUR model tries to identify the relationship between urban form and congestion using changes in congestion between 2000 and 2006 (ΔRCI, ΔTTI, ΔDelay and ΔCongestion Cost) as dependent variables and changes in urban form (ΔUF) as independent variables. The regression model can be expressed as the following equation (9).

$$\Delta CG_i = \alpha_i + \beta_0 * CG_{2000i} + \beta_k * \Delta \mathbf{UF}_i + \beta_{k+1} * TRANSEXP_i + \beta_{k+2} * ROADLENGTH_{2000i} + \varepsilon_i \quad (9)$$

Where ΔCG is the change in congestion and CG_{2000} is the congestion level in 2000. For this model, the governments' expenditure on transportation infrastructure per capita from 2000 to 2006 (TRANSEXP), and the road length per 1,000 population in 2000 (ROADLENGTH) are used. The higher governments' expenditure on transportation infrastructure such as road and transit (TRANSEXP) is expected to reduce congestion because it increases the supply of roads,

or provides alternative modes of transportation. The road length (ROADLENGTH) is expected to have a negative effect on congestion because, if all other things are equal, more road length implies a higher supply of road infrastructure.

2.1.8. MODEL ABOUT THE EFFECTS OF IMPACT FEES IN CONGESTION

In the third SUR model, the direct relationship between impact fees and congestion is examined by adding impact fees variables into the second model. The regression model can be expressed as the following equation (10).

$$\Delta CG_i = \alpha_i + \beta_0 * CG_{2000i} + \beta_k * \mathbf{IF}_i + \beta_l * \Delta \mathbf{UF}_i + \beta_{k+l+1} * TRANSEXP_i + \beta_{k+l+2} * ROADLENGTH_{2000i} + \varepsilon_i \quad (10)$$

IF represents a vector of impact fee variables that includes the Intensity of Impact Fee (IIF), the Difference of Impact Fee (DIF), and the Transportation Impact Fee Revenue (TIFR). Changes in urban form (ΔUF), transit expenditure (TRANSEXP), and road length (ROADLENGTH) are included as control variables in this model.

The following table represents the hypotheses that are expected to be tested with the econometric models.

Table 2-1. Hypotheses to be tested

Model	*Impact Fee → Urban Form*	*Urban Form → Congestion*
Individual Econometric Models	Housing density, concentration, centrality, proximity (↑↑)	RCI, TTI, delay time, congestion cost(↓)
	Job density, concentration, centrality, proximity (↑)	RCI, TTI, delay time, congestion cost (↓)
	Job-housing ratio(↑) Job-housing distance (↓)	RCI, TTI, delay time, congestion cost (↑) RCI, TTI, delay time, congestion cost (↓)
Integrated Econometric model	Total impact fee → congestion (↓) : growth control effect Impact fee → (urban form: compactness(↑)) → congestion(↓) : location change effect Transportation impact fee → congestion (↓) : revenue effect	

Note : ↑/↓ weak effect; ↑↑/↓↓ strong effect

2.2. SELECTION OF CASE STUDIES

For the case studies, four counties are selected by considering the characteristics of impact fee policies. After reviewing the impact fee policies of the selected counties, new developments between 2000 and 2009 are analyzed by applying GIS mapping and geospatial statistics with Hot Spot Analysis. These development patterns are compared with the changes in congestion. Based on the information from econometric analysis and GIS analysis, interviews with county officials are conducted to discuss in more detail the effectiveness of impact fee policies on promoting compact urban form and reducing congestion.[13]

The main objective of this analysis is to provide evidence for the location change effect using GIS data and methods. Based on the pattern of impact fee policy, the following counties were selected.

(1) Alachua County: the county imposes impact fees, but, the central city (Gainesville) has not had impact fees since 2005. This county has one of the lowest IIF and TIFR. (Table 2-2). This case is expected to present location change effect since 2005.

(2) Broward County: different amounts of road impact fees are imposed according to transportation concurrency zones. This county presents a medium-high DIF (and medium to low IIF and TIFR). Thus, the expectation in this case is a moderate location effect (Table 2-2).

(3) Orange County: the same road impact fees are imposed regardless of subareas. This county has one of the highest DIF (and the highest IIF as well as a high

[13] A total of 10 public officials representing the City of Gainesville in Alachua County, Broward County, Orange County and the City of Orlando, and the Duval County and the City of Jacksonville were interviewed through teleconferences in the months of May and June 2011.

TIFR). Therefore, this county should present a strong location change effect towards a higher 'compactness' of urban form (Table 2-2).

(4) Duval County: the main city (Jacksonville) and the county are consolidated and there is no impact fee policy except in minor municipalities. This county has one of the lowest IIF and TIFR, and the value of DIF is close to zero. Hence, this case is expected to present no location change effect (Table 2-2).

Table 2-2. Attributes of case counties in terms of Impact Fees, Urban Form, and Congestion

	Alachua	Broward	Orange	Duval
IIF ($/1,000ft^2)	57 (37/40)	1,133 (22/40)	4,915 (1/40)	13 (38/40)
DIF ($/1,000ft^2)	54 (21/40)	915 (9/40)	2,729 (2/40)	211 (17/40)
TIFR ($/new housing unit)	138 (32/40)	544 (25/40)	4,060 (2/40)	0.4 (37/40)
ΔHOUSING Density	1.013 (38/40)	1.083 (26/40)	1.126 (19/40)	1.114 (22/40)
ΔHOUSING Concentration	1.008 (11/40)	0.938 (25/40)	0.788 (38/40)	0.93 (29/40)
ΔHOUSING Centrality	0.983 (32/40)	1.012 (17/40)	1.029 (14/40)	1.03 (13/40)
Δ HOUSING Proximity	1.001 (21/40)	1.003 (19/40)	1.013 (7/40)	1.009 (14/40)
ΔJOB Density	0.966 (24/34)	1.077 (11/34)	1.104 (10/34)	1.076 (12/34)
ΔJOB Concentration	1.033 (20/34)	1.059 (15/34)	0.887 (32/34)	0.990 (26/34)
ΔJOB Centrality	1.074 (5/34)	0.972 (20/34)	0.992 (15/34)	1.042 (8/34)
Δ JOB Proximity	1.012 (6/34)	0.992 (20/34)	1.000 (14/34)	1.003 (12/34)
Δ JOB HOUSING Ratio	0.953 (15/34)	0.995 (7/34)	0.980 (9/34)	0.965 (12/34)
Δ JOB HOUSING Distance	0.994 (2/34)	1.286 (30/34)	1.148 (19/34)	1.157 (21/34)
ΔRCI	1.005 (18/40)	1.221 (2/40)	0.951 (28/40)	1.19 (4/40)
ΔTTI	0.975 (25/40)	0.98 (22/40)	0.967 (28/40)	1.179 (2/40)
ΔDelay	0.945 (26/40)	0.995 (22/40)	0.792 (29/40)	1.323 (13/40)
ΔCost	1.067 (26/40)	1.293 (21/40)	1.062 (28/40)	1.766 (13/40)

Note: values in parenthesis are rankings among counties

CHAPTER 3 FINDINGS AND APPLICATIONS

3.1. RESULTS OF THE ECONOMETRIC ANALYSIS

3.1.1. DESCRIPTIVE STATISTICS

Tables 3-1 and 3-2 show the descriptive statistics for the variables used in the econometric models. The mean of the Intensity of Impact Fee (IIF) in the 40 counties with housing urban form information (Table 3-1) indicates that, on average, developers paid $1,525.27 for every 1000 feet built between 2000 and 2006. This seems to be low when compared with other costs of development or the price of the final product, taking into account that the average price for single family housing in Florida was about $150,000 in 2011. Moreover, there is a high variability in the IIF among counties as the standard deviation ($1,147. 17) and the range (from $0.9 to $4,914.5) show.

The mean for the Difference of Impact Fee (DIF) is negative, which means that, on average, central cities charge higher impact fees than areas outside the central city. This figure, although low when compared with the IIF, indicates that on average there are no incentives for a location change effect towards more compact development. However, there is a big variability among counties with the DIF ranging from $-6,397.3 to $2,868.1. Transportation Impact Fee Revenue (TIFR) shows the same pattern as IIF: a low mean (when compared with other cost of development) and a high variation among counties. The mean values for the variables representing urban form show that, on average, counties in Florida are becoming more compact, albeit at a slow pace, from a low point, and with a high degree of variability. The descriptive statistics related to congestion show that, on average, counties are becoming less congested but,

once again, there is a large variability. These trends are also evident in the 34 counties with employment urban form information (Table 3-2)

Table 3-1. Summary Statistics for 40 counties (Residential Urban Form)

Variable	N	Mean	Std.dev.	Minimum	Maximum
IIF	40	1525.270	1147.170	0.914	4914.510
DIF	40	-30.857	1740.570	-6397.330	2868.150
TIFR	40	1628.200	1433.900	0.000	5427.520
HOUSING DENSITY 2000	40	602.222	318.256	181.782	1508.230
HOUSING CONCENTRATION 2000	40	0.338	0.101	0.072	0.472
HOUISNG CENTRALITY 2000	40	0.879	0.295	0.553	2.512
HOUSING PROXIMITY 2000	40	0.944	0.046	0.823	1.045
ΔHOUSING DENSITY	40	1.128	0.101	0.999	1.539
ΔHOUSING CONCENTRATION	40	0.950	0.080	0.757	1.112
ΔHOUSING CENTRALITY	40	1.003	0.051	0.845	1.080
ΔHOUSING PROXIMITY	40	1.002	0.017	0.919	1.036
RCI00	40	1.375	0.263	0.854	2.068
TTI00	40	1.359	0.157	1.029	1.690
DELAY per capita00	40	10.752	6.990	0.366	25.085
COST per capita00	40	204.304	130.019	7.116	457.043
ΔRCI	40	1.006	0.149	0.659	1.584
ΔTTI	40	0.999	0.080	0.793	1.214
ΔDELAY per capita	40	1.341	1.245	0.000	7.806
ΔCOST per capita	40	1.707	1.641	0.000	10.415
DPOPGROW	40	0.026	0.255	-1.215	0.365
ΔPOP	40	1.163	0.126	0.932	1.627
ΔAMI	40	1.172	0.047	1.082	1.262
ROADEXP	40	1348.290	574.964	639.107	3421.010
TRANSEXP	40	145.241	263.235	0.000	1369.890
ROADLENGTH	40	9.957	6.051	2.923	28.259

Table 3-2. Summary Statistics for 34 counties (Employment Urban Form)

Variable	N	Mean	Std.dev	Minimum	Maximum
IIF	34	1676.190	1153.870	0.914	4914.510
DIF	34	-1.070	1868.440	-6397.330	2868.150
TIFR	34	1815.040	1447.040	0.000	5427.520
JOB DENSITY 2000	34	671.045	531.083	82.703	2257.380
JOB CONCENTRATION 2000	34	0.413	0.169	0.039	0.653
JOB CENTRALITY 2000	34	0.697	0.245	0.302	1.658
JOB PROXIMITY 2000	34	0.892	0.064	0.746	1.037
JOB HOUSING RATIO 00	34	0.941	0.346	0.308	1.613
JOB HOUSING DISTANCE 00	34	13.091	3.346	8.605	19.817
ΔJOB DENSITY	34	1.053	0.139	0.832	1.519
ΔJOB CONCENTRATION	34	1.041	0.151	0.621	1.390
ΔJOB CENTRALITY	34	0.972	0.090	0.677	1.097
ΔJOB PROXIMITY	34	0.996	0.019	0.947	1.041
ΔJOB HOUSING RATIO	34	0.929	0.137	0.734	1.432
Δ JOB HOUSING DISTANCE	34	1.163	0.124	0.974	1.540
RCI00	34	1.417	0.238	0.899	2.068
TTI00	34	1.380	0.150	1.029	1.690
DELAY per capita00	34	11.708	6.594	1.092	25.085
COST per capita00	34	221.991	123.317	19.518	457.043
ΔRCI	34	1.007	0.148	0.659	1.584
ΔTTI	34	0.997	0.074	0.793	1.180
ΔDELAY per capita	34	1.291	1.267	0.165	7.806
ΔCOST per capita	34	1.641	1.677	0.219	10.415
DPOPGROWTH	34	0.023	0.276	-1.215	0.365
ΔPOP	34	1.178	0.127	0.996	1.627
ΔEMP	34	1.161	0.171	0.990	1.841
ΔAMI	34	1.175	0.047	1.082	1.262
ROADEXP	34	1356.290	615.378	639.107	3421.010
TRANSEXP	34	163.808	279.416	0.000	1369.890
ROADLENGTH	34	8.391	4.328	2.923	20.533

The results of correlation analysis between impact fee, urban form, and congestion variables are summarized in Tables 3-3 and 3-4. As noted earlier, within each group of

measurement (impact fees, urban form, and congestion) the variables are highly correlated. Specifically, correlations are higher among the variables related to job urban form and congestion. Therefore, as a set of dependent variables for econometric analysis, the correlation should be adjusted by applying SUR estimator.

The correlations between impact fees and urban form variables vary depending on the measurements used to operationalize them. Impact fees are positively related with housing density but negatively related with job density. The correlation between impact fees and concentration variables consistently has a negative value. Impact fees are negatively related with housing centrality, but positively related with job centrality. There are no consistent relationships between impact fees and proximity. Impact fees and job housing ratio have a negative relationship. In contrast, impact fees and job-housing distance have a positive relationship. IIF and TIRF are negatively related with changes in congestion and DIF is positively related with changes in congestion.

Table 3-3. Correlation between variables: Residential Urban Form (N=40)

	IIF	DIF	TIFR	Change Hosing density	Change Hosing concent.	Change Housing centrality	Change Hosing proximity	Change in RCI	Change in TTI	Change in Delay	Change in Cost
IIF	1.000										
DIF	0.284	1.000									
TIFR	**0.727**	0.163	1.000								
C_hden	0.164	0.059	0.165	1.000							
C_hcon	**-0.417**	-0.144	**-0.387**	-0.052	1.000						
C_hcen	-0.011	-0.027	-0.107	-0.082	**-0.327**	1.000					
C_hpro	-0.120	-0.172	-0.069	0.072	-0.271	0.304	1.000				
C_rci	-0.246	0.193	-0.140	**0.503**	-0.092	-0.113	-0.143	1.000			
C_tti	-0.210	0.063	-0.021	**0.361**	-0.124	-0.129	-0.047	**0.788**	1.000		
C_delay	-0.214	0.123	-0.069	**0.655**	0.090	**-0.319**	-0.139	**0.764**	**0.572**	1.000	
C_cost	-0.207	0.121	-0.083	**0.670**	0.084	-0.281	-0.131	**0.763**	**0.557**	**0.995**	1.000

Table 3-4. Correlation between variables: Employment Urban Form (N=34)

	IIF	DIF	TIFR	C_job density	C_job Concent	C_job centrality	C_job proximity	C_job-housing	C_job Housing	C_ RCI	C_ TTI	C_ Delay	C_ Cost
IIF	1.000												
DIF	0.295	1.000											
TIFR	**0.719**	0.195	1.000										
C_jden	**-0.368**	**-0.410**	**-0.360**	1.000									
C_jcon	**-0.405**	**-0.374**	**-0.393**	**0.621**	1.000								
C_jcen	0.108	**0.487**	0.142	**-0.637**	-0.285	1.000							
C_jpro	0.044	**0.431**	-0.017	**-0.522**	**-0.434**	**0.499**	1.000						
C_jhr	**-0.379**	**-0.427**	**-0.356**	**0.814**	**0.433**	**-0.511**	**-0.346**	1.000					
C_jhdis	0.257	0.120	0.252	-0.107	-0.301	-0.203	-0.137	-0.048	1.000				
C_rci	-0.261	0.271	-0.247	0.271	0.184	-0.075	-0.163	-0.065	0.022	1.000			
C_tti	-0247	0.159	-0.128	0.124	-0.010	-0.064	0.066	-0.128	0.097	**0.763**	1.000		
C_delay	-0.186	0.189	-0.100	0.287	**0.370**	-0.151	-0.274	-0.166	-0.118	**0.761**	**0.541**	1.000	
C_cost	-0.178	0.185	-0.115	0.297	**0.377**	-0.165	-0.280	-0.160	-0.119	**0.766**	**0.538**	**0.997**	1.000

3.1.2. THE EFFECT OF IMPACT FEES ON URBAN FORM

The results for the first model (effects of impact fees on urban form) are summarized in Tables 3-5 and 3-6. Consistent with the growth control effect hypothesis, the Intensity of Impact Fee (IIF) significantly affects job density and job-housing ratio negatively. That is, counties with high impact fees tend to have less job density and a lower job-housing ratio. This might indicate that impact fees reduce job creation in a given county by decreasing new development and investment, thereby incentivizing developers to locate in low-impact fee counties. However, direct evidence of the effect of impact fees in job growth was not found. Correlation and regression analyses (included as part of the appendices) show that IIF decrease job growth but the results were not significant.

Table 3-5. Effects of Impact Fee on Residential Urban Form

Dependent variable	Change in housing density	Change in housing concentration	Change in housing centrality	Change in housing proximity
Intercept	0.192603 (0.61)	0.830731 (2.51)	1.174283 (4.79)	1.142575 (13.39
Urban Form 00	0.000017 (0.43)	0.131325 (0.90)	-0.02856 (-1.05)	-0.08276 (-1.61)
IIF	-0.0000004 (-0.03)	-0.00002 (-1.35)	-0.000001 (-0.15)	-0.000002 (-0.73)
DIF	-0.0000019 (-0.27)	0.00000005 (0.01)	-0.000001 (-0.24)	-0.000002 (-1.16)
ΔPOP(ΔEMP)	**0.39634** **(3.62)**	-0.1553 (-1.40)	0.011254 (0.14)	0.024243 (1.05)
DPOPGROW	**-0.13196** **(-2.57)**	-0.09061 (-1.64)	0.025041 (0.64)	**0.023425** **(2.02)**
ΔAMI	0.363738 (1.48)	0.271664 (1.03)	-0.14966 (-0.77)	-0.08473 (-1.48)
ROADEXP	0.000031 (1.37)	-0.00002 (-0.95)	0.000013 (0.73)	0.000008 (1.53)
Durbin-Watson	1.98	1.92	1.41	2.12
White test (Pr> ChiSq)	0.77	0.51	0.71	0.66
F-test (Pr>F)	0.00	0.09	0.91	0.12
N / degree of freedom	40 / 128			
System Weighted R^2	0.4038			
System Weighted MSE	0.9971			

Note: parentheses are t-value. Bold are significant coefficients at 0.1 p-value

Table 3-6 Effects of Impact Fee on Employment Urban form and Job-Housing Balance

Dependent variable	Change in job density	Change in job concentration	Change in job centrality	Change in job proximity	Change in job-housing ratio	Change in job-housing distance
Intercept	-0.18383 (-0.50)	1.192275 (2.11)	1.638363 (4.39)	0.962921 (13.06)	-0.05114 (-0.13)	0.85162 (1.56)
Urban Form 00	0.0000078 (0.36)	-0.04181 (-0.29)	0.037262 (0.80)	-0.03102 (-0.81)	**0.095213** **(2.53)**	**0.01324** **(2.28)**
IIF	**-0.00003** **(-2.64)**	-0.00004 (-1.64)	-0.0000008 (-0.06)	-0.000003 (-1.34)	**-0.00003** **(-2.56)**	0.000028 (1.48)
DIF	-0.00000004 (0.00)	**-0.00003** **(-1.89)**	0.000013 (1.43)	**0.000004** **(2.66)**	-0.000004 (-0.38)	0.000004 (0.27)
ΔPOP(ΔEMP)	**0.607283** **(6.43)**	0.123818 (0.85)	**-0.24264** **(-2.60)**	**-0.03127** **(-1.77)**	**0.54443** **(5.42)**	0.00103 (0.01)
DPOPGROW	-0.08839 (-1.61)	**-0.27879** **(-3.03)**	0.009697 (0.18)	**0.036369** **(3.52)**	0.051402 (0.88)	-0.06654 (-0.80)
ΔAMI	**0.533631** **(1.82)**	-0.15896 (-0.35)	-0.35775 (-1.22)	0.073731 (1.32)	0.337174 (1.06)	0.15084 (0.35)
ROADEXP	-0.00003 (-1.19)	-0.00002 (-0.41)	0.000008 (0.32)	**0.000011** **(2.35)**	**-0.00006** **(-2.16)**	**-0.00006** **(-1.69)**
Durbin-Watson	1.85	2.26	1.88	1.96	2.24	1.72
White test (Pr> ChiSq)	0.45	0.52	0.59	0.45	0.73	0.45
F-test (Pr>F)	0.04	0.00	0.22	0.01	0.03	0.00
N / degree of freedom	34 / 156					
System Weighted R^2	0.5368					
System Weighted MSE	0.9870					

Note: parentheses are t-value. Bold are significant coefficients at 0.1 p-value

This qualification is important because other empirical research has shown that impact fees have mixed effects on job growth (Burge and Ihlanfeldt**,** 2009; Jeong and Feiock, 2006; Nelson and Moody, 2003). In addition, as described in the next section, interviews with planning officials in the four case study areas revealed that impact fees are not a significant factor of location of development between counties. Moreover, IIF does not significantly affect other variables related to urban form. For these reasons, the results must be understood with caution and definitive evidence of a growth control effect of impact fees needs more research.

The relations of the Difference of Impact Fee (DIF) with the variables of urban form are generally insignificant with the exception of increases in job proximity and decreases in job concentration. Since a higher DIF means lower development fees in the central city compared to other areas, the result of job proximity could suggest the possibility of a location change effect in commercial and industrial development towards more compact urban forms. However, the coefficient is very low, suggesting that this effect, if it exists, is not a very important factor. Moreover, this could also mean that new commercial and industrial developments tend to locate adjacent to existing jobs in the central city to share the positive externalities from agglomeration and further, that preferential impact fees reinforce this tendency. In contrast, in the case of job concentration, the relationship is opposite. The combination of higher job proximity and lower job concentration may imply that new jobs tend to be distributed in multiple job centers across the central city rather than the CBD area when a DIF has a higher value. The distribution of new jobs in the central city may be related with the type of industries. Further studies may be required to examine the relationship with more specific job data.

In sum, this result shows that lower impact fees in the city center reinforce the attraction of firms to this area but are not able to counteract the attraction of residential development to the

suburbs. Therefore, there is no strong evidence to suggest that different impact fees among jurisdictions within a given county are affecting development location. Thus, the location change effect of impact fees in congestion is not significant. As described in the next section, public officials overwhelmingly supported this conclusion in the interviews conducted in the case studies.

The initial values of job-housing ratio and job-housing distance positively affect their own change, suggesting some path dependency in these variables of urban form. The directions of the effect of the control variables are not consistent across the different measures of 'compactness'. This implies that sprawl (or compact development) cannot be defined uni-dimensionally and that a proper conceptualization and measurement of urban form should take into account different elements of the intensity and distribution of urban uses.

For instance, the increase in population (or jobs) significantly increases housing (or employment) density but decreases employment centrality and proximity. Something similar happens with income and the population growth difference between central cities and outer areas: the first increases density and the second decreases it (as it should be expected), but both change the other variables of urban form in different ways. It is important to note that density is an absolute measure of the intensity of land use in the Extended Urban Area and that concentration, centrality and proximity are more related to the distribution of that intensity. Therefore, it is possible to have a case in which density and the distribution measures are changing in different ways according to the actual spatial location of the activities. In this case, for example, a decrease in density but an increase in housing and job proximity could mean that housing and jobs are becoming concentrated in few suburbanized areas.

3.1.3. THE EFFECT OF URBAN FORM ON CONGESTION

The results for the estimated effects of urban form on congestion are summarized in Tables 3-7 and 3-8. Generally speaking, and in contrast to the hypothesis of this study, compactness of urban form causes more congestion. Increase in housing density causes increase in RCI, delay per capita, and congestion cost per capita. Similarly, changes in job density positively affect changes in RCI, TTI, delay, and congestion cost. These results are consistent with the results of Sarzynski et al. (2006). Change in job proximity and job-housing distance also positively affect change in TTI. Only change in job-housing ratio negatively affects change in RCI, delay and congestion cost. All other things being equal, counties having relatively more jobs than housing may have shorter commuting distance, and subsequently, reduced congestion levels. However, job-housing balance is not a direct measure for compact urban form, so the estimated result of the variables does not support the location change effect.

Table 3-7. Effects of Residential Urban Form on Congestion

Dependent variable	ΔRCI	ΔTTI	ΔDELAY	ΔCOST
Intercept	2.274931 (1.25)	**1.780440** **(1.75)**	10.87273 (1.00)	10.58283 (0.72)
CONGESTION 2000	**-0.14618** **(-2.12)**	**-0.24338** **(-3.10)**	**-0.03248** **(-2.17)**	**-0.00201** **(-1.82)**
ΔDENSITY	**0.669513** **(3.02)**	0.183952 (1.50)	**7.705475** **(5.85)**	**10.52790** **(5.90)**
ΔCONCENTRATION	-0.29025 (-0.92)	-0.21069 (-1.24)	-1.70434 (-0.89)	-1.85808 (-0.72)
ΔCENTRALITY	-0.19274 (-0.41)	-0.29776 (-1.16)	-4.24625 (-1.49)	-4.32283 (-1.12)
ΔPROXIMITY	-1.36277 (-0.83)	-0.15379 (-0.17)	-12.5616 (-1.25)	-14.9836 (-1.11)
TRANSEXP	0.000076 (0.68)	0.000073 (1.22)	0.000234 (0.35)	0.000448 (0.49)
ROAD LENGTH	-0.00004 (-0.01)	-0.00164 (-0.64)	**0.055107** **(1.96)**	**0.070309** **(1.85)**
Durbin-Watson	1.94	1.67	2.09	2.08
White test (Pr> ChiSq)	0.75	0.45	0.57	0.43
F-test (Pr>F)	0.05	0.06	0.00	0.00
N / degree of freedom	40 / 128			
System Weighted R^2	0.4924			
System Weighted MSE	0.9813			

Note: parentheses are t-value. Bold are significant coefficients at 0.1 p-value

In sum, these results support the argument that compactness of urban form is not effective in decreasing congestion because compact urban form may have the potential to increase trip frequency. This could be because increases in the compactness of urban form intrinsically mean an increase in demand for roads at a given fixed road infrastructure capacity. These explanations could mean that counties in Florida are not taking advantage of the increases in compactness to promote the use of transit, or that density, while increasing, is still not enough to support efficient mass transportation systems.

