PROMOTING SUSTAINABLE COMMUNITIES THROUGH INFILL: THE EFFECT OF INFILL HOUSING ON NEIGHBORHOOD INCOME DIVERSITY

By

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To my wife and children

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Infill development, as an alternative to sprawl, can promote socio-economic sustainability as well as environmental sustainability by realizing more compact urban form and ensuring economic vitality and diversity. Compact development and more diverse housing options realized through infill can alleviate spatial segregation and promote social diversity in communities by attracting diverse new residents into the neighborhood.

However, as infill housing reflects neighborhood conditions, the impacts of infill housing on neighborhood income diversity vary depending on neighborhood types. Specifically, providing assisted rental housing in economically distressed neighborhoods may further concentrate the poor. Gentrification derived from infill can displace lower income households and lead to new residential sorting. Also, moderate or more expensive infill housing, which is similar to what exists, in middle or higher income neighborhoods will only attract households with a similar level of income as existing residents. Accordingly, a mixture of incomes in these neighborhoods may not be achieved through infill.

In this regard, this study seeks to provide empirical evidence about the effects of infill housing on neighborhood income diversity and to outline the strategies for sustainable infill development through the combination of quantitative and qualitative analysis. As a case, infill development and subsequent neighborhood change in the Orlando metropolitan area from 1990 to 2009 is analyzed using various data sources such as property tax rolls, the U.S. Census, and American Community Survey.

The spatio-temporal patterns of infill housing, results of spatial econometrics and case studies for selected neighborhoods are related and evaluated for policy implications. The results of these analyses indicate that infill development is only positively associated with neighborhood income diversity in gentrifying communities. But, a larger share of new construction among infill housing and the mix of housing types have the potential to promote neighborhood income diversity. Also, incremental infill development rather than a large scale infill with multifamily housing can positively affect neighborhood income diversity. Therefore, more detailed infill development guidelines and incentive programs that address housing types, price, and development phases should be implemented in order to promote a mixture of incomes.

CHAPTER 1
INTRODUCTION

Statement of the Problem

Infill development, defined as improving underutilized land or brownfields in an already urbanized area with new development or redevelopment, is a popular strategy, and many argue that it meets a multitude of sustainability goals (Jepson, 2004; Saha & Paterson, 2008). According to a survey conducted by Saha and Paterson (2008), 89% of 215 responding U.S. cities adopted infill development as their main action plan to promote sustainability. This popularity is based on the belief that infill development can reduce land consumption on the urban fringe, decrease automobile use, and revitalize economically distressed neighborhoods (Farris, 2001; Landis, Hood, Li, Rogers, & Warren, 2006; McConnel & Wiley, 2010; Steinacker, 2003).

The Partnership for Sustainable Communities defines sustainable communities as "places that balance their economic and natural assets so that the diverse needs of local residents can be met now and in the future" (United States Environmental Protection Agency [USEPA], 2010a, p. 1). Further, sustainable communities are realized through the integration of three pillars of sustainability: economic, social, and environmental sustainability (Roseland, 2000; Basiago, 1999; Beatley, 1995). The creation of environmentally sustainable communities using infill to realize more compact urban form is commonly accepted. Many studies present empirical evidence suggesting positive impacts of infill development on land conservation, energy use, and air quality (Qing & Feng, 2007; Schweizer & Zhou, 2010; USEPA, 1999, 2001, 2007).

However, environmentally sustainable or compact urban form does not automatically guarantee social or economic sustainability (Bramley & Power, 2009; Dale

& Newman, 2009). In addition, most studies do not systematically explore the socio-economic impacts of infill development on communities despite the fact that community opposition is one of the most frequently encountered barriers to infill development (Danielsen, Lang, & Fulton, 1999; Farris, 2001; Johnston, Schwartz, & Tracy, 1984). Specifically, the community opposition is frequently based on prejudice against higher density and affordable housing, which are considered sources of negative externalities, but the neighborhood change process resulting from infill is little known (Farris, 2001, Wiley, 2009).

Since infill development, unlike sprawling development on the urban fringe, occurs near or within existing communities, a greater potential exists for conflicts between long-standing and new residents (Larsen, 2005). The long-standing residents have concerns about the negative impacts of infill development on their neighborhoods such as loss of community amenities (Farris, 2001; Wiley, 2009). Therefore, in order to promote infill as sustainable development, the nature of neighborhood change derived from infill development must be better understood, so that reliable information can be provided to community members and policy makers about the effect of infill development on neighborhoods.

From a perspective of socio-economic sustainability, a critical and often sought after outcome of neighborhood change associated with infill development is increased income diversity defined as the degree of mixing among different income groups in a given neighborhood. Thus, this study focuses on finding the connection between infill development and neighborhood income diversity. As a planning goal, ensuring diversity, including mixed income communities, may be beneficial to place vitality, economic health, social equity, and sustainability (Talen, 2006a). Also, promoting diversity at the neighborhood level increases social capital,[1] a key to building healthier and better communities (Calthorpe & Fulton, 2001).

Research Objectives and Questions

Thus, this study seeks to provide empirical evidence about the effects of infill housing on neighborhood income diversity and to outline the strategies for sustainable infill development from the perspective of neighborhood change. The main research question concerns whether infill development creates mixed income communities. Specifically, three research questions are addressed:

- What is the effect of infill development on neighborhood income diversity?
- Does the effect of infill development on neighborhood income diversity vary depending on neighborhood types?
- Are there any differences between short- and long- term effects of infill development?

Conceptually, compact development and more diverse housing options realized through infill can alleviate spatial segregation and promote social diversity in communities (Talen, 2006b; Pendall and Carruthers, 2003). Specifically, since infill development increases neighborhood density, it may attract not only gentrifiers like highly educated young singles or couples without children but also people who prefer densely built environments, such as “compact city home buyers and lifestyle renters” (Farris, 2001; Myers & Gearin, 2001, p.652). Revitalization derived from infill may attract upper- and middle- income households to economically distressed neighborhoods. Also,

[1] Conceptually, social capital is the benefit from an individual’s social network. Portes (2000) defines social capital as “the ability of actors to secure benefits by virtue of membership in social networks or other social structures” (p. 48).

infill development with various housing sizes and types can accommodate a mixture of incomes, attracting diverse new residents into the neighborhood.

However, as infill housing reflects neighborhood conditions, the impacts of infill housing on neighborhood income diversity vary depending on neighborhood types. Specifically, providing assisted rental housing in economically distressed neighborhoods may further concentrate the poor. Gentrification derived from infill can displace lower income households and lead to new residential sorting. Also, moderate or more expensive infill housing, which is similar to what exists, in middle or higher income neighborhoods will only attract households with a similar level of income to existing residents. Accordingly, a mixture of incomes in these neighborhoods may not be achieved through infill.

Research Methodology

To answer the research questions and examine hypotheses in a comprehensive way, this study analyzes residential infill development from 1990 to 2009 and its impact on neighborhood change in the Orlando metropolitan area in Florida. Ways to identify infill areas using density thresholds and a developed land ratio are outlined, and the characteristics of infill housing are analyzed in terms of housing types, sizes and prices. The attributes of infill housing are compared with those in urbanized areas and urban fringe areas. The spatio-temporal development patterns of infill housing are analyzed using spatial analysis techniques such as the Getis-Ord Gi* statistic.

The connection between infill housing and neighborhood income diversity is analyzed using spatial econometric models to address spatial autocorrelation, heterogeneity, and heteroskedasticity in variables.[2] Econometric models with and without consideration of the neighborhood types are separately conducted. Four infill housing variables — the quantity of infill housing, the ratio of newly built infill housing, the diversity of infill housing types, and the ratio of multifamily infill housing — are introduced into the econometric models, and their short term effects during the 1990s and 2000s and long term effects from 1990 to 2009 on neighborhood income diversity are examined.

In order to strengthen the findings from the econometric models, case studies for five representative neighborhoods are conducted. The case studies include documentary data review, mapping of infill development, and analysis of the socio-economic change of the case neighborhoods. Interviews with local government officials and planners are conducted to gain a better understanding of neighborhood contexts and to suggest more nuanced conclusions. Existing land development policies and regulations, neighborhood plans, housing programs, and development patterns of infill housing, as well as results of spatial econometrics are evaluated for policy implications.

Organization of the Study

The structure of this study is summarized in Figure 1-1. In chapter 1, the problem statement, research questions, methodologies and findings are briefly introduced. In chapter 2, the theoretical framework of infill development and neighborhood change—concept of infill development, such as definition and attributes, impacts of infill, and

[2] Spatial autocorrelation refers to "the coincidence of value similarity with locational similarity" (Anselin, 1999, p. 4). Spatial heteroskedasticity refers to non-constant variance in unobserved error term across spatial units (Anselin, 1999). Spatial heterogeneity refers to "difference in relationship between the dependent variables of interest and the independent variables across spatial units in a study region" (Bhat & Zhao, 2002, p. 558). In order to address these location related biases in econometric models, spatial econometric models are applied.

housing market factors, as well as the conceptual model for the hypotheses — are described. In chapter 3, the research design including data and methods of analysis are summarized. In chapter 4, the results and findings from spatial analysis, econometric models, and case studies are presented. Finally, in chapter 5, policy implications of the study and suggestions for future study are addressed.

In sum, the purpose of this study is to examine the potential of infill housing to achieve mixed income communities and to assess the policy implications of infill strategies that can promote a mix of incomes for sustainable communities. In the following chapter, literature about infill development and neighborhood change is reviewed and the theoretical framework of this study is presented.

Table 1-1. Structure of the dissertation

Chapter	Contents
Chapter 1. Introduction	1.1. Statement of the Problem - creating sustainable communities through infill development - understanding the nature of neighborhood change derived from infill to address community opposition to infill 1.2. Research Objectives and Questions - exploring the effects of infill development on neighborhood income diversity - outlining strategies for sustainable infill development
Chapter 2. Theoretical Framework	2.1. Concept of Infill Development - infill as sustainable development / definition of infill / characteristics of infill housing / impacts of infill development 2.2. Housing Market for Infill Development - potential for infill / supply and demand for infill housing / barriers to infill and community opposition 2.3. Neighborhood Income Diversity through Infill - neighborhood change through infill / conceptualization of effects of infill on neighborhood income diversity / hypothesis
Chapter 3. Research Design	3.1. Study Area - case: Orlando metropolitan area (Orange and Seminole County) - time: 1990 to 2009 3.2. Data: U.S. Census 1990, 2000, ACS 2005-2009, tax rolls 3.3. Operationalization - infill housing (quantity of infill, ratio of new construction, diversity of infill housing types, ratio of multifamily infill housing) - income diversity (entropy index) for six income groups - neighborhood types: K-means cluster analysis 3.4. Econometric Models: spatial econometric models 3.5. Case Studies - qualitative analysis including interviews, fieldwork, and plan review to clarify and confirm findings
Chapter 4. Results and Findings	4.1. Patterns of Infill Housing - spatio-temporal patterns of infill development 4.2. Econometric Models - effects of infill housing on neighborhood income diversity 4.3. Case Studies - infill development profiles and neighborhood context - descriptive analysis of socio-economic change
Chapter 5. Conclusion	5.1. Policy Implications: strategies for sustainable infill 5.2. Suggestions for future study

CHAPTER 2
THEORETICAL FRAMEWORK

The theoretical framework chapter consists of three sections: the concept of infill development, the housing market for infill development, and the conceptual framework of the hypotheses. The first section, the concept of infill development, addresses the role of infill development as a popular strategy for sustainable development, the conceptual and operational definition of infill development, attributes of infill housing, and impacts of infill development. The second section, housing market for infill development, summarizes the increasing potential of infill housing through socio-economic and demographic change, the supplier of infill housing such as private developers and public housing agencies, and the demand for infill housing characterized as "compact city home buyers and lifestyle renters," as well as barriers to infill development focusing on community opposition (Myers & Gearin, 2001, p.652). The final section presents the conceptual model of the relationship between infill housing and neighborhood change in terms of densification, gentrification, and diversification. The effects of infill housing on neighborhood income diversity for each neighborhood type are hypothesized.

Concept of Infill Development

Infill as Sustainable Development

With the advent of the automobile in the early 20th century, particularly after World War II, much of the subsequent development of U.S. metropolitan areas, facilitated by the new highway programs, mortgage reforms as a result of the Great Depression and increased demand for homeownership, resulted in sprawl (Bruegmann, 2005; Burchfield, Overman, Puga, & Turner, 2006; Jackson, 1985; Schwartz, 2010).

Sprawl's unsustainable outcomes, such as excessive land consumption, high auto dependency, and aggravation of spatial segregation, have been widely criticized (Bruegmann, 2005; Ewing, Pendall, & Chen, 2002). In order to address these issues of urban sprawl and to promote sustainable communities, proponents of the New Urbanism and Smart Growth support compact development as an alternative to sprawl (Duany, Plater-Zyberk, & Speck, 2000; Smart Growth Network, 2006).

New Urbanism is an urban design movement that supports walkable, mixed use neighborhoods. Traditional neighborhood design (TND) and transit oriented development (TOD) are two major principles of the new urbanism movement. The advocates of the New Urbanism do not directly intend to increase density,[1] but higher density and mixed use development does support alternative transportation modes, such as walking, bicycling, and public transit, in the new urbanism communities (Churchman, 1999).

Smart growth originates from the land preservation movement with a focus on environmental and fiscal issues derived from urban sprawl (Danielsen et al., 1999). Although definitions of smart growth vary, the Smart Growth Network (2006) offers a common description: "growth is smart when it gives us great communities, with more choices and personal freedom, good return on public investment, greater opportunity across the community, a thriving natural environment, and a legacy we can be proud to leave our children and grandchildren" (p.1). As an alternative to urban sprawl, smart

[1] In general, new urbanist communities are considered high density residencies, but the Charter of the New Urbanism does not directly advocate high density development. High density is a kind of an outcome of new urbanism development rather than a goal.

growth offers mixed use, mixed income higher density development to create better communities.

Compact development with a balanced mix of uses has sustainable characteristics compared to urban sprawl, which is characterized by homogeneous, low density, leapfrog development on the urban fringe. High density can reduce land consumption, provide better opportunities for public transit, and decrease energy use derived from longer trips and auto dependency, as well as revitalize existing neighborhoods (Churchman, 1999; Danielsen et al., 1999). Moreover, high density provides financial savings by reducing local government's expenditure on infrastructure and public services such as education, parks and recreation (Carruthers & Ulfarsson, 2008; Danielsen et al., 1999). Also, high density may alleviate spatial segregation (Pendall & Carruthers, 2003; Talen, 2006b). However, high density has several unintended consequences such as congestion and loss of amenities; The more people in a given place may result in congestion and overcrowding in public facilities such as roads and parks, implying decreases in community amenities (Churchman, 1999; Danielsen et al., 1999).

As an effective tool for densification, infill development shares costs and benefits from high density development. When it is properly implemented, infill development plays an important role in creating sustainable communities by realizing compact urban form. Earlier "leap-frog development" created opportunities for infill throughout the central city and suburbs. By filling vacant and underutilized land in these areas and decreasing development on the urban fringe, infill development results in densification in existing urbanized areas. Subsequently, it can preserve open space and farm land, reduce automobile use, as well as promote efficient use of the existing road system by minimizing investment in road infrastructure. Moreover, infill development can revitalize economically distressed neighborhoods by attracting financial investment and upper- and middle- income people into communities (Cervero, 2000; Farris, 2001; Landis et al., 2006; McConnel & Wiley, 2010; Steinacker, 2003). However, existing residents can raise concerns about infill, citing congestion and loss of community amenities (Wiley, 2009).

Definition of Infill

Conceptual definition

Infill development is distinguishable from high density development in terms of location, type, and scale. First, infill development occurs within existing urban areas such as inner city areas and brownfields. For instance, Sacramento County (1980), one of the earliest local governments that adopted infill development as their growth management strategy, specifies that it occurs in existing urban areas. According to Jepson (2004), infill policies “encourage the development of vacant, abandoned, or underdeveloped urban lots through a strategy of subsidization and regulatory adjustment” (p. 239).

Of course, the term “urban” varies depending on researchers. For instance, some researchers simply define urban areas as jurisdictions of central cities including downtown and inner city areas (Deitrick & Ellis, 2004; Farris, 2001; Steinacker, 2003). Others expand the term “urban areas” to already developed suburban areas, including inner suburbs (Congress for the New Urbanism [CNU], National Resources Defense Council, & United States Green Building Council, 2011; Wiley, 2007), Other scholars apply density thresholds to identify “urban areas” instead of distinguishing central city and suburban areas (Landis et al., 2006; Wiley, 2009). One of the most frequently used definitions of "urban" is provided by the U.S. Census Bureau. For Census 2000, the term "urban" is defined as "all territory, population, and housing units located within an urbanized area and an urban cluster, which consists of core census block groups or blocks that have a population density of at least 1,000 people per square mile and surrounding census blocks that have an overall density of at least 500 people per square mile" (United States Census Bureau, 2002). Therefore, the term "urban (or urbanized)" should be properly operationalized based on the objectives and contexts of the study.

Second, infill development includes not only new development but also redevelopment. Redevelopment and reuse of old, abandoned, or vacant buildings in an urban neighborhood may not directly increase housing density in the neighborhood, but it can revitalize the neighborhood by filling underutilized buildings. Thus, conceptually redevelopment can be an important type of infill, otherwise called "refill" (Deitrick & Ellis, 2004; Landis et al., 2006; Metro, 2010). Metro (2010) uses the term "refill" instead of infill to include both new development and redevelopment.[2] Deitrick and Ellis (2004) consider redevelopment an important type of infill to revitalize inner city neighborhoods, classified in terms of its scale and types: "(1) Community refill, (2) neighborhood infill, and (3) scattered-site infill" (p.430).[3] Landis et al. (2006) define infill as construction in

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[2] "Refill is composed of two types of development: redevelopment and infill. Redevelopment means demolishing an existing structure to build a new building. Infill means building on land that is classified as developed, but does not require tearing down an existing structure to build a new one" (Metro, 2010, p.A9-1).

[3] According to Deitrick and Ellis (2004), "*Community refill* is large-scale redevelopment project intended as the main catalyst to neighborhood revitalization, *Neighborhood infill* is smaller-scale project to redevelop within the context of an existing neighborhood, and *Scattered-site infill* is small-scale, unit-by-unit development within the neighborhood's density and design context" (p.430).

vacant and underutilized parcels in already urbanized areas. According to these scholars, refill indicates construction on redevelopable parcels that are underutilized based on land and structure values. In the City of Portland, infill housing is frequently built through redevelopment or densification of existing residential lots. Specifically, 71.5% of new multifamily housing and 53.2% of new single family housing from 2001 to 2006 was built through this process (Metro, 2010).

Third, the scale of infill development varies depending on available land ranging from a small vacant lot to a large brownfield site. Based on existing site conditions, infill housing can range from a renovated or newly built house to a large scale planned redevelopment (Deitrick & Ellis, 2004). Based on interviews with developers, Suchman (2002) reports that the scale of an urban infill project can vary significantly from six to 1,000 units. Therefore, the term infill development should include all development activities regardless of project scale. For the purposes of this study, infill development means improving underutilized land or brownfields in an already urbanized area with new development or redevelopment.

Operational definition

With regard to identification of infill development, researchers have applied different approaches based on their case study area and/or focus and available data sets. For instance, Farris (2001) simply considers infill development as any new construction in central cities. Steinacker (2003) suggests an operational definition of infill development as the ratio between new construction in a central city and new construction in a Metropolitan Statistical Area (MSA). The ratio is normalized using land areas of central cities and MSAs to control for variations in land size.

Landis et al. (2006) provide one of the most specific operationalizations of infill development using the property tax roll data to identify the potential of infill for all California cities. Infill areas are defined as “vacant and/or potentially redevelopable parcels located within existing urban neighborhoods” (Landis et al., 2006, p.686). If the ratio between improvement value and land value from tax rolls is below one for commercial and multifamily housing parcels (or below 0.5 for single family housing parcels), the land is considered redevelopable land. Existing urban neighborhoods are identified using a residential density ranging from 2.4 to 4.0 units per acre depending on the population size of the respective cities.

Wiley (2009) applies two criteria to identify infill areas for cities in Maryland: residential density is over one housing unit per acre on developable land, and 70% of the land area is already developed. Some studies do not apply an operational definition for infill areas. Instead, they identify specific infill development projects based on the location of the developments and urban contexts of the region (USEPA, 1999, 2001, 2007).

More recently, CNU et al. (2011) outline four possible infill site conditions at a parcel level for the Leadership in Energy and Environmental Design (LEED) for Neighborhood Development Rating System.

> 1) At least 75% of its boundary borders parcels that individually are at least 50% previously developed, and that in aggregate are at least 75% previously developed.
>
> 2) The site, in combination with bordering parcels, forms an aggregate parcel whose boundary is 75% bounded by parcels that individually are at least 50% previously developed, and that in aggregate are at least 75% previously developed.
>
> 3) At least 75% of the land area, exclusive of rights-of-way, within a 1/2 mile distance from the project boundary is previously developed.

4) The lands within a 1/2 mile distance from the project boundary have a preproject connectivity of at least 140 intersections per square mile (CNU et al., 2011, p. 8).

In sum, the methods to operationalize infill development vary depending on the spatial level of analysis (MSAs, cities, parcels, or specific development projects) and available data. Based on the literature, this study applies an operationalization of infill development at the neighborhood level using density criteria and developed land area ratio as described in the next chapter.

Characteristics of Infill Housing

No formalized rule exists for infill development project design due to variations depending on available land, neighborhood contexts, and housing market conditions (Suchman, 2002; Suchman & Sowell, 1997). However, several general characteristics of infill housing are found in the existing literature.

Infill housing often incorporates denser housing types. Unlike suburban residential development characterized by single family detached houses on large lots, a variety of housing types, such as single family homes on small lots, townhouses, apartments, and condominiums, are developed in infill areas (Suchman & Sowell, 1997). Compared to suburban areas, the share of townhouse and multi-unit homes, such as apartments and condominiums, is higher in infill areas (McConnel & Wiley, 2010).

With regard to the size of infill housing, lot size of single family homes in infill sites is much smaller than in the urban fringe. According to Steinacker (2003), the development cost of infill housing in the 50 largest metropolitan areas is similar to that of suburban housing. On average, the development cost of one single family housing unit in central city areas is slightly cheaper than that in suburban areas. The development cost of multifamily housing in central city areas is only 5% higher than that in suburban areas (Steinacker, 2003). Considering the greater risks of infill development, such as higher land acquisition costs and political opposition, if development costs of infill housing are similar to those of housing in urban fringe areas, the size of infill housing should be smaller than that of suburban housing. Indeed, the average lot size of new single family detached homes in infill areas is about one third that in non-infill areas in Montgomery County, Maryland (McConnel and Wiley, 2010). However, the lot and structure size of infill housing vary depending on neighborhood conditions and housing submarkets where the infill housing located, implying that common characteristics of infill housing in terms of size may not exist (Wiley, 2009).

In general, all other things being equal, housing price in infill areas is relatively higher than that in suburban or urban fringe areas. A comparative study between smart growth communities and conventional suburban communities finds that smart growth communities, which are often located in infill areas, have more diverse housing options and more stable and higher housing values (USEPA, 2010b). The slightly higher development costs of multifamily housing in infill areas may threaten affordability for low income households. Still, affordability levels of infill housing exhibit greater variance depending on the MSA (Steinacker, 2003). New Urbanism development on infill sites to revitalize economically distressed inner city neighborhoods may provide only a limited amount of affordable housing, but the supply of affordable housing can be increased through local incentives and support combined with housing programs such as the federal government's Housing Opportunity for People Everywhere (HOPE) VI (Bohl, 2000; Deitz, 2008; Deitrick & Ellis, 2004; Johnson & Talen, 2008).

In sum, diverse housing options are a key characteristic of infill development. The diversity may be derived from various conditions of existing neighborhoods and housing submarkets. Based on the historical neighborhood context, existing road network, and linkages to other neighborhoods, as well as response of existing residents, developers provide infill housing that reflects neighborhood conditions in order to minimize and manage market risk of infill development (Suchman, 2002). In other words, the housing types, sizes, and price of infill housing in a neighborhood tend to be similar to those of existing housing in the neighborhood in stable communities. Otherwise, developers determine the attributes of infill housing to meet future housing demand of the neighborhood based on the neighborhood's demographic and economic change in gentrifying or declining communities. Although infill development can provide a variety of housing choice in terms of type, size, and price, the diverse housing options are reflective of various neighborhood conditions. Therefore, characteristics and impacts of infill housing should be understood based on neighborhood contexts.

Impacts of Infill Development

Increasingly, the literature supports the positive impacts of infill development on environment. First, infill development can preserve agricultural land and open space on the urban fringe (Farris, 2001; Landis et al., 2006; Steinacker, 2003). Urban containment policies, such as urban growth boundaries (UGBs) and urban service areas (USAs), which target new development within designated boundaries and incentivize infill development, can revitalize downtown or central city areas, subsequently reducing land consumption on the urban fringe (Nelson et al., 2004; Qing & Feng, 2007; Wassmer, 2002; Weitz & Moore, 1998).

Specifically, in a study for land conversion in Maryland, Qing and Feng (2007) found the probability of land conversion from nonurban to urbanized land was positive in Priority Funding Areas (PFA) where infill development is encouraged, and the probability was further increased after implementing smart growth policies. Also, the probability of land conversion was decreased in Rural Legacy Areas.[4] The result implies that smart growth policies, such as prioritizing government expenditures into infill areas, can be effective tools to promote infill development and preserve agricultural land.