Table 3-8. Effects of Employment Urban Form on Congestion

Dependent variable	ΔRCI	ΔTTI	ΔDELAY	ΔCOST
Intercept	-0.83453 (-0.46)	-0.52421 (-0.64)	-1.20878 (-0.10)	-1.31054 (-0.08)
CONGESTION 2000	**-0.22589** **(-2.50)**	**-0.33683** **(-4.22)**	**-0.03532** **(-2.02)**	**-0.00239** **(-1.90)**
ΔDENSITY	**1.163590** **(2.92)**	**0.453339** **(2.47)**	**9.377862** **(3.61)**	**12.83828** **(3.70)**
ΔCONCENTRATION	-0.16292 (-0.74)	-0.12541 (-1.24)	0.618895 (0.43)	1.029657 (0.54)
ΔCENTRALITY	0.311399 (0.84)	0.067055 (0.39)	0.615492 (0.25)	0.560772 (0.17)
ΔPROXIMITY	1.172565 (0.73)	**1.536381** **(2.13)**	-0.78781 (-0.08)	-0.92073 (-0.07)
ΔJOB HOUSING RATIO	**-0.70156** **(-2.06)**	-0.22657 (-1.45)	**-9.17963** **(-4.35)**	**-12.7019** **(-4.51)**
Δ JOB HOUSING DISTANCE	0.220861 (0.93)	**0.213971** **(1.92)**	0,425281 (0.28)	0.364198 (0.18)
TRANSEXP	0.000094 (0.98)	0.000068 (1.57)	0.000788 (1.28)	0.001048 (1.27)
ROAD LENGTH	0.001804 (0.27)	-0.00064 (-0.20)	0.057847 (1.25)	0.055865 (0.90)
Durbin-Watson	2.06	1.77	2.42	2.38
White test (Pr> ChiSq)	0.74	0.82	0.52	0.59
F-test (Pr>F)	0.08	0.02	0.00	0.00
N / degree of freedom	34 / 96			
System Weighted R^2	0.5263			
System Weighted MSE	0.9751			

Note: parentheses are t-value. Bold are significant coefficients at 0.1 p-value

With regard to control variables, the change in congestion is negatively affected by the initial conditions of congestion. This means that congestion is increasing more rapidly in areas

where congestion was lower at the beginning of the period. This is consistent with recent findings showing that congestion is spreading to minor urban and rural areas (FHA, 2005; FDOT, 2007; Blanco et al., 2010). This may be because in highly congested areas traffic is close to reaching the maximum capacity of the system. Transportation expenditure, in general, increases congestion, but the results are not significant for all estimations. Road length shows mixed results, but significantly increases delay and congestion cost in residential urban form model.

3.1.4. THE EFFECTS OF IMPACT FEES ON CONGESTION

Since Difference of Impact Fees (DIF) was not significant for most variables of urban form in the first model, the location change effect is not expected to have an important role in the relationship of impact fees and congestion. Thus, the econometric analysis to examine this relationship is centered on finding the growth control effect and the revenue effect. The estimated results for the effects of impact fees on congestion are summarized in Tables 3-9 and 3-10. The effects of control variables are similar to the previous results.

Table 3-9. Effects of Impact Fee on Congestion (Residential Urban Form)

Dependent variable	ΔRCI	ΔTTI	ΔDELAY	ΔCOST
Intercept	3.837482 (2.35)	2.117227 (2.04)	18.35697 (1.78)	21.0686 (1.48)
CONGESTION 2000	**-0.12314** **(-1.87)**	**-0.217** **(-2.58)**	**-0.02836** **(-1.84)**	-0.00175 (-1.53)
IIF	**-0.00008** **(-3.08)**	**-0.00004** **(-2.31)**	**-0.00046** **(-2.87)**	**-0.00058** **(-2.63)**
DIF	0.000018 (1.57)	0.000004 (0.61)	0.000109 (1.51)	0.00013 (1.35)
TIFR	-0.000003 (-0.13)	0.000009 (0.73)	0.000054 (0.42)	0.00004 (0.23)
ΔDENSITY	**0.790003** **(4.18)**	**0.235708** **(1.96)**	**8.249257** **(6.99)**	**11.2607** **(6.91)**
ΔCONCENTRATION	-0.4027 (-0.98)	-0.31158 (-1.21)	**-5.11378** **(-1.95)**	-5.60809 (-1.55)
ΔCENTRALITY	**-0.69941** **(-2.4)**	**-0.33845** **(-1.88)**	**-3.64747** **(-1.94)**	**-4.52103** **(-1.75)**

ΔPROXIMITY	-2.33004 (-1.65)	-0.40319 (-0.46)	**-17.1735** **(-1.89)**	**-21.4303** **(-1.71)**
TRANSEXP	0.000027 (0.27)	0.000073 (1.19)	0.00002 (0.03)	0.00014 (0.16)
ROAD LENGTH	-0.00349 (-0.84)	-0.00225 (-0.86)	0.039011 (1.44)	0.0477 (1.29)
Durbin-Watson	2.28	1.71	2.26	2.23
White test (Pr> ChiSq)	0.48	0.56	0.74	0.57
F-test (Pr>F)	0.00	0.03	0.00	0.00
N / degree of freedom	40 / 116			
System Weighted R^2	0.5851			
System Weighted MSE	0.9881			

Note: parentheses are t-value. Bold are significant coefficients at 0.1 p-value

Table 3-10. Effects of Impact Fee on Congestion (Employment Urban Form)

Dependent variable	ΔRCI	ΔTTI	ΔDELAY	ΔCOST
Intercept	1.280511 (0.7)	-0.06715 (-0.07)	10.90936 (0.95)	14.38 (0.92)
CONGESTION 2000	**-0.18892** **(-2.05)**	**-0.29751** **(-3.2)**	**-0.03502** **(-1.93)**	**-0.00245** **(-1.86)**
IIF	-0.00004 (-1.37)	-0.00002 (-1.2)	-0.00028 (-1.53)	-0.00034 (-1.36)
DIF	**0.000029** **(1.94)**	0.000005 (0.59)	**0.000275** **(2.89)**	**0.00035** **(2.73)**
TIFR	-0.000009 (-0.42)	0.000004 (0.32)	0.000094 (0.65)	0.00009 (0.47)
ΔDENSITY	**0.980831** **(2.6)**	**0.439783** **(2.25)**	**7.644431** **(3.19)**	**10.6021** **(3.25)**
ΔCONCENTRATION	0.044184 (0.12)	-0.00432 (-0.02)	-2.02846 (-0.87)	-2.74377 (-0.86)
ΔCENTRALITY	-0.18373 (-0.88)	-0.13561 (-1.27)	1.015991 (0.77)	1.50386 (0.84)
ΔPROXIMITY	-0.34868 (-0.22)	1.229007 (1.56)	-8.69092 (-0.9)	-11.2905 (-0.86)
Δ JOB HOUSING RATIO	**-0.7137** **(-2.12)**	-0.27943 (-1.56)	**-8.18023** **(-4.06)**	**-11.3957** **(-4.15)**
Δ JOB HOUSING DISTANCE	0.167638 (0.75)	0.185932 (1.58)	-0.2288 (-0.17)	-0.40818 (-0.22)
TRANSEXP	0.000063 (0.68)	0.000071 (1.5)	0.00058 (0.99)	0.00075 (0.94)
ROAD LENGTH	-0.00011 (-0.02)	-0.00121 (-0.37)	0.04654 (1.1)	0.04036 (0.7)
Durbin-Watson	2.19	1.77	2.45	2.38
White test (Pr> ChiSq)	0.73	0.69	0.99	0.54
F-test (Pr>F)	0.03	0.05	0.00	0.00
N / degree of freedom	34 / 84			
System Weighted R^2	0.6237			
System Weighted MSE	0.9842			

Note: parentheses are t-value. Bold are significant coefficients at 0.1 p-value

The Intensity of Impact Fees (IIF) decreases all congestion measurements and the results are generally significant. The results could support the hypothesis that there is a growth control effect of impact fee on congestion: the more IIF can reduce congestion by decreasing new development and job growth (Skidmore and Peddle, 1998). Indeed, according to Burge and Ihlanfeldt (2009), impact fees imposed on retail, office and industrial development have negative impacts on employment. This is because increasing monetary costs of the commercial impact fees overrides benefits for developers. Then the cost burden could decrease investment on commercial development (Burge and Ihlanfeldt**,** 2009). However, as discussed in the analysis of the first model, it was not possible to demonstrate a direct effect of impact fees on jobs. Thus more research is needed to understand how impact fees are reducing congestion and if the growth control effect is occurring. Some measures of congestion were significantly increased by DIF but since this effect can operate only through a change in urban form and there was no evidence of such effect in the first model, these results are not conclusive of the existence of a location change effect.

The Transportation Impact Fee Revenue (TIFR) does not have a significant relation with congestion. Therefore, there seems to be no evidence of revenue effect. This could be because the revenue generated from transportation impact fees is not sufficient to improve transportation infrastructure. In Florida, transportation impact fees are often calculated based on the estimated increase in VMT and the change in Level of Service (LOS) derived from the new development. This method could not directly reflect real infrastructure costs. New development can also get some credits for road impact fees from future payments of gas tax. Thus, this fee tends to be relatively lower than the actual road construction or improvement cost. In this situation the demand for roads produced by new developments would be higher than the supply, producing

more congestion. Also, there is a time lag between the imposition of impact fees and the road construction or improvement. Moreover, impact fees are generally used for local roads, but congestion is mainly concentrated in major arterials or highways. All the measures of congestion used in this research are only taking into account freeways and principal arterials. Therefore, improvements in local roads will not be captured by the analysis.

3.1.5. SUMMARY OF RESULTS OF ECONOMETRIC MODELS

In sum, the three econometric models used to evaluate the relationship of impact fees, urban form and congestion show that there is some evidence of growth control effect suggesting that impact fees are reducing congestion by decreasing total development and job creation per county. However, direct evidence of the effect of impact fees in development and job creation was not found. There is no evidence of location control effect, which implies that the difference of impact fees between central cities and other areas is not enough to promote more 'compactness'. Likewise, there is no evidence of revenue effect. There is a clear, significant and substantial positive relationship between compact urban form and congestion. Finally, changes in congestion are highly negatively correlated with the congestion levels at the beginning of the period. The next section of this report elaborates more on these results through a series of case studies.

3.2. RESULTS OF THE CASE STUDIES

3.2.1. ALACHUA COUNTY

1) Overview of Impact Fee Policy

Alachua County adopted impact fees in 1990 (Jeong, 2006) but ceased imposing them in 1999. The county re-imposed the policy in March 28, 2005.[14] As of 2010, the county imposes impact fees for transportation infrastructure, fire protection and parks. Among municipalities in Alachua County, only High Spring has continuously implemented impact fees since 2006. Table 3-11 summarizes the years when revenues generated from impact fees are reported. Gainesville, the central city of Alachua County, does not have an impact fee policy.

According to the Florida Office of Economic and Demographic Research, an estimated two million dollars of revenue were generated from impact fees between 2006 and 2008 and most of them corresponded to transportation impact fees. In 2009, $12,772,270 impact fees for physical environments were generated from commercial developments in Gainesville. This explains the exceptional increase of impact fees revenue for municipalities in Figure 3-1.[15]

Table 3-11. Years Impact Fees reported since 2000 in Alachua County

Type	Public Safety	Physical Environment	Transport ation	Economic Development	Human Service	Culture and Recreation	Other
Alachua County	05-09	-	01,05-09	-	-	05-09	-
Alachua	-	-	-	-	-	-	-
Archer	-	-	-	-	-	-	-
Gainesville	-	06, 09	-	-	-	-	05
Hawthorne	-	-	-	-	-	-	-
High Springs	-	06-08	-	-	-	-	09
LaCrosse	-	-	-	-	-	-	-

[14] Referred from Alachua County Code of Ordinance Sec. 364.06. (a)
[15] As noted above, the categories are defined by the State Uniform Accounting System Manual in Florida. School impact fee is excluded in the table and the figure.

Micanopy	-	-	-	00	-	-	-
Newberry	-	-	-	-	-	-	-
Waldo	-	-	-	-	-	-	-

Source: Florida Office of Economic and Demographic Research

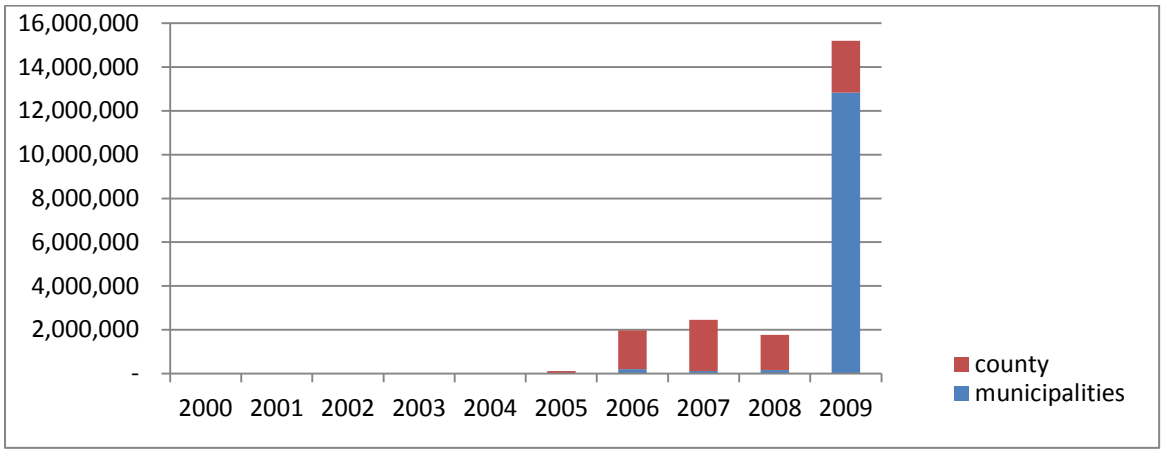


Figure 3-1. Revenue from impact fees by government's types in Alachua County

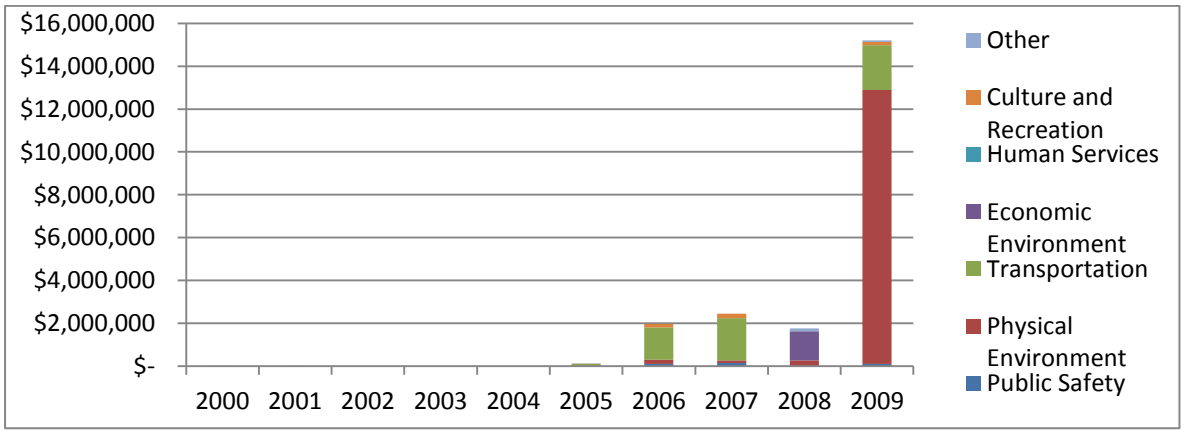


Figure 3-2. Revenue from impact fee by types of fees in Alachua County

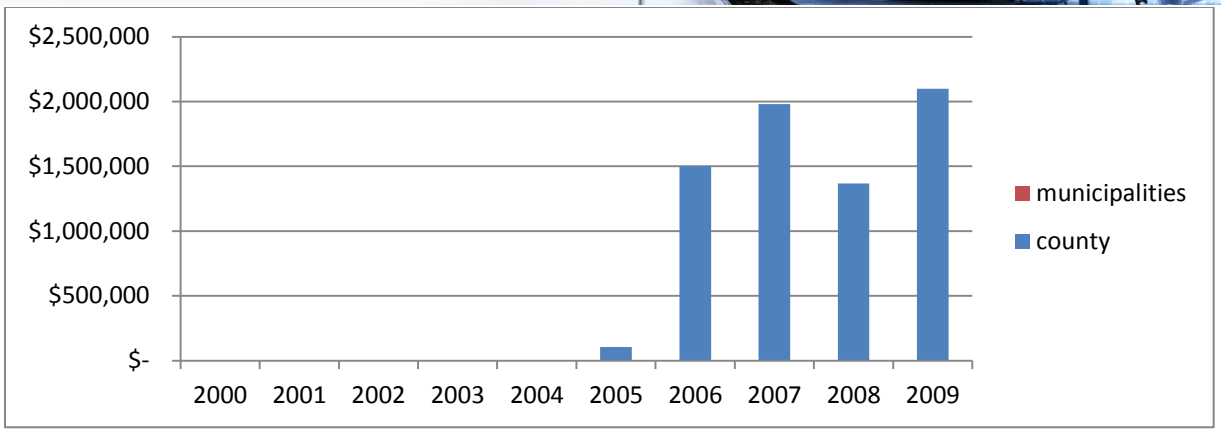


Figure 3-3. Revenue from transportation impact fees by government's types in Alachua County

Among local governments in Alachua County, only the county imposes transportation impact fees. The unincorporated areas are divided into three transportation districts, and the impact fees generated in each district are earmarked in the same district. Every year, about $1.5~2 million are generated from transportation impact fees.

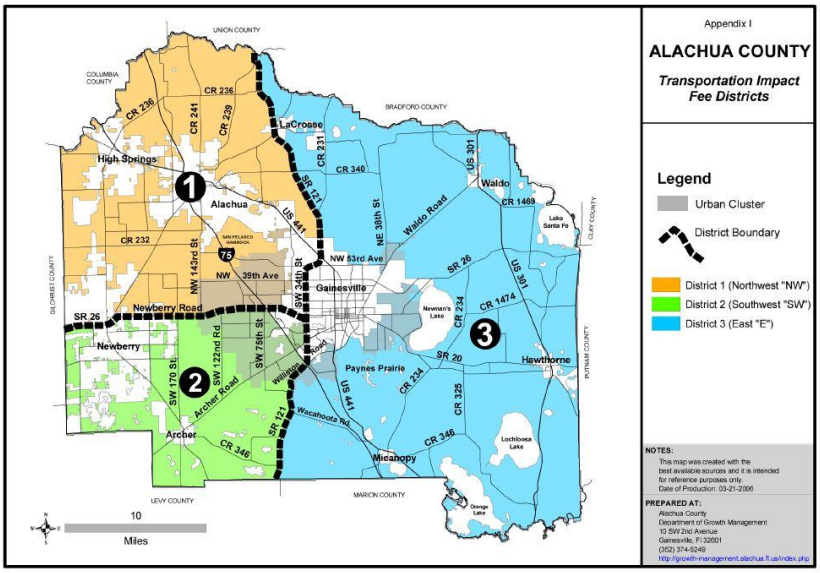


Figure 3-4. Transportation impact fee districts in Alachua County (Source: http://growth-management.alachua.fl.us/formsdocs/IF_Districts_color.pdf)

2) Development Pattern

Regarding urban form in 2000, Alachua County is ranked at 22nd of 40 counties in housing density, 39th in housing centrality and housing proximity, and 3rd in housing concentration. It also ranked at 13th for job density, 33rd for job centrality, and 34th for job proximity among 34 counties. In terms of urban form change, the county is middle or low ranking in almost all dimensions, but is highly ranked in job centrality, job proximity, and job-housing distance. The population of Alachua County increased by 8.5% between 2000 and 2006, but housing density increased by only 1.3% and job density decreased by 3.4%. These figures imply that Alachua is not moving towards 'compactness'.

However, the adoption of impact fees by Alachua County in 2005 may affect the recent changes in urban form towards improving the compactness of urban form because Gainesville, the central city, does not generally impose impact fees but the county does. This should make the development cost in the urban fringe higher than at the urban center (all other things being equal). However, the actual charges at the county level are not significant, making the differences in development costs between Gainesville and Alachua County rather low, as summarized in Table 3-12. With regard to residential development, home builders pay impact fees of about $5,900 per unit[16]. For commercial development, the difference ranges from $3,699 to $25,393 per 1,000 square foot. For industrial buildings the fees are similar to residential development.

[16] The Code of ordinance in Alachua County considers that the floor area of single family housing in Alachua County is about 2600 ft^2.

Table 3-12. Difference in Impact Fees between Gainesville and Alachua County

Type	Single Family Housing ($1{,}000ft^2$)	Commercial Building ($1{,}000\ ft^2$)	Industrial Building ($1{,}000ft^2$)
Alachua County	Transportation $2,073 Fire $76 Park $126 Total $2275	Transportation $3,623~25,317 Fire $76 Park $0 Total: $3,699~25,393	Transportation $920~2,857 Fire $76 Park $0 Total $996~2,933
Gainesville	No impact fee	No impact fee	No impact fee

Source: impact fee schedule, retrieved from http://growth-management.alachua.fl.us/formsdocs/IF_2010_schedule.pdf

In order to examine whether the development patterns in Alachua County have changed since the imposition of impact fees in 2005, the location of new developments are analyzed using GIS techniques. The county area is divided into one square mile cells, then, new developments from 2000 to 2004, and those from 2005 to 2009 are aggregated into the cells. Next, the differences in the spatial clustering of new developments are analyzed by applying hot spot analysis (Getis-Ord Gi statistic). For hot spot analysis, the inverse distance weighting squared (IDW2) weighting matrix and the Manhattan distance option are applied. The distribution of new developments and the results of hot spot analysis for each type of developments are mapped in Figures 3-5 to 3-8.

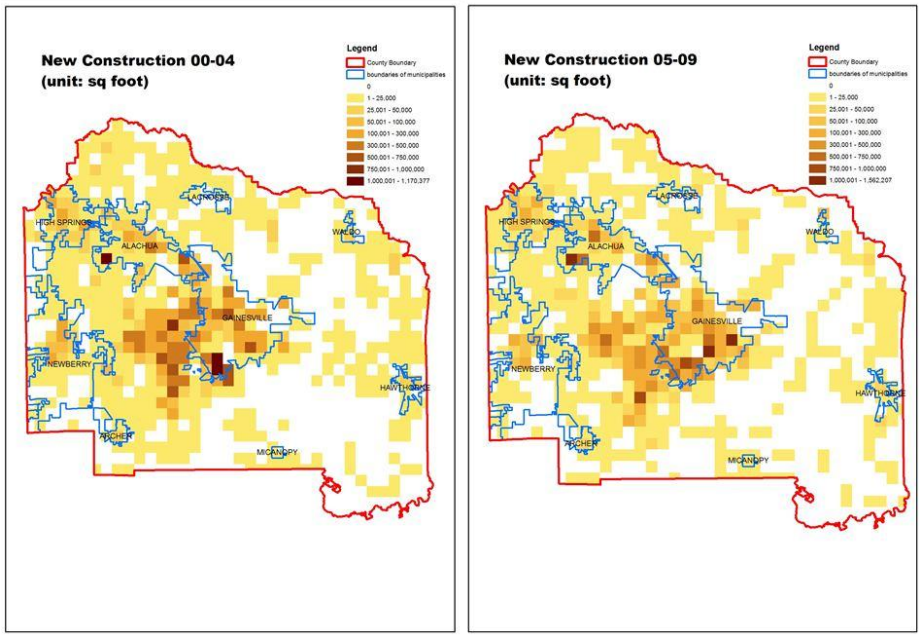


Figure 3-5. Distribution of new developments in Alachua County[17]

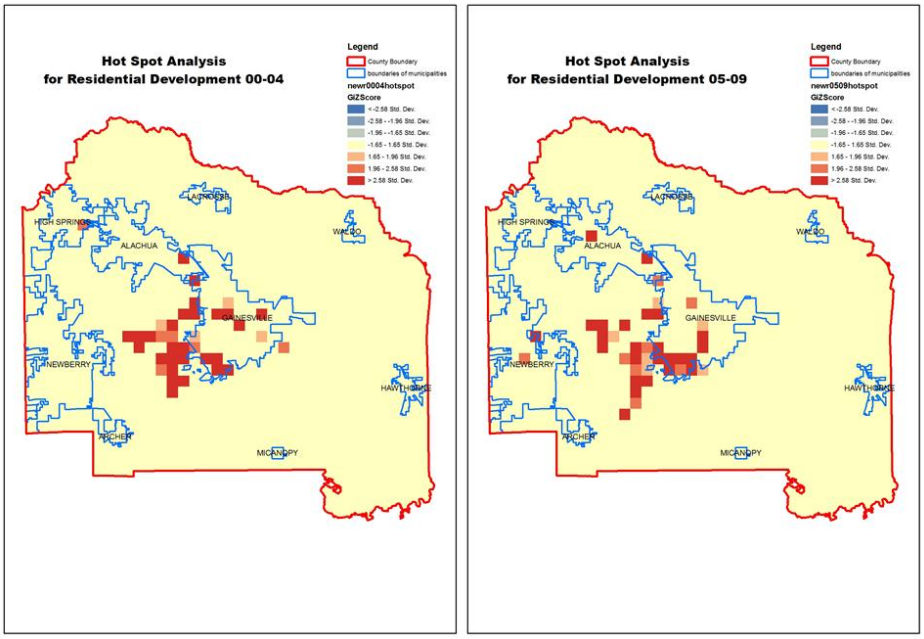


Figure 3-6. Hot spot of residential developments in Alachua County

[17] Unlike newly built floor areas used in operationalizing IIF, the renovation is not excluded in calculating new construction for case study. The portion of renovation is not big in new construction. Also, although impact fee is not charged to renovated unit, the renovation activities can also affect congestion level because renovation frequently occurs in gentrifying communities and attracts various urban activities.