However, some researchers argue that growth management policies such as the UGB and the PFA do not discourage residential development in urban fringe areas (Sohn & Knaap, 2010; Jun, 2004). Sohn and Knaap (2010) analyzed building permits between 1998 and 2003 at the census tract level in Maryland using panel data analysis and found that residential development located outside of the PFA had continued even after the introduction of the PFA policy. Jun (2004) also found that the UGB in the Portland metropolitan area resulted in spillover of new residential development into the outside of the UGB rather increasing residential development within the UGB.

With regard to the impacts of compact development on travel behavior, researchers argue that overall trip distance and auto dependency is reduced in high density mixed use communities (Cervero & Duncan, 2006; Chatman, 2008; Crane & Crepeau, 1998; Holtzclaw, Clear, Dittmar, Goldstein, & Hass, 2002; National Research Council, 2009).[5] Indeed, infill development projects can decrease trip distance and

[4] Within the Rural Legacy Areas (RLAs), “funds are provided to local government and land trusts to purchase land, easements, and transferable development rights from willing sellers in order to protect valuable agricultural, forestry, and natural and cultural resources based on the Rural Legacy Act” (Qing & Feng, 2007, p. 1,458).

[5] Of course, some researchers argue that compact development may not reduce auto dependency by increasing trip frequency (Crane, 1996; Krizek, 2003; Shiftan, 2008). Also, the negative association

vehicle miles traveled (VMT) in various urban contexts such as redevelopment in Central Business District (CBD) areas and abandoned industrial sites (USEPA, 1999, 2001, 2007). Subsequently, decreased auto dependency with lower VMT can result in less energy use and CO_2 emissions (National Research Council, 2009, USEPA, 2007) and alleviate the concentration of air pollutants like ozone (Schweitzer & Zhou, 2010). Thus, in terms of environmental sustainability, the positive impacts of infill development are widely accepted.

Research on the socio-economic impacts of infill development is primarily based on property value, spatial segregation and social mixing. Regarding the property value effect, many researchers focus on the effects of redevelopment, high density mixed use development, and urban containment policies on property value. The announcement and implementation of a large scale redevelopment project can increase adjacent property values due to the expectation of improvements in economically distressed neighborhoods through redevelopment (Immergluck, 2009). New urbanism design features, such as high street connectivity and mixed use, can be positively capitalized into property value in economically distressed urban neighborhoods (Ryan & Weber, 2007; Song & Quercia, 2008). However, infill development can reduce nearby home values, specifically in higher income neighborhoods due to concerns about congestion and loss of community amenities, which are negatively capitalized into property value (Wiley, 2009).

The effect of urban containment policies on property value is also debatable. For instance, some researchers argue that the shortage of land supply derived from urban

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between high density mixed use communities and auto dependency may be the effects of self-selection rather than the effects of a compact built environment (Handy, 2005).

containment policies may result in increases in land and housing prices (Fischel, 2002; Knaap, 1985; Segal & Srinivasan, 1985). However, others reveal that no strong empirical evidence exists that UGBs increase housing price (Jun, 2006; see also Downs, 2002; Knaap & Nelson, 1992; Nelson, Pendall, Dawkins, and Knaap, 2002). These mixed results may be because housing submarkets are not taken into account. In fact, Cho, Poudyal and Lambert (2008) find that the effects of urban growth boundaries on land values vary depending on housing submarkets in Eastern Tennessee. Specifically, the authors classified Knox County in Tennessee into five housing submarkets: Downtown, Rural, Farragut, Suburban, and Northshore. They found that the UGB in Konx County only increased land values in the Downtown submarkets, but had no effect in other submarkets.

Some studies explore the association between residential density, as a proxy of smart growth or compact development, and spatial segregation. The negative role of post-war policies and programs that relegated many racial and ethnic groups to the city and accommodated sprawling development that aggregated the primarily white population along economic lines has been considered a significant factor of spatial segregation (Schwartz, 2010; Jackson, 1985). According to Yang and Jargowsky (2006), the suburbanization process, which they measure using five different dimensions — density gradient, density, homogeneity of new growth, exclusivity of local zoning, and inaccessibility of jobs[6] — resulted in increased income segregation in the

[6] "Urban density gradient describes how the population per square mile of an area drop off with distance from the center of the metropolitan area" (Yang and Jargowsky, 2006, p. 257). To operationalize this, a density gradient function is estimated. Gross population density is used as a density measure. As a proxy of exclusionary zoning, "number of local governments per 100,000 households within a given metropolitan area" (p.257) is used. The homogeneity of new development is measured by "the ratio of the third to first quartile of housing value in newly developed neighborhoods" (p.261). Finally, inaccessibility of

U.S. MSAs during the 1990s. Lee (2011) found that from 1970 to 2000 sprawling MSAs like Atlanta and Dallas had higher income inequality than MSAs having compact development patterns such as Portland and Seattle.

Based on the assumption that urban sprawl aggravates spatial segregation, the advocates of the New Urbanism and Smart Growth argue that compact and mixed use development realized through infill can alleviate spatial segregation and promote social diversity in neighborhoods (Duany et al., 2000; Pendall & Carruthers, 2003; Talen, 2006b). At the MSA level, Pendall and Carruthers (2003) analyze the effect of density on income segregation in 318 metropolitan areas between 1980 and 2000. They find that density aggravates income segregation, but when density is squared it reduces income segregation. These results mean that density increases residential sorting by income groups, but when density exceeds a certain point, it can reduce income segregation. The authors also argue that the MSAs experiencing density changes have less segregation than MSAs with stable density. At the neighborhood level, Talen (2006b) examines the effect of density on income diversity in the Chicago metropolitan area. As opposed to Pendall and Carruthers (2003), this author suggests that density promotes income diversity up to a certain point, then, reduces it after that point. Both studies document the nonlinear effect of density on income segregation and the possibility of both positive and negative effects of infill development on income diversity.

The possibility of negative social impacts of infill is also reported by several researchers. Based on case studies of three Canadian neighborhoods — the Dock-side Green area in Victoria, British Columbia, the Kensington Market area of Toronto, and

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jobs is measured by “the length of average daily commuting time of the central city residents” (Yang and Jargowsky, 2006, p. 261).

downtown areas of Vancouver — Dale and Newman (2009) show that brownfield redevelopment and infill projects tend to displace low income households. The authors argue that environmentally sustainable development does not guarantee social sustainability like equity. Also, Bramley and Power (2009) argue that high density and mixed use urban form can promote “equity of access to service and opportunities” such as retail, post offices, and doctors, but have negative impacts on people’s satisfaction with their neighborhoods (p. 39). They conclude that the dense and mixed use development as environmentally sustainable urban form only selectively promotes social sustainability.

Some researchers explore whether mixed income housing projects, including HOPE VI, are successfully implemented to achieve their goal for social mixing. Based on case studies of seven successful mixed income multifamily housing projects, Brophy and Smith (1997) suggest that “mixed-income housing works best where there are sufficient units aimed at the higher income renters to create a critical mass of market units and where there are no differences in the nature and quality of the units being offered that are due to the income of the renters” (p.25, 26). Based on in-depth interviews, Chaskin and Joseph (2010) report that residents of mixed income HOPE VI developments expect and experience enhancements in neighborhood quality including amenities and safety.

However, studies regarding the impact of infill development on neighborhood change are limited. For instance, Pendall and Carruthers (2003) focus on income segregation at the MSA level rather than the neighborhood level, and do not directly examine the connection between infill development and income diversity. Talen (2006b) analyzes the effect of density on income diversity in neighborhoods. But the study is a cross-sectional analysis, so it does not address neighborhood change through infill development over time. Several studies exploring the relationship between mixed income development and social mixing only analyze social integration within the project communities rather than the entire neighborhood. Also they focus on change in residents' perception or life-style rather than neighborhood change itself. Therefore, more direct and systematic research regarding the relationship between infill development and neighborhood change should be conducted in order to expand understanding regarding the impacts of infill development from a socio-economic perspective. A more detailed literature review and conceptual model for the impacts of infill development on income diversity at the neighborhood level are summarized in the following sections.

Housing Market for Infill Development

Potential for Infill

Recent trends in demographic change indicate significant growth in potential consumers of infill housing, such as young singles and couples and aging baby boomers (Farris, 2001; Suchman, 2002; Urban Land Institute [ULI], 2001). Increases in one- or two-person households, such as young single or couples without children and aging baby boomers who become empty nesters, implies decreasing demand for larger homes and increasing demand for city residences rather than suburban residences (Lang, Hughes, & Danielsen, 1997; Myers & Gearin, 2001; Varady, 1990). As shown in Table 2-1, the number of married couple households with children decreased, but married couple households without children increased during the 1990s and 2000s. In addition, the increasing rate of unmarried couple households is more than five times compared to the increasing rate of the total number of households. The growth rate of single person households are also increased about 1.4 times compared to the growth rate of total number of households. Moreover, the ratio of aging people, who are 65 years old and over, increased from 12.4% to 13% during the 2000s, and population growth rate of aging groups is more than one and half times the national population growth rate (Werner, 2011). These changing demographics can create a greater potential for an infill housing market.

Moreover, since the 1990s, many U.S. cities have experienced population growth in both downtown and central city areas (Lee & Leigh, 2005; Sohmer, Lang, & Fannie Mae Foundation, 2001; ULI, 2001, USEPA, 2009, 2010c). According to Sohmer et al. (2001), about 75% of 24 downtowns, which are identified based on interviews with city organizations and local government leaders at the census tract level by researchers from the University of Pennsylvania, experienced population growth during the 1990s. More recently, new construction in central cities, which is measured by number of building permits, drastically increased in about half of the 50 largest MSAs during the 2000s (USEPA, 2009, 2010c). This central city rebound trend reflects the increasing potential for infill.

The decline of old, inner ring suburbs can also provide potential sites of infill through redevelopment (Calthorpe & Fulton, 2001). In general, inner ring suburbs, mainly built during the 1950s and 1960s,[7] are vulnerable to decline due to their loss of attractiveness between revitalizing central city neighborhoods and new outlying

[7] The definition of “inner ring suburbs” varies depending on researchers. In general, inner ring suburbs are suburban communities built adjacent to central cities between the end of World War II and 1965 or 1970 (Lee & Leigh, 2005).

suburban areas (Lee & Leigh, 2005; Orfield, 1997). However, gentrification processes in inner city areas can also extend to old suburban areas, and “suburban gentrification”, by which people reinvest to renovate buildings, may promote redevelopment of inner suburbs (Charles, 2011a).

In addition, increasing concerns regarding sustainability and smart growth create politically friendly environments for infill as an alternative to sprawl as shown in several surveys (Jepson, 2004; Saha & Paterson, 2008). Local government officials’ efforts to address negative factors of economically distressed neighborhoods, such as crime and congestion, and their implementation of incentive programs to promote infill may create a better opportunity for urban infill (ULI, 2001).

In sum, the changing demographics, the central city rebound, the decline of inner suburbs, and increasing concerns for sustainability create a great opportunity for infill. In the following sections, the detailed description of actors in the infill housing market in terms of supply and demand is summarized.

Supply and Demand for Infill Housing

Infill housing is a product of economic activities through the interaction between the supply of housing and the demand for housing in already urbanized areas. On the supply side, both private actors, such as for-profit developers, non-profit developers and landlords, and public actors like local government agencies (i.e. the local housing authority and planning officials) can provide infill housing. In the demand side, households who have higher preference for densely built environments and gentrifiers are potential consumers of infill housing.

Supply of infill housing

The private and public sectors working individually and in partnership, play an important role in providing infill housing. Although, the development process is often perceived as more complicated and as higher risk compared to conventional suburban development, developers interested in inner city revitalization and redeveloping brownfields, may be willing to invest in infill development, especially under local government incentive programs. In a survey of nearly 700 developers, the majority expressed interest in investing in dense, mixed use development specifically in inner suburbs, but they perceived local regulations as the primary barrier to the development (Levine and Inam, 2004). The result implies that the relaxation of land use regulation, such as density and lot size, can promote infill development. Based on interviews with eleven infill developers, Mejias and Deakin (2005) report that accessibility to major urban arterials offers an important advantage if certain regulations are removed and incentives are properly targeted along arterials. Wernstedt, Meyer, Alberini, & Heberle (2006) also argue that "protection from third party liability, protection from cleanup liability, and relief from public hearing requirements" can be effective incentives to developers for promoting infill development on contaminated brownfields based on a survey about developers' perceptions (p. 115).

Other important private actors, such as homeowners and landlords, make investment decisions regarding renovation in already developed neighborhoods at the individual parcel level. Researchers identified the factors that promote renovation or redevelopment of existing houses. For instance, Helms (2003) analyzed building permits for renovation in Chicago between 1995 and 2000, then concluded that "older, low-density houses in older, moderate-density neighborhoods are most likely to be renovated" (p. 496). Older buildings with a lower land coverage ratio have a higher probability of demolition for new development in gentrifying communities (Weber, Doussard, Bhatta, & Mcgrath, 2006). Similarly, small houses with lower floor area ratios and relatively lower property values compared to the neighborhood mean housing value have a higher probability of redevelopment in inner ring suburb neighborhoods in the Chicago metropolitan area (Charles, 2011b). In terms of location, parcels close to the CBD with better public transit accessibility have a higher probability of renovation (Helms, 2003).

The public sectors, such as local public housing authorities, not only directly provide infill housing by constructing public housing but also indirectly support subsidized rental housing programs on infill sites. The HOPE VI program is a typical example of public housing construction since the 1990s. Through this program, old and distressed public housing, which is generally located in economically distressed inner city neighborhoods, is demolished. Then new mixed income and mixed tenure housing — a mix of subsidized rental housing, market rate rental housing and owner occupied housing — is built to promote mixed income communities.

Federal agencies, such as the U.S. Department of Housing and Urban Development (HUD) and the Internal Revenue Service (IRS), and state housing agencies like the Florida Housing Finance Corporation also indirectly support new construction of subsidized rental housing, including the Low Income Housing Tax Credit (LIHTC) program. According to Freeman (2004), during the 1990s, 75.7% of newly built assisted rental housing units and 57.9% of newly built low income housing tax credit (LIHTC) units were located in central city areas. In fact, the LIHTC units account for one-sixth of total multifamily housing built between 1987 and 2008, indicating the importance of subsidized rental housing as a type of residential infill development (Schwartz, 2010, as cited in Danter Company, 2009).

Also, infill development is frequently conducted by public and private partnership as a part of economic development or community development projects (Felt, 2007; Suchman, 2002). Non-profit developers or non-profit corporations, such as community development corporations (CDCs) and community land trusts, are typical of public and private partnerships for infill development (Felt, 2007; Harmon, 2003, 2004; Suchman, 2002). Through the partnership, regulatory barriers to infill, such as density and minimum lot sizes, can be effectively relaxed, and more affordable housing can be provided (Farris, 2001; Felt, 2007; Suchman, 2002). Also, infill development can effectively address community's needs and political opposition to infill development can be minimized through the collaboration of public and private sectors (Farris, 2001).

Demand for infill housing

In general, young singles and couples, and empty nesters are considered potential customers of infill housing (Farris, 2001; Suchman, 2002). In addition, people who prefer compact built environments, including gentrifiers, and low income households may tend to choose infill housing.

Gentrification is generally derived from an "in-migration of white college graduates under 40 without children" (McKinnish, Walsh, & White, 2010, p.181). However, potential consumers of infill housing are not limited to young white gentrifiers. "Middle class black households with children or with elderly householders" are also important gentrifiers in black dominated gentrifying communities (McKinnish et al., 2010, p.192). In addition, aged 45 or older "lifestyle renters", defined as those who have enough income to purchase their own home, but are willing to rent multifamily housing as their life style, and “compact city home buyers”, who are expected to move into townhouses in city areas to seek higher accessibility to public transit, shopping and jobs, are growing (Myers & Gearin, 2001, p.652, 656).

People who have a positive perspective on compact development can also be a potential consumer of infill housing. According to the survey results from California and Southwestern states, black, Hispanic, foreign born, low or high income, college graduated people have a higher preference for dense and transit oriented neighborhoods (Lewis & Baldassare, 2010). African-Americans and people with conservative ideology have a lower preference for infill development, but low-income groups and college-graduate groups have positive attitude on infill development (Lewis & Baldassare, 2010).

Low income households are important consumers of infill housing, especially, affordable units provided through public or subsidized housing programs. Low income households have been typical residents of inner city neighborhoods because of transportation cost burden (Glaeser, Kahn, & Rappaport, 2008). In order to reduce their commuting costs, low income households prefer neighborhoods with higher accessibility to the CBD or transit service. According to Lewis and Baldassare (2010), low income households have a higher preference for short commutes, a dense transit oriented neighborhood, a mixed use walkable neighborhood, as well as infill development than other income groups. Therefore, affordable infill housing with higher accessibility to jobs and shopping can be one of the best options for residential location choice of low income households.

In general, many people have positive attitudes about infill housing. A survey conducted by the National Association of Home Builders shows that people highly ranked “new homes on vacant land in the central city or inner suburbs as their housing” than new housing in outlying suburban areas (National Association of Home Builders, 2002, p.6). However, in reality they tend to prioritize low density, less traffic, larger lots and larger homes when they purchase their home (National Association of Home Builders, 2002; Duany et al., 2000). In other words, a discrepancy exists between people’s attitude and their actual choice regarding infill housing. This may be because residential location choice is decided based on several trade-offs between their preferences: for instance, the trade-off between low density and less auto dependency (Myers & Gearin, 2001). However, the recent trend of central city revitalization implies a growing demand for compact urban communities (Sohmer et al., 2001; ULI, 2001).

Barriers to Infill and Community Opposition

Despite the fact that infill housing has market potential both from a supply and a demand side, several barriers to infill development exist. Land acquisition and assembly for infill development is more complicated and challenging than development on the urban fringe (Suchman, 2002; Farris, 2001; ULI 2001). Contaminated brownfield sites may increase development costs and risk related to infill projects (ULI, 2001). Land regulation on infill sites may be more complex, and financing of infill development is more challenging than outlying suburban development (Farris, 2001; ULI, 2001). Most of these barriers can be addressed through local government incentive programs and public and private partnerships (Farris, 2001; Suchman & Sowell, 1997; Suchman, 2002; ULI, 2001).

However, unlike other physical and financial barriers, political opposition by existing communities, which is one of the most frequently encountered barriers to infill development, is more difficult to address because the community's opposition is based on people's negative perceptions of infill development such as concerns about higher density and low income housing (Danielsen et al., 1999; Farris, 2001; Johnston et al., 1984). Specifically, the concerns of communities regarding infill development are related to three major concerns: loss of community amenities, loss of affordable housing, and loss of community homogeneity.

First, residents who have negative perspectives on densely built environments may be concerned about the loss of amenities and a resulting decrease in property values associated with infill development (Farris, 2001; Vallance, Perkins, & Moore, 2005). They believe that the increase of density associated with infill development near their homes reduces the quality of public services, and consequently decreases their property value (Pendall, 1999; Wiley, 2009). Specifically, because infill development increases the population and housing density of the area, neighborhood residents may experience congestion or overcrowding of public spaces such as roads and parks, and may experience loss of open space. This impact on the community's amenities and the reduced level of service of the public facilities can be negatively capitalized into property value. Accordingly, infill development may downgrade the quality of life in the community (Wiley, 2009). As noted earlier, this attitude reflects Americans' preference for a suburban lifestyle with increased amenities. Indeed, a survey by the National Association of Home Builders (2002) shows that in general, people support infill housing more than suburban housing, but in practice they continuously prefer conventional suburban housing styles such as “houses spread out, less traffic in neighborhoods, and bigger homes and lots” (p.6).

Second, low income residents may be worried about the loss of affordable housing and displacement through gentrification or revitalization derived from infill development (Farris, 2001; Steinacker, 2003). Infill development of economically distressed areas can result in gentrification, particularly with a combination of decent and diverse housing with greater accessibility to urban activities. In particular, renovation in gentrifying communities improves the physical condition of older buildings, thus enhancing the overall community. These homes can attract relatively higher income households into the community and increase the tax base. The influx of investment and people revitalizes the distressed neighborhoods. But, displacement of existing low income residents and loss of affordable housing can also occur as generally witnessed in redevelopment projects like HOPE IV (Dale and Newman, 2009; Farris, 2001, Lees, 2008, Redfern, 2003). Therefore, long standing low income residents may oppose or have concerns regarding infill projects.

Third, existing residents may dislike the loss of homogeneity with the influx of new residents. Since income and racial homogeneity is a common condition in many U.S. cities, existing residents in these communities may be uncomfortable with newcomers who are different from them in terms of income and race. Various causes of residential segregation exist. For instance, racism, personal prejudices and institutional discrimination against African Americans and other racial and ethnic minorities, and cultural conflicts have contributed to racial segregation (Bobo & Zubrinsky, 1996; Massey & Denton, 1993; Meyer, 2000; Williams & Collins, 2001; Yinger, 1976).

Similarly, a prejudice against the poor, NIMBYism, a progressive taxation, exclusionary zoning have resulted in higher levels of income segregation (Fischel, 2004; Schmidheiny, 2006; Tegeler, 2005). Residential segregation may be an inevitable outcome due to the interplay of residential choices by individuals who belong to different groups (Schelling, 1971). Accordingly, if infill development is perceived as a source of disturbing community homogeneity in terms of income and race, the infill project may be opposed by existing residents.

In sum, residents of infill neighborhoods may oppose infill development due to concerns regarding neighborhood change derived from infill development. As noted earlier because infill development occurs near or within existing communities, it has a higher potential to result in conflicts with existing residents (Larsen, 2005). Therefore, in order to promote infill, the nature of the community concerns must be understood, and reliable information must be provided to community members about the effect of infill development on neighborhoods. In this study, the effect of infill development on subsequent neighborhood change is conceptualized in three ways: densification, gentrification, and diversification. The specific explanations for these effects in a neighborhood change model are presented in the following sections. In particular, the impacts of infill development on neighborhood income diversity among various neighborhood types are hypothesized based on the neighborhood change model.

Neighborhood Income Diversity through Infill

Neighborhood Change through Infill

Before discussing the meaning of neighborhood change, the definition of "neighborhood" should be addressed. Grigsby, Baratz, Galster, & Maclennan (1987) present three different definitions of neighborhood — "communities of interest or a spatial unit of social network, a political unit for participation on local issues, and a spatially proximate subsection of a city" — and suggest a synthetic description for the concept of neighborhood by integrating them (p.20-22): "communities of interest associated with spatial proximity fall on a continuum, starting at one end with households in adjacent dwellings and proceeding to city- or metropolitan-wide aggregations. Different 'neighborhoods' form around different values, objectives, and concerns. These neighborhoods not only nest, one within another, they also overlap" (p. 22). Similarly, Jane Jacobs (1961) also expands the scope of the term "neighborhood" by defining neighborhoods as organs of self-government that include different spatial levels such as city, district and street.

However, it is difficult to operationalize this expanded scope of neighborhood in a quantitative study. Therefore, this study assumes a neighborhood as a small residential area rather than using expanded meanings such as districts and cities. In this regard, "a neighborhood is a small residential area plus something else which distinguishes it from all other residential areas" (Grigsby et al., 1987, p. 20).

When we accept the above definition and consider data availability, geographic units of the Census, such as a census block group, a census tract, a transportation analysis zone (TAZ), and a five digit zip code area, could be an adequate operational definition of the neighborhood depending on the research purpose and design. In this study, a census block group, one of the smallest geographical units with information for socio-economic data, is considered a neighborhood.

Neighborhood change can be defined as "a variety of objectively measurable changes to a neighborhood's physical and social environment" (Temkin & Rohe, 1996, p.159). If we combine the operational definition of neighborhood, the term “neighborhood change” implies any kind of socio-economic or demographic change, or alterations to the built environment of a census block group.

Theoretically, neighborhood change is explained from three distinctive perspectives: ecological, subcultural, and political (Temkin and Rohe, 1996). The ecological perspective focuses on the economic forces that change a neighborhood, including invasion/succession models by urban ecologists and filtering and the bit rent theory by urban economists. The subcultural perspective emphasizes the non-economic factors such as social networks and sense of place. The political perspective emphasizes the importance of the institutional forces and the role of powerful elites (Temkin and Rohe, 1996).

Based on Grigsby et al. (1987) and Temkin and Rohe (1996), the conceptual framework for neighborhood change through infill development are presented in Figure 2-2. Neighborhood change is affected by not only changes at a neighborhood level but also changes at a regional[8] and national level. In other words, changes in the nation, regions, and neighborhoods are interactively connected to each other.

At the national level, for instance, the recent economic downturn started with the subprime mortgage crisis during the mid-2000s resulting in increased foreclosures within neighborhoods across the nation, so that many neighborhoods have experienced changes in their socio-economic attributes due to these foreclosures (Li & Morrow-Jones, 2010). This implies that the national macro economy and federal housing policies, such as tax deductions on mortgage interest, can directly affect neighborhood

[8] The term “region” can indicates various ranges of spatial units. In this study, the term “region” includes state, metropolitan areas and cities.

attributes. At the regional level, urban development patterns, such as sprawling development in urban fringe areas, maturation of inner suburbs, and revitalization of inner city areas, transportation networks, and regional policies are important determinants of neighborhood characteristics (Calthorpe & Fulton, 2001). For example, state growth management policies and local governments' comprehensive plans provide guidelines for future land use, and housing and land development of a neighborhood should be consistent with objectives and strategies of local and regional plans. At the neighborhood level, current socio-economic, demographic, and physical attributes of a neighborhood are outcomes of maturation of the neighborhood. Thus, a neighborhood's historical contexts should be incorporated in analyzing current neighborhood characteristics.

Based on given contexts of a nation, a region, and a neighborhood, infill development results in short-term changes in the neighborhood, such as in-migration of new residents and increases in housing density. Fundamental neighborhood changes occur based on the responses of residents and institutions over the long term. The residents' responses are one of the most important intervening factors to cause neighborhood change. In terms of migration, residents' responses can be categorized into three choices: in-migration, out-migration, and staying (Ellen & O'Regan, 2011; McKinnish et al., 2010; Quercia and Galster, 2000; Grigsby et al., 1987). In particular, the migration of different income groups, who may make different decisions regarding their residential location, should be addressed in the neighborhood change modeling. Institutional actors like local governments may provide incentives for infill development and provide affordable housing through public or subsidized housing programs.

Revitalization or changes in social mixing of the neighborhood could be examples of long term outcomes of infill development. All these processes cannot be described as a simple unidirectional flow. Instead, the change process involves feedbacks between characteristics of neighborhoods and responses of residents and institutions, as well as short and long term neighborhood changes. The specific relationship between infill development and neighborhood income diversity is addressed in the following sections.

Conceptualization of Effects of Infill on Neighborhood Income Diversity

Based on the literature, the effects of infill development on neighborhood change, with a focus on neighborhood income diversity are conceptualized as three types: (1) densification effect, (2) gentrification effect, and (3) diversification effect. First, regarding the densification effect, infill development increases housing and population density of a neighborhood, and the increased density associated with infill results in both positive and negative impacts on neighborhoods. Specifically, density can create walkable neighborhoods and expand transportation choice including transit, as well as support diverse housing choices including affordable units (Local Government Commission & USEPA, 2003). As higher density implies more urban activities in a given space, density can promote a community's vitality (Churchman, 1999). However, as noted earlier, density may result in overcrowding and congestion, subsequently causing loss of community amenities (Churchman, 1999; IDAHO Smart Growth & ULI Idaho, 2005; Wiley, 2009). Accordingly, increased density through infill can selectively attract people who prefer compact built environments such as "compact city home buyers and lifestyle renters", or low income households, who are more sensitive to transportation costs than community amenities in their residential location choices (Glaeser et al., 2008; Myers & Gearin, 2001).

With regard to the gentrification effect, residential infill development can revitalize economically distressed neighborhoods by introducing financial investment in newly built infill housing and in-migration of relatively higher income households into existing communities (Landis et al., 2006; Steinacker, 2003; Farris, 2001). As socio-economic and locational characteristics of houses are similar in the same neighborhood, overall the rents or sale prices of new housing units are relatively higher than those of existing housing units, implying that the income levels of new residents in these new infill housing units may be higher than that of existing residents. The influx of relatively upper- and middle- income households into economically distressed neighborhoods can increase certain types of retail services, such as upscale restaurants, cafes, and boutiques, thus revitalizing these neighborhoods (Zukin et al., 2009). Also, property taxes from newly built housing increase the tax base of the communities, and subsequently, public services such as education and recreation, can be improved (Lees, 2008). As a consequence of these changes, the livability and vitality of the neighborhoods are promoted. However, in the long term, the improved neighborhood quality can elevate housing prices including rents, and promote rehabilitation of existing housing. Subsequently, the gentrification process resulting from infill development may displace low income households due to the loss of affordable housing (Dale & Newman, 2009; Day, 2003; Lees, 2008; Redfern, 2003). In short, infill development may improve the economic status of the neighborhood, reducing poverty and increasing income level, by attracting upper- and middle- income groups and displacing low income groups.

Regarding the diversification effect, infill development with various housing sizes and types can promote a mixture of incomes, by attracting diverse new residents into the neighborhood (CNU & HUD, 2000). For instance, infilling residential development within economically distressed inner city communities can attract relatively higher income residents who prefer higher accessibility to urban amenities and jobs. Similarly, infill development in upper- and middle- income suburban neighborhoods can provide relatively affordable housing compared to nearby housing, promoting a mix of incomes. Although physical change of a neighborhood does not guarantee the achievement of social goals like income mixing, diverse housing options can potentially attract diverse people (CNU, 200; Day, 2003). In sum, infill development can promote income diversity by introducing various ranges of housing types and prices, by mixing new housing with older housing, and by integrating new residents and existing residents.

These three conceptualized effects are combined and may affect neighborhood income diversity through the neighborhood succession process.[9] The residents in a neighborhood respond to physical, demographic, and socio-economic changes in the neighborhood, and their responses, which can be expressed by their residential choices, affect neighborhood characteristics over time (Grigsby et al., 1987). Conceptually, infill development attracts new residents into the community and changes the built environment or socio-economic attributes of neighborhoods. These changes can cause a voluntary or involuntary migration of existing residents who dislike the changes in the built environment, or who cannot afford increased housing prices, or who are uncomfortable with new residents. Subsequently, these migrations derived from infill

[9] In general, the term neighborhood change is used when indicating outcomes from the change, and neighborhood succession is used when emphasizing the process itself. For the purpose of this study, the term neighborhood change and neighborhood succession are used interchangeably. Both terms refer to the process by which neighborhood characteristics, including resident' profiles and the built environment, are changed over time.

development— through in-migration of new residents and/or out-migration of existing residents — can lead to neighborhood succession in the long term (Ellen & O'Regan, 2011; McKinnish et al., 2010; Temkin & Rohe, 1996; Grigsby et al., 1987). As a result of neighborhood succession caused by infill, income diversity of the neighborhood is changed.

Hypotheses

The conceptual framework of this study regarding the impact of infill housing on neighborhood income diversity is described in Figure 2-3. Since developers provide infill housing that reflects neighborhood conditions to manage the risk of infill projects, each neighborhood as a housing submarket may attract different types of infill development (Suchman, 2002). Consequently, the neighborhood change process derived from infill development and the impact of infill housing on neighborhood income diversity varies depending on neighborhood types. Based on the literature, the specific hypotheses to test in this study are as follows.

First, infill housing decreases neighborhood income diversity in economically distressed neighborhoods. In these neighborhoods, homeowners may abandon their housing or minimize their investment in the housing rather than renovate it because they cannot expect higher economic return from the renovation (Mayer, 1981). Similarly, without subsidies or incentives, developers may not invest in this area due to the lack of economic return from investment. As a result, publicly subsidized affordable housing such as public housing and assisted rental housing is a main source of infill. The supply of public or subsidized rental housing in economically distressed neighborhoods can result in in-migration of lower income households; subsequently poverty concentration in these neighborhoods can intensify, and neighborhood income diversity will decline (McClure, 2008; Tegeler, 2005).

Second, infill housing may promote neighborhood income diversity in the short term, but does not promote neighborhood income diversity in the long term in gentrifying communities. Renovation or new construction through private investors is common in gentrifying neighborhoods and can attract upper- and middle- income households; Subsequently, a mix of incomes can be achieved (Freeman, 2009). However, the gentrification process may result in displacement of low income households and concentration of upper- and middle- income households instead of creating mixed income communities (Dale & Newman, 2009; Day, 2003; Lees, 2008; Redfern, 2003). As a result, the long-term effect of infill housing on neighborhood income diversity in gentrifying communities is an open question.

Third, in both stable and declining middle income neighborhoods, infill housing can promote neighborhood income diversity. In these areas, diverse housing options provided by infill development can attract diverse income groups, and a greater mix of income can be achieved. Based on the neighborhood life cycle theory,[10] the declining neighborhoods are in the process of neighborhood filtering, so diverse income groups can co-exist (Grigsby et al., 1987, Little, 1976; Rosenthal, 2008).

Finally, infill housing may reduce neighborhood income diversity in higher income neighborhoods. In these communities, relatively unaffordable and expensive infill housing is provided, and the income level of new residents is similar to that of existing

[10] From an ecological perspective, neighborhood change is understood as a life-cycle: the phases of birth, growth, maturity, and decline. Based on the neighborhood life-cycle theory, the decline of neighborhoods is inevitable and the decline is mainly caused by the replacement of upper- and middle income groups by lower income groups (Downs, 1981; Lang, 2000; Temkin & Rohe, 1996).

residents. Consequently, the concentration of higher income groups is intensified, and neighborhood income diversity can be weakened.

Summary

In this chapter, the definition, attributes and impacts of infill development are reviewed, and the demanders and suppliers of infill housing are identified. Additionally, the effect of infill housing on neighborhood income diversity in different neighborhood types is hypothesized. The review of the infill literature provides several important points to address in this study. First of all, little is known about the impacts of infill development on neighborhoods, so more systematic studies to explore this connection are needed. As noted by Blanco et al. (2009), the relationship between urban form and diversity, and the role of planning in promoting diversity are areas where more research is needed. Therefore, the objective of this study is to find empirical evidence and policy implications about the relationship between infill housing and neighborhood income diversity.

Second, although there is no consensus to define “infill”, infill development should include both new construction and redevelopment, and an adequate operational definition for “already urbanized areas” should be addressed. In this study, the criteria to identify infill areas at the neighborhood level and measurements for infill housing, which addresses both new construction and redevelopment, are developed.

Third, there is no formalized type of infill housing, and developers may provide neighborhood specific infill project design in terms of size, types, and prices. In this study, the patterns and attributes of infill housing are compared with those of outlying suburban housing, and unique characteristics of infill housing by neighborhood types are also identified.

Finally, the impacts of infill housing on neighborhoods may vary depending on neighborhood types. Thus, the spatially varying impact of infill housing on neighborhood income diversity is tested using econometric models. Also, the role of planning and housing programs in promoting infill development and diverse communities are addressed, focusing on neighborhood contexts through case studies. In the next chapter, the specific research design regarding the relationship between infill development and neighborhood income diversity is presented.

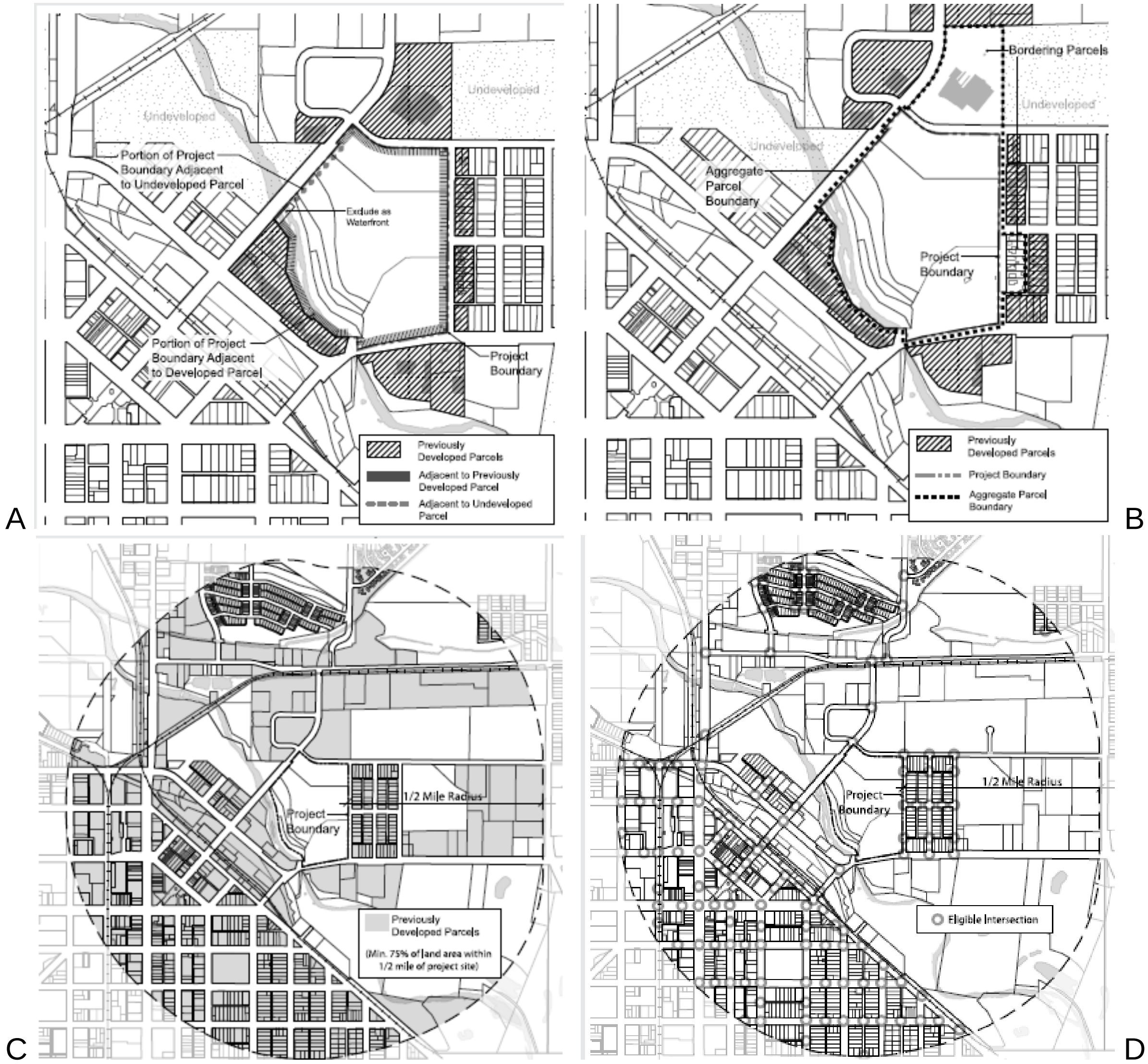

Figure 2-1. The conditions of infill sites in the LEED for Neighborhood Development Rating System. A) minimum 75% of perimeter adjacent to previously developed parcels. B) minimum 75% adjacent to previously developed parcels using project boundary and selected bordering parcels. C) minimum 75% of land area within ½ mile of project boundary being previously developed. D) minimum 140 intersections per square mile within ½ mile of project boundary. (Source: CNU et al., 2011, p.20-21)

Table 2-1. Households by Type: 1990, 2000, and 2010

	1990	2000	2010	Change 1990 to 2010	
	Number	Number	Number	Number	%
Total households	91,993,582 (100.0)	105,480,101 (100.0)	116,716,292 (100.0)	24,722,710	26.9
Family households	64,517,947 (70.1)	71,787,347 (69.1)	77,538,296 (66.4)	13,020,349	20.2
Husband-wife households with own children	24,551,621 (26.7)	24,835,505 (23.5)	23,588,268 (20.2)	-963,353	-3.9
Husband-wife households without own children	26,156,701 (28.4)	29,657,727 (28.1)	32,922,109 (28.2)	6,765,408	25.9
Female householder, no spouse present, with own children	6,962,752 (7.6)	7,561,874 (7.2)	8,365,912 (7.2)	1,403,160	20.2
Female householder, no spouse present without own children	3,703,291 (4.0)	5,338,229 (5.1)	6,884,437 (5.9)	3,181,146	85.9
Male householder, no spouse present with own children	1,588,739 (1.7)	2,190,989 (2.1)	2,789,424 (2.4)	1,200,685	75.6
Male householder, no spouse present without own children	1,554,843 (1.7)	2,203,023 (2.1)	2,988,146 (2.6)	1,433,303	92.2
Nonfamily households	27,429,463 (29.8)	33,692,754 (31.9)	39,177,966 (33.6)	11,748,503	42.8
Live alone	22,580,420 (24.5)	27,230,075 (25.8)	31,204,909 (26.7)	8,624,489	38.2
Not live alone	4,849,043 (5.3)	6,462,679 (6.1)	7,973.057 (6.9)	3,124,014	38.2
Unmarried couple households	3,225,626 (3.5)	5,475,768 (5.2)	7,744,711 (6.6)	4,519,085	140.1

Source: Hobbs (2005). Lofquist, D., Lugalia, T., O'Connel, M., & Feliz, S. (2012), National Historical Geographic Information System (NHHGIS)

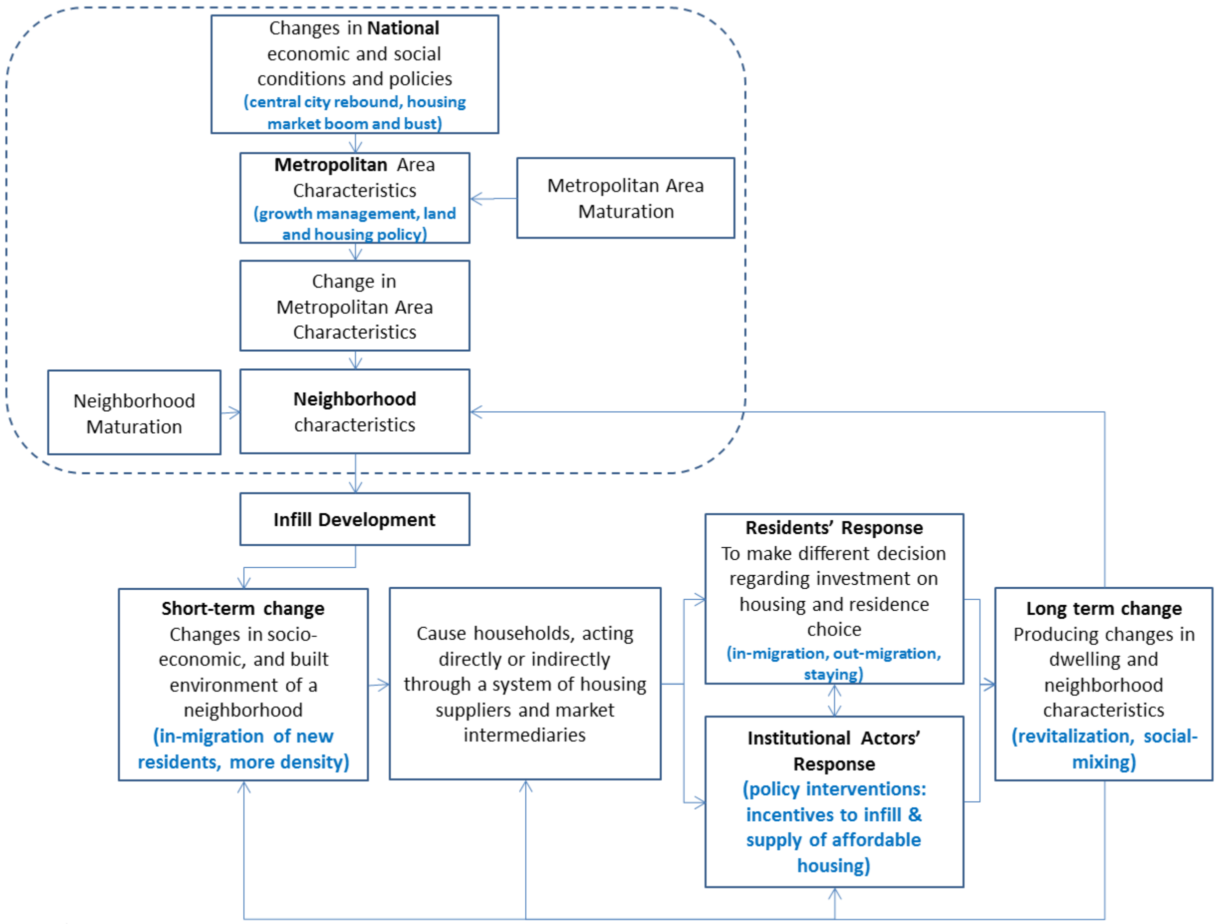

Figure 2-2. Conceptual framework for neighborhood change by infill; re-organized using Grigsby et al. (1987, p.31) and Temkin and Rohe (1996, p.165).

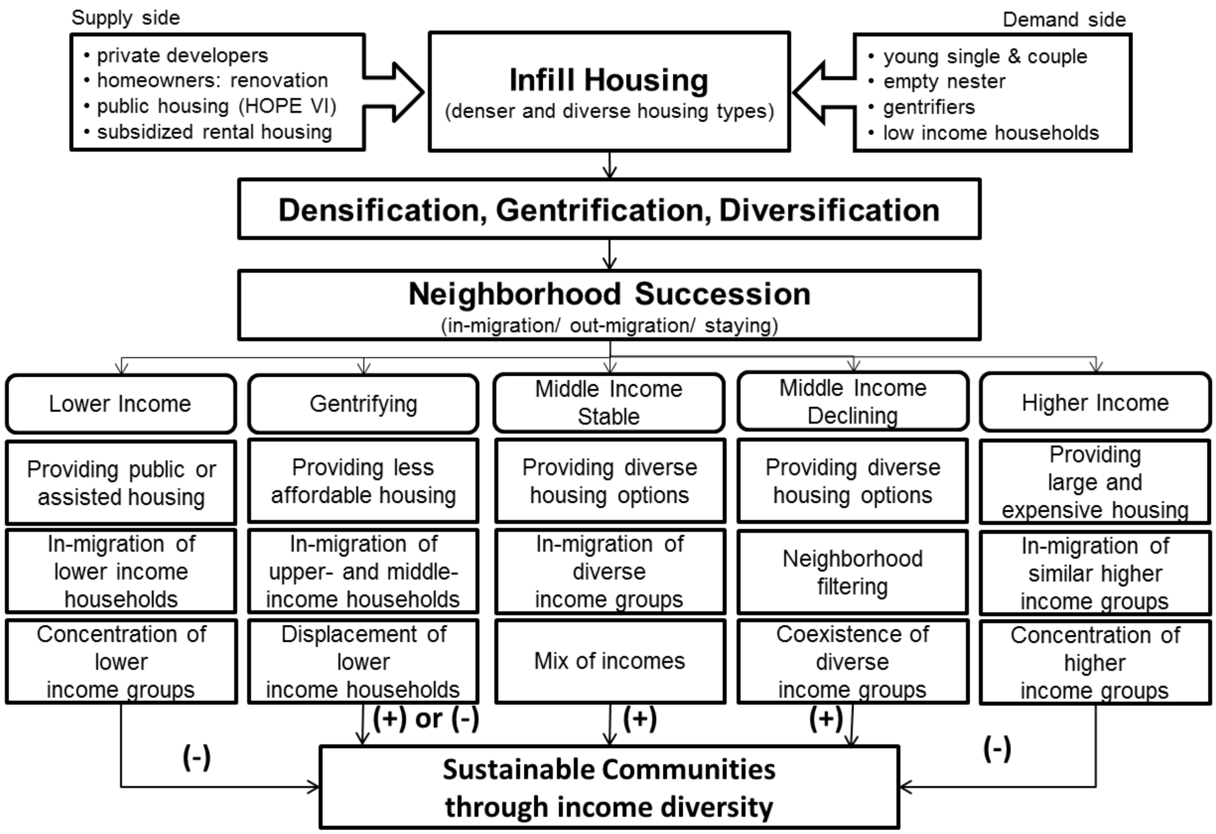

Figure 2-3. Conceptual model for the impact of infill housing on neighborhood income diversity

CHAPTER 3
METHODOLOGIES

This study analyzes residential infill development from 1990 to 2009 and its impact on neighborhood income diversity in the Orlando-Kissimmee-Sanford Metropolitan Statistical Area (Orlando MSA). In order to provide a better understanding of the relationship between infill development and subsequent neighborhood change, this study combines a quantitative analysis using spatial econometrics and a qualitative case study. The spatial econometric models can provide a more robust estimation by addressing spatial autocorrelation, spatial heterogeneity, and spatial heteroskedasticity. Also, the case studies strengthen the findings of the econometric models by examining the detailed contexts of neighborhoods.

The demographic, socio-economic characteristics of the Orlando MSA and the growth management and comprehensive plans of municipalities in the Orlando MSA are briefly reviewed to provide regional contexts of the study area. For the quantitative analysis, data used in this study, operationalization of main variables, such as infill housing and income diversity, and spatial econometric models are presented. Regarding the case studies, neighborhood classification based on cluster analysis, selection of case neighborhoods, and methods of analysis for selected case areas are summarized.

Study Area

The Orlando MSA is one of the fastest growing regions in the United States. From 1990 to 2010, the population increased by more than 0.9 million, a population growth rate of 74.3%. The population growth rate is more than three times the national average (24.1%). During this period, City of Orlando's population increased 44.7%, but approximately half of this increase occurred in newly annexed areas.[1] Thus, the population growth rate within the boundary of City of Orlando of 1990 is similar to the national average.

As of 2000, the Orlando MSA comprises Orange, Seminole, Osceola, and Lake Counties, but only two counties, Orange and Seminole County, were included in the Census designated urbanized area in 1990. Since this study focuses on infill development, the geographical boundaries included here consist only of Orange and Seminole County. The population growth in Orange and Seminole County accounts for two-thirds of the total population growth in the Orlando MSA.

The economic status of the Orlando MSA and the City of Orlando are summarized in Table 3-2. In general, the median household income of the City of Orlando is about 85% of the Orlando MSA's. The poverty rate in the City of Orlando is about five percentage points higher than that of the Orlando MSA. These economic indicators suggest that relatively lower income households are concentrated within the central city areas rather than suburban areas in the Orlando MSA. However, the level of housing value and monthly rent in the City of Orlando is similar to that of the Orlando MSA.

The spatial patterns of neighborhood income (median household income) in 1990 are shown in Figure 3-2. Lower income neighborhoods are concentrated in downtown Orlando along Interstate Highway 4 (I-4) and in the City of Sanford. The urban fringe areas, which are located outside the census designated urbanized area of 1990, tend to

[1] As of April, 1990, the incorporated area of City of Orlando was 73.351 square mile, and 38.254 square miles of land was annexed to City of Orlando by April, 2010. Based on the population density from the American Community Survey (ACS) 2005-2009, it is estimated that about 35,000 persons live in the annexed area. Accordingly, the population of the annexed areas accounts for half of the increased population within in the City of Orlando.

be higher income neighborhoods. The northeast areas of the City of Orlando are also higher income neighborhoods.