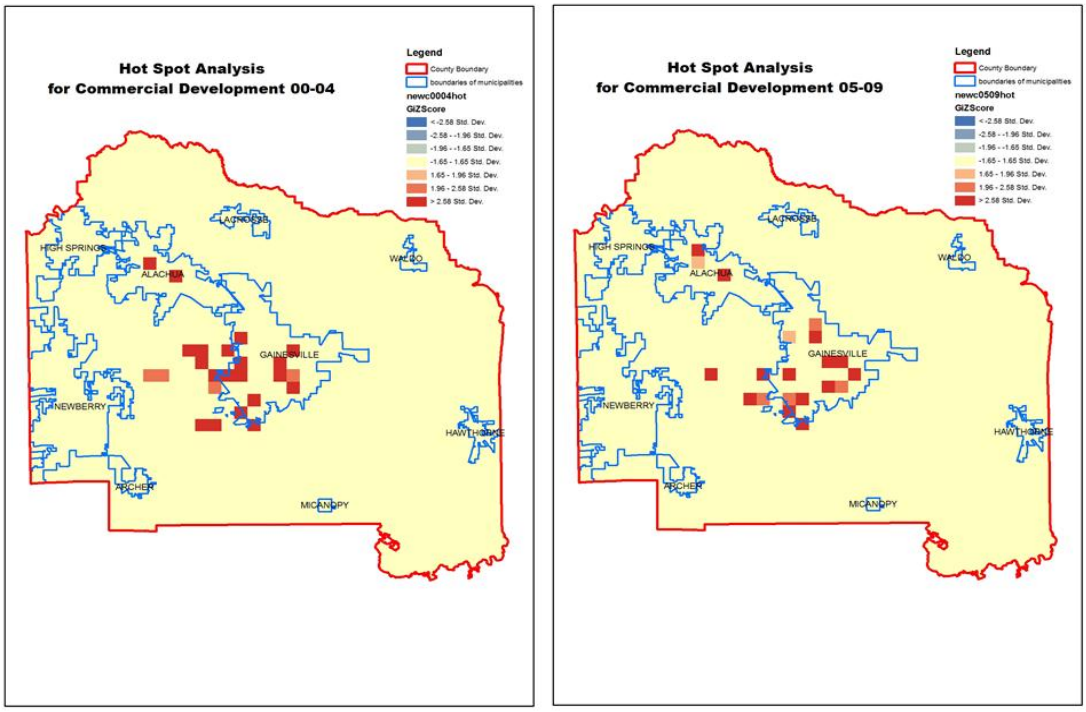


Figure 3-7. Hot spot of commercial developments in Alachua County

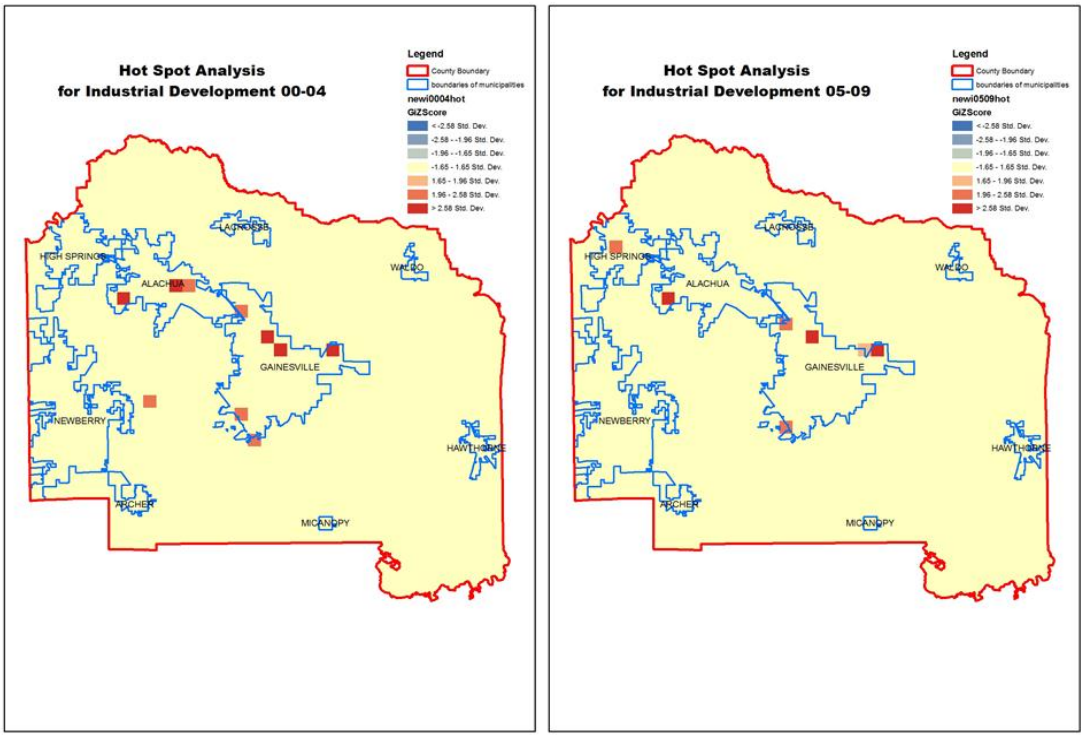


Figure 3-8. Hot spot of industrial developments in Alachua County

After the adoption of impact fees by the county in 2005, the developments in the urban fringe have continued, especially in the south west areas beyond the city limits of Gainesville. The results of the hot spot analysis for commercial development show a stronger pattern of moving the development location from county to the central city, but the results are not substantial. Regarding new industrial developments, the maps show that the hot spots of industrial development are reduced across the county regardless of local governments.

3) Congestion

According to the information in Table 2-2, in general, congestion levels in Alachua County have not deteriorated between 2000 and 2006. The RCI and congestion cost have increased marginally during this period, but TTI and Delay time have decreased. The maps of Average Daily Vehicle Miles of Travel (ADT) per lane in Figure 3-9 show that the increase in traffic volume is concentrated in the I-75 corridor and other areas near the University of Florida. Locally, the ADT per lane in NW 43rd street show highest increase.

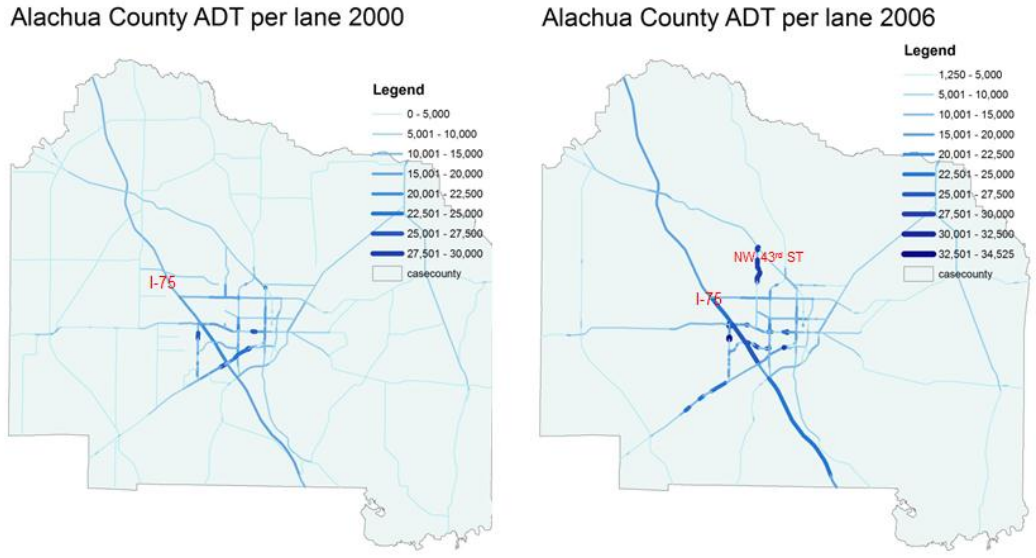
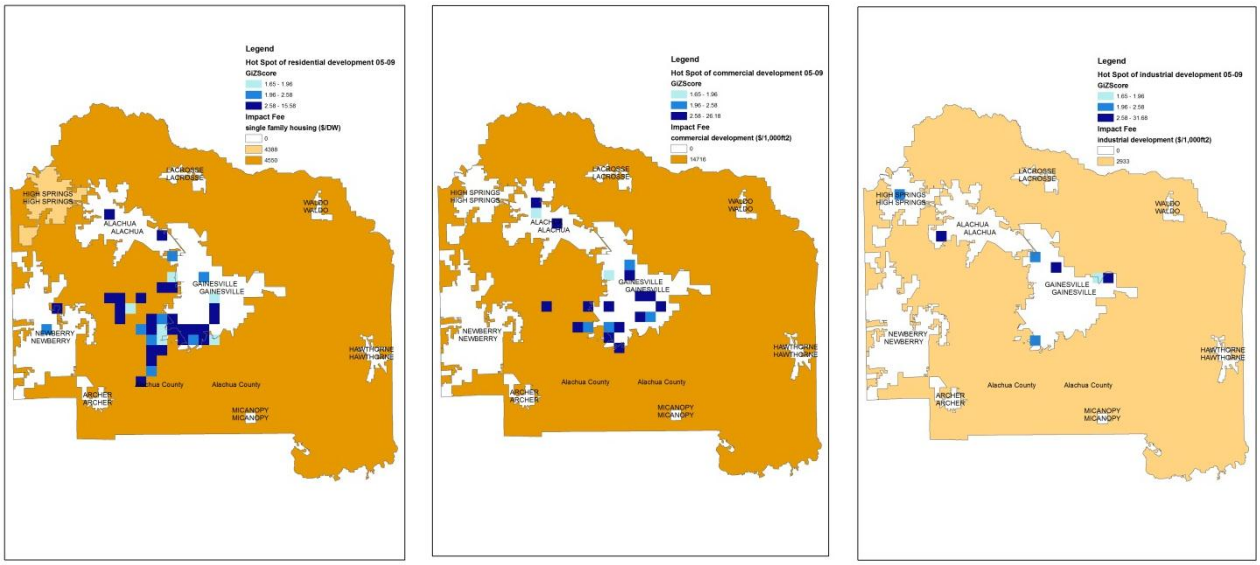


Figure 3-9. Change in ADT in Alachua County

4) Impact Fees and New Development

In order to analyze the relationship between impact fee and location of new development, the map of impact fee charges for each local government and the map of hot spots of new development are overlaid. In calculating impact fee, this study assumes an average area per unit of 2,000 ft^2 for single family housing, 200,000ft^2 for commercial development, and 100,000ft^2 for industrial development. The unit of impact fee maps is dollars per dwelling unit for single family housing and dollars per 1,000 ft^2 for commercial and industrial development. As shown in Figure 3-10, single family housing development is concentrated outside of Gainesville even when Alachua County imposes impact fees and the central city does not. But, commercial and industrial developments are concentrated in local governments that do not impose impact fees. This does not necessarily imply causality between low impact fees and more 'compactness' of commercial development. It is true that if a developer has plans to develop a 200,000 ft^2 commercial complex (a little bit larger than average size of Walmart supercenters[18]) in Gainesville instead of Alachua County, he could save about 3 million dollars in impact fees but he would also face higher land values. The location is more likely to be driven by the desire of sharing agglomeration economies with existing commercial buildings. Therefore, as it was suggested in the analysis of the effects of impact fees in urban form, commercial developments have additional advantages in central city locations compared to other uses that are not necessarily dependent on impact fees.

[18] Referred from http://walmartstores.com/AboutUs/7606.aspx

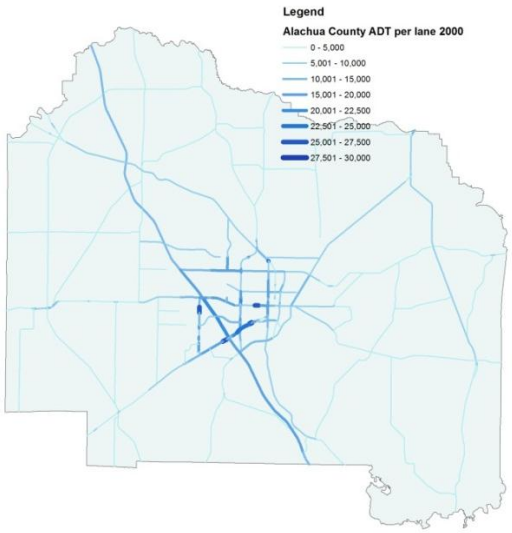


Impact fee and residential development | Impact fee and commercial development | Impact fee and industrial development

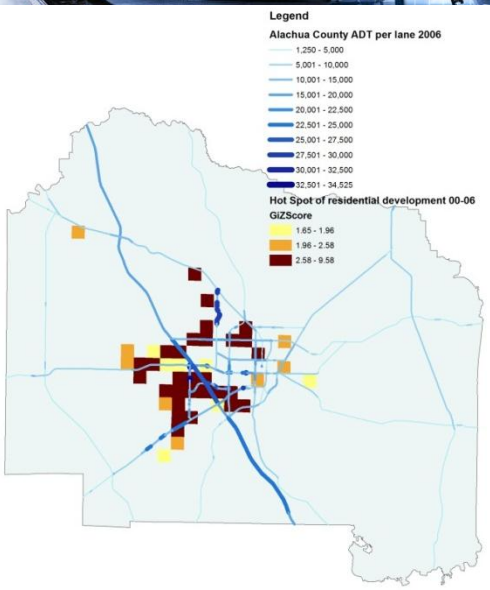
Figure 3-10. Impact fee and new developments in Alachua County

5) New Development and Congestion

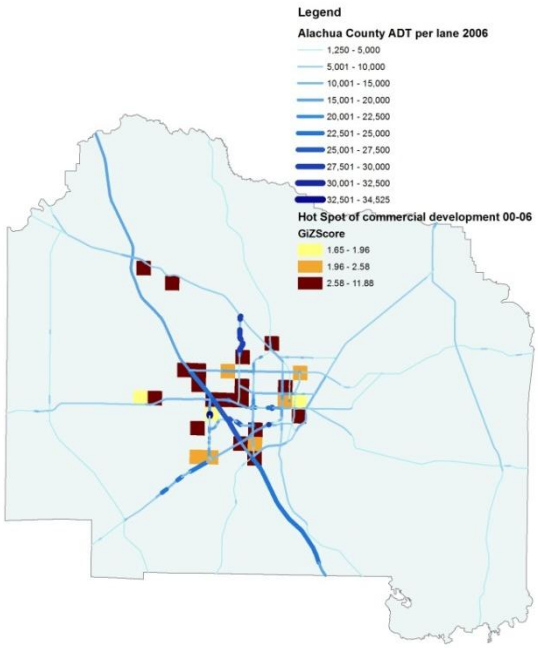
In order to analyze the relationship between the location of new development and the increase of congestion, the map of hot spots for each development type and the map of congestion (ADT per lane) between 2000 and 2006 are overlaid as shown in Figure 3-11. Since hot spots for new residential and commercial development are clustered along I-75, these new developments may increase the traffic along this corridor. Also, the maps confirm that the increase of ADT on NW 43rd street was also associated with adjacent new developments.



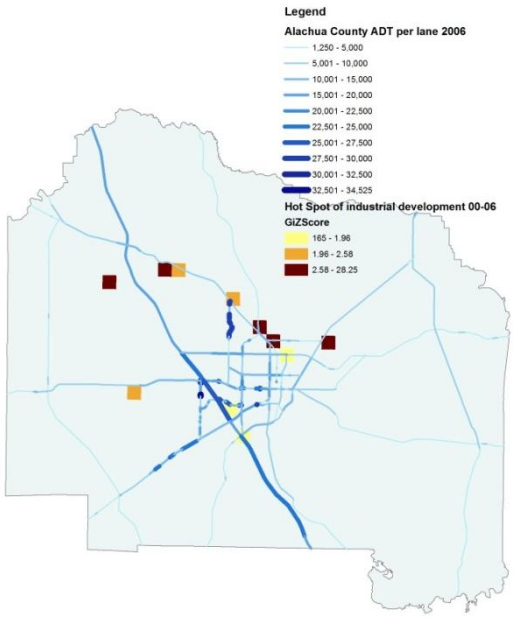
ADT 2000



Residential development and ADT 2006



Commercial development and ADT 2006



Industrial development and ADT 2006

Figure 3-11. New developments and congestion in Alachua County

6) Interviews

Public officials in the City of Gainesville have not perceived a tendency of development to move outside Alachua County to counties with lower impact fees, suggesting that the growth control effect is not evident in this case. Location change towards compactness within the

county, based on the fact that impact fees are lower in the central city than in unincorporated areas, is not evident either. This is because impact fees are often a low extra cost for the developer that is easily overrun by other considerations, such as higher prices of land in central areas or environmental regulations.

In terms of the revenue effect, public officials do not expect impact fees to be able to directly solve the congestion problem because of the impossibility of solving congestion issues by widening roads and because of the backlog in infrastructure maintenance. Other interventions like investments in traffic management systems have proven more effective in decreasing congestion and could be a better alternative for the allocation of impact fee and concurrency revenues. However, it is important to note that a large proportion of the traffic in Gainesville and Alachua County is generated in other counties since many employees of the University of Florida and Shands Hospitals (the main sources of employment in the county) live outside the county.

3.2.2. BROWARD COUNTY

1) Overview of Impact Fee Policy

Since 1977, Broward County has continuously maintained an impact fee policy (Jeong, 2006). Also, 24 of 30 municipalities have imposed impact fees in the last ten years. The years in which impact fee revenues are reported are summarized in Table 3-13 and the amounts of impact fee revenues are described in Figures 3-12 to 3-14. Impact fee revenues peaked in 2005 and then decreased as the housing market crash intensified. The portion of impact fee revenues from municipalities (80%) is high in Broward County compared to other counties. This high portion may be because Broward County tends to incorporate newly developed areas into municipalities.

In spite of that, Fort Lauderdale, the central city of the Broward County, rarely impose impact fees. It only collected impact fees for culture and recreation in 2000 and 2009. Regarding the impact types, the portion of impact fees revenue for public safety and transportation is higher compared to other types of impact fees.

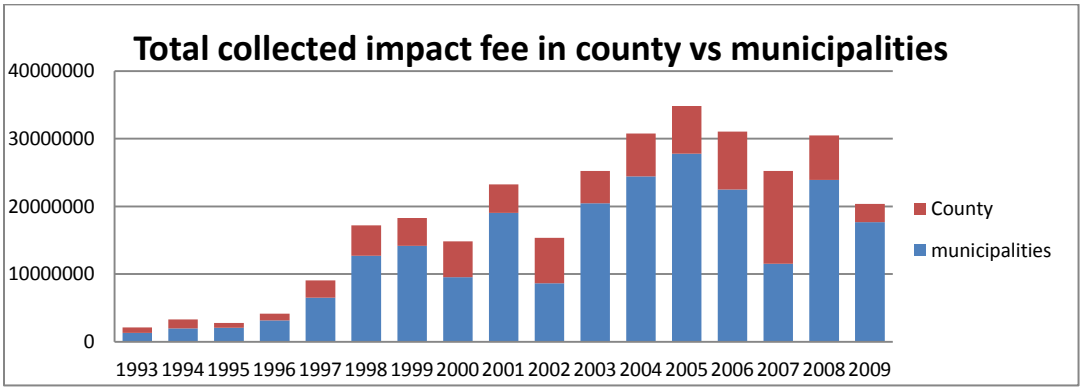


Figure 3-12. Revenue from impact fees by government's types in Broward County

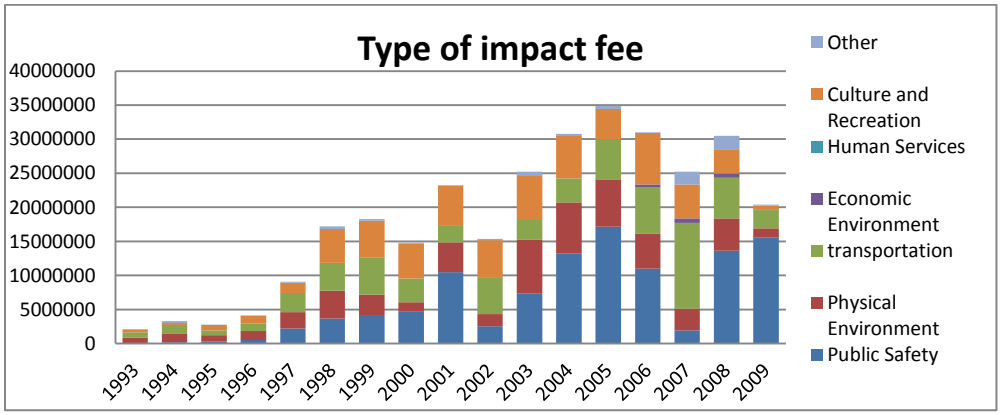


Figure 3-13. Revenue from impact fee by types of fees in Broward County

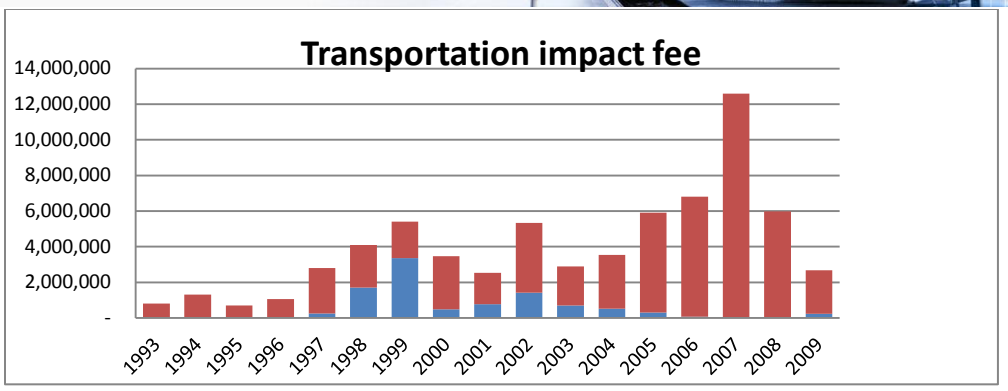
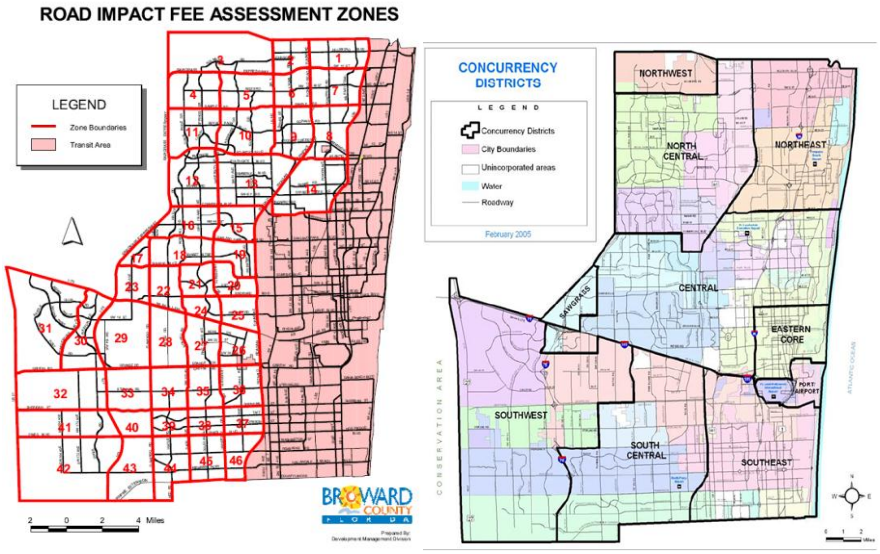


Figure 3-14. Revenue from transportation impact fees by government's type in Broward County

Regarding transportation impact fees, Broward County collects all the revenues on behalf of the municipalities. Prior to March 1, 2004, Broward County imposed road impact fees on all developments based on the trip generation simulation method. In 2004, the county applied a new impact fee system and created 46 road impact fee zones as described in Figure 3-14 (a). In these 46 zones, developers pay road impact fess but they pay transit impact fees in the Urban Infill Area as designated by Broward County. However, this system was abolished in 2005 because only a few roads were improved and because it was considered too fragmented. When the county created the impact fee districts, more than 100 fractured accounts were created (Nelson et al., 2009). These accounts jeopardized capital improvements because the earmarked revenue for each account was too small to fulfill the desired road improvements (Nelson et al. 2009). In 2005, Broward rezoned transportation impact fee zones considering transportation concurrency districts. The county divides districts for concurrency management into two groups: 8 concurrency districts of Transportation Concurrency Management Areas (TCMA) and 2 districts of Standard Concurrency districts as described in Figure 3-15.[19] The two Standard Districts

[19]Ordinance Section 5-182

(Southwest and Northwest) still maintain road impact fees. The other eight districts require developers to pay transit concurrency fees instead of road impact fees. It is important to note that developments approved prior to the last change are still subject to the 46 road impact fee zones. The next section shows whether these modifications in the transportation impact fee system have caused changes in development before and after 2005.



a. Road impact fee assessment zone b. concurrency districts

Figure 3-15. Impact fee assessment zones and transportation concurrency district in Broward County

Table 3-13. Years Impact Fees reported since 2000 in Broward County

Type	Public Safety	Physical Environment	Transportation	Economic Development	Human Service	Culture and Recreation	Other
Broward County	-	-	00~09	-	-	00~09	-
Coconut Creek	07~09	04~08, 09	-	07~09	-	00~02, 04~07	07, 08
Cooper City	00~08	06	-	-	-	00~08	00~08
Coral Springs		00~09	-	-	-	-	-
Dania Beach	00~09	00~08	-	-	-	03, 07	02, 07~09
Davie	00, 01, 03~05, 09	03	-	-	-	00, 01, 09	-
Deerfield Beach	04~09	-	07, 09	-	-	00, 01	-
Fort Lauderdale	-	-	-	-	-	**00, 09**	-
Hallandale Beach	-	07~09	-	-	-	-	-

Hillsboro Beach	-	-	-	-	-	-	-
Hollywood	01	09	-	-	-	-	-
Lauderdale Lakes	02	00, 01,04~07	-	-	-	00~02,04, 07	03
Lauderdale-by-the-Sea	05	-	-	-	-	-	-
Lauderhill	-	03	-	-	-	-	-
Lazy Lake	-	-	-	-	-	-	-
Lighthouse Point	-	-	-	-	-	-	-
Margate	-	-	-	-	-	-	-
Miramar	00~09	08	01	-	-	00~09	-
North Lauderdale	-	-	-	06, 07	-	-	00, 08
Oakland Park	-	-	-	-	-	08	-
Parkland	-	-	-	-	-	08	-
Pembroke Park	00	00, 01,04, 06~09	-	-	-	02, 04, 08	03
Pembroke Pines	-	02	-	-	-		08
Plantation	-	03~06, 08, 09	-	-	-	00~03, 05, 06, 08	07, 09
Pompano Beach	-	01~06	01~04	-	-	00~09	-
Sea Ranch Lakes	-	-	-	-	-	-	-
Southwest Ranches	-	-	-	-	-	-	-
Sunrise	00~09	00~07, 09	08, 09	-	-	00~03, 05, 07~09	-
Tamarac	00, 01, 03~06, 08, 09	00~09	00~07	-	-	02~05, 07	-
West Park	-	-	-	-	-	-	-
Weston	-	-	00~03	-	-	-	-
Wilton Manors	04, 07~09	08, 09	-	07, 09	-	04~09	08

Source: Florida Office of Economic and Demographic Research

As noted earlier, the central city, Fort Lauderdale, rarely imposes impact fees to new developments, but Broward County has continuously implemented impact fee policies. The difference in transportation impact fees across the county is compared in Figures 3-15 to 3-17. In Broward County, the transportation impact fee is calculated based on trip generation by each land use category. For instance, according to the Road Impact Fee Schedule effective in February 9, 2011,[20] a developer should pay $1,427 per trip in residential development in one of the 46 road impact fee zones. The developer should pay $1,582 per trip generated by office building

[20] Road Impact Fee Schedule, retrieved fromhttp://www.broward.org/Regulation/Development/Documents/RoadFees.02%2009%2011.pdf

development and $1,494 per trip in commercial development. In several other zones, developers only pay less than $100 for each trip generated. High transportation impact fee zones are mostly concentrated on the southern part of the county and low impact fee zones are more common in the northern part. In contrast, the transit impact fee is only imposed on development located in designated areas in Broward County Land Use Plan. These areas specify infill and redevelopment areas, which are usually located in the eastern part of the county according to Transit Impact Fee Schedule effective in October 1, 2010.[21]