In terms of land development patterns, the Orlando MSA is a moderately sprawling region among U.S. MSAs. According to Fulton, Pendall, Nguyen, and Harrison (2001), the Orlando MSA experienced a drastic increase in urbanized land between 1982 and 1997.[2] During this time period, the urbanized land of the Orlando MSA increased by 92.2% — the 20th highest increase among 281 MSAs — with an increase of 560,000 in population and 150,000 acres in urbanized land. However, the change in population density of the Orlando MSA during the same period was minus 9.7% — the 53rd highest density gain among 281 MSAs — implying that the Orlando MSA had used land relatively efficiently in response to the rapid urbanization compared to other MSAs (Fulton et al., 2001).

According to Ewing et al. (2002), one of the most systematic studies to measure sprawl, the Orlando MSA was ranked 40th most sprawling area among 83 metropolitan areas based on a sprawl index score.[3] Specifically, the density score was ranked 42nd,[4] and the centeredness score, which represents strength of downtowns, was ranked

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[2] The authors applied the urbanized land classification based on the National Resources Inventory (NRI) conducted by the U.S. Department of Agriculture.

[3] The eighty-three metropolitan areas include every MSA having 500,000 or more population in 2000. The authors obtained a complete dataset to measure sprawl for only these MSAs.

[4] The density score is measured using seven indicators: "(1) gross population density, (2) percentage of population living at densities less than 1,500 persons per square mile, (3) percentage of population living at densities greater than 12,500 persons per square mile, (4) estimated density at the center of the metro area, (5) gross population density of urban lands, (6) weighted average lot sizes for single family dwellings, and (7) weighted density of all population centers within a metro area" (Ewing et al., 2002, p.28).

46th.[5] However, the mixed use factor was ranked 6th, indicating that homes, jobs and services were poorly mixed in the Orlando MSA compared to other MSAs.[6] In contrast, the street accessibility factor was ranked 66th, implying that the urbanized area of the Orlando MSA consists of relatively small-sized blocks compared to other MSAs.[7] The results from Fulton et al. (2001) and Ewing et al. (2002) indicate that the Orlando MSA has had a sprawling development pattern, but the degree of sprawl is moderate considering its fast growth rate.

In order to discourage urban sprawl and promote infill development, local governments in the Orlando MSA have implemented growth management policies. Under Florida's 1985 Growth Management Act, the City of Orlando, Orange County and Seminole County adopted comprehensive plans or growth management plans in 1991. These comprehensive plans include strategies to discourage urban sprawl and encourage a compact urban form through infill development.

Infill development with new urbanism design features is one of the most important strategies in the growth management plan adopted by the City of Orlando as described in the Future Land Use Element of the plan as follows:

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[5] The centeredness score is measured using six indicators: "(1) variation of population by census tract, (2) rate of decline in density from center, (3) percentage of population living within 3 miles of the central business district, (4) percent of the population living more than 10 miles from the CBD, (5) percentage of the population relating to centers within the same MSA, and (6) ratio of population density to the highest density center in the metro area" (Ewing et al., 2002, p.29).

[6] The mixed use score is measured using six indicators: "(1) percentage of residents with businesses within ½ block of their homes, (2) percentage of residents with satisfactory neighborhood shopping within 1 mile, (3) percentage of residents with a public elementary school within 1 mile, (4) balance of jobs to residents, (5) balance of population serving jobs to residents, and (6) mix of population serving jobs". (Ewing et al., 2002, p. 29).

[7] The street accessibility factor is measure using three indicators: "(1) average block length in the urbanized portion of the metro area, (2) average block size in square miles, and (3) percentage of small blocks" (Ewing et al., 2002, p. 29).

> The City shall encourage the utilization of new urbanist concepts for infill development and redevelopment in the Post World War II area, and development opportunities in the newly developing suburban areas of the City . . . . Throughout the planning period, the City shall achieve a compact urban form by maintaining the highest average density and intensity of development in Central Florida. This shall be accomplished in part by maintaining the City's Land Development Regulations which include districts and standards which discourage the proliferation of urban sprawl, encourage a compact urban form, encourage the redevelopment and renewal of blighted areas, and provide incentives for infill development (City of Orlando, 2012, p. LU-2, LU-4).

Specifically, this infill strategy applies new urbanism through urban design standards within the Traditional City, which includes subdivisions developed before World War II in the City of Orlando as shown in Figure 3-3.[8] Based on the objectives and policy in the Urban Design Element of Orlando's Growth Management Plan, the Traditional City Design Standards were developed based on historic development patterns and applied to new construction within the Traditional City boundary. Density and intensity bonuses can be allowed for mixed use development within the Traditional City to encourage a compact urban form.[9] For instance, at double the density and/or intensity allowed as an incentive, a mixed use development in the Downtown Activity Center can add 200 dwelling units per acre and 400% of floor area ratio.[10]

Another important policy to promote infill development in the City of Orlando was the adoption of a Transportation Concurrency Exception Area (TCEA). Under the

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[8] The Traditional City is defined as “areas subdivided prior to the Second World War with a mixture of uses, incomes, architectural styles and densities, varied building setbacks and gridded streets for a dispersed traffic pattern” in the Urban Design Element of the Growth Management Plan of the City of Orlando (Larsen, 2005, p. 802).

[9] Since 2001, the areas where density and intensity bonuses are allowed are not limited to the Traditional City. Projects in office, mixed use corridor and activity center districts inside and outside the Traditional City are eligible to gain the incentives through the review process.

[10] When the incentives are available, the maximum density and intensity of the Downtown Activity Center (AC-3A) is ten times higher than that in the Community Activity Center (AC-1), which is a common retail center in suburban areas in the City of Orlando.

transportation concurrency requirement, road capacity should be available concurrent with impacts of new development. However, a chronic shortage of road capacity in central city areas has exacerbated urban sprawl by pushing out new development from infill areas to urban fringe areas (DeGrove, 1992; Downs, 2003). Under the concurrency system, new development, which can attract more traffic, is not allowed due to insufficient road capacity in urbanized areas, but sufficient road capacity exists and infrastructure cost is relatively cheap in urban fringe areas compared to urbanized areas (Steiner, 2001). This system then can promote urban sprawl. Therefore, waiving the transportation concurrency requirement in central city areas can create incentives for developers to invest into the TCEA areas (Florida Department of Community Affairs [FDCA], 2007). The City of Orlando designated 26,132 acres of land as the TCEA in 1998 and expanded the areas to include the entire city in 2010. Within the TCEA, capital improvement for alternative modes such as transit and bicycle is required. Accordingly, infill development and redevelopment are promoted, and walking, bicycling, and public transit facilities are enhanced through the adoption of the TCEA, (City of Orlando, 2012).

Orange County has also planned an infill strategy to promote a compact urban form. As a smart growth tool to promote infill development, Orange County adopted an Urban Service Area defined as “the area for which Orange County is responsible for providing infrastructure and services to support urban development” (Orange County, 2011, p. FLU-1). Orange County intends to encourage a compact urban form by directing new development within the Urban Service Area. However, the Urban Service Area is designated to accommodate future land demand by 2030, so that the area is too broad to promote infill development (Orange County, 2011). Thus, Orange County adopted an additional "Infill Master Plan" to encourage infill development in 2008.

Orange County defines infill development as "the development of vacant or underutilized land within the Urban Service Area where restoration or rehabilitation of existing structures or infrastructure maintains the continuity of the original community fabric" (Orange County, 2008, p. 4). The available infill parcels and infill corridors are identified and strategies to promote infill, such as density bonuses and impact fee subsidies for workforce housing, are suggested in the plan. However, the suggestions are not incorporated in the land regulation code yet. Thus, it is too early to access outcomes from the implementation of the "Infill Master Plan."

The original comprehensive plan of Seminole County did not include an infill strategy. Based on the 2006 Evaluation and Appraisal Report for the comprehensive plan, the county adopted infill development as a new growth management strategy in 2008 (Seminole County, 2011). Seminole County defines infill areas as "developable vacant lands located in built up urban areas where public facilities such as sewer systems, roads, schools and recreation areas are already in place or are in close proximity (Seminole County, 2011, p. INT-15). The density of infill areas is planned as at least four housing units per net acre and the infill areas are designated as a TCEA (Seminole County, 2011). However, the policy effort to promote infill in Seminole County is too recent to have a positive outcome for a compact urban form.

In sum, under higher pressure to develop urban fringe areas to accommodate increased population, local governments in the Orlando MSA, specifically the City of Orlando, have encouraged infill development as their strategy for growth management.

The evaluation of the outcomes of their policy efforts, especially within the context of neighborhood change, can provide valuable guidance for a more sustainable community for residents, stakeholders and policy makers.

In the following sections, the research design combining quantitative analyses with qualitative case studies is addressed. The qualitative case studies are introduced to inform and strengthen the findings from the quantitative analyses. Data and variables created for econometric models are applied to the case studies in a more descriptive way such as mapping, and additionally required data is collected through plan review, fieldwork, and interviews.

Sources of Data

Data for quantitative analyses is collected at a neighborhood level and a parcel level. For the purposes of this study, a census block group is considered a neighborhood.[11] All measurements regarding infill development and neighborhood characteristics are operationalized or aggregated at this level to construct a data set for econometric models. The main data sources are the property tax rolls from the Florida Department of Revenue (FDOR), Census 1990, 2000, and the American Community Survey (ACS) 2005-2009.[12] The geographical boundaries and attributes of census block

[11] A census tract is the most frequently used spatial unit for neighborhood research. However, census tracts specifically in low density areas are too large to represent neighborhoods. Thus, this study considers a census block group as a neighborhood. The ideal size of a neighborhood is defined by a walking distance, which is generally 0.25 to 0.5 mile radius boundary. The size of a neighborhood having a quarter mile and half mile radius is about 0.196 and 0.785 square miles, respectively. The average size of the census block groups within infill areas (0.65 square miles) is between these two sizes, implying that the size of census block groups can represent neighborhoods in the Orlando MSA.

[12] Since 2005, the ACS has been conducted every year. It provides neighborhood level data (census tract or census block group level) based on the 5-year estimate. Therefore, the information for neighborhoods from ACS 2005-2009 are not the attributes of the neighborhoods in 2009, but the average or estimated attributes between 2005 and 2009. Every year about 1.5% of total households in a county are selected as a sample for the ACS.

groups are collected from the National Historical Geographic Information System (NHGIS).[13]

In order to identify already developed land for urban use, the land use code[14] and original built year of each parcel in the property tax rolls and land use and land cover database from the South Florida Water Management District and St. Johns River Water Management District of 1990 are used.[15] In identifying water bodies, which are considered undevelopable land, the National Hydrography Dataset (NHD) at a 1: 24,000 scale from the U.S. Geological Survey (USGS) is applied. The geocoded parcels of Orange and Seminole County from the Florida Geographic Data Library (FGDL) are used to construct infill housing variables. The Census and ACS are used to measure neighborhood characteristics including the income diversity index. To ensure consistency in the geographical boundaries of census block groups, attributes of census block groups in the Census 1990 are adjusted based on the boundaries of census block groups of 2000 using density of each variable.[16]

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[13] Minnesota Population Center. *National Historical Geographic Information System: Version 2.0*. Minneapolis, MN: University of Minnesota 2011. The NHGIS provides attributes and geographical boundary files at the various spatial levels, such as counties and census tracts, based on the U.S. Census between 1790 and 2010.

[14] Residential, commercial, industrial, institutional, and government properties having a building built before 1990 are considered developed land. The DOR land use codes of these properties ranges from 000 to 089 and exclude agricultural properties codes from 050 to 069. Using the geo-coded property tax rolls, a map of developed land at the parcel level can be drawn. In general, this vector-based land use database at the parcel level is one of the most precise GIS databases.

[15] Lake County, Seminole County, the north sections of Orange County and the east sections of Osceola County are included in the St. Johns River Water Management District. The south sections of Orange County and the west sections of Osceola County are included in the South Florida Water Management District. Each Florida Water Management District has provided land use and land cover features based on the photointerpretation of 1:24,000 USGS color infrared Digital Orthophoto Quarter Quads since 1990.

[16] For instance, if a census block group in 1990 split into two census block groups in 2000 due to boundary changes, the number of housing units in the census block groups in 2000 can be calculated using the following process: (1) calculating housing density —number of housing units per developable land acre— of the census block group of 1990; (2) calculating the land acres of two split areas using a

Data for case studies, which are conducted for five selected communities within the City of Orlando, are collected through review of planning documents and interviews. Planning documents, such as comprehensive plans and growth management plans, and infill project profiles were collected from the websites of the City of Orlando, the Orlando Housing Authority, and the Orange County Property Appraiser. Also, the Assisted Housing Inventory from the Shimberg Center for Housing Studies at the University of Florida is used to identify assisted rental housing development during the study period, including the Low Income Housing Tax Credit development.[17]

Additionally, information about current and historical contexts of case neighborhoods was collected through interviews with planning officials in the City of Orlando. Two in-person interviews were conducted with Paul S. Lewis, Chief Planning Manager, and Bruce Hossfield, Senior Planner, of the City of Orlando in August, 2012. Questions about incentive programs for infill development, community responses to large-scale infill projects, effects of recent housing market crashes on neighborhoods, and other related topics were asked during the interviews. The responses of interviewee regarding the relationship between infill development and subsequent neighborhood change are related with the data for quantitative analyses. The information in case neighborhoods is synthesized to gain a better understanding of the contexts of policies implemented in the case neighborhoods.

GIS software; (3) calculating the number of housing units of each split area by multiplying the housing density with the land area; (4) aggregating the calculated number of housing units based on the census block group boundaries in 2000.

[17] The Assisted Housing Inventory is the datasets to provide information about the assisted rental housing properties developed under federal, state, and local housing programs in Florida.

Operationalization

Identifying Potential Infill Areas and Infill Housing

As noted earlier, researchers have applied different approaches to identify infill development based on the context of their case region, such as existing density and urban development patterns, and available data sets. For instance, Landis et al. (2006) applied various density thresholds ranging from 2.4 to 4.0 per acre to identify potential infill parcels based on the population size of cities in California. For the purpose of this study, potential infill areas and infill development should be operationalized at the neighborhood level. Thus, combining the approaches of Landis et al. (2006), Wiley (2009) and CNU et al. (2011), the way to identify potential infill areas at the census block group level using land cover data and density thresholds is developed and applied. Specifically, census block groups that meet both density and developed land area ratio criteria are considered potential infill areas.

- Density thresholds (one of two density criteria)
  a) Housing density, number of housing units per developable land, is higher than 1 unit per acre.
  b) Job density, number of workers per developable land, is higher than 10 workers per acre.
- Developed land area ratio: 75% of the developable land is already developed for urban use.

In order to create a contiguous boundary of the potential infill areas, if a census block group is surrounded by the potential infill areas defined according to the above criteria, the census block group is also considered a potential infill area regardless of meeting the criteria. Also, only the identified potential infill areas surrounding the City of Orlando are considered areas in which infill development occurs. The contiguous boundary of infill areas enables the researcher to conduct spatial pattern analysis and spatial econometric analysis.

The one housing unit per acre gross density (640 units per square mile), with a national average of 2.4 people per unit, is slightly higher than the density threshold of the Census designated urbanized area (500~1,000 people per square mile). Theobald (2001) suggests that one housing unit per acre residential density distinguishes urban areas from suburban areas in U.S. MSAs. The job density, ten workers per acre, is generally used to identify employment sub-centers in many studies (McMillen, 2003). The criteria for developed land ratio (75%) is based on the infill site criteria of the Leadership in Energy and Environmental Design Neighborhood Development (LEED-ND) (CNU et al., 2011).[18] Water bodies identified using National Hydrography Dataset (NHD) are considered undevelopable land. If one of the two developed land area ratios from the two land cover databases — property tax rolls and the land cover database from the Florida Water Management Districts — is 75% or larger, the census block group meets the developed land area ratio criterion.

The identified infill areas based on the proposed methodology are shown in Figure 3-4. Among 507 census block groups, 307 census block groups are classified as infill areas. The total land area of the identified infill areas is 200.03 square miles, and it is about 14.8% of the total land area of Orange and Seminole Counties. Average housing density in the infill areas is 2.26 housing units per acre in 1990, 2.48 housing units per acre in 2000, and 2.61 housing units per acre in 2009. Since the gross density is calculated based on land areas that include all public facilities and open spaces, such

[18] Based on a review of the literature, the LEED-ND is the best source of a metric for developed land area ratio.

as roads and parks, the net residential density of infill sites is much higher than the gross density. All infill areas are located inside the U.S. Census designated urbanized areas of 1990, indicating that the identification of potential infill areas, which is intended to include inner suburban communities, is properly conducted. However, the adjusted density threshold can be applied in other metropolitan areas having different land development patterns. For instance, a higher density threshold should be applied in relatively densely developed regions such as the Portland MSA and East Coast cities.

All newly built and renovated housing units within the identified infill areas during the analysis time period are assumed to be infill housing. As noted in the theoretical background, infill development can be classified into two types: new construction and redevelopment. But, the property tax roll data in Florida does not provide information about previously existing buildings when parcels are merged or split. Thus, identifying redevelopment based on the property tax rolls is limited. Therefore, this study uses ‘renovation’ instead of ‘redevelopment’ in classifying infill development types based on the available data and operationalization. Specifically, the property tax rolls update the effective built year information when a property is significantly renovated. Based on this information, if a difference exists between an actual built year and an effective built year, the housing units are considered renovated units.[19]

In order to capture various aspects of infill housing, four infill housing variables are applied in the econometric models. The quantity of infill housing (QIF) refers to the amount of residential infill development in a neighborhood. Three other variables for

[19] In the Orlando MSA, property appraisers visit each property at least once every three (Seminole County) to five (Orange County) years. Accordingly, at least a five-year difference between an actual built year and an effective built year is reliable information. Therefore, in this study re-fill (renovation or rehabilitation) units are defined as the properties having at least a five-year difference between an actual built year and an effective built year.

infill housing – the ratio of new construction, the diversity of infill housing types, and the ratio of multifamily infill housing – represent the characteristics of infill development.

- Quantity of infill housing (QIF): number of newly built housing units in a census block group / acres of developable land in the census block group.
- Ratio of new construction (NEWR): number of newly built infill housing units in a census block group / total infill housing units in the census block group.
- Diversity of infill housing types (DIF): entropy index for mix of housing types.
- Ratio of multifamily housing (MULTIR): number of infill housing units that is multifamily housing in a census block group / total infill housing units in the census block group

The quantity of infill housing (QIF) is normalized using developable land area within the census block group to control for the effect of different neighborhood sizes. The ratio of new construction (NEWR) and the ratio of multifamily housing (MULTIR) among total infill housing units can be easily calculated. The entropy index for the diversity of infill housing types (DIF) is calculated using four housing type categories based on the land use code of the property tax rolls: single family housing, multifamily housing, condominium, and other types such as mobile homes and retirement homes. The entropy index used in this study can be expressed by equation (1).

$$DIF_i = \sum_{m=1}^{M} \frac{Q_{im}}{\ln(M)} \quad (1)$$

"Where $Q_{im} = -r_{im}\ln(r_{im})$ if $-r_{im} > 0$ or $Q_{im} = 0$ otherwise.

r_{im} is a share of a housing type m among infill housing of census block group I consisting of individuals from group m (m = 1, 2, 3, 4).

M = number of groups (four in this study)" (Galster, Booza, & Cutsinger, 2008, p. 265).

Based on these four operationalizations, the spatio-temporal patterns and characteristics of infill housing are analyzed. Specifically, the share of new construction and renovation among total infill housing units over time is analyzed. Housing types, sizes, and prices of residential infill development by neighborhood types are compared. Also, the spatial clustering of infill housing is analyzed using the Getis-Ord Gi* statistic which is expressed by equation (2).

$$G_i^* = \frac{\sum_j w_{ij} x_j - W_i^* \bar{x}}{s\{\frac{[(nS_{1i}^*) - W_i^{*2}]}{n-1}\}^{1/2}}, all\ j \quad (2)$$

"Where, $\bar{x}$ is the sample mean, w_{ij} is a symmetric one/zero spatial weight matrix, $S_{1i}^* = \sum_j w_{ij}^2, all\ j$, $W_i = \sum_{j \neq i} w_{ij}$, $W_i^* = W_i + w_{ii}$, n is number of sample, s^2 is the sample variance" (Ord & Getis, 1995, p.289-289).

Conceptually, the G_i* statistic is the ratio between the sum of spatially weighted x value and sum of unweighted x value at the reference point i. Statistically, expected value of G_i* is zero. Therefore, we can test whether the G_i* value is statistically high or low. In the context of this study, if a G_i* of a census block group i is statistically larger than zero, the census block group i is a hot-spot of infill development. Similarly, if G_i* of a census block group i is statistically less than zero, the census block group i is a cool-zone of infill development. The hot-spots of infill development are the areas where higher values of infill development are spatially clustered compared to adjacent areas. The cool-zones of infill development are the areas where lower values of infill development are spatially clustered compared to adjacent areas. By mapping the G_i*,[20] we can identify the areas where infill development frequently or rarely occurs considering the spatial relationship between census block groups.

[20] G_i* statistic has characteristics of a Z-score: mean zero and unit variance. The Z-score is a statistic to test the statistical difference between a value and zero. For instance, a Z-score is larger than 2.58 or less than - 2.58, the value is statistically larger or less than zero at a 99% confidence level, respectively.

In order to construct a spatial weighting matrix w_{ij}, which defines the spatial relationship between census block group i and j, the Queen Contiguity Method with row standardization is used. In the Queen Continuity Method, when corners or edges of census block group i is connected to those of census block group j, the spatial relationship w_{ij} is one, otherwise, w_{ij} is zero. The "zero" means that no spatial effects exist between the two census block groups.

Operationalization of Neighborhood Income Diversity

To operationalize income diversity, the number of households in six different income groups is calculated based on Galster et al. (2008).[21] This classification of income groups follows the guidelines of the U.S. Department of Housing and Urban Development (HUD) in order to create more easily translatable policy implications: very low income (income is 50% or less of Area Median Income (AMI)), low income (over 50% to 80% of AMI), moderate income (over 80% to 100% of AMI), and high-moderate income (over 100% to 120% of AMI), high income (over 120% to 150% of AMI), and very high income (more than 150% AMI).

As an income diversity index, the entropy index, which is one of the most frequently used indices in diversity or segregation studies, is applied (Freeman, 2009; Galster et al., 2008; Massey and Denton, 1988).[22] Conceptually, the entropy index measures whether households are evenly distributed across different income groups in

[21] Galster et al. (2008) suggest a methodology to calculate number of households within a certain income group using a Pareto Interpolation method based on the Census data. The authors classify families into six income groups the same as this study. The difference between Galster et al. (2008) and this study is that this study considers all households rather than family households in calculating number of households in each income group.

[22] Many researchers apply the entropy index to analyze income inequality and income segregation. Galster et al. (2008) provide a further list of studies that apply the entropy index.

a neighborhood. The entropy index ranges from zero to one. The zero value of the entropy index means that all households are classified into one income group. In contrast, the one value of the entropy index implies that households are evenly distributed across six income groups: one-sixths of total households in each income group. Similar to the diversity index for infill housing types, the entropy index for neighborhood income diversity can be expressed using an equation (3).

$$H_i = \sum_{m=1}^{M} \frac{Q_{im}}{\ln(M)} \quad (3)$$

"Where

$Q_{im} = -r_{im}\ln(r_{im})$ if $-r_{im} > 0$ or $Q_{im} = 0$ otherwise.

r_{im} is the proportion of the households of census block group i consisting of individuals from group m (m = 1, 2, . . . , M).

M = number of groups (six in this study)" (Galster et al., 2008, p. 265).

The spatial distribution of neighborhood income diversity based on the entropy index in 1990 for the Orlando MSA is shown in Figure 3-5. The less diverse neighborhoods are concentrated northeast of I-4 and southwest of I-4 in the downtown areas. Also, the urban fringe areas, which are located outside of the Census designated urbanized area of 1990, tend to be less diverse communities. In general, lower income neighborhoods and higher income neighborhoods have lower values in the entropy index, implying less diverse neighborhoods in terms of income.

Neighborhood Types

As summarized in the conceptual model, the effect of infill housing on neighborhood income diversity may vary depending on the economic status of neighborhoods. As infill development reflects neighborhood conditions, the attributes of infill housing vary depending on neighborhood types. These differences in characteristics of infill housing may result in different outcomes in each neighborhood type. For the purpose of this study, economic conditions of neighborhoods are considered in classifying the types of neighborhoods.

Specifically, neighborhood types are classified based on the median household income of 1990 and its change from 1990 to 2005-2009 using a cluster analysis. In order to compare the level of neighborhood income between two time points, the median household income of census block groups in 1990 and 2005-2009 is normalized by the median household income of the Orlando MSA. For the cluster analysis, a K-means clustering method is applied. The K-means clustering, originally introduced by MacQueen (1966), classifies observations into K groups based on distances computed from variables. The K groups are determined when the sum of the distance between observations and the center of the cluster, where the observations are located, is minimized. The K-means clustering method under the setting of a maximum of ten groups and a minimum of five observations in each group suggests five clusters as summarized in Table 3-3 and Figure 3-6.

Based on the mean values of neighborhood income and change in neighborhood income between 1990 and 2005-2009 for each clustered group, the identified five neighborhood types are named to represent their economic status: lower income, lower-gentrifying, middle income, middle-declining, and higher income neighborhoods. The location of each neighborhood type is shown in Figure 3-7. In general, lower income and gentrifying neighborhoods are concentrated in the downtown Orlando and inner city areas, but middle and higher income neighborhoods tend to be located in suburban areas.

Econometric Models

Since economically homogeneous communities and income segregation are common situations in U.S. cities, neighborhood income diversity and other neighborhood characteristics are often clustered spatially. The spatial clustering of variables may result in bias in regression estimation (Anselin, 1988). Spatial econometric models can explain the effects of clustering of similar neighborhoods and their spatial interactions. Specifically, according to LeSage and Pace (2009), several advantages of using spatial econometrics exist: (1) the model can capture the space-time dependence; (2) the autoregressive terms can explain the effects of omitted or unobserved variables; (3) the problems of spatial heterogeneity are minimized; (4) the model is useful in addressing spillover effects caused by positive or negative externalities. Therefore, a spatial econometric model should be applied in order to address potential unobserved locational effects such as spatial autocorrelation, spatial heterogeneity, and spatial heteroskedasticity in variables.

Spatial autocorrelation, also called spatial dependency, refers to “the coincidence of value similarity with locational similarity” (Anselin, 1999, p. 4) or “a spatial stochastic process yielding clustered outliers” (Anselin & Bera, 1998, p. 240). According to Bhat and Zhao (2002), “spatial autocorrelation occurs among observations clustered within a spatial unit because of unobserved locational effects” (p. 557). Spatial heteroskedasticity refers to non-constant variance in unobserved error terms across spatial units (Anselin, 1999). Spatial heterogeneity refers to a “difference in relationships between the dependent variable of interest and the independent variables across spatial units in a study region" (Bhat and Zhao, 2002, p.558) or "structural instability in the form of non-constant error variance or model coefficients across spaces" (Anselin, 1999, p. 3-4). Group-wise heteroskedasticity across spaces is an example of spatial heterogeneity (Anselin, 1999).

In this study, several spatial econometric models such as the spatial autoregressive (SAR), spatial error model (SEM) and spatial combo model (SCM) suggested by Anselin (1988) and Arraiz, Drukker, Kelejian, and Prucha (2010) are applied.[23] The following is a conceptual model specification of these spatial econometric models.

- SAR: $EI_{t2} = \rho W^*EI_{t2} + \beta_0 + \beta_1{}^*EI_{t1} + \beta_k{}^*IF_{t1\text{-}t2} + \beta_l{}^*Control_{t1} + \varepsilon$ (4)
- SEM: : $EI_{t2} = \beta_0 + \beta_1{}^*EI_{t1} + \beta_k{}^*IF_{t1\text{-}t2} + \beta_l{}^*Control_{t1} + \lambda Wu + \varepsilon$ (5)
- SCM: $EI_{t2} = \rho W^*EI_{t2} + \beta_0 + \beta_1{}^*EI_{t1} + \beta_k{}^*IF_{t1\text{-}t2} + \beta_l{}^*Control_{t1} + \lambda Wu + \varepsilon$ (6)

Where, EI is the neighborhood income diversity measured by the entropy index. In estimating EI_{t2}, EI_{t1} is included as a control variable. $IF_{t1\text{-}t2}$ is the vector of infill housing variables between t_1 and t_2, and $Control_{t1}$ is the vector of control variables at time point t_1. W is the spatial weighting matrix that represents the spatial relationship among spatial units (census block groups in this study), and ρ and λ are coefficients of the spatial autoregressive term and the spatial error term, respectively. The Queen contiguity method with row standardization is applied to construct the spatial weighting matrix W.[24]

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[23] Because of the complex interaction among spatial locations, different types of model specification for spatial dependency are estimated at the same time to provide a more convincing result. The SAR, SEM, SCM are one of the most frequently used model specifications in spatial econometric studies.

[24] As noted earlier, in the Queen contiguity method, when corners or edges of census block group i is connected to those of census block group j, the spatial relationship w_{ij} is one, otherwise, w_{ij} is zero. The "zero" means that no spatial effects exist between two census block groups. The Queen, Rook, and the k-th nearest neighborhood are most frequently used methods to define spatial relationship among spatial units. Compared to the Rook contiguity method, the Queen contiguity allows more connections with

In order to address different effects of infill housing depending on neighborhood types, interaction variables between the quantity of infill housing variable (QIF) and neighborhood type dummies are included in the econometric model. Also, short term and long term effects of infill housing are addressed by analyzing three different time periods separately: the 1990s model, the 2000s model, and entire period model from 1990 to 2009.

In order to control other factors which can affect neighborhood income diversity, the economic status and built environments of neighborhoods are added into the econometric model. The suggested variables used in the econometric model are summarized in Table 3-4.

All econometric models are estimated using the Python Spatial Analysis Library (PySAL) developed by the GeoDa Center for Geospatial Analysis and Computation at Arizona State University. The SAR is estimated using the two-stage least square (2SLS) method with a White consistent estimator based on Anselin (1999), and the SEM and the SCM are estimated using the generalized method of momentum (GMM) method based on Arraiz et al. (2010).[25] These models address spatial autocorrelation and spatial heteroskedasticity in residuals. For the SAR and SCM, the interaction variables between the spatial weighting matrix and independent variables are included as instruments of the spatial autoregressive term. Estimated results based on the ordinary

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surrounding neighborhoods, so the Queen method is applied in this study. Due to the irregular distribution of census block groups in the study area, the k-th nearest neighborhood method may create a wrong spatial relationship among census block groups because this method defines spatial relationships only based on distances between census block groups without consideration of their actual location.

[25] There are several ways to estimate spatial econometric models: least square, maximum likelihood, generalized method of momentum, and Bayesian approach. But, the estimated results in terms of directions and significance are similar regardless of the estimation of methods (LeSage and Pace, 2009). Thus, this study utilized an already developed software, PySAL, to estimate the spatial econometric models.

least square (OLS) are reported as a reference. Spatial autocorrelation in residuals of each econometric model is examined by using the Moran's I statistic. The Moran's I can be expressed by equation (7) (Getis, 2010, p264).

$$I = \frac{n \sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij} (y_i - \bar{y})(y_j - \bar{y})}{S_0 \sum_{i=1}^{n} (y_i - \bar{y})^2}, \neq j \ , \quad (7)$$

Where, w_{ij} is spatial weighting matrix, $S_0 = \sum_i^n \sum_j^n w_{ij,} \, for \, j \neq i$, y_i and y_j is the y value at location i and j respectively, $\bar{y}$ is mean value of y, and n is number of spatial units. The expected value E(I) is zero. If the value of I is statistically larger than zero, positive spatial autocorrelation or spatial clustering exists, implying that the estimated results may be biased due to the spatial dependency. In this case, the econometric model should be improved.

Case Studies

In order to provide further understanding regarding the results of the econometric models and the role of housing programs in neighborhood change through infill, case studies for selected neighborhoods are conducted. A neighborhood where housing programs, such as HOPE VI projects and LIHTCs, are targeted or a large amount of infill development occurs is selected in each neighborhood type. All selected neighborhoods are located within the jurisdiction of the City of Orlando. The neighborhood boundaries provided by the City of Orlando are not exactly matched with boundaries of census block groups. Since neighborhood attributes are only available at the census block group level, the neighborhood boundaries of case studies are based on the boundaries of census block groups. If a neighborhood boundary of the City of Orlando includes several census block groups, the socio-economic and demographic data of the census block groups are aggregated. The name and location of case neighborhoods are shown in Table 3-5 and Figure 3-8.

Holden-Parramore is one of the most economically disadvantaged neighborhoods in Downtown Orlando. Public investments for infill development, such as a HOPE VI project and a LIHTC, are concentrated in this area and a neighborhood revitalization initiative called “Pathways for Parramore” was implemented in order to revitalize this neighborhood. Colonialtown South located in the eastern section of the Traditional City is a gentrifying community where the other HOPE VI project was completed. Thus, the comparison of these two neighborhoods can provide a better understanding of the role of public housing programs in terms of infill development and income diversity.

Audubon Park, a stable middle income neighborhood, is selected in order to examine the impact of a large scale infill development on nearby neighborhoods. This neighborhood is located adjacent to the former Orlando Naval Training Center, which was redeveloped into a mixed use residential community for high income households.

Engelwood Park is a declining middle income community that experienced rapid demographic transition and concentration of foreclosures during the study period. Due to the high concentration of foreclosures, this neighborhood is a target area of the Neighborhood Stabilization Program. Engelwood Park also includes a LIHTC project and two renovation projects of multifamily housing, so this neighborhood provides an effective means to explore the role of public and/or private infill investments within the context of shifting neighborhood income diversity.

Spring Lake located in the western section of the Traditional City near downtown is one of the highest income neighborhoods in the Orlando MSA. During the study period, two gated communities were newly built, and many old existing households were renovated within this neighborhood. Thus, the Spring Lake case reflects the characteristics of infill development in high income communities and the impacts these infill projects have on concentrated high income groups.

Each case neighborhood's historical and policy contexts are briefly reviewed and the location and attributes of infill housing, including those produced via housing programs, are mapped and analyzed. Shifts in neighborhood characteristics, including job and housing density, neighborhood income diversity and proportion of each income group, are presented to understand neighborhood change. In addition, interviews with planners and local government officials are conducted to gain a better understanding of the relationship between infill development and neighborhood change focusing on neighborhood income diversity. As mentioned earlier, questions posed during the interview include Orlando's incentive programs for infill, such as density bonuses, historical contexts of case neighborhoods, and community response to large-scale infill development in the case neighborhoods.

The results of spatial econometric models provide empirical evidence about the effect of infill housing on neighborhood income diversity in each neighborhood type. The results of econometric models can imply a generalizable causality between infill development and neighborhood change in the Orlando MSA, but the detailed contexts of neighborhoods, where the interaction between infill development and neighborhood change occurs, are not considered. Thus, the interpretation or alternative explanations of estimated results that are statistically less significant or inconsistent with the hypothesis are limited. The case studies can provide a better explanation of these results, implying that the estimated results of the econometric models are strengthened through qualitative case study analysis. Moreover, by offering real world examples with detailed information, such as infill development profiles and more specific neighborhood attributes, the case studies themselves provide a better intuitive understanding of the relationship between infill development and subsequent neighborhood change.

In this regard, existing land development policies and regulations, housing programs, and development patterns of infill housing, as well as findings from spatial econometrics and case studies are related and evaluated for policy implications. The results and findings from the spatial analysis, spatial econometric models and case studies are summarized in the next chapter.

Table 3-1. Population of the Orlando MSA

Area	1990	2000	2010	Population growth	growth rate
Orlando MSA	1,224,844	1,644,558	2,134,411	909,567	74.3%
Orange County	677,491	896,354	1,145,956	468,465	69.1%
Seminole County	287,521	365,202	422,718	135,197	47.0%
Osceola County	107,728	172,493	268,685	160,957	149.4%
Lake County	152,104	210,509	297,052	144,948	95.3%
City of Orlando	164,693	185,951	238,300	73,607	44.7%

Source: U.S. Census 1990, 2000, 2010

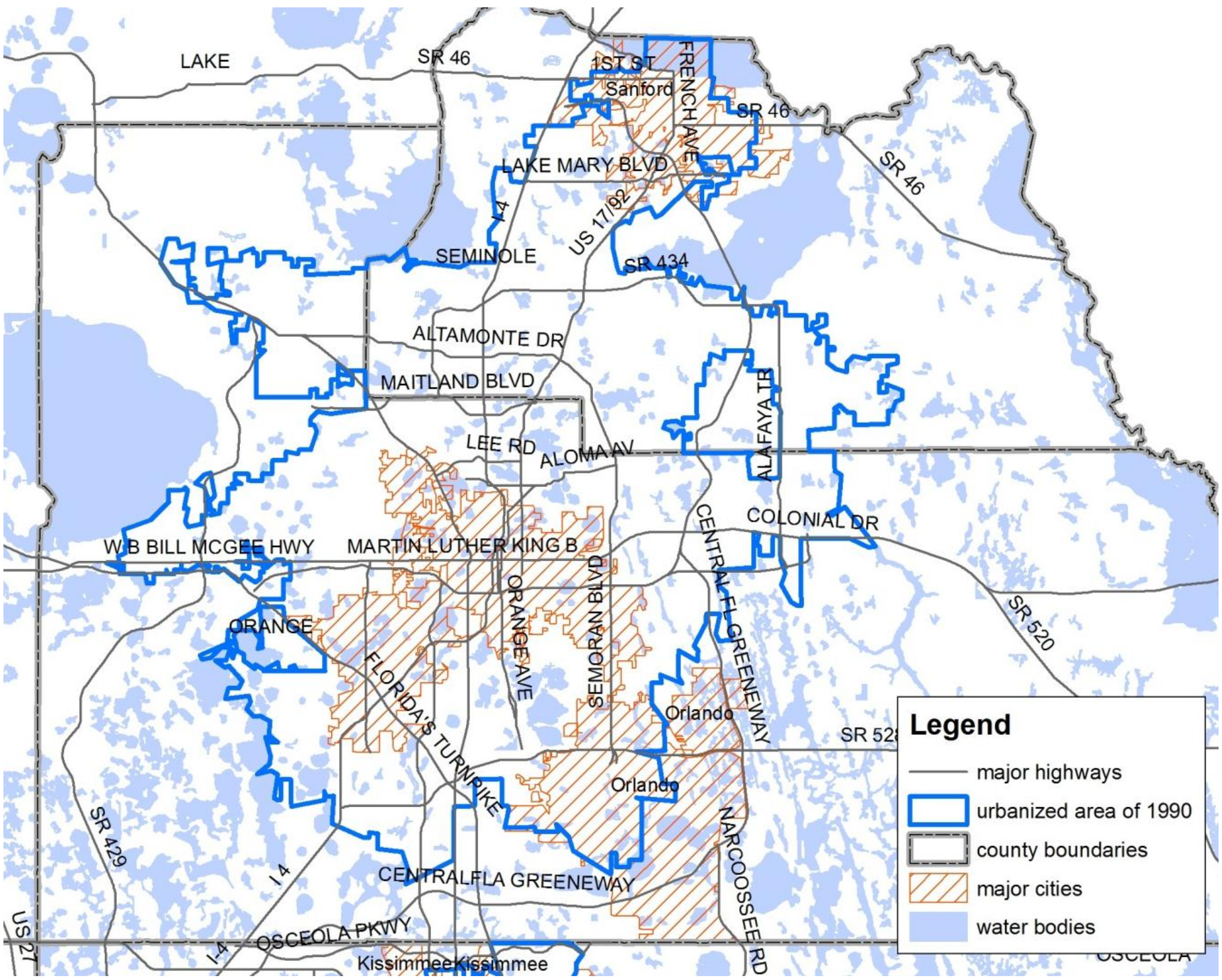

Figure 3-1. Study area

Table 3-2. Economic characteristics of the Orlando MSA

	Orlando MSA			City of Orlando		
Area	1990	2000	2005-2009	1990	2000	2005-2009
Median household income ($)	31,230	41,871	50,391	26,119	35,732	43,196
Median housing value ($)	84,300	109,100	222,800	74,300	103,200	227,600
Median rent ($)	447	698	976	428	700	954
Poverty rate (%)	10.0	10.7	11.7	15.8	15.9	16.0

Note: The median rent of 2000 and 2005-2009 is the median gross rent, which includes monthly rent and utility cost. The median rent of 1990 is the median contract rent which does not include utility cost. In 1990, only the median contract rent is available in the summary files of the Census. Source: U.S. Census 1990, 2000, ACS 2005-2009, NHGIS.

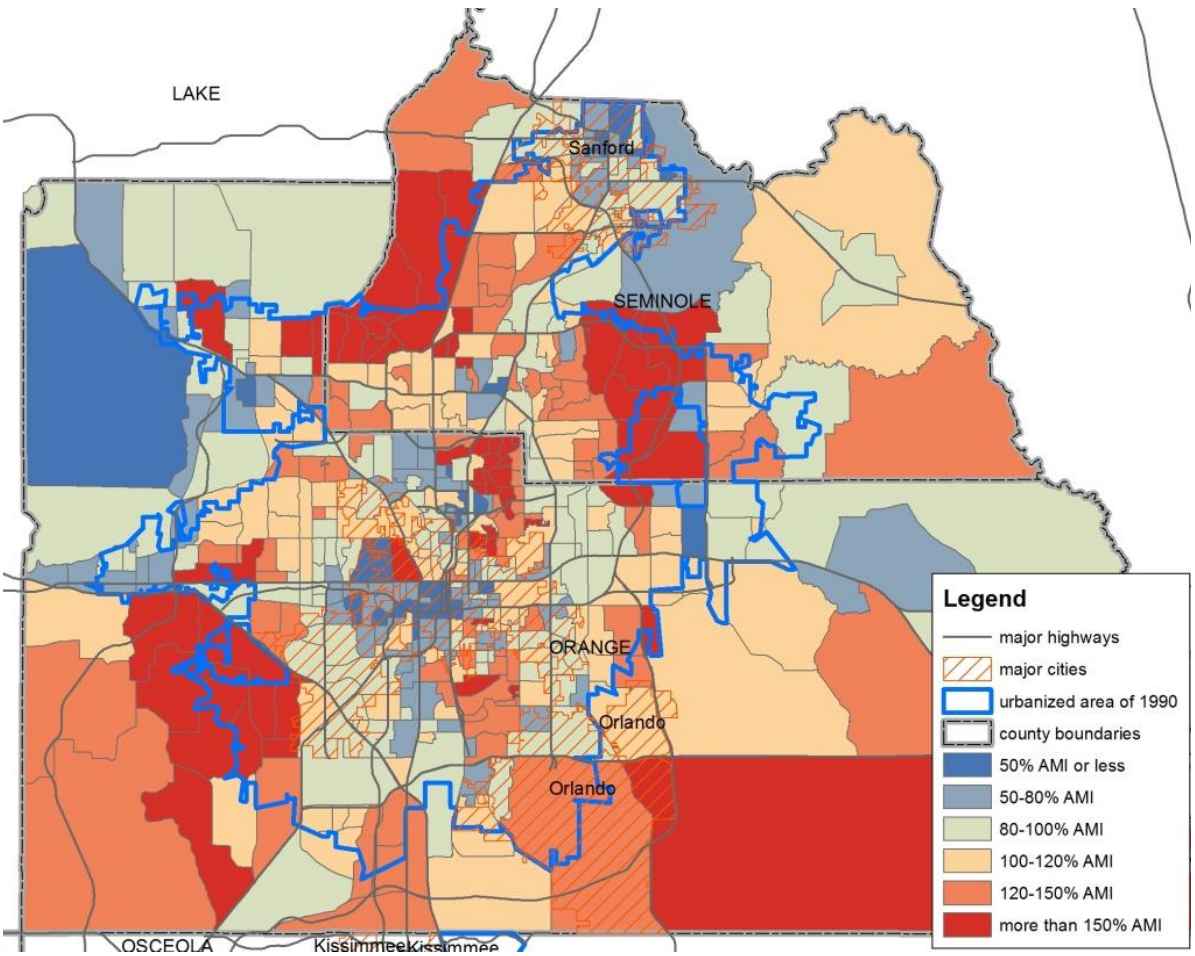

Figure 3-2. Neighborhood income in the study area in 1990

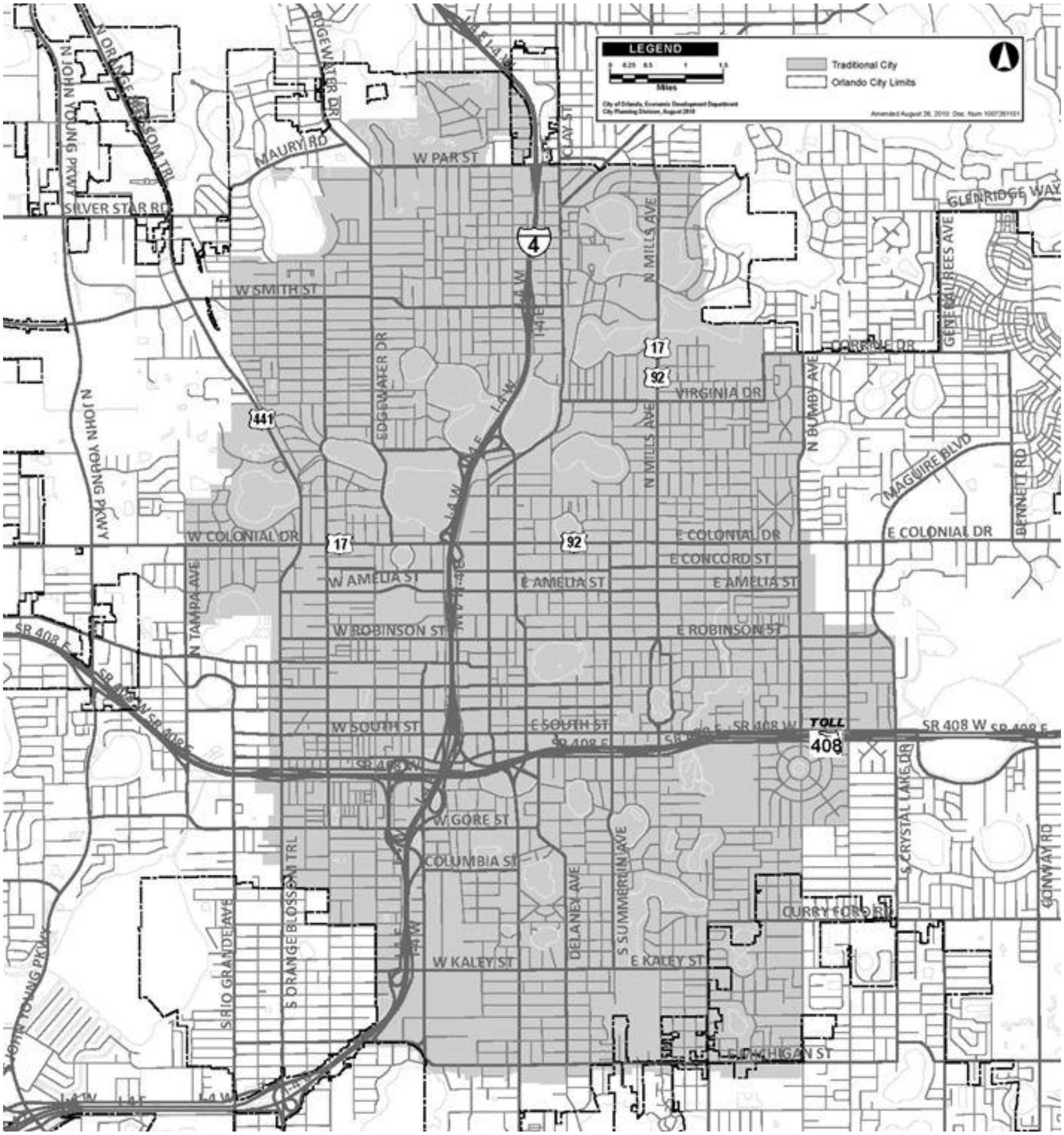

Figure 3-3. Traditional City boundary in the City of Orlando as of 2010. (Source: City of Orlando, 2012, p. UD-18).