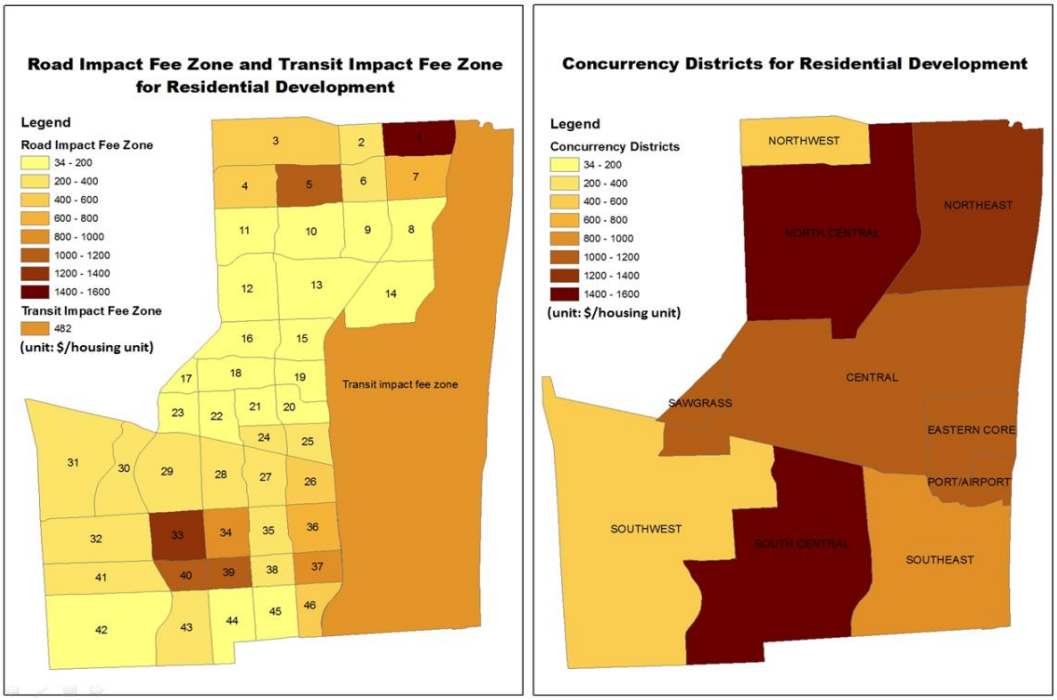


Figure 3-16. Amount of road and transit impact fees by zone for residential development in Broward County

[21] Refer to Transit Impact Fee Schedule, retrieved in April 24, 2011 from http://www.broward.org/Regulation/Development/Documents/TransitFees.pdf

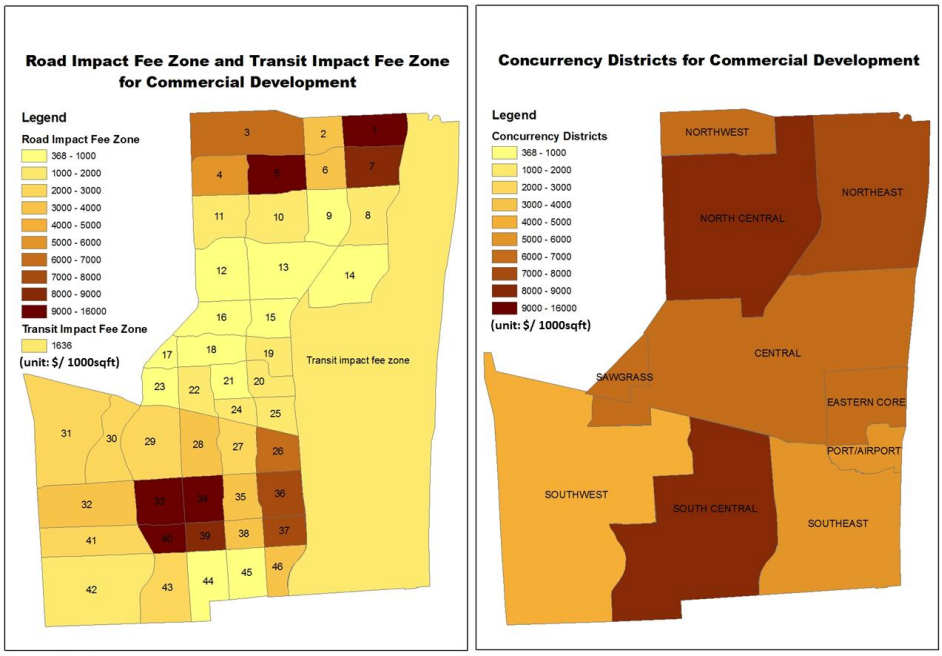


Figure 3-17. Amount of road and transit impact fees by zone for commercial development in Broward County

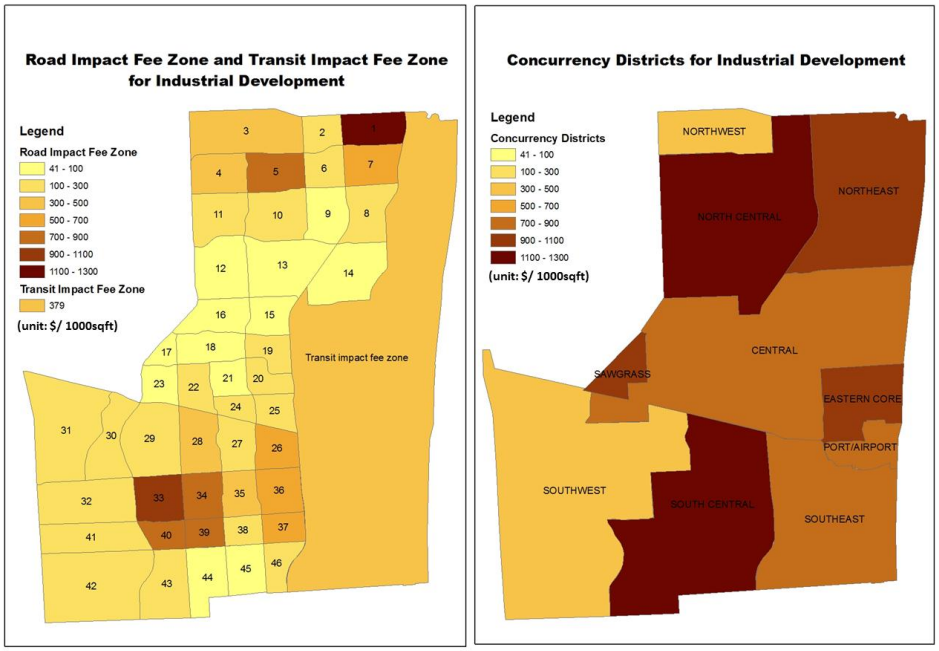


Figure 3-18. Amount of road and transit impact fees by zone for industrial development in Broward County

2) Development Pattern

Regarding urban form in 2000, Broward is the densest county in terms of residential development in Florida. The county also ranked at 10th of 40 counties in housing centrality and 14th in housing proximity although it was ranked at 32nd in housing concentration. These results mean that Broward County has relatively very compact urban form. In terms of urban form change, the county shows middle or low rank in all measurements except job housing ratio, as summarized in Table 2-2.

To investigate whether the development patterns in Broward County have changed since the modifications to the impact fees policies in 2005, the locations of new developments before and after that year are analyzed using GIS techniques.

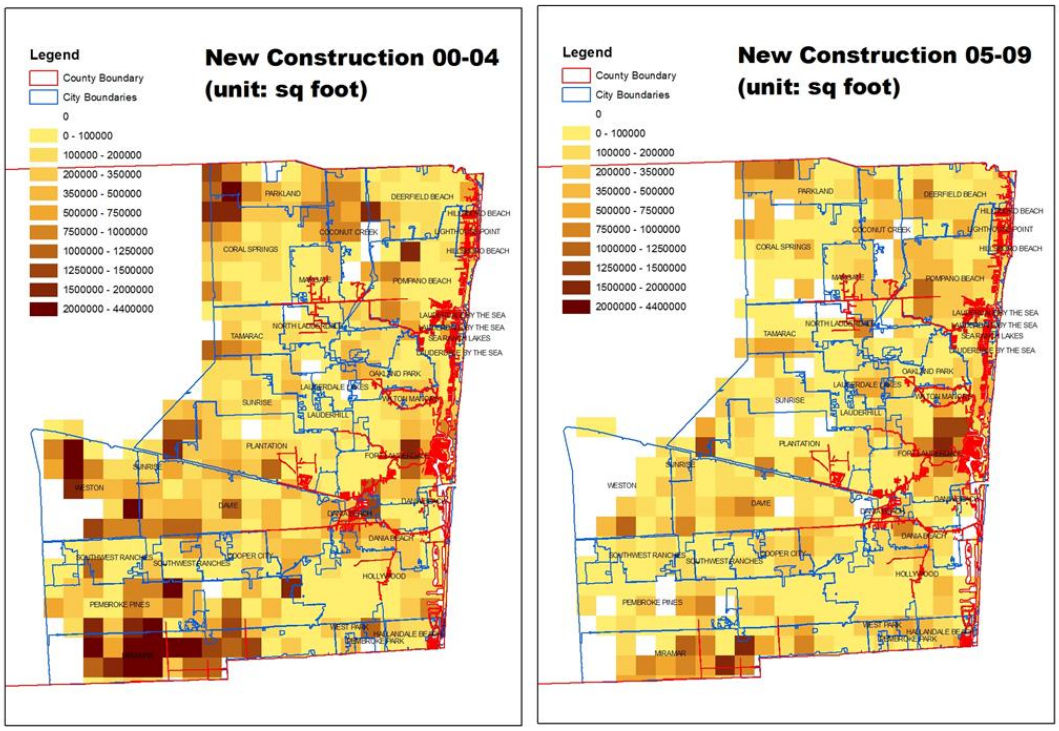


Figure 3-19. Distribution of new developments in Broward County

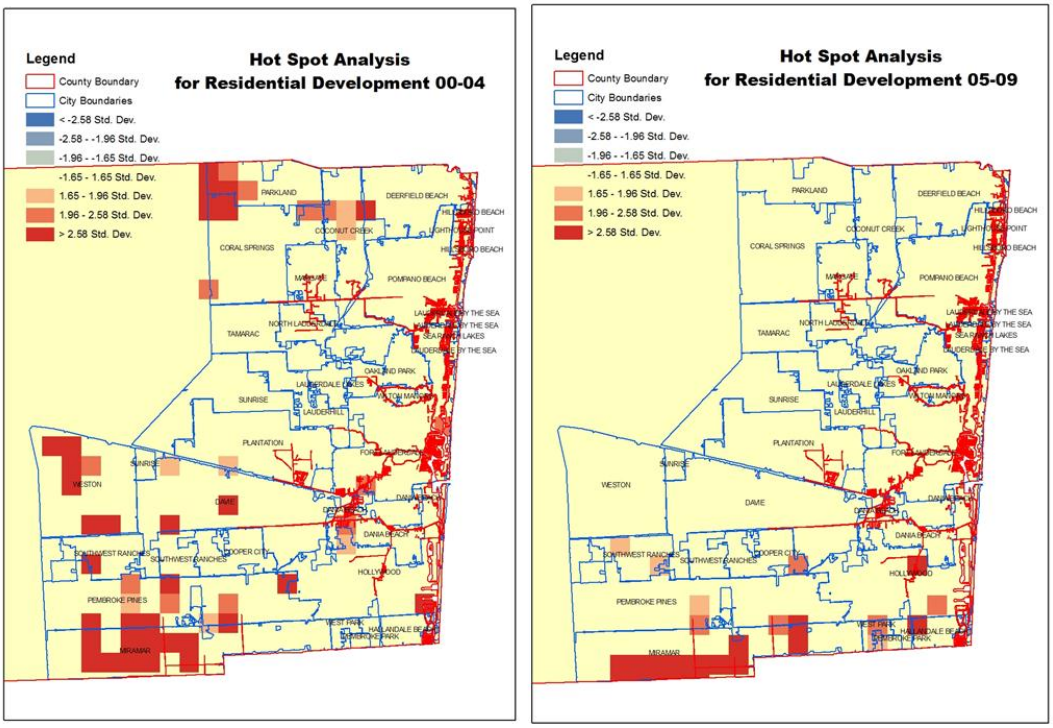


Figure 3-20. Hot Spot of residential developments in Broward County

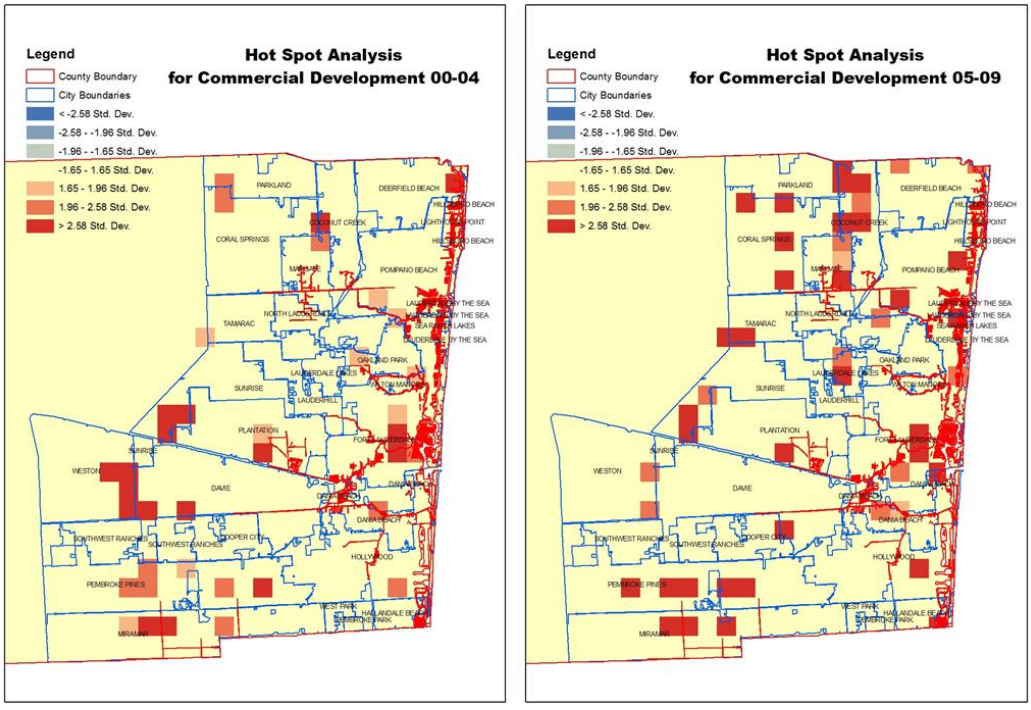


Figure 3-21. Hot Spot of commercial developments in Broward County

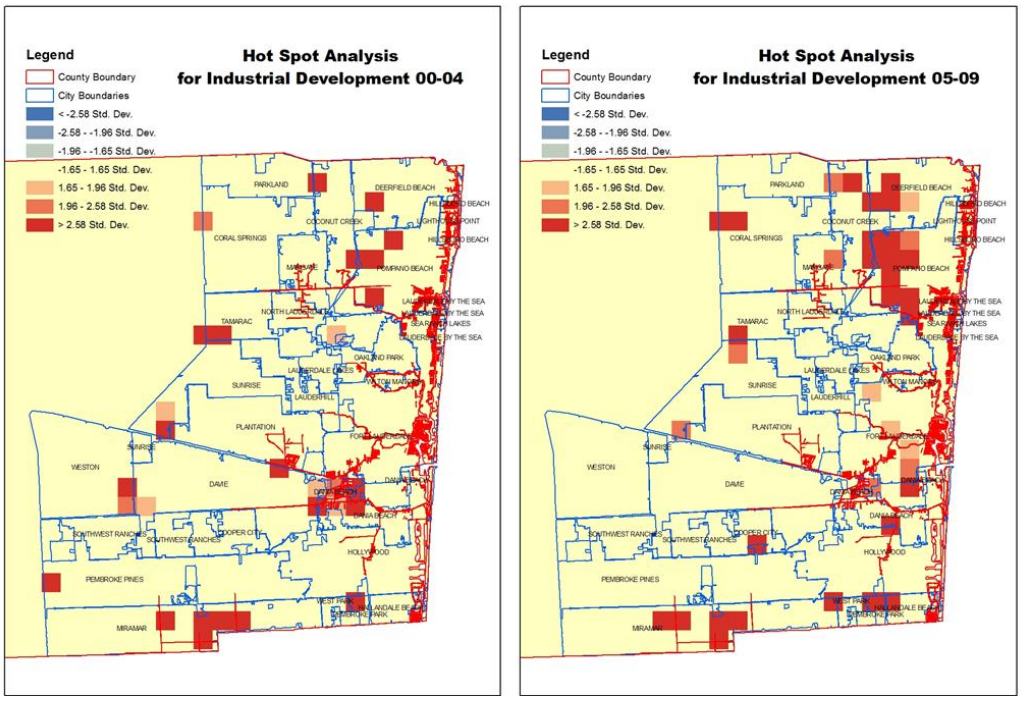


Figure 3-22. Hot Spot of industrial developments in Broward County

After the 2005 modification in the transportation impact fee policy in Broward County, new development has maintained the same pattern of location in the urban fringe and the southern part of county. The results show that residential developments are concentrated in north and southwestern areas from 2000 to 2004 and in the southwest after 2005. New commercial and industrial development followed a similar spatial pattern during the two periods concentrating to the south and northwestern directions. The locations of hot spots for new development in all uses are generally consistent with areas having high transportation impact fees. This is an indication that the amount of transportation impact fees is not sufficient to change the development locations and that developers can easily buy out the required infrastructure. Therefore, the analysis suggests that the transportation impact fee policy is not an effective tool to manage the growth.

3) Congestion

The traffic volume is highly concentrated in the I-95 corridor (north to south) and I-595 corridor (east-west). From 2000 to 2006, the ADT in highways in the north-south direction such as I-75, SR869, and Florida turnpike, have increased significantly. ADT have also increased in some highways in the east-west direction, such as I-595. This may be because new residential developments are concentrated in south west areas of the county, generating more trips. There is no significant decrease in the southwest areas that impose very high transportation impact fees. In fact, two of the main roads that connect the areas of high new development in the south west, such as I-75 and Florida Turnpike, have become more congested.

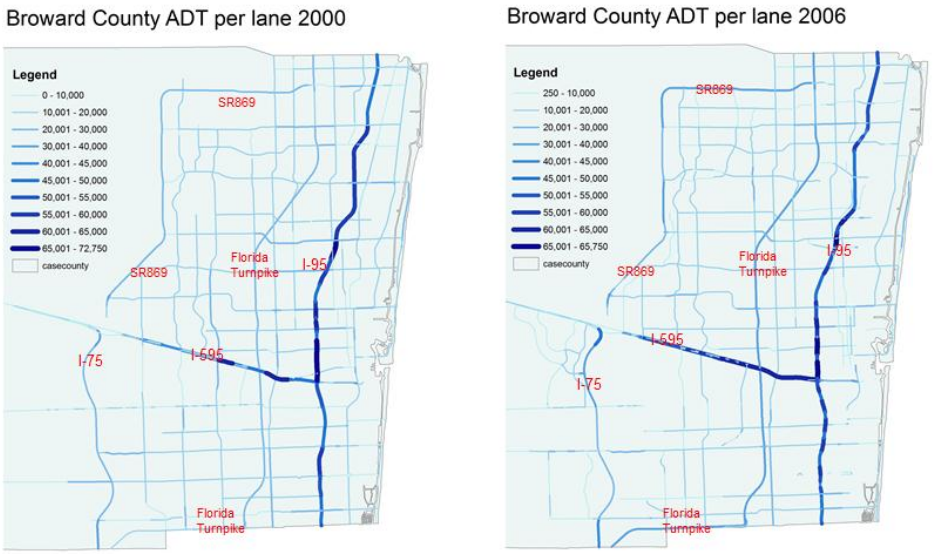
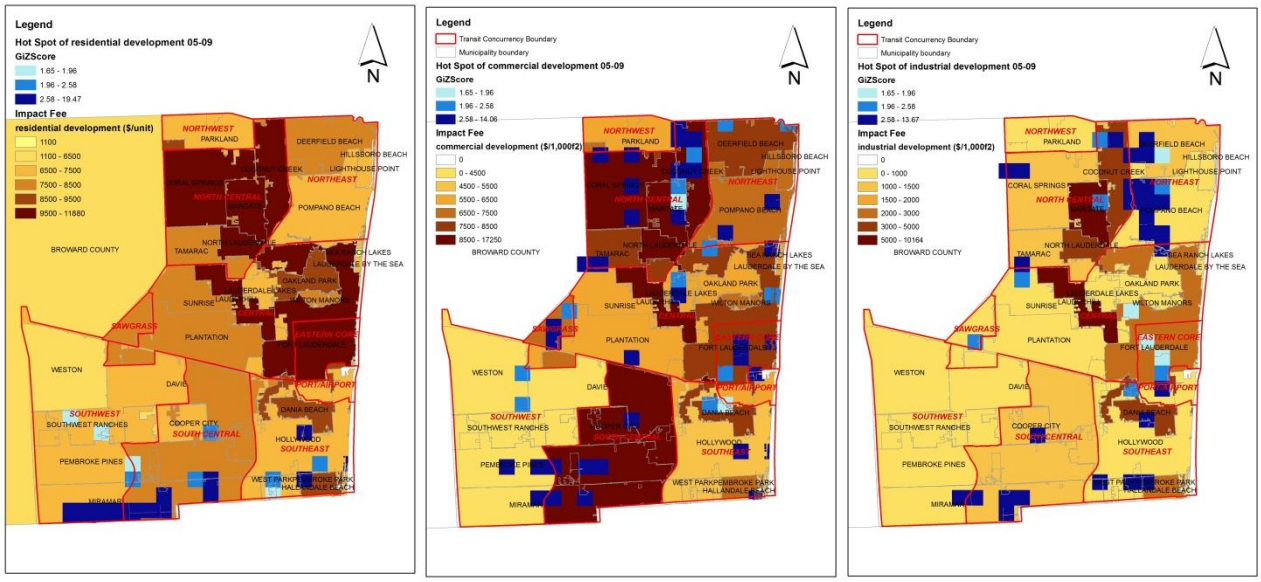


Figure 3-23. Change in ADT in Broward County

4) Impact Fees and New Development

The relationship between actual total impact fees (including not only transportation but other types of impact fees) and hot spots of new developments per type are mapped in Figure 3-

24. Southwest of Broward County has a lower to middle range of impact fees and has a very high concentration of residential development. Residential developments are not frequently located in the high impact fee areas to the north central direction and the eastern core. However, commercial developments tend to be concentrated in locations with very high impact fees such as the south central area and the north central area. Industrial developments are concentrated in locations having relatively lower impact fees such as northeast and southeast areas.



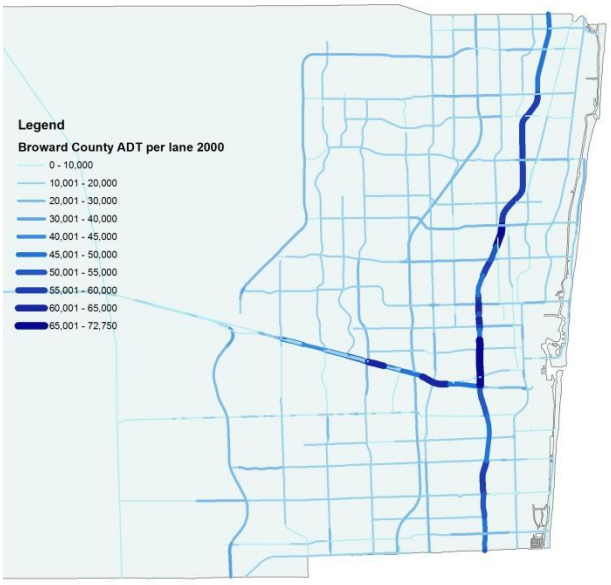
Impact fee and residential development | Impact fee and commercial development | Impact fee and industrial development

Figure 3-24. Impact fee and new developments in Broward County

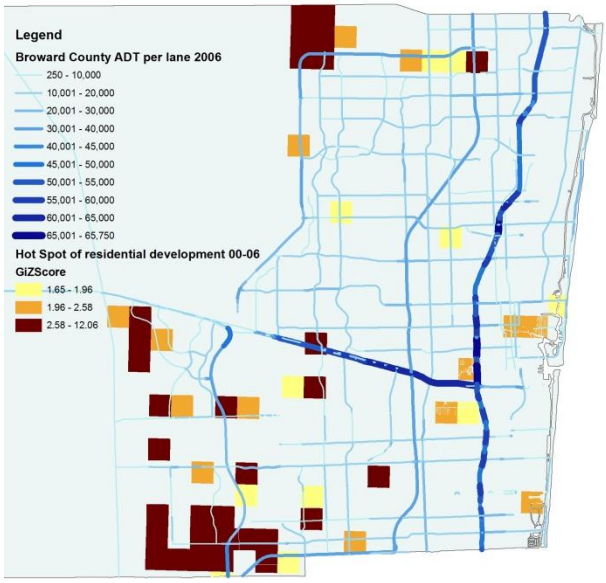
5) New Development and Congestion

The hot spots of new developments and the maps of congestion levels between 2000 and 2006 are compared to examine the relationship between location of new development and congestion change as shown in Figure 3-25. The higher increase of congestion on I-595 may be affected by new commercial and industrial development adjacent to this corridor. The high concentration of residential development in the southwest area may have increased the

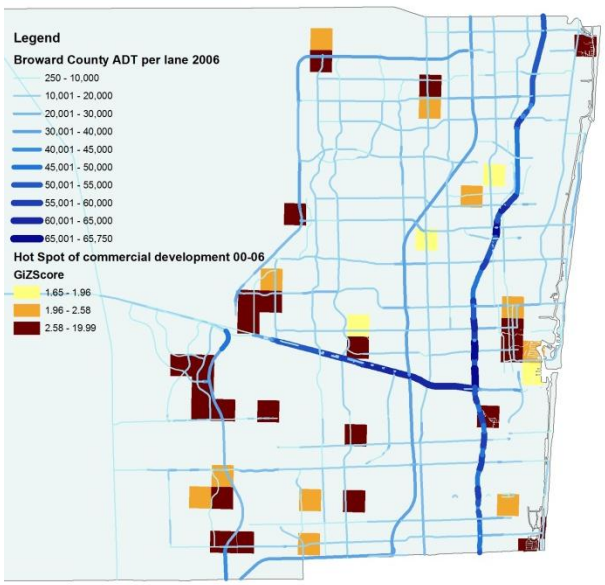
congestion level in east-west directed highways such as I-595 and Florida Turnpike, and north-south corridors such as I-75. The concentration of industrial development in the northeast area may have increased the congestion level in I-95 and Florida Turnpike along the north-south direction.



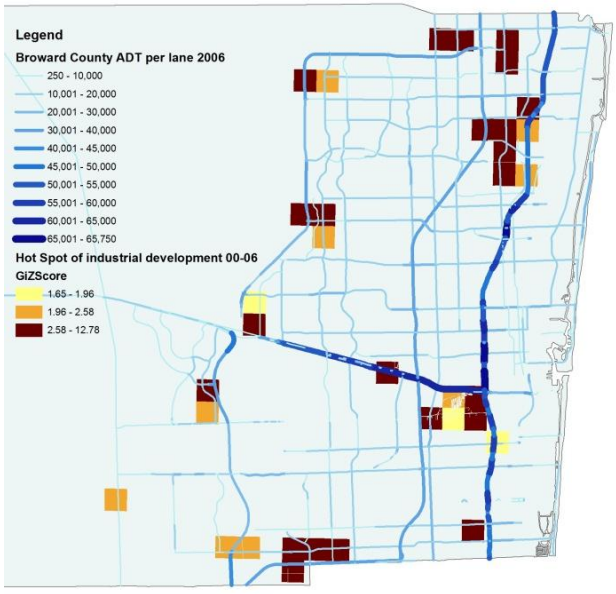
ADT 2000



Residential development and ADT 2006



Commercial development and ADT 2006



Industrial development and ADT 2006

Figure 3-25. New developments and congestion in Broward County

6) Interviews

Public officials have not perceived a tendency of development to move outside Broward or among jurisdictions within the county as a response to impact fees. This suggests that neither the growth control nor the location change effects are important in this case. Although impact fees are relatively high in Broward in the context of Florida, the charges are not high enough to be a determinant location force. In addition, they could be passed into the final demand. In general the most important driver of location is the availability of land in a county that is almost entirely built-up.

Road impact fees are also unlikely to solve congestion problems because they are directed to investment in local roads while congestion is worst on freeways and principal arterials. In addition, experience has shown that as soon as a road is widened it becomes congested. Therefore, a revenue effect of impact fees on congestion is unlikely. Other interventions, such as investment in transit systems, could be more effective but it is important to note that people in Broward favor the use of their cars because they tend to take multiple trips in the same day, and because the built environment is not particularly pedestrian friendly.

3.2.3. ORANGE COUNTY

1) Overview of impact fee policy

Orange County has implemented impact fee policies since 1983 (Jeong, 2006). As of 2010, the county imposes four types of impact fees: road, law enforcement, fire, and parks. Ten of thirteen municipalities, including the City of Orlando, reported impact fee revenue during 2000~2009. In Table 3-14, the years when revenue generated from impact fees are reported are summarized and the amounts of impact fee revenue are described in Figures 3-26 to 3-28. The

reported amount of impact fees has the highest value in 2006, and then the amount decreases. These recent decreasing trends may be affected by the economic recession. The portion of impact fees for physical environment and transportation infrastructure accounts for over 50% of impact fee revenue.

Table 3-14. Years Impact Fees reported since 2000 in Orange County

Type	Public Safety	Physical Environment	Transpo rtation	Economic Development	Human Service	Culture and Recreation	Other
Orange County	00~09	01~09	00~09	-	00~09	06~09	-
Apopka	-	00~09	00~09	-	-	00~09	-
Bay Lake	-	-	-	-	-	-	-
Belle Isle	-	-	06~09	-	-	-	-
Eatonville	-	04	-	-	-	-	05~07
Edgewood	00~09	04	00-04, 06~09	-	-	-	04, 06~08
Lake Buena Vista	-	-		-	-	-	-
Maitland	00~09	00-02,04~06, 08	03~08	-	-	01, 09	-
Oakland	00~05, 09	00~05,09	00~05, 07~09	-	-	00~05, 07~09	00~09
Ocoee	00~08	00~08		-	-	00~08	-
Orlando	05~06	00~08	00~08	06, 09	-	-	09
Windermere	-	-		-	-	-	-
Winter Garden	00~09	00~09	00~09	-	-	00~09	-
Winter Park	-	09		-	-	04~09	-

Orange County has imposed transportation impact fees since 1986 and the City of Orlando has implemented transportation impact fee policies since 1997. Six other municipalities also reported revenue from transportation impact fees. In 2008, over $80 million in revenue from transportation impact fees was reported. Orange County is divided into four road impact fee zones but the amount of the fee is the same regardless of zone. The City of Orlando is divided into seven transportation impact fee districts, and different amounts of road impact fees are imposed according to districts. These districts are shown in Figures 3-29 and 3-30.

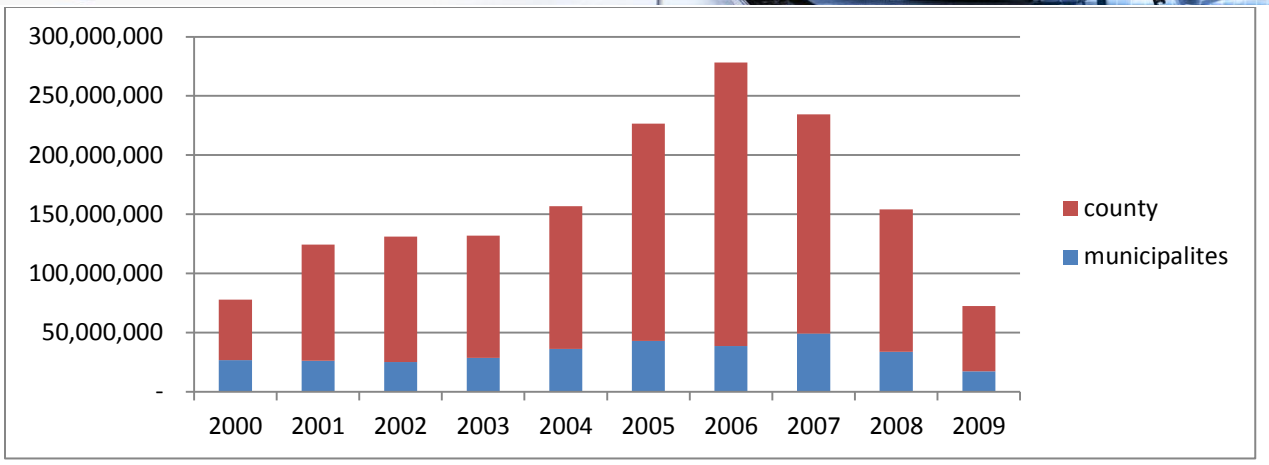


Figure 3-26. Revenue from impact fees by government's types in Orange County

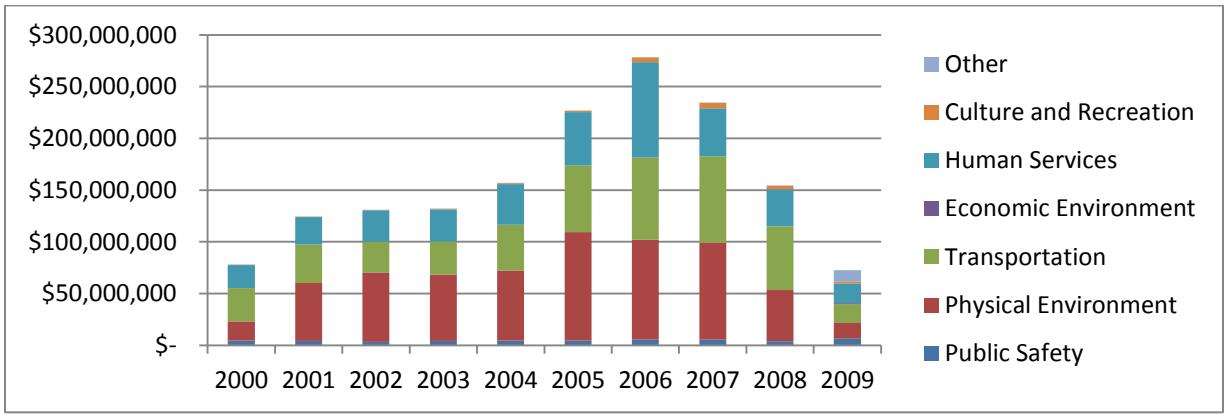


Figure 3-27. Revenue from impact fee by types of fees in Orange County

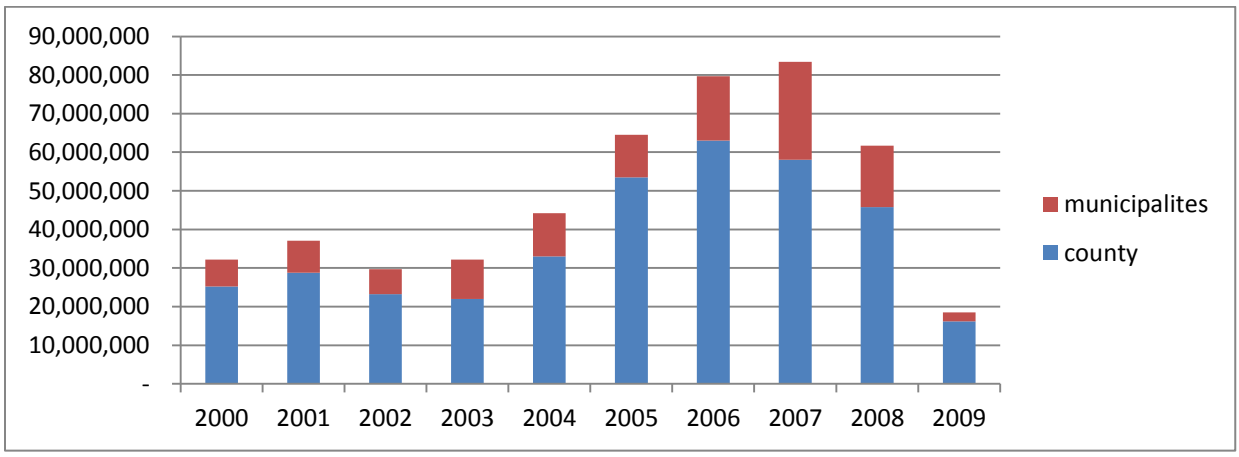


Figure 3-28. Revenue from transportation impact fees by government's types in Orange County

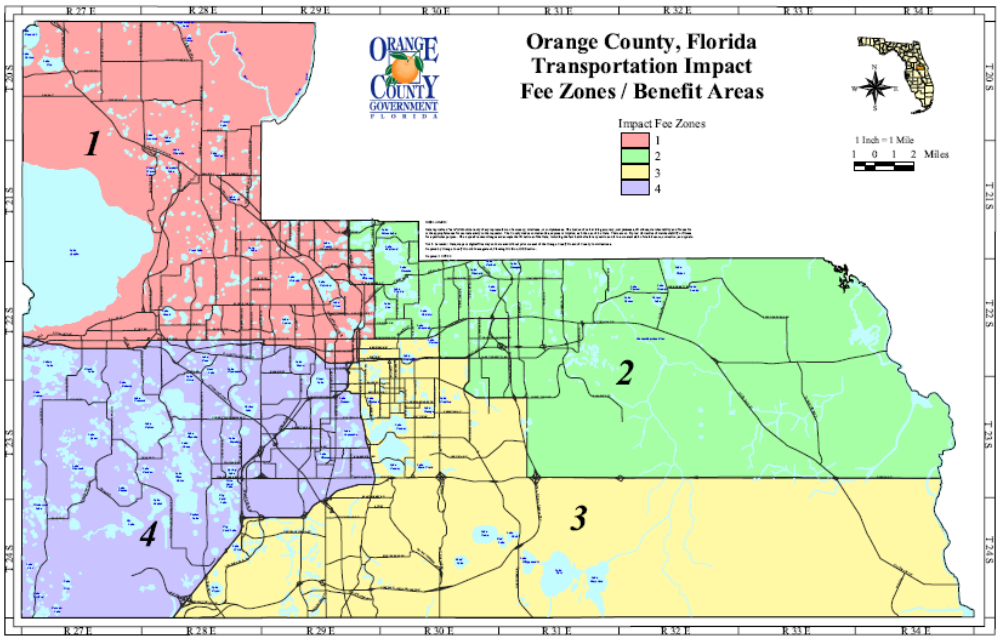


Figure 3-29. Transportation impact fee districts in Orange County. Source: Orange County

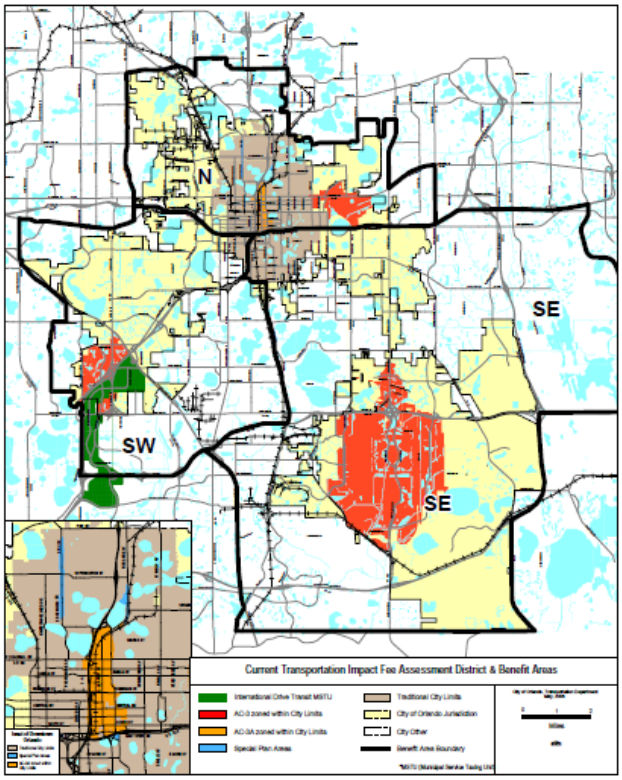


Figure 3-30. Transportation impact fee districts in City of Orlando. Source: City of Orlando

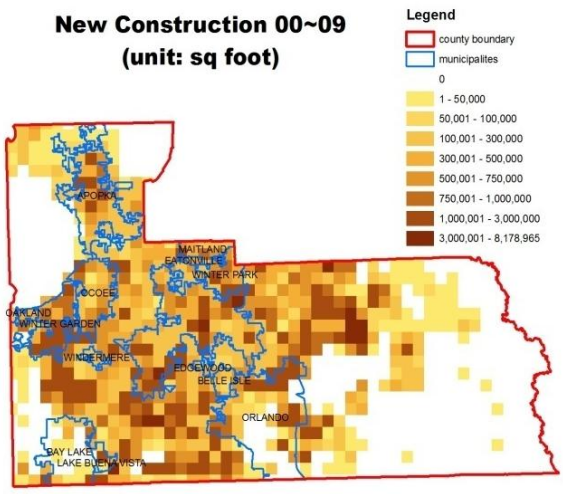
2) Development Pattern

Regarding urban form in 2000, Orange County is ranked at 8th out of 40 counties in housing density, 27th in housing centrality, 36th in housing proximity, and 37th in housing concentration. These results mean that Orange County is densely developed but highly dispersed. In terms of impact fee measurements, this county is highly ranked for all measurements as described in Table 2-2: 1st for IIF, 2nd for DIF, and 2nd for TIFR. This implies that Orange County has a high theoretical potential for compact development and location change effect. However, the results of urban form change do not support this. The county ranked 19th in change of housing density, 14th rank in change of housing centrality, and 7th rank in change in housing proximity. Moreover, regarding the change of housing concentration, the county is ranked at 38th. Also, Orange has middle or low rankings in terms of job urban form changes. Thus, the impact fee policy seems to be ineffective in making compact urban form in Orange County. This could be because, even if the county imposes higher impact fees compared to other counties, the difference in impact fees between the central city and outer areas is not sufficient to change the development locations. Table 3-15 summarizes the amount of impact fees in Orange County and the City of Orlando. The spatial distribution of new developments between 2000 and 2009, and hot spots of new developments for each development types from 2000 to 2009 are mapped in Figure 3-31.

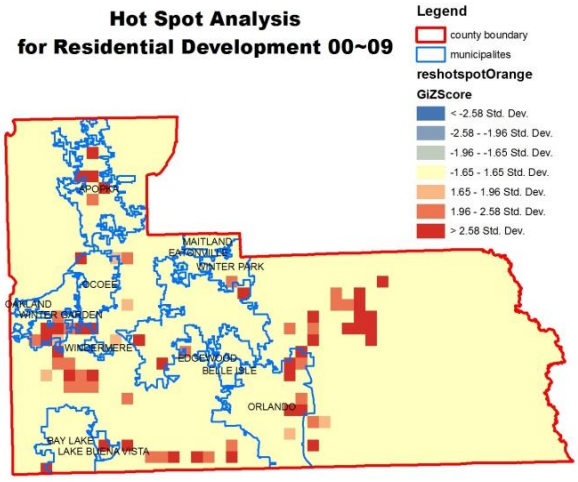
Type	Single Family (unit)	Commercial Building (1,000 ft^2)	Industrial Building (1,000ft^2)
Orange County	Road: $3,825 Law Enforcement: $207.84 Fire: $222.69 Park: $1,391.07 Total: $5,647	Road: $4,850~14,113 Law Enforcement: $331.68 Fire: $247.62 Park: $0 Total: $5,430~14,693	Road: $978~3420 Law Enforcement: $50.61 Fire: $43.65 Park: $0 Total: $1,073~3,515
Orlando	Transportation: $2,523~3,708	Transportation: $4,139~13,708	Transportation:$1,034~2,769

Note: School impact fee (13,041$ per unit for single family housing) are not included.
Source: Florida Office of Economic and Demographic Research

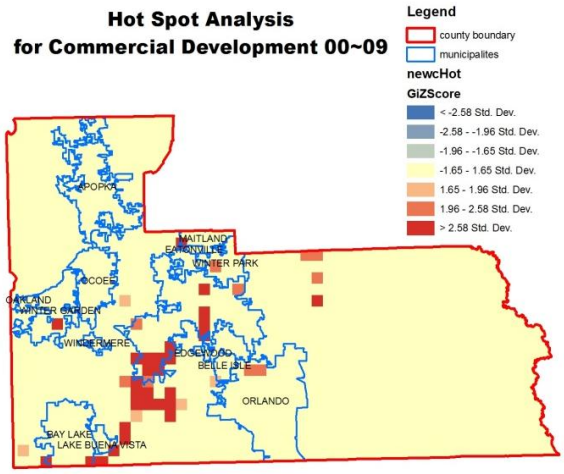
Table 3-15. Difference in Impact Fees between Orlando and Orange County



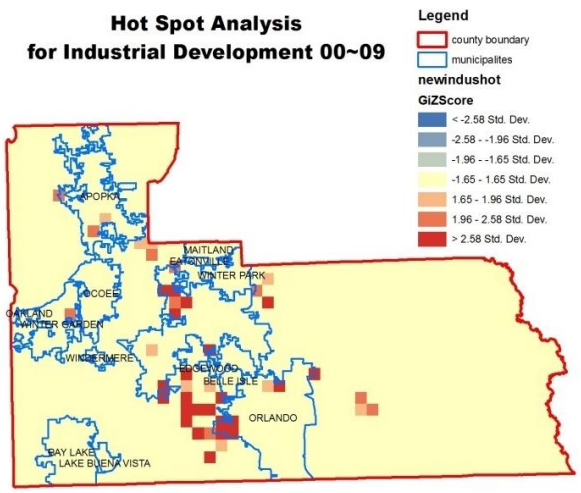
a) Distribution of New Development



b) Hot Spots of Residential Development



c) Hot Spot of Commercial Development



d) Hot Spot of Industrial Development

Figure 3-31. Distribution of new developments and hot spot of new development in Orange County

As described in Figure 3-31(a), new developments are distributed throughout the county. Specifically, residential developments in Figure 3-31(b) are clustered in areas outside the central city. New commercial and industrial developments are clustered to the southwest of the City of Orlando as shown in Figures 3-31(c) and (d). Since the impact fee policies have been implemented continuously both in Orange County and other municipalities during the analyzed

time periods, the maps do not provide information about whether impact fees affect the location of new developments. But, the results of the GIS mapping suggest that new developments are concentrated not in the central city but in suburban areas of Orange County.

3) Congestion

The traffic volume is highly concentrated in the I-4 corridor (north to south). Between 2000 and 2006, the ADT per lane in Florida Turnpike and SR528 increased. ADT in major arterials linking Orange County and adjacent counties such as Lake, Seminole and Osceola have grown, too. But, the ADT in SR408 and in downtown areas (north side of SR 408) have decreased. In general, Orange County experienced a decrease in congestion indicators such as RCI, TTI, and Delay during this period. However, new developments outside the central city may have increased ADT at the suburban major arterials, especially in the northeast direction. There is no distinctive change in ADT according to road impact fee zones.

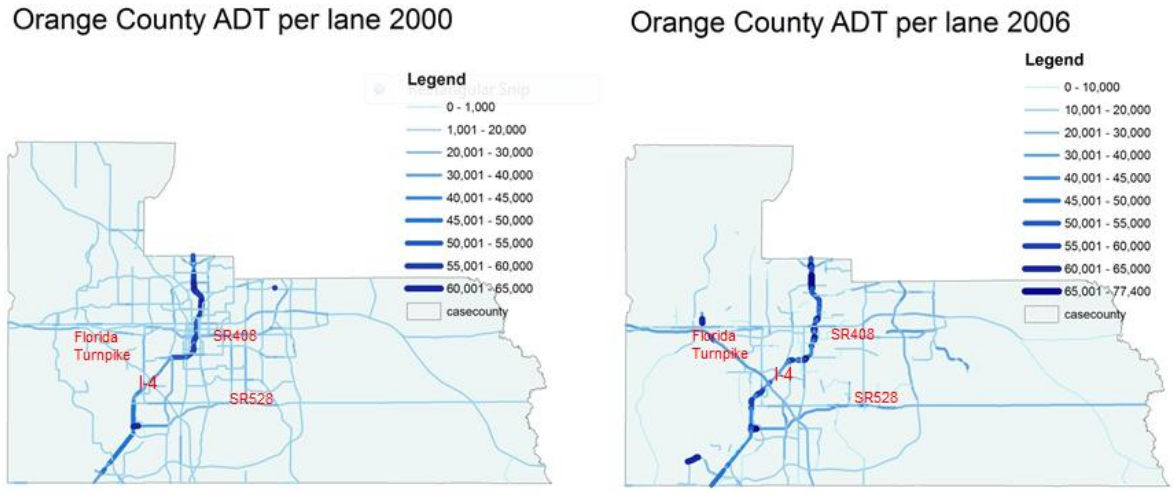
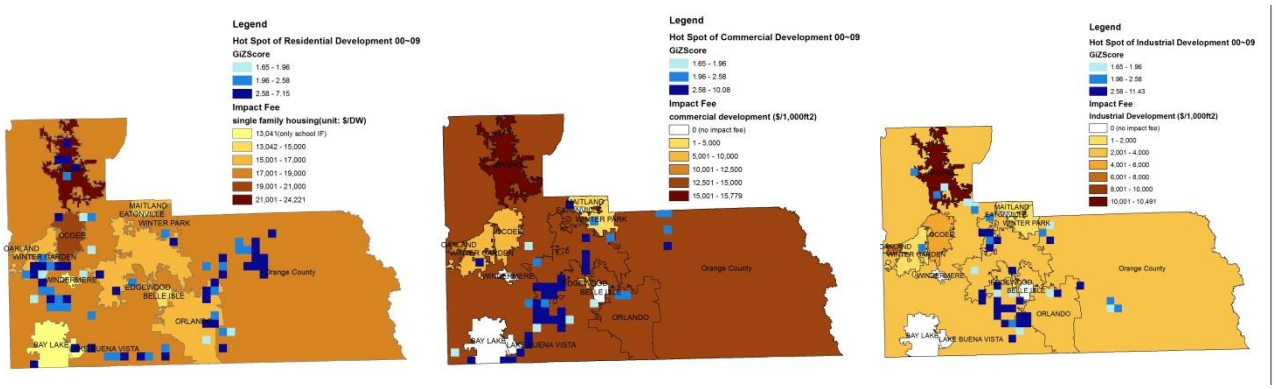


Figure 3-32. Change in ADT in Orange County

4) Impact Fees and New Development

The relationship between actual impact fee and hot spots of new developments for each development types are mapped in Figure 3-33. Residential developments are concentrated in unincorporated areas of Orange County although the level of impact fee is not lower compared to the City of Orlando. Also, some residential developments are concentrated in the City of Apopka, which has the highest impact fees. Commercial and industrial developments are concentrated southwest side of City of Orlando regardless of impact fees. These areas include a convention center and several theme parks along International Drive and are highly accessible from I-4 and SR 528. Therefore, this concentration appears to be more related to agglomeration economies than to impact fees.



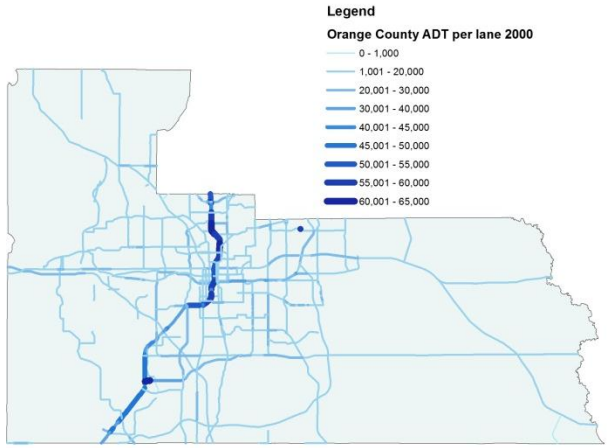
Impact fee and residential development | Impact fee and commercial development | Impact fee and industrial development

Figure 3-33. Impact fees and new developments in Orange County

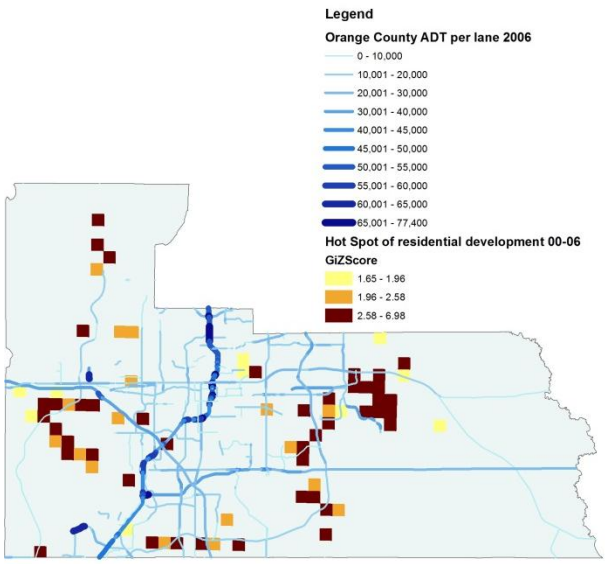
5) New Development and Congestion

The hot spots of new developments and the maps of congestion in 2000 and 2006 are compared in order to examine the relationship between location of new development and congestion change as shown in Figure 3-34. As noted earlier, new commercial and industrial developments are concentrated in southeast areas along I-4 and SR 528. This concentration of

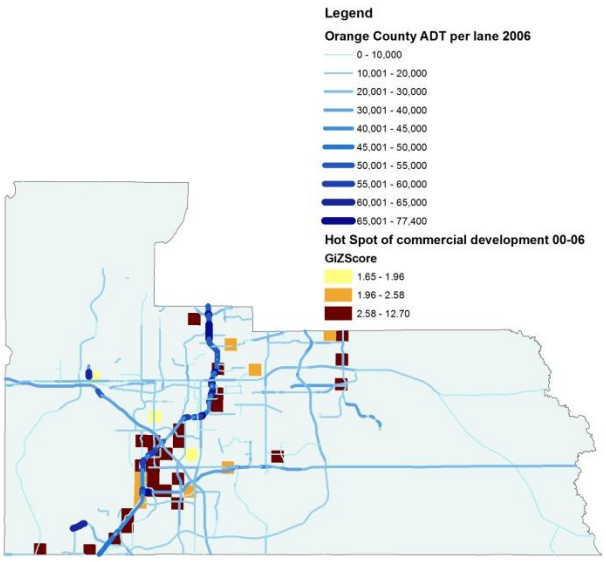
new development might explain the large increase of ADT in I-4 and SR 528 corridors. The concentration of residential development in the west area of Orange County may be related with the increased congestion on Florida Turnpike.