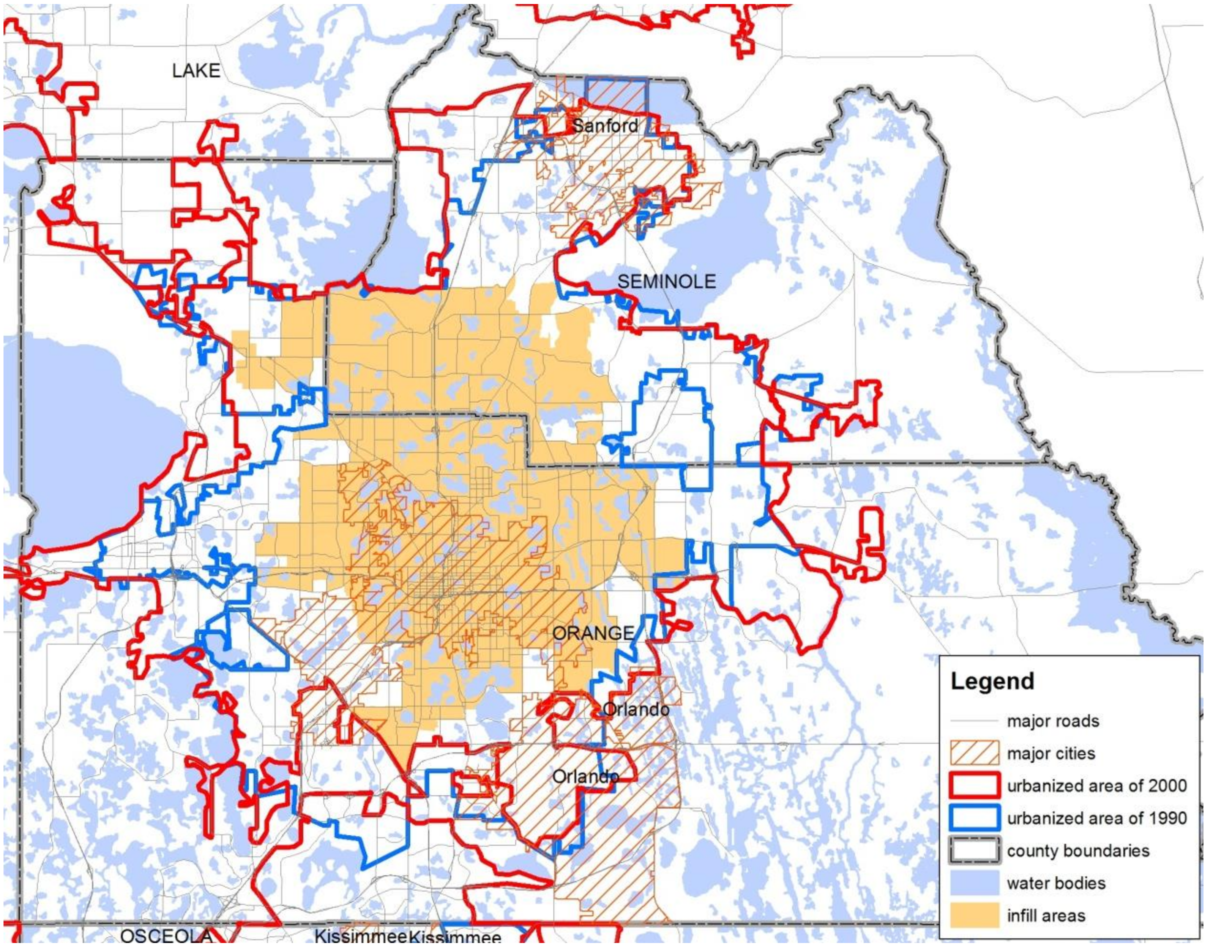

Figure 3-4. Identified infill areas and Census designated Urbanized Areas in the Orlando MSA. (Source: Census tiger line 1990, 2000, 2010)

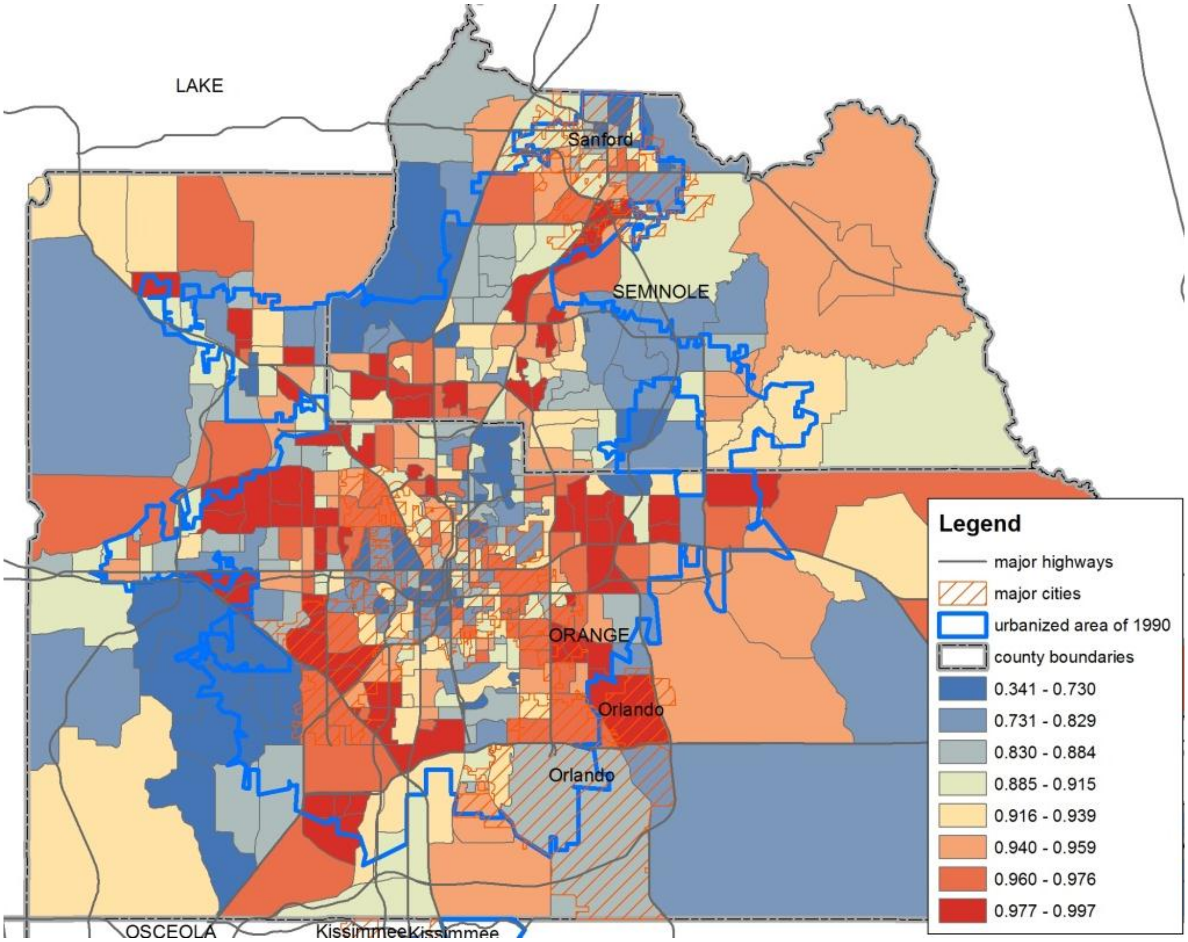

Figure 3-5. Neighborhood income diversity of the Orlando MSA in 1990

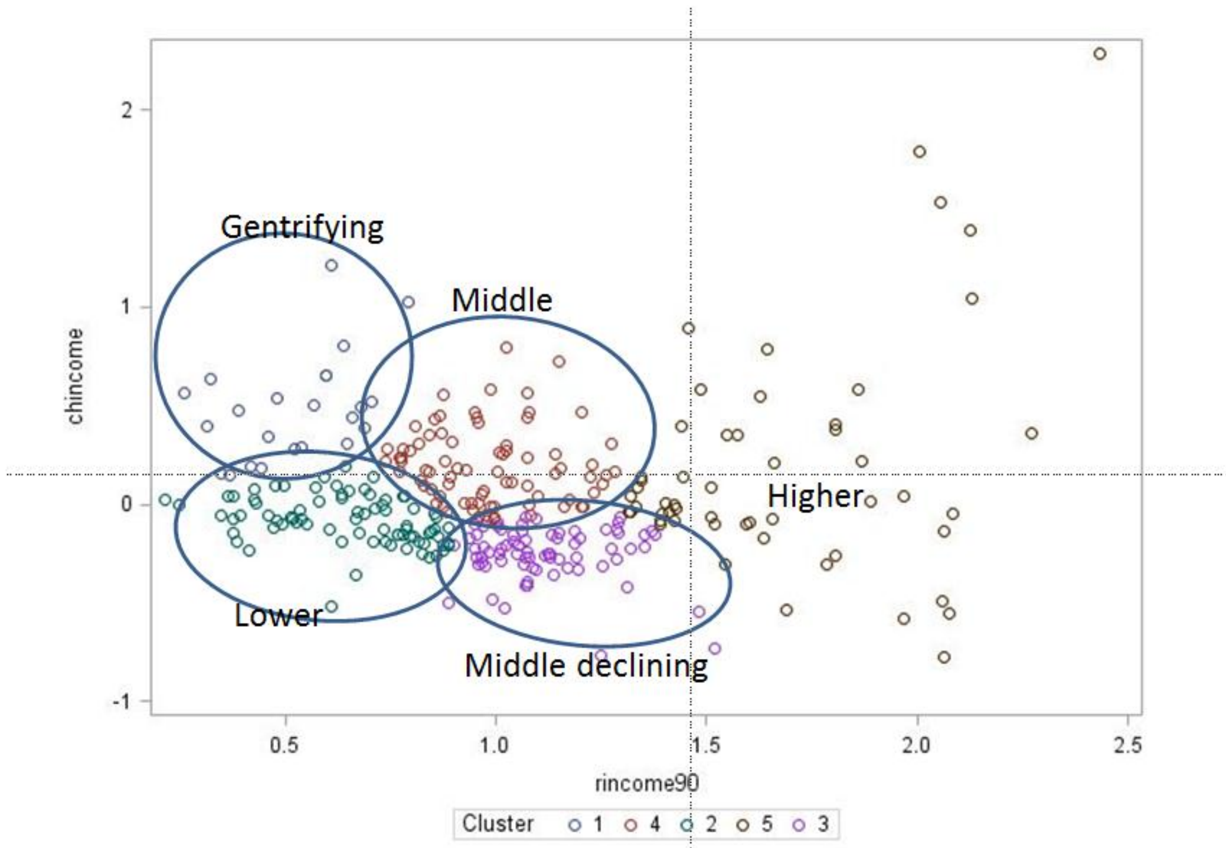

Figure 3-6. Clustering of neighborhoods based on neighborhood income in 1990 and income change between 1990 and 2005-2009. Note: rincome90 refers to the median household income of a census block group normalized by the median household income of the Orlando MSA in 1990. Chincome refers to the ratio between median household income of a census block group in 1990 and 2005-2009. Median household incomes of census block groups are normalized by the median household income of the Orlando MSA for each time period.

Table 3-3. Neighborhood types based on the K-means clustering

Neighborhood type	N	Neighborhood income 1990		Increase of income (0509-1990)	
		Mean	Std.Dev	Mean	Std.Dev
Lower Income	79	0.650	0.173	-0.082	0.123
Lower-Gentrifying	23	0.524	0.147	0.486	0.267
Middle Income	79	0.984	0.145	0.191	0.194
Middle-Declining	73	1.118	0.140	-0.252	0.137
Higher Income	53	1.677	0.293	0.183	0.581

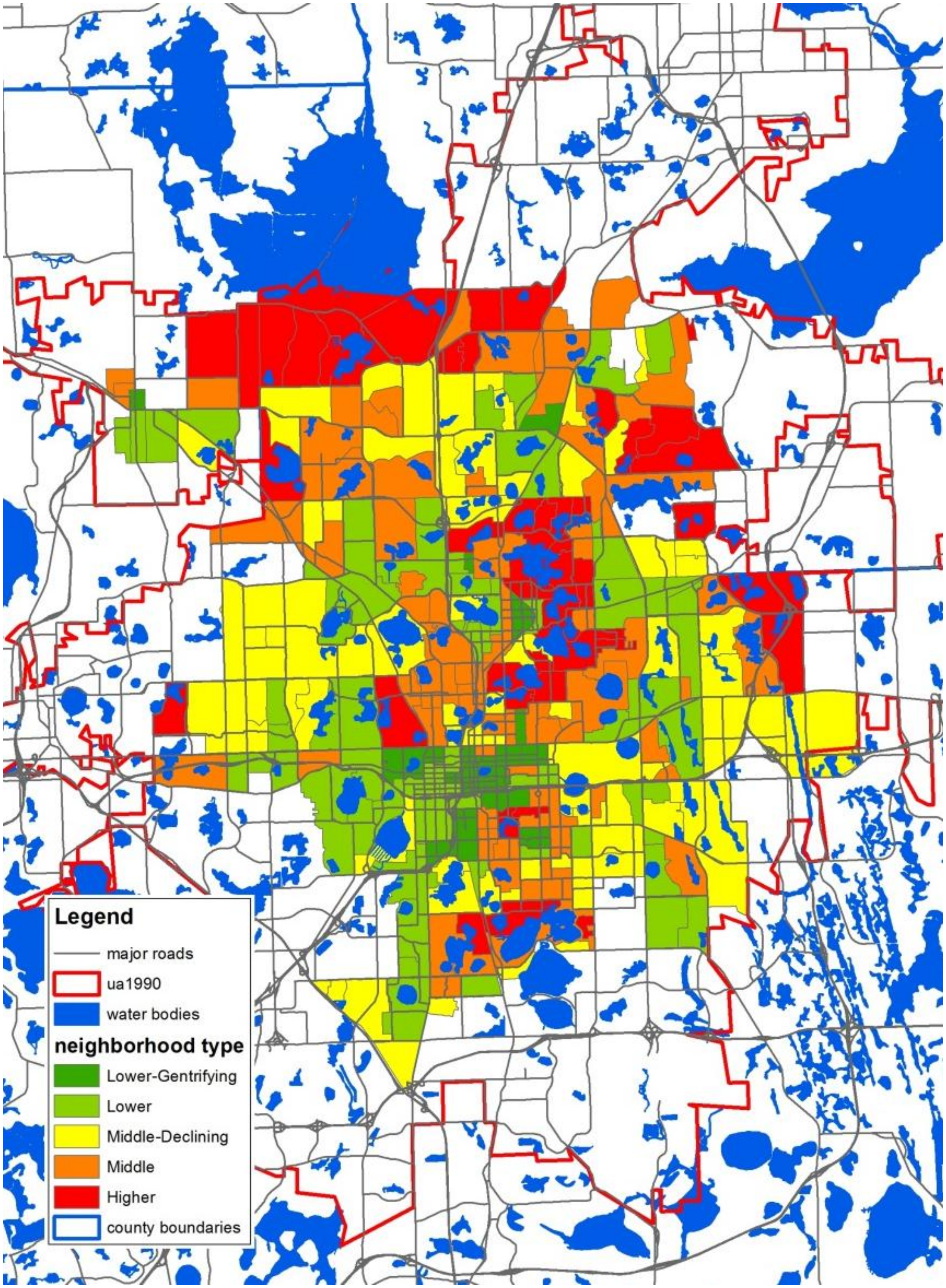

Figure 3-7. Neighborhood types in infill areas of the Orlando MSA

Table 3-4. List of variables for econometric models

Variables		Measurement
Dependent	Neighborhood income Diversity	Entropy index based on six income groups
Independent	Autoregressive term of dependent variable	Weighting matrix based on Queen contiguity
	Quantity of Infill housing (QIF)	Number of infill housing units per developable land acre
	Ratio of newly built infill housing (NEWR)	Ratio between newly built infill housing units and total infill housing units
	Diversity of infill housing types (DIF)	Entropy index based on four housing types (single family / multifamily / condominium / others)
	Ratio of multifamily infill housing	Ratio between multifamily infill housing units and total infill housing units
	Interaction between QIF and neighborhood types	QIF * lower income neighborhoods QIF * higher income neighborhoods QIF * gentrifying neighborhoods QIF * declining neighborhoods (reference: middle income neighborhoods)
Control	Initial neighborhood income diversity	Entropy index for neighborhood income diversity at a base year
	Built environment of neighborhoods	Housing density at a base year (units / acre) Job density at a base year (workers / acre) Ratio of housing that is 40 years old or more
	Economic status of neighborhoods	Median household income ($) Change in median household income Poverty rate (%)

Table 3-5. Neighborhoods for case studies

Neighborhoods		Attributes of neighborhoods
Lower income	Holden & Parramore	Downtown, HOPE VI project
Lower-Gentrifying	Colonialtown South	Traditional City, HOPE VI project
Middle income	Audubon Park	Near brownfield redevelopment
Middle-Declining	Engelwood Park	Inner ring suburb, Neighborhood Stabilization Program
Higher income	Spring Lake	Traditional City, partially gated communities

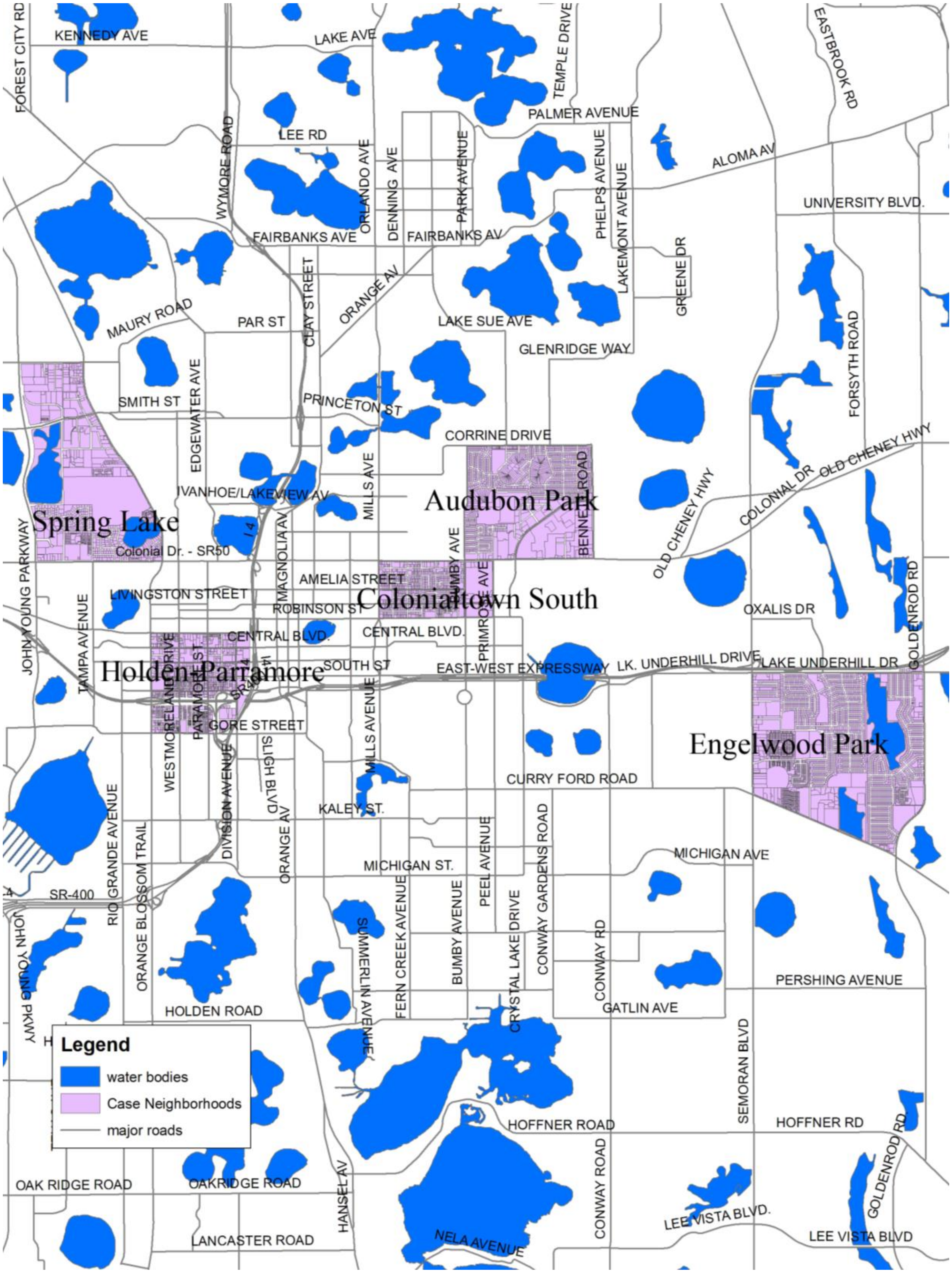

Figure 3-8. Location of case neighborhoods

CHAPTER 4
RESULTS AND FINDINGS

Infill development is an environmentally sustainable development pattern, but its socio-economic impacts on neighborhoods are less known. From the perspective of socio-economic sustainability, the income diversity of neighborhoods increases the potential to achieve sustainable communities by promoting place vitality, economic health, social equity and social capital in neighborhoods (Calthorpe & Fulton, 2001; Talen, 2006a). Thus, this study explores the relationship between infill development and subsequent neighborhood change with an emphasis on neighborhood income diversity.

In this chapter, the results and findings from the analyses described in the methodology chapter are presented. Regarding the patterns of infill housing, the quantity of infill housing by years, spatial clustering of infill housing, and housing types, sizes and price of infill housing by neighborhood types are summarized. The results of spatial econometrics with or without consideration of neighborhood types for three time periods are presented. The findings from case studies are related to the results of spatial econometrics to further understand the causality between infill housing and subsequent neighborhood change.

In particular, the attributes of infill housing in each neighborhood type are analyzed in order to examine whether infill housing reflects neighborhood economic conditions. The effects of the quantity and characteristics of infill housing on neighborhood income diversity for each neighborhood type are analyzed by combining spatial econometric analyses and case studies. The combination of the quantitative and qualitative analyses provides a deeper understanding of the mechanisms by which infill development affects neighborhood income diversity.

Patterns of Infill Housing

Type, Size and Value of Infill Housing

From 1990 to 2009, 67,237 infill housing units, or 22.5% of the total newly built or renovated housing units in Orange and Seminole County, were developed as summarized in Table 4-1. The share of infill housing among total newly built or renovated housing decreased from 27.7% during the 1990s to 17.8% during the 2000s. In general, about 2,000 or more newly built infill housing units were developed every year, with the number of newly built infill housing units from 1995 to 2000 relatively higher than that of other years.[1]

The amount of new construction on the urban fringe has drastically increased since 1995, and the urban fringe areas had the largest share of new construction during the housing market boom period from 2000 to 2006. Then the share fell during the housing market bust period as shown in Figure 4-1 and 4-2. In general, infill areas have a larger share of renovation than urbanized areas and urban fringe areas as shown in Figure 4-4.

As shown in Table 4-2, 71.8% and 28.2% of infill housing units were newly built or renovated, respectively. The infill areas have a relatively higher share of renovation compared to urbanized areas and urban fringe areas. Within infill areas, lower income, gentrifying, and declining neighborhoods show higher shares of renovation than middle and higher income neighborhoods. The ratio of new construction and renovation among infill housing units in gentrifying neighborhoods during the 1990s was opposite to that of the 2000s. Specifically, the share of renovation in the 1990s was larger than two-thirds,

[1] On average, 2,415 newly built infill hosuing units were developed every year, but the average of newly built infill housing units from 1995 to 2000 was 3,107 units.

but the share decreased to 29.3% during the 2000s. As different types of infill housing — renovation during the 1990s and new construction during the 2000s— were developed, the effect of infill housing on income diversity in the 1990s may differ from that in the 2000s in gentrifying neighborhoods.

In general, housing types in infill areas are more diverse than those in urbanized areas and urban fringe areas (see Tables 4-3 to 4-5). The mixture of newly constructed housing types in infill areas is not different from that in urbanized areas. However, a more diverse range of renovated housing occurs in infill areas than in urbanized areas. In urban fringe areas, the share of single family housing is very high. More than three-fourths of newly built housing units were single family housing in this area. But, a higher share of multifamily housing is renovated in urban fringe areas than urbanized areas.

Infill housing types also vary depending on the neighborhood. Overall a more diverse range of newly constructed housing was developed during the study period in middle income and declining neighborhoods. Lower income and gentrifying neighborhoods have a larger share of renovated multifamily housing, but higher income neighborhoods have a larger share of newly constructed single family housing. However, the extent of mix of housing types varies depending on the time period. For instance, the share of newly constructed single family housing among all new construction in gentrifying neighborhoods during the 1990s was 82.2%, but the share decreased to 16.9% during the 2000s. Similarly, the percentage of multifamily housing among all new construction in lower income neighborhoods during the 1990s was 66.8, but decreased to 38.9 during the 2000s. These results imply that infill housing types depend not only on neighborhood attributes but also on housing market conditions.

The types of housing that are renovated also may vary depending on neighborhood type. Overall, renovating multifamily housing is very popular in most neighborhoods except higher income communities. The percentage of renovations classified as multifamily housing was relatively lower in middle and declining neighborhoods during the 1990s than the 2000s. The share of renovated housing units classified as condominium is very small probably because the overall number of condominiums is low as homeowners in the Orlando MSA traditionally preferred single family housing rather than multiple unit developments or attached housing. Indeed, the proportion of condominiums among the overall housing stock in the Orlando MSA is relatively small compared to other MSAs in Florida.

The mean property values, lot size, and unit size for single family housing units are summarized in Table 4-6. In general, lot size and floor area of single family housing in urban fringe areas tends to be larger than those in infill areas or urbanized areas. The value of newly built or renovated infill housing during the 1990s is lower than that in urban fringe areas. In contrast, the value of newly built or renovated infill housing during the 2000s is higher than that in urban fringe areas despite the fact that the average property size of single family housing in infill areas is relatively small compared to that in urban fringe areas. During the 2000s, the property value of infill housing in gentrifying, middle income and higher income neighborhoods may outweigh that of urban fringe areas by providing a combination of better economic conditions in neighborhoods and higher accessibility to urban activities.

Within the infill areas, the size and value of infill housing were affected by the economic status of these neighborhoods. The size and value of infill housing in higher income neighborhoods was much higher than in lower income neighborhoods. Specifically, the majority of infill housing in higher income neighborhoods consists of very expensive single family homes, so infill housing in higher income neighborhoods does not appear to attract relatively lower income households. Similarly, relatively affordable single family housing units are built in lower income infill neighborhoods. These patterns imply that the income diversity of the higher or lower income neighborhoods may not be increased through infill development because this housing may attract households with similar incomes to existing residents.

Moreover, according to the assisted rental housing inventory from the Shimberg Center for Housing Studies at the University of Florida, 5,961 assisted rental housing units were constructed within lower income infill neighborhoods in Orange and Seminole County from 1990 to 2009. This subsidized rental housing represents more than 55% of the multifamily housing supply in the lower income neighborhoods as shown in Table 4-7. In the declining neighborhoods, the subsidized housing unit accounts for 42% of total newly built or renovated multifamily housing units. This result indicates that public subsidy can be a critical factor to promote the supply of infill housing in economically disadvantaged or declining communities. If infill housing consists of subsidized rental housing, the supply of infill housing may attract lower income households rather than relatively upper- and middle- income households. Subsequently, lower income households can be concentrated in these communities.

As described above, the attributes of infill housing vary depending on neighborhood type in terms of housing types, lot size, square footage, and value. In addition, variance in infill housing variables exists within the same neighborhood type as shown in Tables 4-8 to 4-10. For example, the diversity in infill housing types during the 1990s in lower income neighborhoods ranges from 0 to 0.777 with a mean of 0.196 and a standard deviation of 0.206. These large variances may result from unique socio-economic and historical backgrounds of each neighborhood, which cannot be characterized by a simple neighborhood classification. In other words, each neighborhood has its own housing submarket conditions so that a variety of infill housing is developed, implying that no generalizable attributes of infill housing exist.