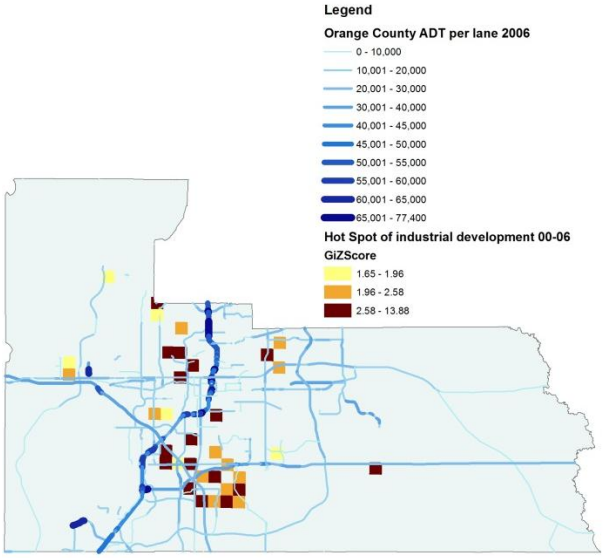
ADT 2000



Residential development and ADT 2006



Commercial development and ADT 2006



Industrial development and ADT 2006

Figure 3-34. New developments and congestion in Orange County

6) Interviews

Public officials in Orange County and the City of Orlando have not perceived a tendency of development to move outside the county, making the growth control effect unlikely in this case. Location change towards compactness within the county is not evident either. Indeed, policies that offer discount in impact fees for infill development and redevelopment in the city center have not changed location patterns. Before the construction industry crisis in 2006 impact fees were too small compared to the final price of the buildings in the market. Now, new development is very rare because of the weakness of demand and the lack of financial resources. Impact fees are not likely to change that. However, it is possible that impact fees will play a more important role in the future when the construction industry and final demand stabilize in a more sustainable pattern. The previous analysis also applies to concurrency fees.

According to the interviewees, a revenue effect of impact fees on congestion is not likely either because there is lag not only between the revenue collection and the investment, but also between the identification of congestion and the implementation of the impact fee. Moreover, the revenues are allocated to local road development more than to the widening of existing roads. In addition, most of the congestion in Orange County is produced by the tourism activity, an estimated 50 million annual visitors, and by employees commuting from other counties. In the future, other interventions such as changes in urban form produced by limiting the width of roads and promotion of transit could be more effective strategies to decrease congestion. For that reason, the county and the city have been working to shift from road impact fees to mobility fees that can be used for more general purposes.

3.2.4. DUVAL COUNTY

1) Overview of impact fee policy

When Duval County was created in 1967, it was consolidated with the City of Jacksonville. In Duval, some municipalities reported impact fee revenue but this policy has not been widely applied. Between 2000 and 2009, the City of Jacksonville only reported small impact fee revenues in the year 2000. Other small municipalities have implemented impact fee policies more frequently when compared to the City of Jacksonville as described in Table 3-16. Specifically, Atlantic Beach, Baldwin, and Neptune have continued to collect impact fee for physical environment over the last ten years. This should mean that the Difference of Impact Fees (DIF) has a small positive value since the City of Jacksonville is not charging impact fees but other municipalities are. However, the Intensity of Impact Fee (IIF) and the Transportation Impact Fee Revenue (TIFR) have very low values (almost zero) during this period. This implies that there is no expectation of the effect of impact fees on urban form and congestion in Duval County.

Table 3-16. Impact Fee reported since 2000 in Duval County

Type	Public Safety	Physical Environment	Transportation	Economic Development	Human Service	Culture and Recreation	Other
Atlantic Beach		00~ 09	00, 01				
Baldwin		00~ 09					
Jacksonville							00
Jacksonville Beach	06						07, 08
Neptune Beach		00~ 08					09

Source: Florida Office of Economic and Demographic Research

The reported amount of impact fees has the highest value in 2000 as shown in Figure 3-35. Afterwards, the amount of impact fee revenue decreases. These decreasing trends may be consequences of the recent economic recession. The portion of impact fees for physical

environment and 'other' fees account for over 80% of the impact fee revenue. Transportation has only 2% of total impact fee revenue between 2000 and 2009.

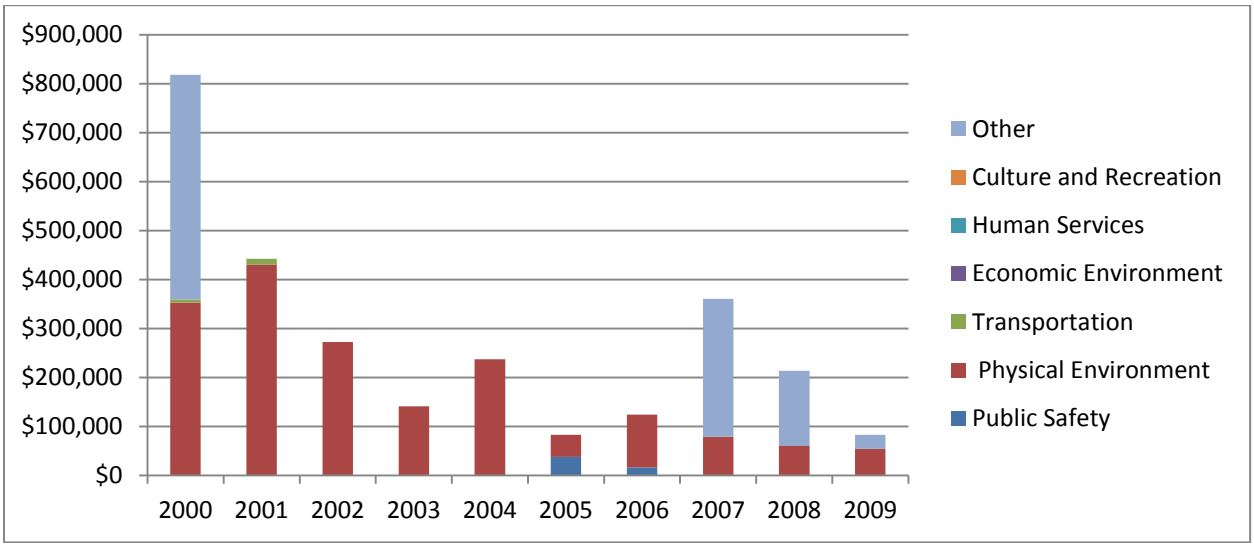


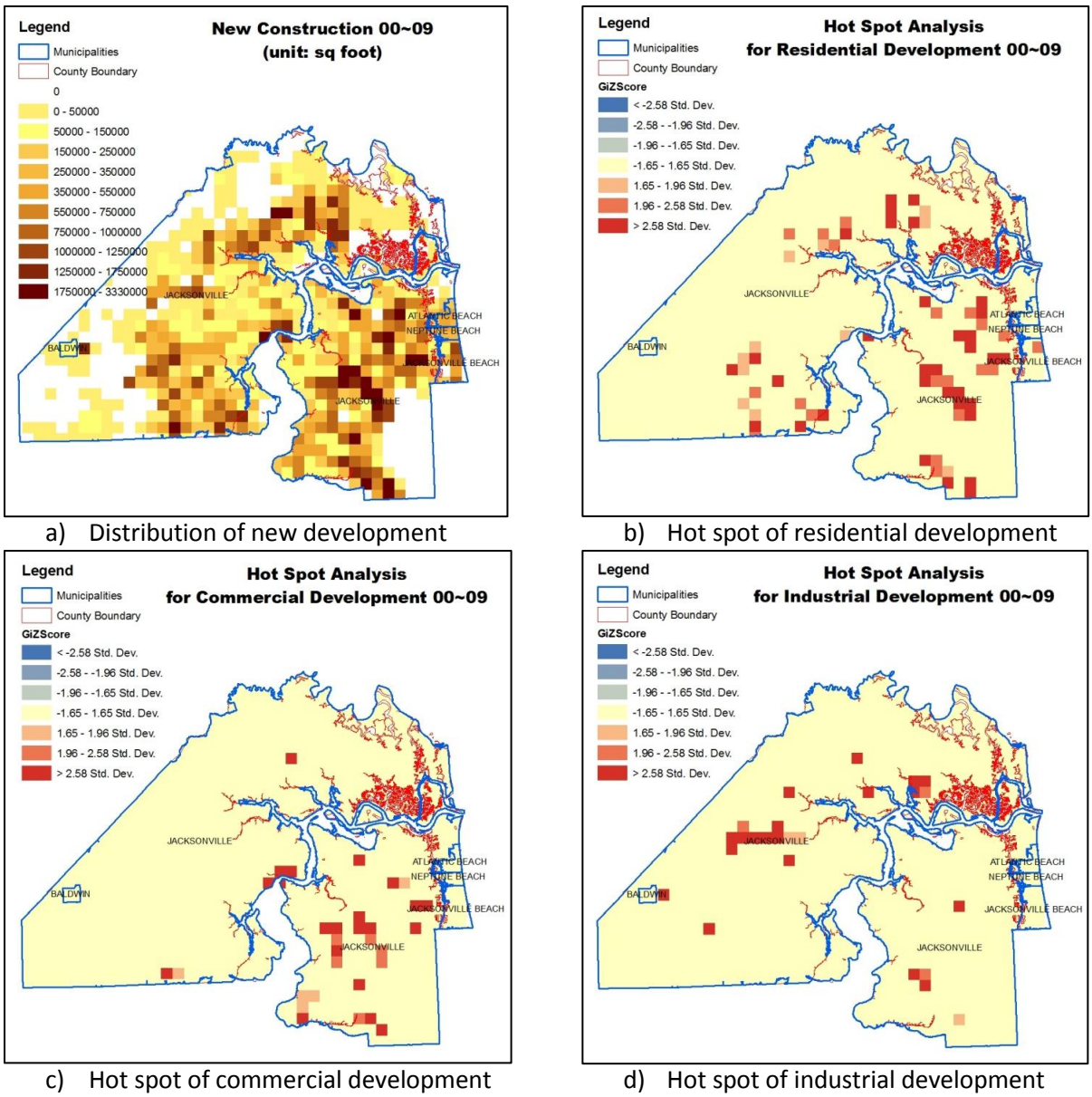
Figure 3-35. Revenue from municipalities by impact fee type in Duval County

2) Development Pattern

With regard to urban form in 2000, Duval County ranked at 5th of 40 counties in housing density, 18th in housing centrality, 30th in housing proximity, and 14th in housing concentration. These results imply that housing development in Duval County is not only highly-developed as clusters, but also highly dispersed. Regarding urban form change, the county ranked low in housing density and concentration, but relatively high in housing proximity and centrality as described in Table 2-2. Also, in general, the county has upper-middle ranks in job related urban form changes. Job concentration and job-housing ratio have decreased, but the other measures of compactness of employment have increased.

The spatial distribution of new developments between 2000 and 2009, and the hot spots of new developments for each development type from 2000 to 2009 are mapped in Figure 3-36. As illustrated in Figure 3-36(a), the total new development is dispersed across the county.

However, different development types are concentrated in different areas. For instance, residential development is dispersed across the suburban areas in the county as described in Figure 3-36(b) but, the commercial developments are clustered in the southeastern part of the St. Johns River as shown in Figure 3-36(c). In contrast, industrial developments are located in the northwestern part of the St. Johns River as described in Figure 3-36(d).



a) Distribution of new development

b) Hot spot of residential development

c) Hot spot of commercial development

d) Hot spot of industrial development

Figure 3-36. Distribution of new development and hot spots of new development in Duval County

3) Congestion

Due to the limitation of the congestion data for Duval County,[22] only the ADT in 2000 and 2004 are compared. Most of the traffic volume is concentrated on interstate highways, such as I-10, I-95 and I-295 corridors. The concentration of traffic volumes in these highways increased during the four years of the analysis. The ADTs in major arterials which link I-95 with the beaches have also increased.

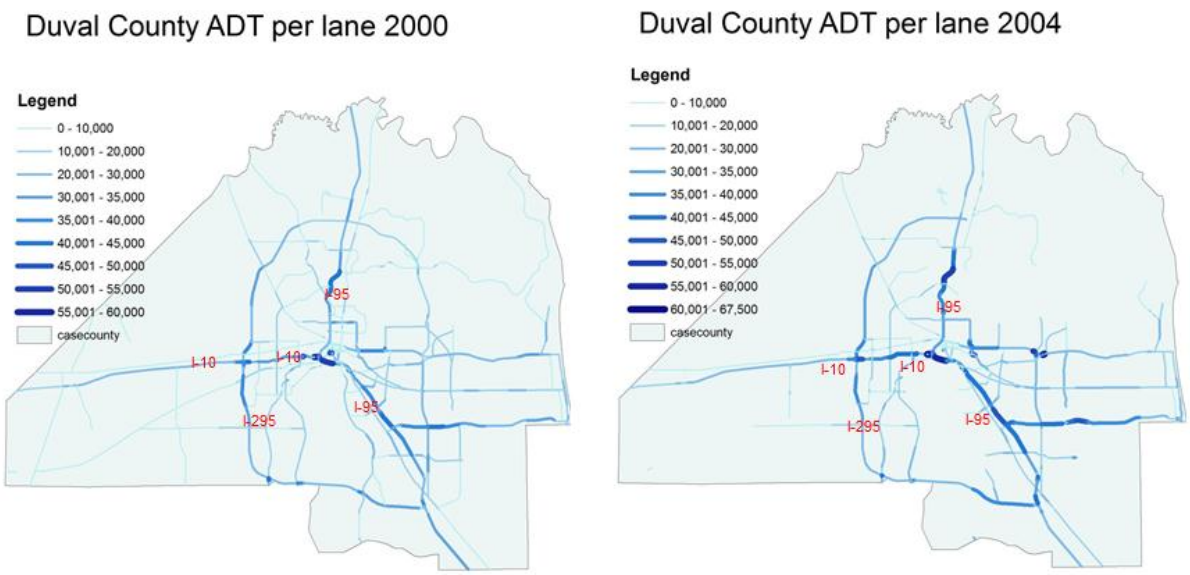
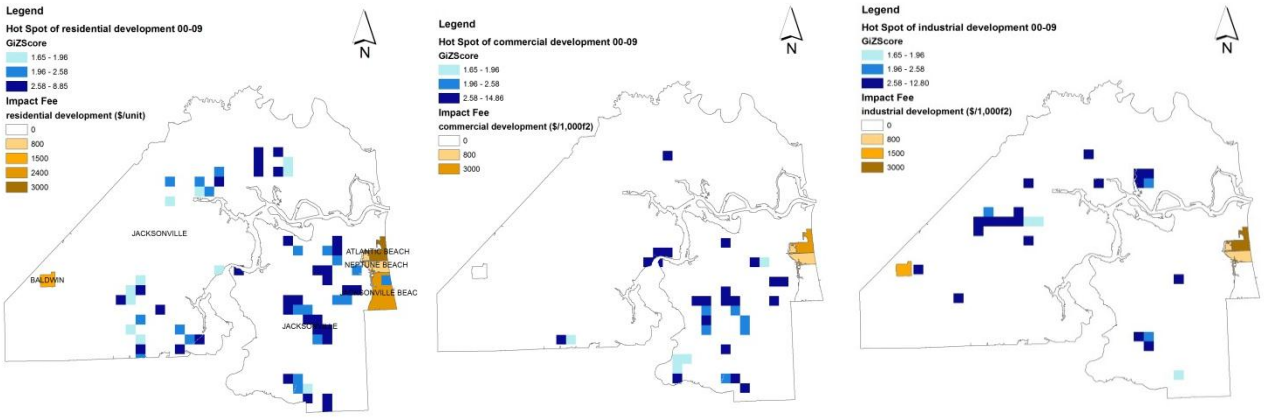


Figure 3-37. Change in ADT in Duval County

4) Impact Fee and New Development

The relationship between actual impact fees and hot spots of new development per types is mapped in Figure 3-38. Since the City of Jacksonville does not implement impact fee policy, the maps do not provide any reliable relationship between impact fee and new development.

[22] The ADT database does not provide the information about I-295 since 2005. Thus, this study compared ADT change between 2000 and 2004.

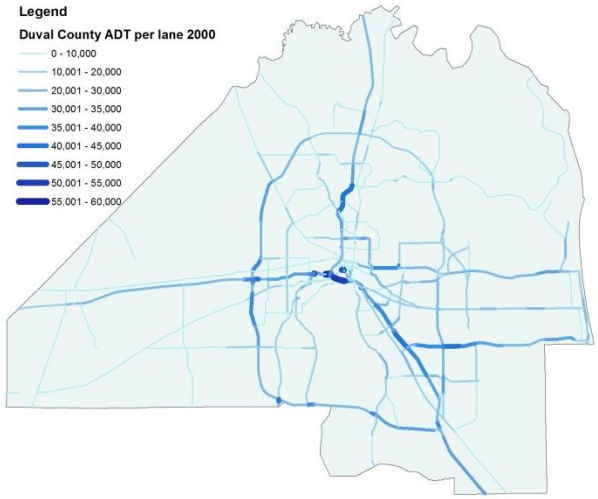


Impact fee and residential development | Impact fee and commercial development | Impact fee and industrial development

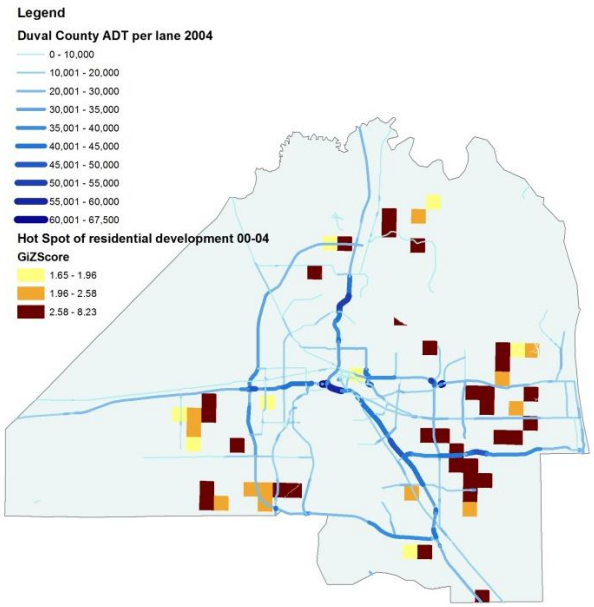
Figure 3-38. Impact fee and new development in Duval County

5) New Development and Congestion

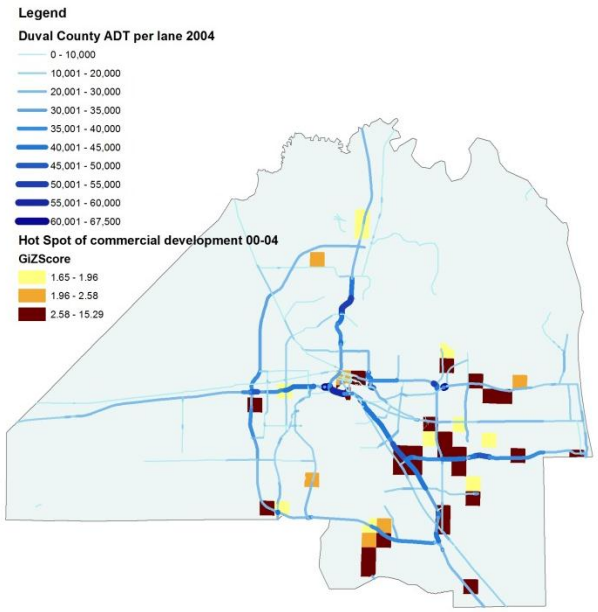
The hot spots of new developments and the maps of congestion levels between 2000 and 2004 are compared to examine the relationship between location of new development and congestion change as shown in Figure 3-39. The concentration of new residential and commercial developments along I-95 and I-295 corridors may have affected the increase of ADT on these roads. The higher concentration of residential developments in east areas of Duval County could also have affected the increase of ADT along the major arterials that link I-95 and the beaches.



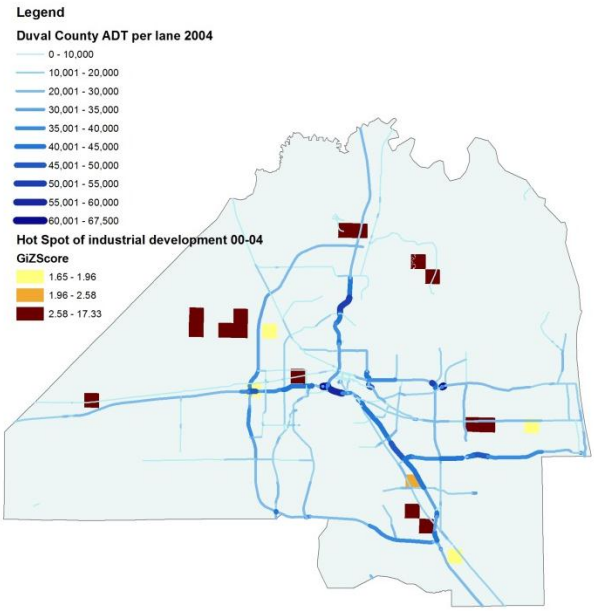
ADT 2000



Residential development and ADT 2006



Commercial development and ADT 2006



Industrial development and ADT 2006

Figure 3-39. New development and congestion in Duval County

6) Interviews

Public officials the City of Jacksonville do not consider impact fees to be an important factor of location in this case because only small municipalities representing less than 5% of the

land and the population have this type of policy. In the majority of Duval County there are no impact fees. The fact that outer municipalities have impact fees and the central city does not, has not changed the pattern of development towards a more compact urban form. This is because impact fees are insignificant and most of the municipalities charging them are located in the beaches where land is almost entirely built up, as opposed to Jacksonville. Other factors of location, such as accessibility, education, availability of land for master planned communities, and the perception of public safety are much more important than impact fees. For these reasons, the growth control and the location change effects are highly unlikely. Transportation impact fees are rare and small so there is no expectation for revenue effect either. Currently, the mobility plan is proposing mobility fees and incentives to increase redevelopment in downtown but the plan has not yet been implemented.

3.2.5. SUMMARY OF CASE STUDIES

Four case studies representing different degrees of impact of fee policies and diverse potential of growth control, location change, and revenue effects were selected for a more disaggregated and in-depth analysis. For these counties -Alachua, Broward, Orange and Duval- impact fee intensity, new development and congestion were mapped to identify whether spatial correlations exist. The analysis shows that impact fees are not likely to be an important factor of location since the spatial patterns of residential, commercial, and industrial new developments are not related with areas of low impact fees. This makes the location change effect of impact fees in urban form and congestion unlikely. Interviews with planning officials confirm these results with all the participants stating unanimously that impact fee charges are insignificant and

that other location factors such as land values and the conditions of the final demand are much more important, for example.

Congestion seems to spatially correlate with the location of new development since traffic volumes have increased more in areas with clusters of new development. However, interviewees state that in most cases traffic is generated in other counties and that local road impact fees are not likely to solve congestion problems. For these reasons, there is no expectation for a revenue effect of impact fees in congestion. Most public officials identify interventions, such as transit promotion or traffic management systems, more promising for an effective congestion mitigation policy.

CHAPTER 4 CONCLUSIONS, RECOMMENDATIONS, AND SUGGESTED RESEARCH

4.1. CONCLUSIONS

This study addresses three research questions: (1) What is the effect of impact fees on residential and employment urban form? (2) What is the effect of urban form on traffic congestion? (3) What is the effect of impact fees on traffic congestion? Based on the literature review, specific hypotheses are defined and tested through a combination of methods including econometrics, GIS techniques and interviews with planning officials.

In terms of the first question the initial hypothesis of this study is that impact fees have the potential to change urban form since they could affect the location of development by affecting the costs of construction. Therefore, impact fees could create more compact environments if the charges in suburban areas are more expensive than in central cities. In addition, since impact fees increase the cost of construction in a given region they could decrease development and affect job and housing growth and density.

Regarding the second question, this study hypothesizes that more compact environments have the potential to decrease congestion since they can incentivize other transportation modes, such as transit and walking, which generally lessen automotive travel.

For the third question, the previous hypotheses are combined to define three effects of how impact fees can decrease congestion: (1) Growth Control Effect: by increasing the cost of development in the region, impact fees can hinder growth and decrease congestion. (2) Location Change Effect: if impact fees in the central city are lower than in the rest of the region, they can incentivize compact development and decrease congestion by promoting less travel and more use

of transit. (3) Revenue Effect: by increasing the revenues to invest in transportation infrastructure, impact fees could decrease congestion by increasing the supply of roads.

The first econometric model tests the relationship between impact fees and urban form showing that total impact fees can affect some dimensions of urban form such as job density and the job-housing ratio suggesting that the growth control effect is possible. However, direct evidence of the effect of impact fees in development and job creation was not found. The effects of the difference of impact fees between central cities and outer areas on urban form were not significant suggesting that the location change effect is not likely.

The second econometric model tests the relationship between urban form in congestion providing strong evidence that, contrary to the initial hypothesis of this study, 'compactness' of urban form increase congestion. This suggests that compact built environments could increase trip frequency or that the demand is increasing at a faster pace than the road capacity. In any case, this result is an indication that higher densities in Florida are not being associated with more use of alternative modes of transportation. In addition, the analysis shows that the increase of congestion is negatively correlated with its initial level indicating that congestion is increasing faster in areas that used to be less congested.