Spatio-temporal Patterns of Infill Housing

The spatial patterns of infill housing are analyzed using the Getis-Ord Gi* statistic. Spatial patterns of two different time periods are compared in order to address temporal differences. In the hot spot analysis based on the Getis-Ord GI* statistic, the red colored areas indicate the areas where the larger values of infill variables are spatially clustered compared to adjacent areas. Similarly, the blue colored zones imply the neighborhoods where the smaller values of infill variables are spatially clustered compared to nearby neighborhoods. However, the red color or blue color by themselves do not represent the higher or lower value of infill development. Since the color is determined based on the values of adjacent neighborhoods using a spatial weighting matrix, the color implies the clustering of relatively higher or lower values rather than implying the clustering of absolutely higher or lower values. If a Gi* statistic of a census block group is statistically larger than zero, the census block group represents a hot-spot zone of the event (red color on the map). Inversely, if a Gi* statistic of a census block group is statistically less than zero, the census block group is a cool zone of the event (blue color on the map). As noted in the methodology chapter, the Getis-Ord Gi* statistic is calculated by applying a queen contiguity spatial weighting matrix in order to define spatial relationships between census block groups.

The hot spots and cool zones of residential infill development during the 1990s and 2000s are compared in Figures 4-7 to 4-9. Although the location where higher values of new construction are spatially clustered changes over time, in general new construction is spatially clustered in the northwestern and southeastern sections of the infill areas and renovation is clustered in the downtown areas and the eastern section of the infill areas. Due to the redevelopment of the Naval Training Center during the 2000s, higher values of new construction are also clustered near Baldwin Park the new urbanist community developed on this site. In terms of total quantity of infill housing from 1990 to 2009, new construction is clustered in outlying sections of the infill areas, but renovation is clustered in both downtown areas and the eastern section of the infill areas.

The spatial clustering of residential infill development during the housing market boom and bust period of the 2000s is also compared in Figures 4-10 and 4-12. New construction is clustered in downtown areas during the housing market boom period from 2000 to 2006, and the location of spatial clustering during the housing market bust period spread out to the Baldwin Park and Winter Park areas. Renovation was spatially clustered within the eastern boundary of the City of Orlando during the housing market boom period, but was spatially clustered within the downtown areas and north side of Orlando along I-4 during the housing market bust period. From 2007 to 2009, the areas where renovation clustered were gentrifying communities near the downtowns and higher income communities along the east side of I-4. These results imply that renovation activities are affected by housing market conditions.

Results and Findings from the Econometric Models

The descriptive statistics of variables used in the econometric models are summarized in Table 4-11. The mean and standard deviation of the neighborhood income diversity index in 1990 is almost the same as that in 2000. But, the mean value of the neighborhood income diversity index in 2005-2009 slightly decreased, and the standard deviation increased. This result implies that variation in the neighborhood income diversity index increased during the 2000s. On average, 0.291 infill housing units per acre were developed during the 1990s, and 0.265 units per acre were added during the 2000s in each census block group.

As noted in the methodology chapter, econometric analyses with and without consideration of the neighborhood types are separately conducted for three time periods: (1) 1990s-short term, (2) 2000s-short term, (3) 1990 to 2009-long term. For all regression models, the Variance Inflation Factor (VIF) is less than 10, implying that multicollinearity among independent variables is not strong in the regression analyses. Thus, economic characteristics of neighborhoods, such as poverty rate and median household income can be included in the same regression model.

The estimated results of the regression models, which do not consider neighborhood types, are summarized in Table 4-12. The coefficients of spatial autoregressive term (ρW) of the SAR and SCM models are positive in all time periods, and the estimated parameters are statistically significant in two short term models. The positive association between neighborhood income diversity and income diversity of surrounding neighborhoods implies that neighborhoods surrounded by mixed income neighborhoods tend to be more diverse in terms of income. However, in the long term model, the effects of the spatial autoregressive term is weak or less significant, indicating that the changes in attributes within the neighborhood are more important determinants than the level of income diversity of the surrounding neighborhoods in promoting income diversity. The spatial error term in the SEM and SCM models is not statistically significant except for the 1990s SCM model. The Z-scores of the Moran' I statistic are not statistically significant except in the SAR models for the 1990s. The entropy index for neighborhood income diversity is spatially clustered,[2] but residuals of the regression models do not have spatial autocorrelation based on the Moran's I. As the initial condition of neighborhood income diversity is included in regression models, the spatial autocorrelation in neighborhood income diversity may be minimized. The SAR models for the 1990s created spatial autocorrelation issues, so the estimated results of these models may be less reliable compared to other model specifications. However, the estimated results and statistical significance of the SAR 1990s models are similar to those of other models. When three spatial econometric models all provide statistically significant results, the outcome can be considered stronger empirical evidence of a relationship, here between infill housing and neighborhood income diversity.

In general, the quantity of infill housing does not affect neighborhood income diversity in all three time periods. The ratio of new construction only significantly increases neighborhood income diversity during the 2000s. Because the mortgage

[2] The Z-scores of Moran's I for neighborhood income diversity 2000 and 2005-2009 are 12.85 and 8.45, respectively. Both Z-scores are statistically significantly higher than zero, implying that neighborhood income diversity is spatially clustered.

interest rate was low, and subprime mortgage lenders provided much easier access to money for households having lower credit, the homeownership rate increased during the early and middle 2000s (Schwartz, 2010). As newly built infill housing can attract new home buyers, specifically, relatively moderate or low income home buyers with subprime loans, the higher ratio of new construction may result in a mix of incomes within neighborhoods in the 2000s.

The diversity of infill housing types (DIF) significantly promotes neighborhood income diversity in the 1990s and the longer term from 1990 – 2009. Diverse housing types do not guarantee higher income diversity, but they can potentially attract diverse income groups. Overall the income levels of residents living in single family homes are relatively higher than those in multifamily housing, so the mix of single family housing and multifamily housing may attract various income groups. The less significant result of the DIF variable in the 2000s may be affected by the housing market bubble and crash, which could have caused market distortion. Since easy access to mortgages allowed low income households to become homeowners during the 2000s, the income level of residents living in new single family homes may not differ significantly from that of market rate multifamily housing. Subsequently, the diversity in infill housing types may not promote income diversity. However, this speculation requires further examination in a future study.

The ratio of multifamily housing among infill housing reduces income diversity in the long term model. As noted earlier, overall multifamily housing tends to be renter occupied housing, and the income level of renters is relatively lower than home owners.

Thus, a higher dependency on the multifamily housing type in infill development may not promote mixed tenure and mixed income communities.

The results of the long term model present two important implications. First, the ratio of new construction, diversity of infill housing types and the ratio of multifamily housing have significant effects on neighborhood income diversity, but the quantity of infill housing variable is not significant in all models. These results imply that the characteristics of infill housing are a more important factor than the quantity of infill itself in promoting neighborhood income diversity. Second, compared to the short term models, infill housing variables tend to have statistically significant effects on neighborhood income diversity in the long term model. This result suggests that consistent and continuous infill development can promote neighborhood income diversity.

With regard to the control variables, overall housing density is positively associated with neighborhood income diversity, but the results are not statistically significant. The estimated results of the job density variable are not consistent in terms of the direction of coefficients, and they are not statistically significant in all models. These less significant and mixed results can be understood in terms of a non-linear effect of density similar to that found by Pendall and Carruthers (2003) regarding income segregation and Talen (2006b) regarding income diversity. Alternatively, no direct connection between neighborhood density and neighborhood income diversity exists.

Since neighborhood income diversity tends to be lower in both higher and lower income neighborhoods, the median household income variable could have mixed effects on income diversity. Indeed, the median household income negatively affects income diversity only in the 1990s model. A positive change in median household income promotes neighborhood income diversity in all models. This result implies that revitalization of economically distressed neighborhoods or gentrification can promote mix of incomes in the Orlando metropolitan area. The poverty rate is negatively associated with income diversity in the 1990s model, indicating the concentration of the poor intensified during the 1990s in the Orlando area.

Finally, the share of housing that is 40 years old or more consistently reduces neighborhood income diversity in all models. Since housing quality depreciates over time, all other things being equal, older housing is cheaper and tends to be occupied by lower income households through the filtering process (Grigsby et al., 1987). Therefore, the concentration of older housing can result in the concentration of relatively lower income households. Consequently, neighborhood income diversity can decrease.

The regression models with interaction variables between the neighborhood type dummy[3] and the quantity of infill housing variable examine whether the effects of quantity of infill housing on income diversity vary depending on neighborhood types. As shown in Table 4-13, the quantity of infill housing in gentrifying neighborhoods increased neighborhood income diversity in the 1990s model and the long term model from 1990 to 2009. The estimated results of other infill variables such as the ratio of new construction, the diversity of infill housing types, and the ratio of multifamily infill housing are the same as those of the regression models without interaction variables.

[3] The reference of neighborhood type dummies concerns the middle income neighborhoods. Thus, the estimated result of the interaction variable refers to the differentiated effect of the quantity of infill housing in a neighborhood type (lower, gentrifying, declining, or higher) compared to the effect of quantity of infill housing in the middle income neighborhoods.

Also, the estimated direction and significance of other control variables are similar to the results of the regression models with no interaction variables. Thus, the discussion about the results of the regression models with consideration of neighborhood types focuses on the effects of the interaction variables.

The estimated results of the effects of infill housing in higher and lower income neighborhoods are not statistically significant, but the directions of the results are consistent with the hypotheses of this study in all models. More specifically, compared to middle income neighborhoods, the quantity of infill housing in higher and lower income communities is negatively related with neighborhood income diversity. Although the connection is not strong, the possibility that infill may reduce neighborhood income diversity exists in these neighborhoods.

The quantity of infill housing in gentrifying neighborhoods increases neighborhood income diversity in the 1990s and in the long term model (1990-2009). Although the results are not statistically significant, the direction of the interaction variable between gentrifying neighborhood dummy and quantity of infill housing is also positive in the 2000s model. The less significant results in the 2000s model can be understood from the characteristics of infill housing summarized in Table 4-2 and 4-3. Infill housing types during the 1990s are more diverse than those in the 2000s in gentrifying communities. Moreover, more than 80% of infill housing is often a multifamily housing type during the 2000s in gentrifying neighborhoods. Accordingly, the neighborhood income diversity in gentrifying neighborhoods during the 2000s was not significantly increased by the quantity of infill housing.

The effects of gentrification on neighborhood income diversity or income segregation have been controversial. While attracting upper- and middle- income households, gentrification can also result in displacement of low income households (Dale & Newman, 2009; Day, 2003; Lees, 2008; Redfern, 2003). In the Orlando metropolitan area, the gentrification process may positively affect neighborhood income diversity over both the short and long term. This result is consistent with Freeman's (2009) finding that gentrification can induce neighborhood diversity.

The estimated results of the long term model (1990-2009) are similar to those of the 1990s model in terms of direction and statistical significance as summarized in Table 4-14. But, the diversity of infill housing types and the ratio of multifamily infill housing in the 2000s model showed less significance and opposite directions compared to those in the 1990s model and the long term model. As noted earlier, these differences may result from the housing market bubble and crash during the 2000s. In a future study, the effects of housing market change on infill development and neighborhood change should be addressed. Based upon the given information from the 1990s and long term models, this study speculates that diversity of infill housing types may positively affect neighborhood income diversity, and the ratio of multifamily housing among infill housing may be negatively associated with neighborhood income diversity.

In sum, the results of regression models provide only partial evidence about the effectiveness of infill housing in promoting neighborhood income diversity. The ratio of new construction and diversity of infill housing types can increase neighborhood income diversity during some time periods. The quantity of infill housing only can increase neighborhood income diversity in gentrifying communities. In contrast, the ratio of multifamily housing among infill housing may be negatively associated with neighborhood income diversity. Also, infill development in lower and higher income neighborhoods may negatively affect income mix.

These weak connections between infill housing and neighborhood income diversity may result from the fact that each neighborhood has its own characteristics. Even if several neighborhood characteristics, such as economic conditions and density, are controlled and spatial interactions among neighborhoods are considered in the regression models, the unique and complex contexts of each neighborhood cannot be fully explained in an econometric model. Moreover, as characteristics of infill development reflect neighborhood conditions, four variables for infill housing may not wholly represent the diverse aspects of infill housing characteristics, implying that the regression models using these variables only provide partial explanations about the relationship between infill development and subsequent neighborhood change.

Therefore, the connection between infill development and neighborhood change in selected neighborhoods are explored as case studies in order to have a better understanding of the neighborhood succession resulting from infill. The historical and socio-economic contexts of neighborhoods, infill projects, and change in neighborhood attributes are addressed in these case studies.

Results and Findings from Case Studies

As noted in the methodology chapter, five neighborhoods are selected as case study areas. For each case, historical contexts based on the planning documents and interviews are introduced, and neighborhood characteristics and their change at three times (1990, 2000, 2005-09) based on the Census and ACS are summarized. A map which describes current land uses and location of infill housing is presented. Also, the infill project profiles, such as quantity and housing types, are analyzed, and if applicable, public and subsidized housing programs within the case neighborhoods are introduced. Finally, the findings from the cases studies and results of the econometric models are related to provide a better understanding of the results.

Holden-Parramore

Holden-Parramore is one of the most economically distressed neighborhoods in the Orlando metropolitan area. The neighborhood is located west of the intersection between I-4 and SR 408 in downtown Orlando. Historically, Holden-Parramore was an African American community where the share of African-Americans among the overall population in 1990 was 92.2%, and the poverty rate was 51.5%.

According to B. Hossfield, Senior Planner of the City of Orlando (personal communication, August 30, 2012), after the end of (de jure) segregation relatively affluent African Americans left Parramore to find more stable, higher income, and more modern housing in the suburbs. As a result, since the 1970s, many houses became vacant, and quite a number of them were demolished as a range of city and county uses and projects displaced the residents and local businesses that remained in this economically disadvantaged neighborhood. The higher vacancy rate and the continuous decrease in population and number of households confirm the economic disadvantage of Holden-Parramore as shown in Table 4-15. The City of Orlando and non-profit organizations have made an effort to revitalize the neighborhood through housing and community development programs, but the economic conditions of Holden-Parramore have not improved.

During the 1990s and 2000s, 598 housing units were newly built and 105 housing units were renovated. The locations of infill projects are shown in Figure 4-13.

These units include the Carver Park HOPE VI project, new construction along McFall Avenue, a housing project sponsored by Habitat for Humanity, and the City View low income housing tax credit mixed use development. Two large scale infill developments in Holden-Parramore, Carver Park and City View, are government supported housing projects. In order to promote income mix, these two projects provide affordable rental housing for low income households and market rate rental housing.

Carver Park is a redevelopment project of the Carver Court Public Housing complex that was originally built in 1945 and consisted of 212 units. The project was awarded a HOPE VI[4] grant in 2002, and it was also awarded LIHTC[5] from the Florida Housing Finance Corporation (FHFC). As shown in Table 4-17, new construction of 203 units, including 83 homeownership units, is planned. As of 2012, according to HUD (2010) and the Orlando Housing Authority [OHA] (n.d.a), the project has provided a total of 121 units: 64 elderly public housing units, 56 rental housing units including 30 public housing units, and one model single family home. The remaining 82 homeownership units will be constructed in the future. In order to promote a mix of incomes, 53 homeownership units and 10 rental units are provided at a market rate as shown in Table 4-18.

City View is a redevelopment project for mixed use and mixed income, that was completed in 2003. The ground floor contains 23,000 square feet of retail and about

[4] HOPE VI is a federal housing program that demolishes severely distressed public housing and develops a mixed income and mixed tenure housing complex on the site.

[5] Under the Low Income Housing Tax Credit (LIHTC) program, the U.S. Internal Revenue Service (IRS) allocates tax credits to State Housing Agencies to support construction of affordable housing by the private sector. Developers use tax credits, which they earned through a competitive application process, to fund their housing projects. The amount of tax credits is determined based on the development cost and the share of affordable housing units.

200,000 square feet of office space. In addition, the upper floors have 266 housing units. The project was awarded the LIHTC equity from Bank of America. The City of Orlando also funded the project through tax increment financing.[6] For low income households who earn less than 60% of AMI, 40% of the 266 housing units are provided at an affordable rent (Orlando Neighborhood Improvement Corporation, 2005).

As summarized in Table 4-19, about 45% of the total housing units, 703 of 1540 units, were renovated or newly built during the 1990s and 2000s. The share of single family housing among infill housing units is about 15%, and the remaining units are multifamily housing. As of 2010, the mean appraised value of single family infill housing is more than two times that of existing single family housing.[7] However, overall the appraised value of infill housing is less than $100,000,[8] implying that relatively affordable housing is provided through the market in Holden-Parramore.

Consistent with the hypothesis that large amounts of infill housing in economically distressed neighborhoods are provided by the public sector or through public- private partnerships to serve low income households, the two subsidized housing projects, Carver Park and City View, provided 346 housing units, which is about

[6] Tax Increment Financing (TIF) is a public financing method to fund redevelopment and economic development based on increased tax revenue generated by the improvements to the site. This revenue funds further improvements in the area.

[7] Of course, all other things being equal, the value of newly built or renovated housing units should be higher than that of old housing units.

[8] According to the Florida Housing Data Clearinghouse at the Shimberg Center for Housing Studies, the median sale price of a single family house in Orange County in 2010 was $170,000. Thus, the mean of appraised values of single family infill homes in Holden-Parramore is less than 58% of area median sale price.

55% of total infill housing units in the 2000s,[9] and most of them are affordable to low income households.[10] As the supply of affordable housing may attract more low income households into the neighborhood, infill development in lower income neighborhoods can intensify the concentration of the poor rather than revitalize the neighborhoods.

The share of each income group among households and the entropy index demonstrate that the economic condition of the neighborhood was not improved. Further, income mix was not achieved, even if a large amount of infill development occurred during the 2000s as summarized in Table 4-20. The share of very low income households increased from 65.0% to 68.5% during the 1990s, but decreased to 62.2% during the 2000s. The small decrease in the share of very low income households during the 2000s may result from the demolition of public housing units through the Carver Park HOPE VI project based on the fact that the number of public housing units decreased from 212 to 64. Thus, infill development in Holden-Parramore does not effectively promote mixed income communities. However, the mix of assisted housing and market rate rental housing in the Carver Park and City View projects may result in a small increase in the lower income group and the moderate income group, implying that the potential to promote income mix through infill exists in the long term in Holden-Parramore.

[9] The share of subsidized housing is underestimated because the number of multifamily housing units is calculated based on the assumption of one housing unit per each 1,000 square feet. Thus, the dependency on government subsidy is much higher in reality.

[10] As summarized in Table 4-18, only 10 units of a total 120 rental units are market rate rental housing in Carver Park. According to HUD's Low-Income Housing Tax Credit Database, 107 units of a total 226 dwelling units are set aside for low income households who earn 60% of AMI or less in City View.

Colonialtown South

Colonialtown South is a gentrifying neighborhood in the Orlando metropolitan area. Located east of downtown Orlando, Colonialtown South had a median household income of only 55% of the Orlando MSA AMI and 66% of the City of Orlando AMI in 1990. But, in 2005-2009 the median household income increased to 126% of the Orlando MSA AMI and 147% of the City of Orlando AMI. The poverty rate also decreased from 20.6% to 6.4% in the same period. Since the neighborhood includes the Colonial Town Center and commercial lands along Colonial Drive, the job density is about 5 to 6 times higher than the housing density.

From 1990 to 2009, 201 infill housing units were developed as shown in Table 4-22. Two-thirds of these infill units were supplied during the 2000s. The Hampton Park HOPE VI project contributed significantly to this increase in residential infill development during the 2000s, adding 83% of infill housing units during this time. Hampton Park is a redevelopment project of the Orange Villa Public Housing Complex which included 100 housing units originally built by the War Department as temporary World War II housing (City of Orlando, 2009a). The old public housing units were demolished in 1996, and the project was awarded a HOPE VI grant in 1997. Completed in 2006, the project includes new construction of 65 single family homes and renovation of 48 multifamily housing units for the elderly (OHA, n.d.b).[11]

In order to achieve mixed income communities, Hampton Park includes homes for low income households and market rate homes. According to the OHA (n.d.b), the

[11] Both new construction of single family housing and renovation of multifamily housing was counted as new construction during the 2000s because the property tax roll reports new built year for the renovated multifamily housing.

price of single family homes in Hampton Park ranges from $131,000 to $450,000 and 18 of 65 single family houses were reserved for low income home owners. The mean of the appraised value of single family infill houses is $230,552 and the value is 40% higher than that of existing single family homes. In terms of housing types, single family homes and multifamily homes are well represented as shown in Table 4-23.

Despite the effort to promote mixed income communities through the HOPE VI project, the income diversity of Colonialtown South was not realized. During the 1990s, the share of very low income households decreased from 41.7% to 25.9%, possibly due to the demolition of old public housing units and the displacement of low income residents from those units. The incremental renovation of older housing in Colonialtown South may have gradually attracted high and very high income households during the 1990s. Consequently, the entropy index increased from 0.884 to 0.937. However, the completion of the HOPE VI project may have accelerated the gentrification process so that the share of very high income households increased from 28.1% to 42.5%. Subsequently, neighborhood income diversity decreased. The changing pattern of the entropy index in Colonialtown South reflects the typical migration process in gentrifying communities: in-migration of upper- and middle- income households and displacement of low income households. The profiles of income groups indicate that the share of low income households is kept above the 20% level due to the supply of affordable housing in Hampton Park, but other areas in Colonialtown South have been changing rapidly to higher income residences.

Audubon Park

Audubon Park is a stable middle income neighborhood in the Orlando metropolitan area. As noted in the methodology chapter, this neighborhood is selected to understand the impacts of large scale infill development on nearby communities. Audubon Park is located northeast of downtown Orlando and adjacent to the former Orlando Naval Training Center, which was redeveloped into a residential complex for middle and higher income households during the 2000s. Although this very large scale redevelopment occurred near Audubon Park, the neighborhood characteristics remained stable over time as shown in Table 4-25.

The Baldwin Park project, a redevelopment of the Orlando Naval Training Center located along the northeast side of Audubon Park, started in 1998 with the construction of 3,158 housing units including 788 single family homes and 1,820 multifamily units. According to B. Hossfield (personal communication, August 30, 2012), the Baldwin Park project targeted middle and higher income neighborhoods to increase revenue to the City of Orlando from property taxes and to minimize community concern about the construction of low income housing, specifically, from the residents of nearby Winter Park, one of the most affluent communities in the Orlando area.

The main concerns expressed by the public regarding the Baldwin Park project were congestion resulting from increased residential density and decreases in property value due to introduction of low income housing (B. Hossfield, personal communication, August 30, 2012 & P. Lewis, personal communication, August 16, 2012). Also, nearby business owners, including those in Audubon Park, were interested in the impacts of the Baldwin Park project on their businesses (P. Lewis, personal communication, August 16, 2012). More than 200 public meetings were held to engage public participation of adjacent residents and business owners. Consequently, in order to mitigate the traffic impact of the Baldwin Park project, Bennett Road, which runs along the boundary between Baldwin Park and Audubon Park, was improved. Also, as no assisted rental housing or public housing project was introduced, the Baldwin Park project created a less diverse community in terms of income as shown in Tables 4-25 and 4-29.

Various housing types were developed in Baldwin Park, but mix of housing types by itself does not guarantee a mixed income community. Regardless of housing types, most housing in Baldwin Park targeted middle and higher income households. Consequently, diversity of housing types in Baldwin Park did not increase income diversity.

In Audubon Park, a total of 250 infill housing units were developed during the 1990s and 2000s. The new construction of a multifamily housing complex with 226 units at the Colonial Town Center was a major infill development in Audubon Park. As of 2012, the monthly rent of the apartment complex called “Promenade Crossing Apartments” ranged from $970 to $1,209 for a one-bedroom unit and from $1,278 to $1,501 for a two-bedroom unit. The rent level is about 1.3 to 1.5 times higher than the FY 2013 fair market rent in Orange County.[12] Thus, the potential tenants of the apartment complex probably are upper- and middle- income households.

In addition, 21 single family homes were renovated and 4 single family houses were newly built. As of 2010, the mean of appraised value of the single family infill units was about $200,000 and the area median sale price of single family homes in Orange County in 2010 was $170,000, implying that upper- and middle income households probably are potential residents of these infill units.

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[12] The HUD announces the Fair Market Rent of metropolitan areas every year to allow local housing authorities to set up a payment standard for their housing voucher program. In general, a fair market rent is a 40 percentile of a market rent distribution in a metropolitan area, and a payment standard for housing vouchers is between 90% and 110% of the fair market rent of the region.

Although Baldwin Park resulted in increased housing density and traffic near Audubon Park, the median household income increased throughout the study period in this area. In particular, the share of very high income households increased from 23.5% to 36.4% during the 2000s. These results may indicate that Baldwin Park, as a large-scale residential development for higher income households, positively affected the economic status of nearby neighborhoods. Audubon Park was one of the most mixed income communities based on the entropy Index in the Orlando metropolitan area in 1990. Introduction of multifamily housing units within the community during the 1990s did not change the degree of income mix. However, the share of very high income households increased and the income diversity slightly deceased in Audubon Park concurrent with the in-migration of very high income households into Baldwin Park.

The impact of Baldwin Park on income diversity in Audubon Park can be understood based on the results of the regression models. As noted earlier, the parameters of the spatial autoregressive term (ρW) are a positive value, implying that neighborhood income diversity can increase when income diversity of the nearby neighborhoods is high. In contrast, if income diversity of the surrounding neighborhoods is low, income diversity of the neighborhood can be reduced. Accordingly, the decrease in the entropy index in Audubon Park during the 2000s may be affected by the lower value of the entropy index in Baldwin Park.