The third econometric model tests the direct effect of impact fees in congestion. The results show that total impact fees tend to decrease congestion suggesting the possibility of a growth control effect although with the same qualifications of the first model. The analysis also indicates that transportation impact fee revenue per capita does not reduce congestion suggesting that there is no revenue effect. This might be because impact fees usually finance local roads but congestion is concentrated (and measured in our analysis) on freeways and principal arterials. Other explanations can be related with the fact that impact fees are insufficient to cover the

actual road costs or that there could be a time lag between the revenue collection and the actual investment.

The GIS analysis in the four case studies shows that impact fees are not likely to be an important factor of location since the spatial patterns of residential, commercial, and industrial new developments are not related with areas of low impact fees. This makes the location change effect of impact fees in urban form and congestion unlikely. The interviews with planning officials show the perception that impact fee charges are not high enough to produce a change in development location or a decrease in congestion. In terms of location, other factors such as land values or the conditions of the final demand are more relevant. Regarding congestion other interventions such as transit promotion or traffic management systems are deemed more effective.

4.2. RECOMMENDATIONS

As previously stated, the evidence for a growth control effect of impact fees in congestion is not conclusive because there is no evidence of a direct effect of impact fees in jobs and development. More importantly, even if this effect exists, it cannot be considered an optimum way to mitigate congestion because it can affect other public objectives. The ineffectiveness of more desirable effects of impact fees such as the location change and revenue effects can be explained by various reasons, such as the inability of impact fees to cover the actual transportation infrastructure costs and temporal or spatial mismatches between the supply and demand of roads.

A modification of local governments' impact fee policies can enhance the effectiveness of impact fees to control urban development and congestion. In this sense, it is recommended to

define the amount of impact fees based on the actual road construction costs. In addition, to improve the effectiveness of impact fees, inter-governmental coordination and collaboration might be important to minimize the temporal and spatial mismatches in the supply and demand of road infrastructure. Another important consideration is that increases in the compactness of urban form need to be accompanied by more efforts to promote public transit in order to decrease congestion. Therefore, the shift from road impact fees to more flexible mobility fees could be an effective congestion mitigation strategy.

4.3. SUGGESTED RESEARCH

As stated in the introduction the effects of impact fees on congestion is not a common research topic. This study combines different data sources to create innovative indicators and uses different methods of analysis to increase the reliability of the results. However, the study could be expanded and complemented in several ways. First, it is important to conduct more in-depth analyses of the effects of impact fees in development and job growth to better understand the possibility and potential of a growth control effect.

Second, it is advisable to use more disaggregated data sources and methods of analysis. Since this study uses aggregated impact fee data at the county level, it is difficult to identify specific development patterns within each county and their relation to impact fees. The case studies were intended to provide more evidence on this issue but a more rigorous methodological analysis using different observations in one specific Metropolitan Statistical Area (MSA) or county could yield better results. By using disaggregated impact fee data at the parcel level in future research, the effect of different impact fees across different communities within the same county or the MSA can be addressed.

Third, this study uses only six-year period data. Considering the full process of development (including receiving building permit, construction, and issuance of occupancy), six years might not fully explain the effects of impact fees on urban form. Also, a longer study period might better incorporate and control for the effects of drastic housing market changes, such as the recent housing market boom and bust, which can affect impact fee policies.

Fourth, this study only considers the number of units, regardless of development location and type. Since urban density strongly affects lot size, housing unit size, and the number of built units, it could affect the location of single family housing and multifamily housing. Impact fees might have different effects on the development pattern according to the type of housing being considered.

Fifth, since this study only analyzed Florida cases, the results and implications are interpreted within the context of Florida. Adding other counties or MSAs in different states may provide not only more generalizable results but also stronger evidence based on a larger sample.

Lastly, this study could be improved if arterials and local roads are included in the models. As stated in the description of the data sources, our indicators of congestion correspond only to highways and principal arterials. Since most impact fee revenue is expended on local roads, a consideration of congestion on minor arterials could provide better and more accurate results.

This study proposes an interesting direction of research with clear implications concerning one of the main urban problems affecting Florida and the U.S. The potential of impact fees to mitigate congestion deserves careful consideration by researchers and policy makers as part of an integral strategy to increase mobility in the state.

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APPENDIX A COUNTY RANKING OF IMPACT FEE, URBAN FORM AND CONGESTION

Table A-1. Ranking and value for Impact Fees

ranking	IIF ($ / 1,000ft^2)		DIF ($ / 1,000ft^2)		TIFR ($ / new housing unit)	
1	Orange	4,914.5	Palm Beach	2,868.1	Indian River	5,427.5
2	Miami-Dade	3,361.8	Orange	2,728.8	Orange	4,060.1
3	Lake	3,061.4	Sarasota	2,632.1	Martin	4,005.7
4	Palm Beach	3,050.5	Miami-Dade	2,497.3	Pasco	3,925.3
5	Sarasota	2,970.0	Indian River	2,045.0	Palm Beach	3,045.7
6	Osceola	2,834.8	Collier	1,751.8	Lee	2,952.0
7	Martin	2,816.6	Flagler	1,369.0	Pinellas	2,902.7
8	Saint Lucie	2,565.8	Marion	1,234.0	Osceola	2,885.2
9	Collier	2,531.1	Broward	914.6	hernando	2,831.4
10	Pasco	2,379.3	Osceola	907.9	Lake	2,819.6
11	Indian River	2,347.7	Brevard	877.2	Sarasota	2,784.9
12	Lee	2,295.9	Citrus	864.2	Marion	2,754.1
13	Volusia	2,257.7	Saint Johns	758.8	Seminole	2,525.3
14	Seminole	1,921.5	Columbia	620.3	Citrus	2,413.4
15	Manatee	1,920.3	DeSoto	428.0	Miami-Dade	2,401.2
16	Hernando	1,798.7	Hillsborough	267.6	Manatee	2,094.6
17	Columbia	1,767.0	Duval	211.1	Volusia	1,895.8
18	Citrus	1,678.6	Pinellas	205.6	Nassau	1,829.5
19	Brevard	1,545.2	Lee	191.1	Charlotte	1,787.3
20	Charlotte	1,340.4	Clay	170.6	Hillsborough	1,509.4
21	Marion	1,152.5	Alachua	54.2	Saint Johns	1,420.9
22	Broward	1,132.8	Highlands	21.8	Brevard	1,353.9
23	Bay	1,100.2	Leon	2.5	Monroe	1,312.7
24	Nassau	1,059.5	Escambia	0.0	Saint Lucie	1,103.6
25	Saint Johns	1,038.0	Putnam	-97.9	Broward	544.0
26	Pinellas	983.1	Volusia	-239.3	Polk	540.6
27	Hillsborough	922.5	Saint Lucie	-288.9	Clay	529.4
28	Polk	738.3	Seminole	-521.7	Flagler	344.8
29	Monroe	709.5	Okaloosa	-544.9	Okaloosa	284.4
30	Flagler	649.3	Monroe	-919.3	Santa Rosa	269.5
31	Clay	559.3	Charlotte	-1,183.8	DeSoto	215.7
32	Escambia	435.5	Nassau	-1,250.8	Alachua	138.2
33	DeSoto	405.5	Pasco	-1,312.3	Bay	91.9
34	Santa Rosa	392.6	Hernando	-1,357.9	Collier	66.1
35	Okaloosa	223.6	Lake	-1,368.2	Highlands	58.9
36	Highlands	71.4	Santa Rosa	-1,774.5	Leon	2.5
37	Alachua	57.0	Martin	-1,791.7	Duval	0.4
38	Duval	13.1	Polk	-2,755.2	Columbia	0.0
39	Putnam	7.1	Bay	-3,052.0	Escambia	0.0
40	Leon	0.9	Manatee	-6,397.3	Putnam	0.0

Table A-2. Ranking and value for Residential Urban Form change

ranking	Ch_density (2006/2000)		Ch_concentration (2006/2000)		Ch_centrality (2006/2000)		Ch_proximity (2006/2000)	
1	Flagler	1.539	Volusia	1.112	DeSoto	1.080	Hernando	1.036
2	Saint Lucie	1.316	Santa Rosa	1.043	Pasco	1.079	Lake	1.019
3	Indian River	1.277	Putnam	1.030	Saint Lucie	1.077	Polk	1.019
4	Hernando	1.264	Miami-Dade	1.025	Polk	1.054	DeSoto	1.018
5	Osceola	1.260	Leon	1.024	Sarasota	1.049	Osceola	1.017
6	Charlotte	1.209	Okaloosa	1.020	Saint Johns	1.046	Okaloosa	1.014
7	Santa Rosa	1.188	Marion	1.020	Volusia	1.046	Orange	1.013
8	Monroe	1.179	Monroe	1.019	Columbia	1.043	Sarasota	1.012
9	Lee	1.165	Lake	1.012	Osceola	1.042	Columbia	1.010
10	Hillsborough	1.160	Citrus	1.009	Escambia	1.036	Escambia	1.010
11	Polk	1.158	Alachua	1.008	Indian River	1.033	Saint Johns	1.009
12	Volusia	1.153	Highlands	1.006	Santa Rosa	1.031	Hillsborough	1.009
13	Clay	1.150	Bay	0.999	Duval	1.031	Putnam	1.009
14	Marion	1.142	Clay	0.997	Orange	1.030	Duval	1.009
15	Lake	1.140	Columbia	0.991	Lake	1.017	Seminole	1.007
16	Collier	1.137	Charlotte	0.986	Highlands	1.014	Collier	1.007
17	Pasco	1.133	DeSoto	0.978	Broward	1.013	Indian River	1.006
18	Palm Beach	1.131	Hernando	0.977	Seminole	1.011	Saint Lucie	1.005
19	Orange	1.126	Collier	0.977	Okaloosa	1.011	Broward	1.004
20	Bay	1.123	Pinellas	0.973	Manatee	1.005	Manatee	1.003
21	Martin	1.123	Brevard	0.973	Putnam	1.004	Alachua	1.002
22	Duval	1.115	Flagler	0.970	Brevard	1.002	Lee	1.002
23	Sarasota	1.100	Escambia	0.967	Hillsborough	1.002	Brevard	1.001
24	Leon	1.094	Martin	0.941	Marion	1.001	Monroe	1.000
25	Escambia	1.085	Broward	0.938	Bay	0.999	Leon	1.000
26	Broward	1.083	Indian River	0.935	Pinellas	0.995	Highlands	0.999
27	Nassau	1.080	Saint Lucie	0.932	Monroe	0.992	Pinellas	0.998
28	Miami-Dade	1.063	Hillsborough	0.931	Clay	0.989	Santa Rosa	0.998
29	Manatee	1.061	Duval	0.930	Palm Beach	0.988	Palm Beach	0.997
30	Columbia	1.058	Nassau	0.911	Collier	0.987	Bay	0.996
31	Seminole	1.056	Manatee	0.910	Martin	0.985	Pasco	0.995
32	Saint Johns	1.052	Lee	0.906	Alachua	0.983	Charlotte	0.994
33	Citrus	1.052	Seminole	0.875	Nassau	0.982	Martin	0.994
34	Okaloosa	1.051	Pasco	0.855	Leon	0.978	Marion	0.993
35	Highlands	1.046	Palm Beach	0.851	Lee	0.973	Citrus	0.993
36	Pinellas	1.023	Osceola	0.845	Flagler	0.962	Volusia	0.992
37	Putnam	1.017	Polk	0.804	Charlotte	0.928	Flagler	0.991
38	Alachua	1.014	Orange	0.788	Miami-Dade	0.904	Clay	0.989
39	DeSoto	1.010	Saint Johns	0.782	Citrus	0.856	Nassau	0.978
40	Brevard	0.999	Sarasota	0.757	Hernando	0.845	Miami-Dade	0.919

Table A-3. Ranking and value for Employment Urban Form change

ranking	Change in job density (2006/2000)		Change in job concentration (2006/2000)		Change in job centrality (2006/2000)	
1	Manatee	1.519	Flagler	1.390	Lee	1.097
2	Flagler	1.290	Polk	1.278	Osceola	1.093
3	Charlotte	1.289	Manatee	1.259	Citrus	1.091
4	Santa Rosa	1.265	Charlotte	1.235	Volusia	1.090
5	Escambia	1.243	Pinellas	1.204	Alachua	1.074
6	Okaloosa	1.135	Brevard	1.135	Pasco	1.050
7	Pinellas	1.128	Escambia	1.126	Marion	1.048
8	Hillsborough	1.127	Volusia	1.119	Duval	1.042
9	Clay	1.107	Santa Rosa	1.111	Brevard	1.029
10	Orange	1.104	Bay	1.086	Indian River	1.025
11	Broward	1.077	Okaloosa	1.085	Hillsborough	1.025
12	Duval	1.076	Citrus	1.085	Lake	1.025
13	Leon	1.074	Lee	1.063	Collier	1.008
14	Hernando	1.049	Saint Lucie	1.062	Leon	0.993
15	Saint Lucie	1.036	Broward	1.059	Orange	0.992
16	Lee	1.029	Hillsborough	1.047	Pinellas	0.989
17	Bay	1.027	Leon	1.043	Palm Beach	0.976
18	Saint Johns	1.016	Hernando	1.041	Seminole	0.975
19	Marion	1.013	Martin	1.034	Miami-Dade	0.975
20	Polk	1.012	Alachua	1.033	Broward	0.972
21	Palm Beach	1.001	Miami-Dade	1.026	Santa Rosa	0.969
22	Miami-Dade	0.994	Lake	1.019	Saint Lucie	0.959
23	Volusia	0.974	Collier	1.011	Polk	0.945
24	Alachua	0.966	Marion	0.999	Escambia	0.932
25	Osceola	0.965	Indian River	0.995	Martin	0.929
26	Seminole	0.964	Duval	0.990	Bay	0.926
27	Collier	0.961	Osceola	0.958	Okaloosa	0.912
28	Indian River	0.958	Palm Beach	0.952	Sarasota	0.912
29	Brevard	0.955	Seminole	0.952	Saint Johns	0.906
30	Citrus	0.943	Clay	0.939	Clay	0.892
31	Martin	0.912	Saint Johns	0.927	Flagler	0.873
32	Sarasota	0.890	Orange	0.887	Charlotte	0.861
33	Lake	0.878	Sarasota	0.626	Hernando	0.787
34	Pasco	0.832	Pasco	0.621	Manatee	0.677

Table A-3. Ranking and value for employment urban form change (continued)

ranking	Change in job proximity (2006/2000)		Change in job-housing ratio (2006/2000)		Change in job-housing distance (2006/2000)	
1	Okaloosa	1.041	Manatee	1.432	Indian River	0.974
2	Lee	1.029	Escambia	1.146	Alachua	0.994
3	Sarasota	1.021	Pinellas	1.103	Marion	0.994
4	Osceola	1.021	Okaloosa	1.080	Bay	1.031
5	Collier	1.019	Charlotte	1.066	Collier	1.034
6	Alachua	1.012	Santa Rosa	1.065	Flagler	1.077
7	Polk	1.012	Broward	0.995	Citrus	1.077
8	Indian River	1.006	Leon	0.982	Saint Lucie	1.081
9	Saint Johns	1.006	Orange	0.980	Polk	1.082
10	Seminole	1.005	Hillsborough	0.972	Okaloosa	1.099
11	Marion	1.003	Saint Johns	0.965	Charlotte	1.109
12	Duval	1.003	Duval	0.965	Escambia	1.113
13	Citrus	1.001	Clay	0.963	Lake	1.120
14	Orange	1.000	Brevard	0.956	Manatee	1.133
15	Lake	1.000	Alachua	0.953	Clay	1.135
16	Palm Beach	0.997	Miami-Dade	0.935	Lee	1.136
17	Hillsborough	0.997	Bay	0.914	Santa Rosa	1.142
18	Leon	0.995	Seminole	0.913	Martin	1.144
19	Miami-Dade	0.994	Citrus	0.897	Orange	1.148
20	Broward	0.992	Marion	0.887	Brevard	1.153
21	Bay	0.992	Palm Beach	0.885	Duval	1.157
22	Clay	0.992	Lee	0.883	Osceola	1.166
23	Pasco	0.990	Polk	0.874	Volusia	1.169
24	Saint Lucie	0.990	Collier	0.846	Leon	1.176
25	Escambia	0.988	Volusia	0.845	Saint Johns	1.189
26	Brevard	0.988	Flagler	0.838	Seminole	1.196
27	Hernando	0.986	Hernando	0.830	Hillsborough	1.216
28	Pinellas	0.982	Martin	0.813	Sarasota	1.244
29	Volusia	0.981	Sarasota	0.810	Pinellas	1.264
30	Santa Rosa	0.979	Saint Lucie	0.787	Broward	1.286
31	Charlotte	0.977	Lake	0.770	Pasco	1.349
32	Martin	0.966	Osceola	0.766	Miami-Dade	1.392
33	Flagler	0.959	Indian River	0.750	Palm Beach	1.424
34	Manatee	0.947	Pasco	0.734	Hernando	1.540

Table A-4. Ranking and value for Congestion change

ranking	Change in RCI (2006/2000)		Change in TTI (2006/2000)		Change in Delay (2006/2000)		Change in Congestion Cost (2006/2000)	
1	Flagler	1.584	Nassau	1.214	Flagler	7.806	Flagler	10.415
2	Broward	1.222	Duval	1.180	Nassau	3.115	Nassau	3.675
3	Nassau	1.214	Flagler	1.141	Indian River	2.456	Monroe	3.391
4	Duval	1.191	Indian River	1.120	Hernando	2.306	Indian River	3.027
5	Sarasota	1.140	Hernando	1.120	Monroe	2.288	Putnam	2.818
6	Pinellas	1.129	Sarasota	1.092	Putnam	2.170	Hernando	2.811
7	Monroe	1.090	Lee	1.057	Citrus	2.135	Lee	2.362
8	Saint Lucie	1.084	Pinellas	1.040	Santa Rosa	1.789	Santa Rosa	2.207
9	Lee	1.072	Santa Rosa	1.039	Lee	1.766	Citrus	2.165
10	Indian River	1.053	Bay	1.039	Highlands	1.651	Marion	2.088
11	Santa Rosa	1.051	Monroe	1.037	Marion	1.631	Highlands	1.933
12	Highlands	1.044	Leon	1.024	Charlotte	1.380	Brevard	1.791
13	Clay	1.036	Clay	1.023	Duval	1.323	Duval	1.766
14	Bay	1.034	Pasco	1.008	Collier	1.264	Charlotte	1.677
15	Saint Johns	1.033	Highlands	1.000	Brevard	1.222	Collier	1.646
16	Hernando	1.032	Polk	1.000	Sarasota	1.210	Sarasota	1.570
17	Charlotte	1.012	Miami-Dade	0.999	Clay	1.185	Clay	1.497
18	Alachua	1.005	Hillsborough	0.989	Leon	1.131	Polk	1.383
19	Hillsborough	1.004	DeSoto	0.986	Hillsborough	1.063	Leon	1.383
20	Leon	1.002	Saint Johns	0.985	Polk	1.047	Hillsborough	1.303
21	Osceola	0.998	Collier	0.982	Pasco	1.032	Broward	1.293
22	Pasco	0.996	Broward	0.981	Broward	0.995	Saint Lucie	1.288
23	DeSoto	0.989	Saint Lucie	0.980	Miami-Dade	0.990	Miami-Dade	1.281
24	Miami-Dade	0.985	Osceola	0.977	Saint Lucie	0.972	Manatee	1.280
25	Marion	0.979	Alachua	0.976	Manatee	0.956	Pasco	1.249
26	Citrus	0.978	Brevard	0.971	Alachua	0.945	Alachua	1.067
27	Brevard	0.970	Charlotte	0.970	Osceola	0.857	Osceola	1.065
28	Orange	0.952	Orange	0.968	Palm Beach	0.818	Orange	1.062
29	Collier	0.951	Manatee	0.956	Orange	0.792	Palm Beach	1.008
30	Palm Beach	0.943	Lake	0.954	Saint Johns	0.790	Saint Johns	1.003
31	Putnam	0.941	Citrus	0.953	Volusia	0.706	Volusia	0.927
32	Manatee	0.935	Escambia	0.940	Escambia	0.658	Escambia	0.858
33	Polk	0.924	Marion	0.939	Bay	0.620	Bay	0.789
34	Escambia	0.890	Volusia	0.935	Seminole	0.558	Seminole	0.729
35	Volusia	0.887	Palm Beach	0.932	Okaloosa	0.544	Okaloosa	0.689
36	Lake	0.855	Putnam	0.931	Pinellas	0.528	DeSoto	0.644
37	Seminole	0.853	Okaloosa	0.930	DeSoto	0.508	Pinellas	0.578
38	Okaloosa	0.813	Seminole	0.920	Lake	0.254	Lake	0.334
39	Columbia	0.706	Columbia	0.870	Martin	0.165	Martin	0.219
40	Martin	0.659	Martin	0.793	Columbia	0.000	Columbia	0.000

Tables A-2 to A-5 show the descriptive statistics of the variables representing impact fees, change in urban form, and change in congestion for all counties. Regarding impact fee variables, Orange County has the highest IIF value and Leon County has the lowest IIF value representing a large variation that ranges from $0.9 to $4,914.5. In terms of DIF, large and urban counties such as Miami-Dade, Orange and Palm Beach tend to have high values. In contrast, rural counties such as Polk, Bay, and Manatee present the lowest values. DIF ranges from $-6,397.33 to $2,868.1 implying a large variance in impact fee policies between central city and other areas depending on the county's regional context. Indian River has the largest revenue generation from transportation impact fees.

Residential density has increased in almost of all counties except Brevard. Flagler has the largest increase in housing density. In contrast, compactness of urban form in terms of housing concentration, centrality, and proximity has increased in some counties and decreased in others. These variations also occurred in all employment urban form measurements. Job-housing distance has increased in almost all counties except Marion, Alachua, and Indian River.

With regard to changes in congestion, Flagler County experienced the highest increase in congestion. The county is highly ranked for all congestion measurements. Similarly, Nassau County is also highly ranked for three congestion measurements. Eight counties, - Okaloosa, Seminole, Escambia, Volusia, Lake, Martin, Columbia, and DeSoto -, had experienced decrease in all congestion measurements. The results of congestion measurement show that some counties had experienced an increase of congestion, but others had experienced improvement from 2000 to 2006.

APPENDIX B MAPS OF IMPACT FEE, URBAN FORM AND CONGESTION

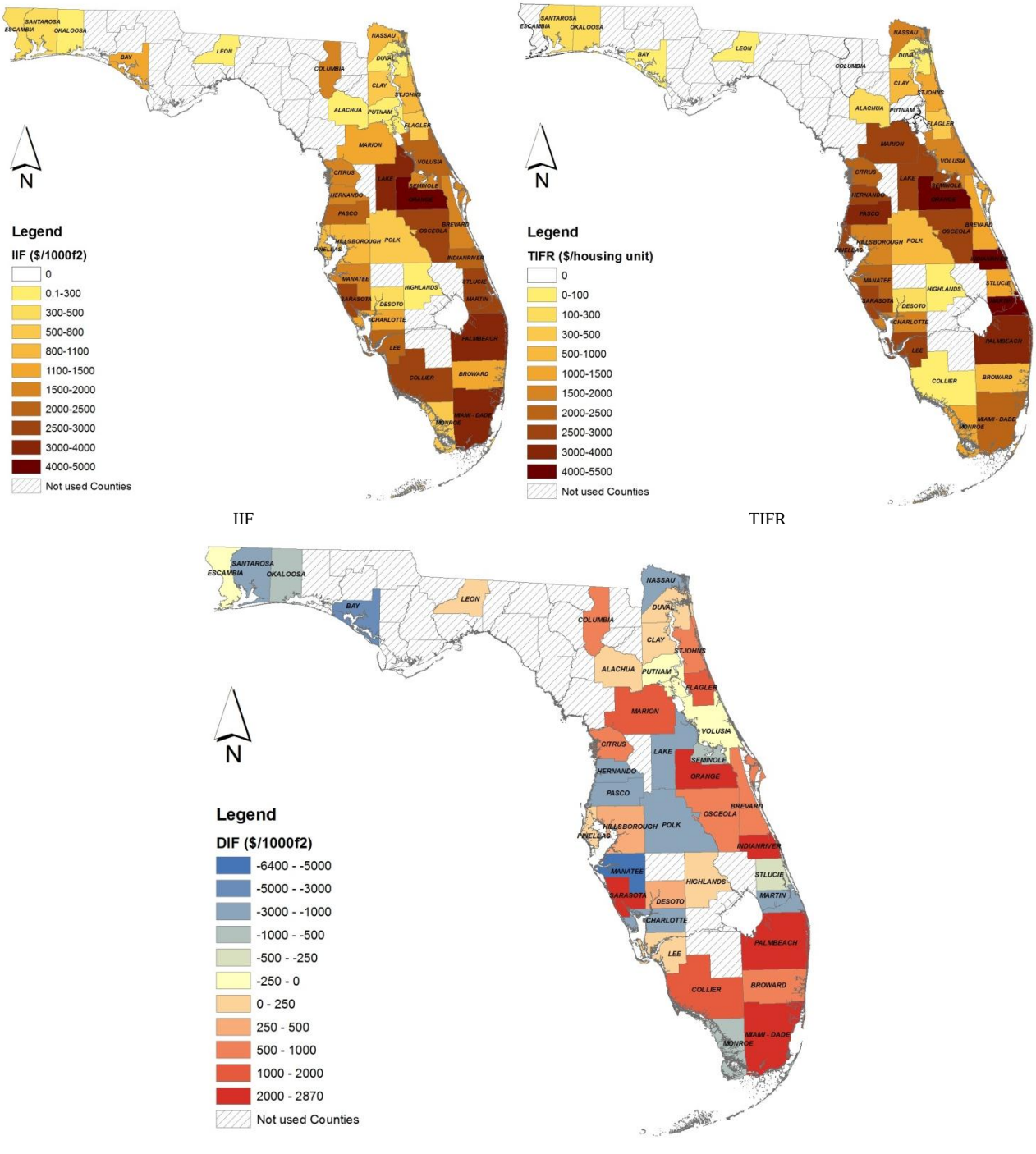
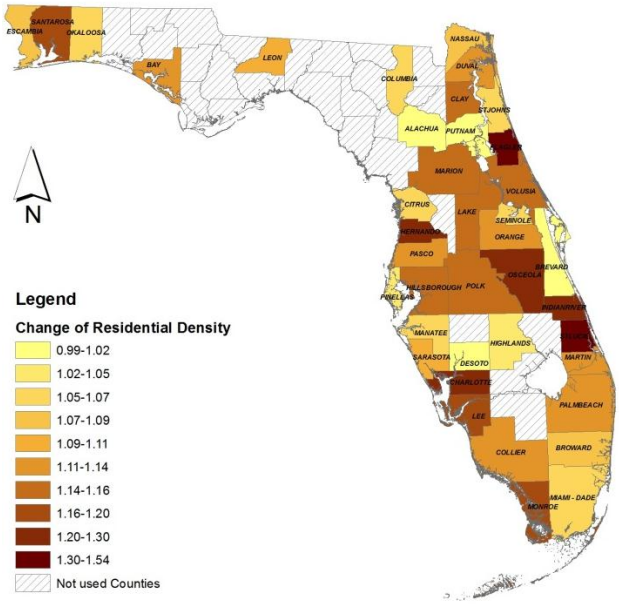
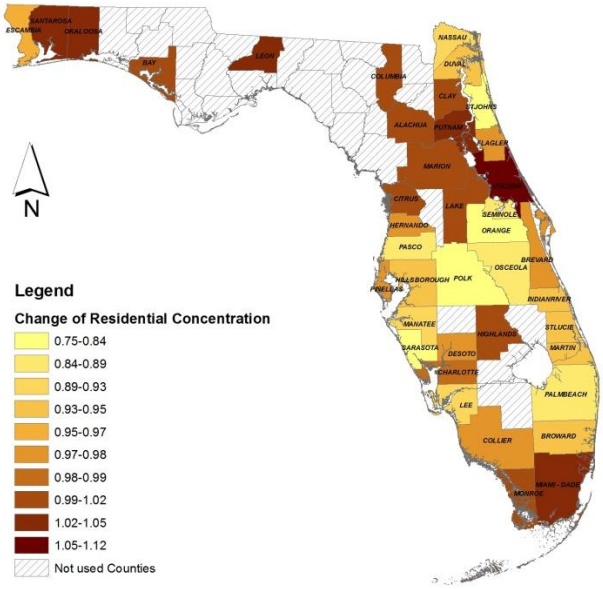


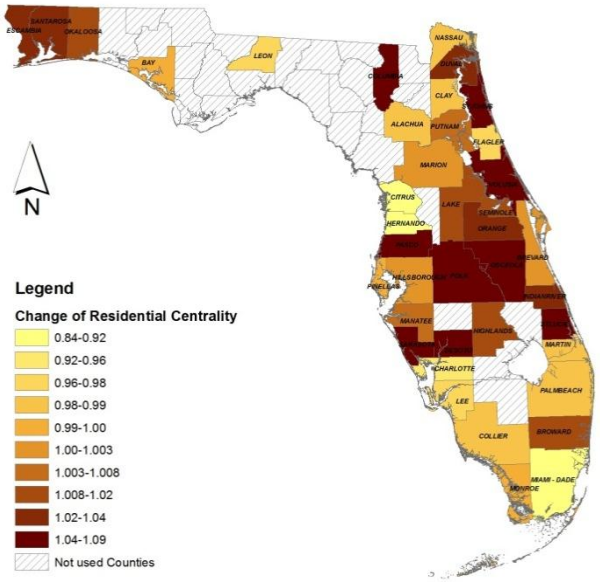
Figure B-1. Map of impact fee change



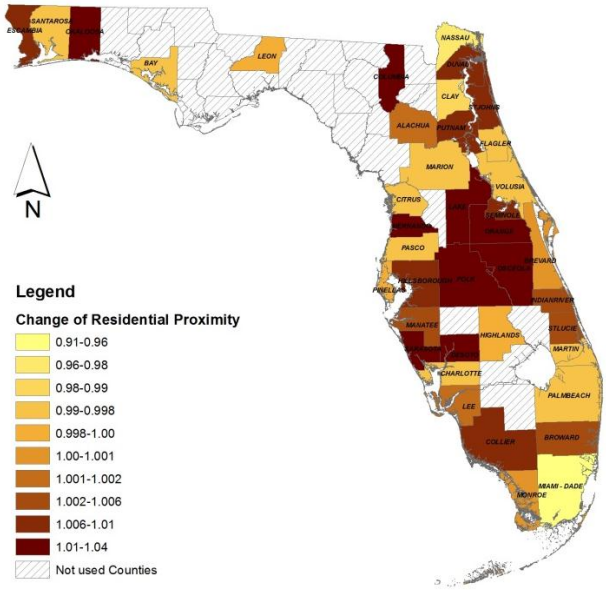
Change of residential density



Change of residential concentration

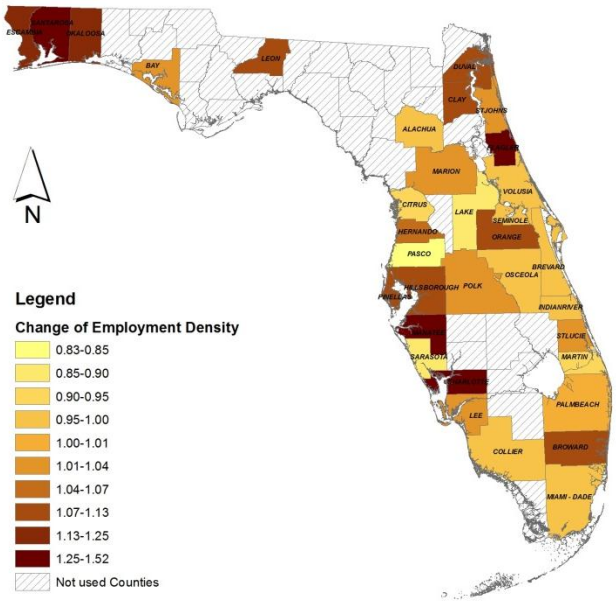


Change of residential centrality

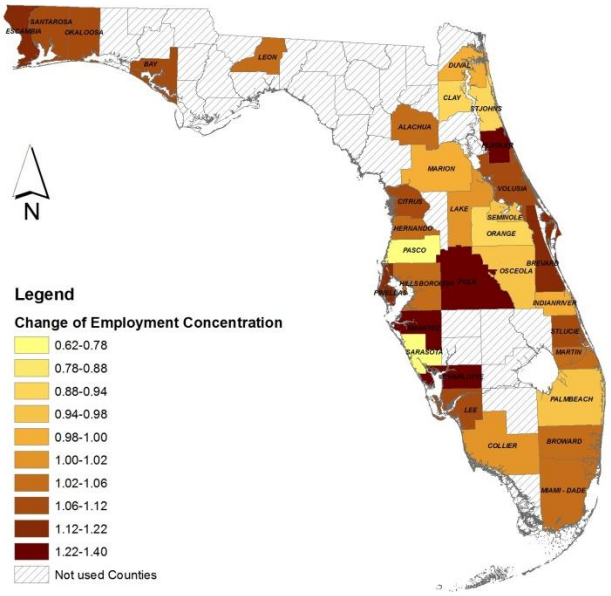


Change of residential proximity

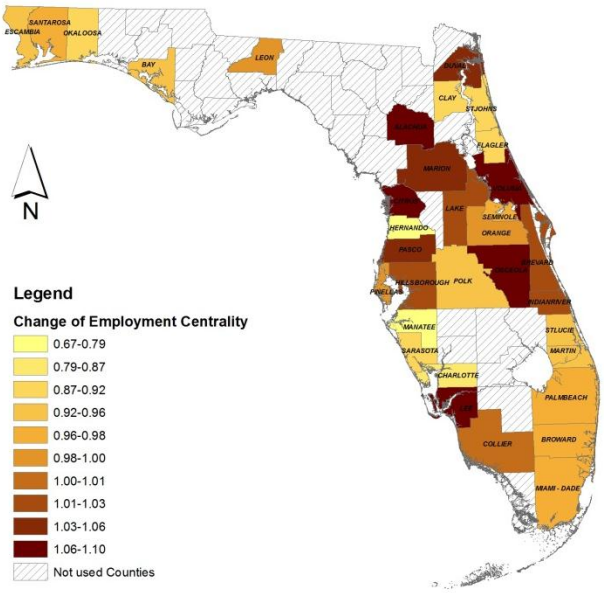
Figure B-2. Map of residential urban form change



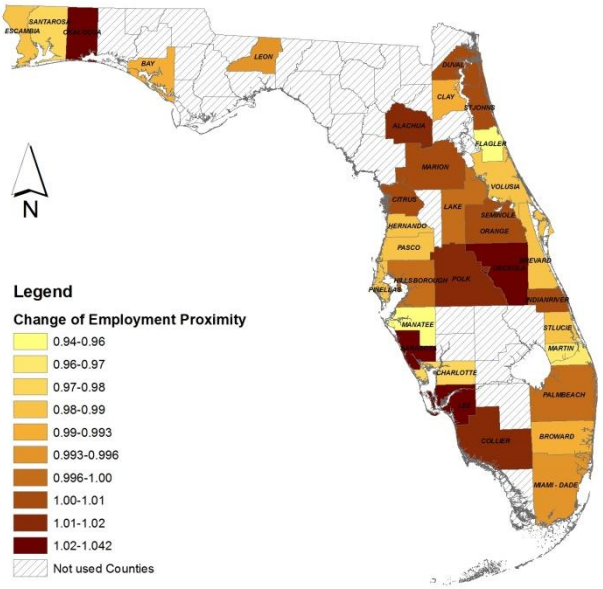
Change of employment density



Change of employment concentration

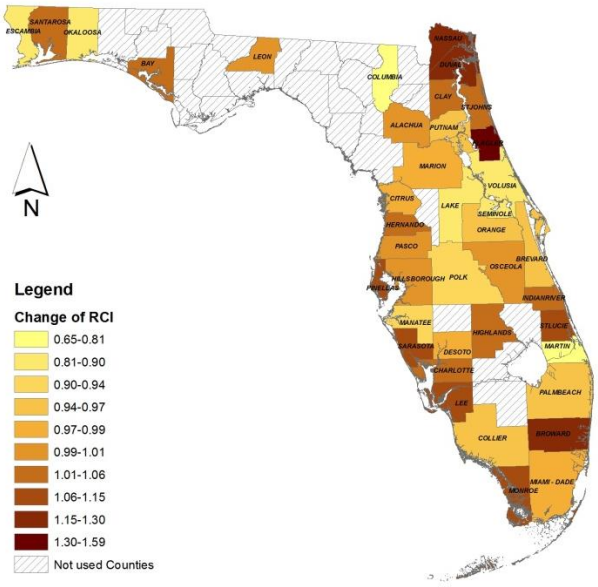


Change of employment centrality

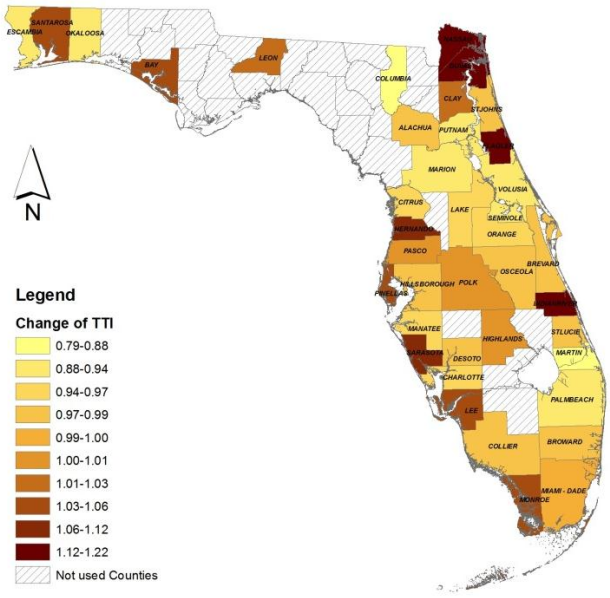


Change of employment proximity

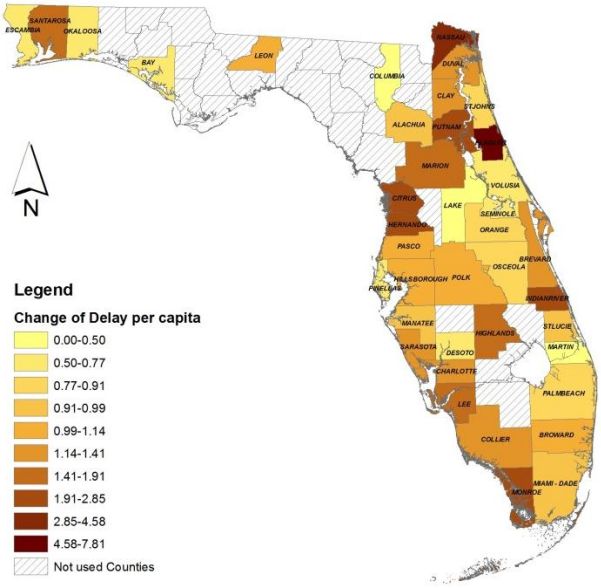
Figure B-3. Map of employment urban form change



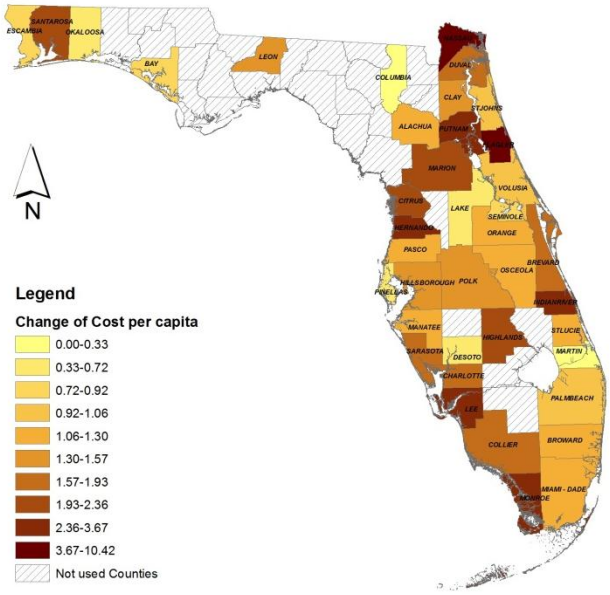
Change of RCI



Change of job TTI



Change of delay



Change of cost

Figure B-4. Map of Congestion change

APPENDIX C THE DETAILS OF THE OPERATIONALIZATION OF URBAN FORM

Appendix C shows details of the quantification process for the different dimensions of urban form. To capture the area with urban characteristics in a county, this study uses the concept of Extended Urbanized Area (EUA). Within each EUA, housing and job urban form measures are operationalized. There are 46 counties located in Metropolitan Statistical Areas (MSAs) in 2006. However, six counties (Baker, Gadsden, Hardee, Hendry, Okeechobee, and Sumter) lack data about congestion. Second, in terms of job urban form, 12 counties (Baker, Columbia, De Soto, Gadsden, Hardee, Hendry, Highlands, Monroe, Nassau, Okeechobee, Putnam and Sumter) did not have sufficient data in 2000 CTPP (Census Transportation Planning Package).

C.1. CREATE NEW GRID

In order to identify the EUA, a new grid system should be generated. The new grid is the geographical baseline in which housing units and jobs are aggregated. Using the fishnet function in ArcGIS 9.3, this study creates statewide of areal unit system in which each grid is 1 square mile.

C.2. DEFINE LAND USE (EXCLUDE 'UNDEVELOPABLE AREA')

In the process of creating the EUA, water bodies and oceans are excluded because they are undevelopable. This study uses a different way to distinguish undevelopable and undeveloped land categories in estimating the actual land area that is used to calculate density. To operationalize EUA, Cutsinger et al. (2005) define Undevelopable Areas as lands that include

open water, perennial ice and snow, woody wetlands, and emergent herbaceous wetlands (Cutsinger et al., 2005: 238). This land use information is specified in the National Land Cover Data Base (NLCDB). Our study identifies national and regional water bodies and wetlands as undevelopable land using the data from the Florida Geographic Data Library (FGDL). The major water body data is primarily obtained from the Environmental Systems Research Institute.

As for census tracts and census block, county demographics boundaries are used to have clear-cut county boundaries that exclude water and ocean areas. The original census tracts include areas that are not populated such as coastline areas. This may affect the results of the analysis by increasing non-populated areas. Thus, we clip the original census tracts with county boundaries for demographics.[23]

C.3. POPULATE HOUSING UNITS

To populate the change in the number of housing units between 2000 and 2006 in each cell, this study uses 2009 parcel data obtained from the Florida Department of Revenue (FDOR). It only uses 2009 polygon parcel data because of data consistency. FDOR parcel data has DOR land use codes which categorize residential development. In calculating housing units of residential use, this study regards single family, mobile home and condominium as one unit. Also, the study assumes that the size of one unit is 1000 square feet in multifamily buildings and retirement homes. In the calculation of the number of residential units in 2000 and 2006, we do not use 2006 data in Hendry and Martin counties because many parcels in 2000 have missing values.

[23] The County demographics boundary data can be downloaded from FGDL: http://www.fgdl.org/metadataexplorer/explorer.jsp.

However, these data do not take into account housing demolition because residential use in previous years could be demolished or converted to other land uses. In order to solve this problem, this study uses tax roll parcel data in 2000 and 2006 obtained from the Shimberg Center for Housing Studies at the University of Florida. Specifically, parcels that were residential use in 2000 and demolished in 2006 are considered to be demolished units for 2006. The demolished units for 2006 are added to the residential units in 2000. Similarly, parcels that were residential use in 2006 and demolished in 2008 are considered to be demolished units for 2008. We add the demolished units for 2008 to residential units for 2006. The number of these residential units is aggregated in each cell.

C.4. ESTABLISH EXTENDED URBANIZED AREA (EUA)

According to the definition of EUA from Cutsinger et al. (2005) and Sarzynski et al. (2006), EUA includes more than 60 housing units and has more than 30% of its commuting rates to the urbanized area. Adopting this definition, Sarzynski et al. (2006) use 1990 Census Transport Planning Package (CTPP) and the U.S. Department of Agriculture/Economic Research Service's (USDA/ERS) Rural-Urban Commuting Areas (RUCAs) data. However, as stated before, 12 counties in Florida in the 2000 Census Transport Planning Package (CTPP) do not contain complete information on job location. The unique numbers of the counties that show location of Census tract are categorized into '999999'. This problem precludes us from following the commuting flow in all counties. Therefore, our study redefines the EUA based on exurban and suburban density.

The EUA is based on the threshold that falls between the minimum suburban density which is 1 unit per 10 acres and the maximum exurban density which is 1 unit per 11 acres

(Theobald, 2001). Thus, considering the threshold and data availability, this study defines EUA as the Census Bureau designated urban areas and the adjacent square miles cells having over sixty dwelling units. Using the populated housing units, EUA can be identified.

C.5. POPULATE EMPLOYMENT

Regarding employment, this study uses Census Transport Planning Package (CTPP) for 2000 and Longitudinal Employer Household Dynamics (LEHD) for 2006 to calculate employment urban form. The two datasets have some differences. CTPP is based on Census tract which represents Origin and Destination. Due to the data problems noted earlier, this study focuses on only 34 counties to calculate the number of jobs and the number of working residents in Census tracts using CTPP. Also, 2006 LEHD data uses Census block which have commuting data from original residence to job location as destination.

In order to populate employment in each cell, census tract/block should be converted to cells. In the process, this study uses employment density of census tract/block. After intersecting cell and census tract/block, this study identifies the number of jobs in each cell. However, the data conversion could generate numerical errors of accuracy. Thus, we examine whether the error ratio of the conversion is acceptable. The results show that the error ratios in CTPP and LEHD are less than 0.1%.

C.6. OPERATIONALIZATION OF URBAN FORM

C.6.1. DENSITY (HOUSING AND JOB)

According to Sarzynski et al. (2006), the definition of density is the average number of housing units (jobs) per square mile of developable land in the EUA, whereas the definition of this project is as follows:

$$\frac{\text{average number of housing units (jobs)}}{\text{square mile of land within EUA}} \quad (11)$$

C.6.2. CONCENTRATION (HOUSING AND JOB)

According to Sarzynski et al. (2006), the definition of concentration is the percentage of housing units (jobs) that would need to move in order to produce an even distribution of housing units (jobs) within square-mile units of developable land across the EUA, whereas the definition of this project is as follows:

$$\frac{\sum\{\text{number of housing units (jobs) in each cell} - \text{ average number of housing units (jobs)}\}}{\text{total number of housing units (jobs) within EUA}} \quad (12)$$

On condition that the
$\text{number of housing units (jobs)in each cell} - \text{ average number of housing units (jobs)} > 0$

C.6.3. CENTRALITY (HOUSING AND JOB)

According to Sarzynski et al. (2006), the definition of centrality is the ratio of the average distance to city hall from the centroids of the grids comprising the EUA to the average distance to city hall of a housing unit (job) within the EUA, whereas the definition of this project is as follows:

$$\frac{\text{average distance to CBD}^{24}\text{ from the centroids of the grids within EUA}}{\text{weighted average distance to CBD from the centroids of the grids within EUA}} \quad (13)$$

Weighting factor: the number of housing units, the number of employees

[24] CBD is defined as the cell where city hall of the central city is located.

C.6.4. PROXIMITY (HOUSING AND JOB)

According to Sarzynski et al. (2006), the definition of proximity is the ratio of the average distance among centroids of square-mile cells in the EUA to the weighted average distance among housing units in the EUA, whereas the definition of this project is as follows:

$$\frac{\text{average distance among centroids of cells within EUA}}{\text{weighted average distance among centroids of the cells within EUA}} \quad (14)$$

Weighting factor: the number of housing units, the number of employees

C.6.5. JOB-HOUSING PROXIMITY

According to Sarzynski et al. (2006), the definition of job-housing proximity is the ratio of the average distance among centroids of square-mile cells in the EUA to the weighted average distance among jobs and housing units in the EUA, whereas the definition of this project is as follows:

$$\frac{\text{average distance among centroids of census block within EUA}}{\text{weighted average distance among centroids of the census block within EUA}} \quad (15)$$

Weighing factor: the number of workers between O-D

Instead of using converted cell data, this process directly use 2000 CTPP census tract O-D and 2006 LEHD census tract O-D considering that census block in LEHD is aggregated to census tract.

APPENDIX D ANALYSIS OF THE EFFECT OF IMPACT FEES IN JOB GROWTH

D.1. EXPLANATION OF VARIABLES

- IIF: intensity of impact fee
- Inemp: employment 2006-employment 2000
- Chemp: employment 2006 / employment 2000
- Inpop: population 2006 – population 2000
- Chpop: population 2006 / population 2000
- Jobinr = inemp / inpop *1000 : employment growth per 1,000 population growth)
- Jobchr = chemp / chpop

D.2. ANALYSIS OF GENERAL RESULTS

- The correlation analysis shows that IIF has weak positive correlation with inemp, but weak negative correlation with chemp.
- For all estimations (inemp, chemp, jobinr and jobchr are dependent variables for each model), IIF decrease job growth, but the results are not significant (p-value is about 0.20). ➔ These results imply that there is possibility that impact fee decrease job creation, but the evidence is not strong.
- Using ‘chemp’ as dependent variables is better than using ‘inemp’ because they can control difference of county size.

- If population growth is used as independent (control) variable, there may be an endogeneity problem between population growth and employment growth. Therefore, using normalized employment growth by population growth (jobinr or jobchr) can solve this problem. In this case, only IIF is used as independent variable.
- Using 'jobinr' or 'jobchr' reduce modeling fitting (F-test).

D.2. CORRELATION AND REGRESSION ANALYSES

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
inemp	34	26198	33803	890722	-1941	135727
chemp	34	1.16096	0.17119	39.47251	0.99007	1.84079
IIF	34	1568	1109	53319	0.88539	4538
inpop	34	65765	50556	2236025	15237	183236
chpop	34	1.20386	0.14010	40.93112	1.02887	1.78751
jobinr	34	442.69082	594.20858	15051	-29.04819	2814
jobchr	34	0.97123	0.15418	33.02186	0.78609	1.57620

Pearson Correlation Coefficients, N = 34
Prob > |r| under H0: Rho=0

	inemp	chemp	IIF	inpop	chpop	jobinr	jobchr
inemp	1.00000	0.42111	0.13803	0.62162	-0.20393	0.57490	0.53960
		0.0131	0.4363	<.0001	0.2473	0.0004	0.0010
chemp	0.42111	1.00000	-0.14885	-0.03319	0.27942	0.54591	0.76936
	0.0131		0.4008	0.8522	0.1095	0.0008	<.0001
IIF	0.13803	-0.14885	1.00000	0.45466	0.11641	-0.21304	-0.23281
	0.4363	0.4008		0.0069	0.5121	0.2264	0.1852
inpop	0.62162	-0.03319	0.45466	1.00000	0.00081	-0.10001	-0.04719
	<.0001	0.8522	0.0069		0.9964	0.5736	0.7910
chpop	-0.20393	0.27942	0.11641	0.00081	1.00000	-0.33945	-0.39429
	0.2473	0.1095	0.5121	0.9964		0.0495	0.0210
jobinr	0.57490	0.54591	-0.21304	-0.10001	-0.33945	1.00000	0.77975
	0.0004	0.0008	0.2264	0.5736	0.0495		<.0001
jobchr	0.53960	0.76936	-0.23281	-0.04719	-0.39429	0.77975	1.00000
	0.0010	<.0001	0.1852	0.7910	0.0210	<.0001	

The REG Procedure
Model: MODEL1
Dependent Variable: chemp

Number of Observations Read	34
Number of Observations Used	34

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	0.08106	0.04053	1.42	0.2575
Error	31	0.88607	0.02858		
Corrected Total	33	0.96714			

Root MSE	0.16907	R-Square	0.0838
Dependent Mean	1.16096	Adj R-Sq	0.0247
Coeff Var	14.56258		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
Intercept	1	0.75867	0.27432	2.77	0.0095	0
iif	1	-0.00002033	0.00002576	-0.79	0.4360	1.02020
chpop	1	0.37056	0.23394	1.58	0.1233	1.02020

The REG Procedure
Model: MODEL1
Dependent Variable: inemp

Number of Observations Read	34
Number of Observations Used	34

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	11085460918	5542730459	6.45	0.0045
Error	31	26621556525	858759888		
Corrected Total	33	37707017443			

Root MSE	29305	R-Square	0.2940
Dependent Mean	26198	Adj R-Sq	0.2484
Coeff Var	111.85943		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
Intercept	1	8526.97224	9379.29885	0.91	0.3703	0
iif	1	-3.90760	5.10711	-0.77	0.4500	1.33445
inpop	1	0.42371	0.12382	3.42	0.0018	1.33445

The REG Procedure
Model: MODEL1
Dependent Variable: jobchr

Number of Observations Read	34
Number of Observations Used	34

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.03061	0.03061	1.26	0.2706
Error	32	0.77936	0.02436		
Corrected Total	33	0.80997			

Root MSE	0.15606	R-Square	0.0378
Dependent Mean	0.99247	Adj R-Sq	0.0077
Coeff Var	15.72444		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
Intercept	1	1.03672	0.04768	21.74	<.0001	0
iif	1	-0.00002640	0.00002354	-1.12	0.2706	1.00000

The REG Procedure
Model: MODEL1
Dependent Variable: jobinr

Number of Observations Read	34
Number of Observations Used	34

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	1.78742	1.78742	0.14	0.7151
Error	32	421.69250	13.17789		
Corrected Total	33	423.47992			

Root MSE	3.63014	R-Square	0.0042
Dependent Mean	-0.13985	Adj R-Sq	-0.0269
Coeff Var	-2595.73757		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
Intercept	1	-0.47793	1.10918	-0.43	0.6694	0
iif	1	0.00020170	0.00054766	0.37	0.7151	1.00000