Engelwood Park

Engelwood Park is one of the declining middle income neighborhoods in the Orlando metropolitan area. Engelwood Park was incrementally developed during the 1950s and 1960s. The median household income increased during the 1990s, but slightly reduced during the 2000s. The increasing poverty rate also reflects economic decline in Engelwood Park. Further, Engelwood Park is undergoing demographic transition from a majority non-Hispanic White to a majority Hispanic neighborhood. Over a twenty-year period, the Hispanic population increased from 24.5% to 60.1%. Among the five case study neighborhoods, Engelwood Park exhibits the highest housing density – more than four housing units per developable acre. In terms of tenure, the quantity of owner occupied housing units and renter occupied housing units are well balanced. But, the increased supply of multifamily housing during the 2000s may have resulted in an increase in the share of renter occupied housing units. According to B. Hossfield (personal communication, August 30, 2012), since the 1990s many Hispanic households moved into Engelwood Park to become homeowners. For many reasons, such as bad credit, subprime mortgages, and loss of jobs, many of them experienced foreclosure during the housing market crash. Indeed, according to the foreclosure information from HUD's Neighborhood Stabilization Program, 510 of 2,134 mortgages were foreclosed during this time in Engelwood Park. Because of the high foreclosure rate (23.9%), Engelwood Park became one of the target areas of the federal Neighborhood Stabilization Program.[13]

During the 1990s, 165 single family infill housing units, including 61 units from a new subdivision, were developed, and 631 multifamily infill units were built during the 2000s. As shown in Table 4-32, the mean of appraised value of single family infill houses was only about $70,000 — 41% of area median sale price of a single family home in 2010 — implying that the potential residents of infill housing units were

[13] The Neighborhood Stabilization Program administrated by the HUD since 2008 provides a grant to purchase or redevelop foreclosed or abandoned housing units in the communities where foreclosures are concentrated in order to stabilize the neighborhood.

relatively moderate or lower income households. Three major multifamily housing developments occurred during the 2000s. An LIHTC project, “Camellia Pointe”, containing 169 units, was completed in 2004.[14] Two renovated multifamily housing projects, “Royal Isles” and “Pendelton Parks Villas”, provided another 450 units. As of 2012, the monthly rent of these two complexes ranged from $700 to $1,200 for a two-bedroom unit. This rent level is similar to the FY 2013 fair market rent ($983) of Orange County.

The incremental infill development through the new construction or renovation of single family homes did not affect mix of incomes based on the Entropy Index as summarized in Table 4-33. However, the higher foreclosure rate and the introduction of multifamily housing, including the LIHTC project, may have increased the share of very low or low income households during the 2000s. Subsequently, the income diversity of Engelwood Park decreased. The profiles of income groups show a continuous increase of lower income households and decrease of higher income households.

Spring Lake

Spring Lake is one of the highest income neighborhoods in the Orlando metropolitan area. Many higher income neighborhoods are located in suburban areas, such as Winter Park and Wekiva Springs, as shown in Figure 3-7, but Spring Lake is located in the Traditional City near downtown. The oldest housing units in Spring Lake were built in the 1920s, and the neighborhood was incorporated into the City of Orlando incrementally beginning in the 1960s. The housing of Spring Lake is an example of

[14] For purposes of calculating a consistent unit size across all multifamily projects analyzed in this study, the assumption of one unit per 1,000 square feet is used. Thus, the number of housing units of the property is 181 units. This value was used in calculating the number of infill housing units in Tables 4-31 and 4-32.

older housing units having significant value. The old golf club, “Country Club of Orlando”, at the northside of the Spring Lake community was opened in 1911.

The median household income in Spring Lake was two times higher than the AMI of the Orlando MSA in 1990 and three times higher than the AMI in 2005-09, indicating that the concentration of affluent households intensified during this period. Most of the housing units were occupied by home owners, and properties are sizable as shown in Tables 4-34 and 4-36.

A total of 165 infill housing units were developed since 1990. In the 2000s, two new single family enclaves were developed on the north and east sides of the Golf Club. Both residences are gated communities as shown in Figure 4-28. The rapid concentration of very high income households may result from new construction of these gated communities. The mean of the appraised value of the newly built units in the 2000s was more than $500,000, implying that residents earn very high incomes.

Unlike the two new gated communities, old residential areas of Spring Lake are not gated as shown in Figure 4-29. The mean of the appraised value of existing housing units is about $330,000 and this value is similar to that of infill housing ($364,194). The higher property values of existing housing units imply that the deterioration of housing over time is less likely to occur in higher income communities.

Summary

The results of the case study of these five neighborhoods present several important findings and provide a better understanding of the estimated results of infill housing variables from the regression models. First, the characteristics of infill housing reflect neighborhood conditions. For instance, relatively inexpensive and small infill housing units were developed in Holden-Parramore and Engelwood Park, which are lower income and declining neighborhoods, respectively as summarized in Table 4-38. Very expensive and larger homes were developed in Spring Lake. As noted earlier, rent charged for new multifamily housing units in Audubon Park is affordable to middle income households.

Moreover, housing programs, such as HOPE VI and the LIHTC, played an important role in providing infill housing, specifically for low income households so that the concentration of the poor may be intensified in the economically disadvantaged or declining neighborhoods. Subsequently, the economic conditions in these neighborhoods were not enhanced. According to B. Hossfield (personal communication, August 30, 2012), infill development often reflects the current socio-economic neighborhood conditions in the City of Orlando. As the price and size of infill housing is similar to those of existing housing units, the quantity of infill housing does not promote neighborhood income diversity directly as confirmed from the results of the regression models.

Second, diversity of infill housing types has the potential to promote neighborhood income diversity in the long term, but it does not automatically guarantee that diverse income groups will be attracted to the area. In the Baldwin Park project, where traditional neighborhood design principles were applied, diverse housing types were provided, but the supply of diverse housing types did not attract diverse income groups. As the Baldwin Park project was intended to attract middle and higher income households, the price and rent level of houses in the community were not affordable to relatively lower income households regardless of housing type. Consequently, Baldwin Park, a large scale infill community, became one of the least diverse neighborhoods in terms of income. The share of very high income households in Baldwin Park in 2005-2009 was 63.3% as shown in Table 4-29, and the entropy index of the area in 2005-2009 was similar to that of Spring Lake in 2000. The weak effect of the diversity of infill housing types on neighborhood income diversity in the 2000s regression models can be explained based on the narrow income group targeted with infill development as in the Baldwin Park case.

Third, development patterns of infill housing vary depending on time periods even in the same neighborhood. These inconsistent development patterns of infill housing within a neighborhood may be reflected in the regression results as less significant coefficients. For example, the ratio of multifamily housing among all infill housing was 92.6% during the 1990s in Audubon Park but no multifamily housing was provided during the 2000s. The ratio of new construction in Colonialtown South during the 1990s was 7.7%, but it increased by 91.2% during the 2000s. These variances may be a reflection of the land availability and market conditions of each neighborhood. Consequently, the estimated results of the short-term models are less significant than the three spatial econometric long term models as shown in Table 4-13.

Fourth, incremental new construction or renovation of single family housing tends to maintain or promote neighborhood income diversity, but a large-scale multifamily housing development affects neighborhood income diversity much more drastically in the case study areas. The large-scale infill development within a neighborhood may result in in-migration of households over a short time period having different demographic and economic characteristics compared to existing residents. In particular, large-scale multifamily housing complexes attracted relatively lower income households, so the concentration of the poor may reduce income diversity in declining neighborhoods as shown in Engelwood Park.

The transformation of a public housing complex to multifamily rental housing and single family homes for homeownership displaced very low income households so that the poor became less concentrated, resulting in a change in neighborhood income diversity in Holden-Parramore and Colonialtown South. The difference between Holden-Parramore and Colonialtown South is that higher income households displaced lower income households through the gentrification process in Colonialtown South. Consequently, the neighborhood income diversity in Colonialtown South decreased due to the HOPE VI project, implying the negative effect of gentrification on income mix. This negative effect of infill on neighborhood income diversity through the displacement of low income households and the concentration of higher income households may result in a less significant effect of infill development in gentrifying communities in the regression models for 2000s as shown in Table 4-13.

Finally, the spatial interaction of neighborhoods in neighborhood income diversity is illustrated in the Audubon Park and Baldwin Park cases. As noted earlier, the creation of a new upper- and higher income community near Audubon Park positively related with the increase of very higher income households in that neighborhood. The statistically significant and positive coefficients of the spatial autoregressive term in the regression models reflect this spatial interaction among neighborhoods.

In this chapter, the analyses for patterns of infill housing, development of spatial econometric models, and case studies for five neighborhoods were conducted to provide a better understanding of the relationship between infill development and the subsequent change in neighborhood income diversity. As the characteristics of infill development reflect the conditions of neighborhoods, the quantity of infill housing itself does not affect neighborhood income diversity. However, the mix of housing types, higher ratio of new construction and lower ratio of multifamily housing within infill housing development may increase neighborhood income diversity. The policy implications of these findings are addressed in the conclusion.

Table 4-1. Ratio of new construction and renovation by locations

Locations	1990s			2000s			1990 to 2009		
	New	Renovation	total	New	Renovation	total	New	Renovation	Total
Lower income	6,609 (5.4%)	3,096 (14.3%)	9,705 (6.8%)	3,144 (2.2%)	2,844 (20.3%)	5,988 (3.9%)	9,753 (3.7%)	5,940 (16.7%)	15,693 (5.3%)
Gentrifying	259 (0.2%)	562 (2.6%)	821 (0.6%)	1,770 (1.3%)	734 (5.2%)	2,504 (1.6%)	2,029 (0.8%)	1,296 (3.6%)	3,325 (1.1%)
Middle income	7,523 (6.2%)	1,345 (6.2%)	8,868 (6.2%)	8,492 (6.0%)	1,944 (13.9%)	10,436 (6.7%)	16,015 (6.1%)	3,289 (9.2%)	19,304 (6.5%)
Declining	9,778 (8.0%)	4,999 (23.1%)	14,777 (10.3%)	4,055 (2.9%)	1,337 (9.5%)	5,392 (3.5%)	13,833 (5.3%)	6,336 (17.8%)	20,169 (6.8%)
Higher income	3,972 (3.3%)	1,536 (7.1%)	5,508 (3.8%)	2,699 (1.9%)	539 (3.8%)	3,238 (2.1%)	6,671 (2.5%)	2,075 (5.8%)	8,746 (2.9%)
Sum of Infill Areas	28,141 (23.1%)	11,538 (53.4%)	39,679 (27.7%)	20,160 (14.3%)	7,398 (52.7%)	27,558 (17.8%)	48,301 (18.4%)	18,936 (53.1%)	67,237 (22.5%)
Urbanized Areas (UA)[1]	53,751 (44.2%)	7,816 (36.1%)	61,567 (43.0%)	39,761 (28.2%)	2,270 (16.2%)	42,031 (27.1%)	93,512 (35.6%)	10,086 (28.3%)	103,598 (34.7%)
Fringe Areas[2]	39,725 (32.7%)	2,272 (10.5%)	41,997 (29.3%)	81,203 (57.5%)	4,367 (31.1%)	85,570 (55.1%)	120,928 (46.0%)	6,639 (18.6%)	127,567 (42.8%)
Sum	121,617 (100.0%)	21,626 (100.0%)	143,243 (100.0%)	141,124 (100.0%)	14,035 (100.0%)	155,159 (100.0%)	262,741 (100.0%)	35,661 (100.0%)	298,402 (100.0%)

Note: 1. Urbanized Areas (UA) refer to the census designated urbanized area of 1990 and it excludes the infill areas. 2. Fringe areas refer to the areas outside the census designated urbanized area of 1990.

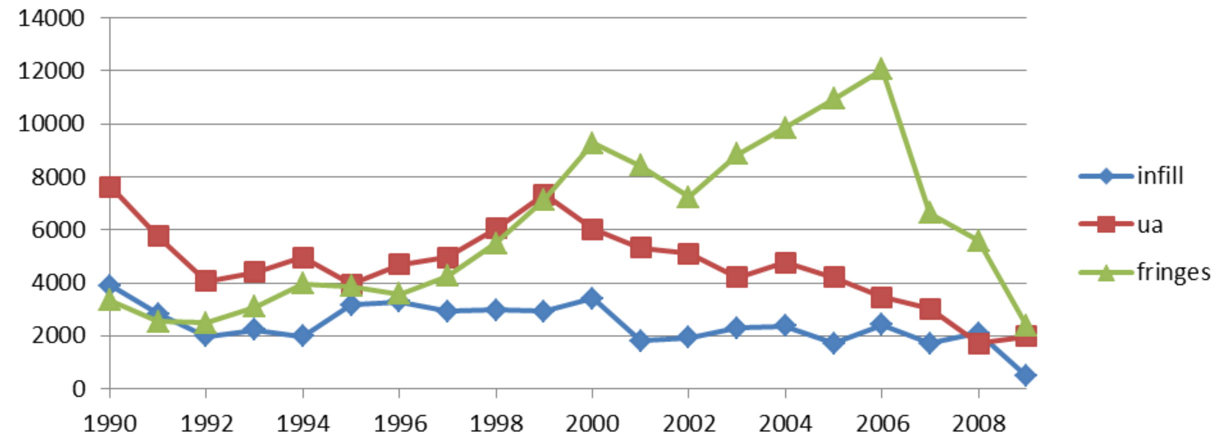


Figure 4-1. Number of newly built housing units by location and year

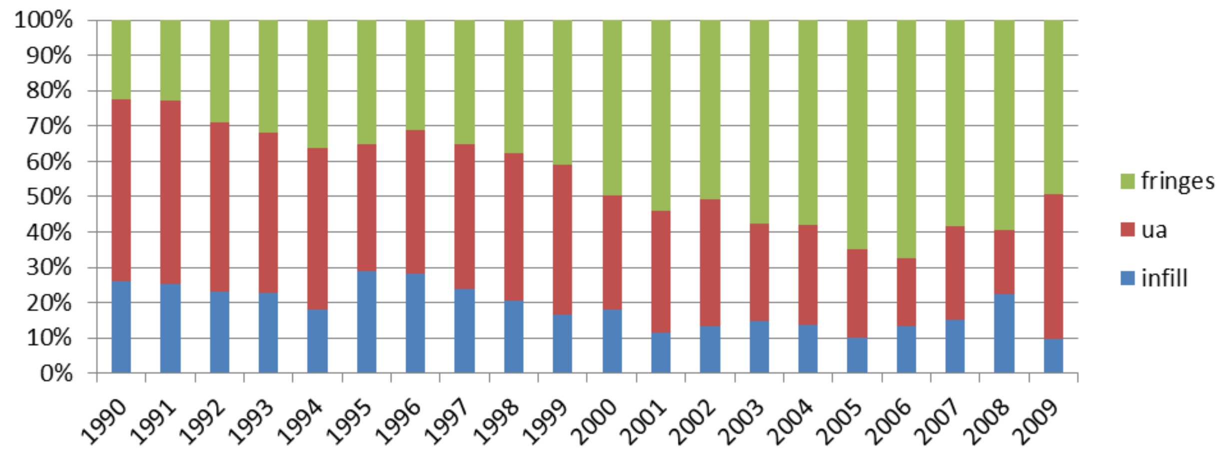


Figure 4-2. The share of number of newly built housing units by location and year

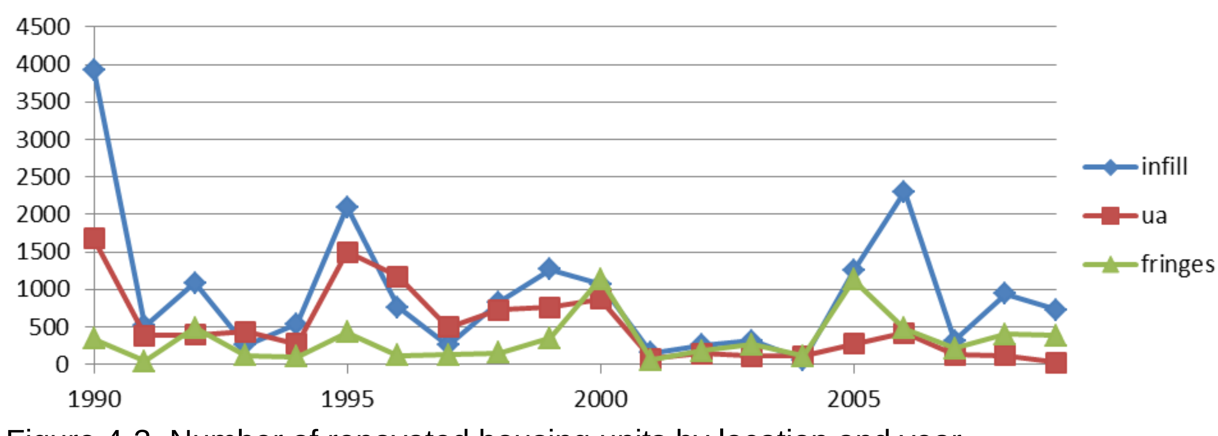


Figure 4-3. Number of renovated housing units by location and year

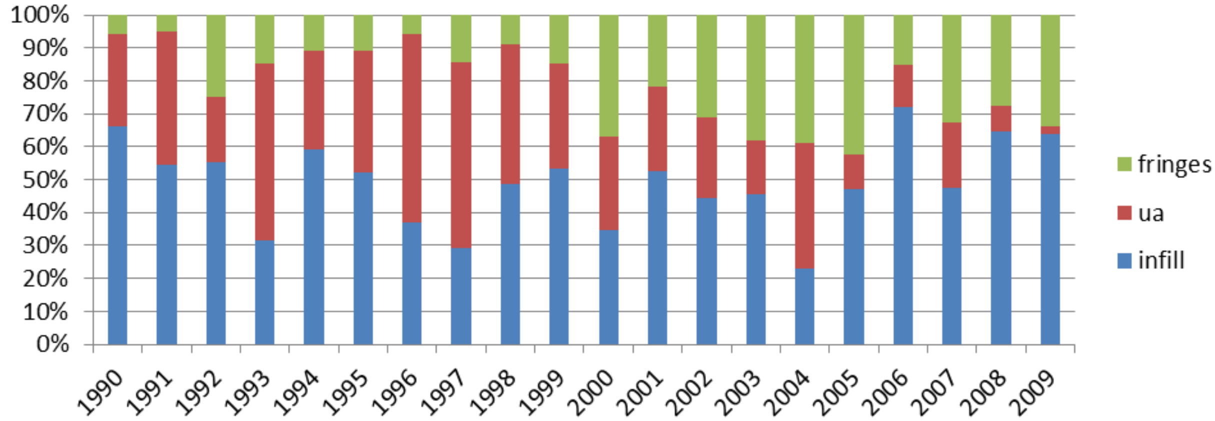


Figure 4-4. The share of number of renovated housing units by location and year

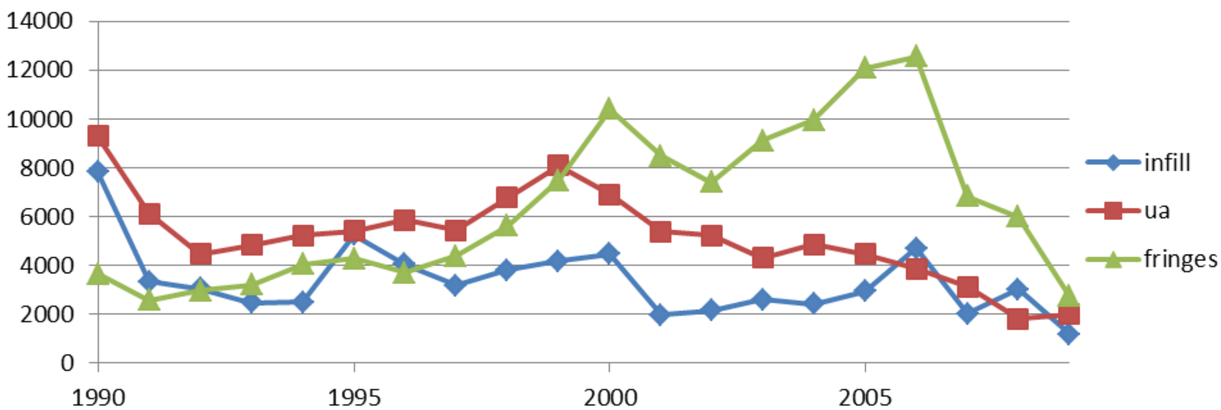


Figure 4-5. Number of newly built or renovated housing units by location and year

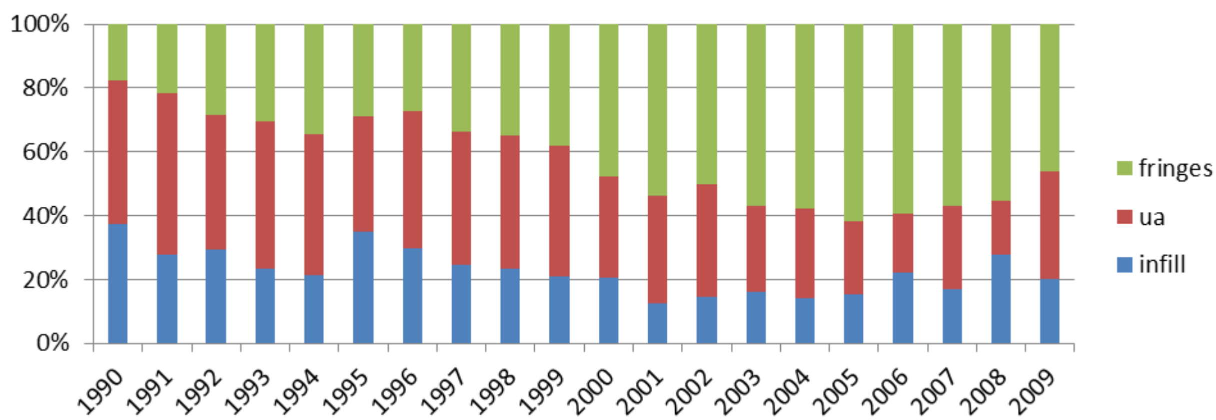


Figure 4-6. The share of number of newly built or renovated housing units by location and year

Table 4-2. Ratio of new construction and renovation by locations (unit: %)

Locations	1990s		2000s		1990 to 2009	
	New	Renovation	New	Renovation	New	Renovation
Lower income	68.1	31.9	52.5	47.5	62.1	37.9
Gentrifying	31.5	68.5	70.7	29.3	61.0	39.0
Middle income	84.8	15.2	81.4	18.6	83.0	17.0
Declining	66.2	33.8	75.2	24.8	68.6	31.4
Higher income	72.1	27.9	83.4	16.6	76.3	23.7
Sum of Infill Areas	70.9	29.1	73.2	26.8	71.8	28.2
Urbanized Areas	87.3	12.7	94.4	5.4	90.3	9.7
Fringe Areas	94.6	5.4	94.9	5.1	94.8	5.2

Note: Urbanized Areas refer to the census designated urbanized area of 1990 and it exclude the infill areas. Fringe areas refer to the areas outside the census designated urbanized area of 1990.

Table 4-3. Housing types by location and neighborhood types during the 1990s (unit:%)

Locations	New Construction				Renovation				Total			
	single	multi	condo	other	single	multi	condo	other	single	multi	condo	Other
Lower income	30.9	66.8	0.9	1.4	19.6	75.2	0.0	5.2	27.3	69.4	0.6	2.6
Gentrifying	82.2	16.6	1.2	0.0	31.0	68.1	0.0	0.9	47.1	51.9	0.4	0.6
Middle income	57.1	41.7	0.7	0.6	92.6	5.9	0.4	1.1	62.4	36.3	0.7	0.6
Declining	62.5	30.2	6.6	0.7	60.5	38.6	0.0	1.0	61.8	33.0	4.3	0.8
Higher income	87.1	0.0	12.7	0.2	90.6	9.4	0.0	0.0	88.1	2.6	9.2	0.1
Sum of Infill Areas	57.3	37.5	4.5	0.8	55.8	42.1	0.0	2.0	56.9	38.8	3.2	1.1
Urbanized Areas	61.7	35.6	2.2	0.5	88.9	8.9	0.7	1.5	65.1	32.2	2.0	0.7
Fringe Areas	77.6	18.9	2.0	1.6	68.5	16.1	0.7	14.6	77.1	18.7	1.9	2.3

Note: Urbanized Areas refer to the census designated urbanized area of 1990 and it exclude the infill areas. Fringe areas refer to the areas outside the census designated urbanized area of 1990.

Table 4-4. Housing types by location and neighborhood types during the 2000s (unit:%)

Locations	New Construction				Renovation				Total			
	single	multi	condo	other	single	multi	condo	other	single	multi	condo	Other
Lower income	52.6	38.9	5.7	2.9	6.3	92.9	0.0	0.8	30.6	64.5	3.0	1.9
Gentrifying	16.9	75.5	7.6	0.0	7.4	92.6	0.0	0.0	14.1	80.5	5.4	0.0
Middle income	54.3	31.4	13.9	0.4	14.8	84.6	0.0	0.6	46.9	41.3	11.3	0.5
Declining	39.3	50.9	9.4	0.3	41.1	58.5	0.0	0.4	39.8	52.8	7.1	0.4
Higher income	87.1	12.0	0.6	0.3	99.1	0.9	0.0	0.0	89.1	10.2	0.5	0.2
Sum of Infill Areas	52.1	37.8	9.4	0.7	21.7	77.8	0.0	0.5	44.0	48.5	6.9	0.7
Urbanized Areas	52.5	40.4	6.6	0.5	64.5	32.9	0.4	2.1	53.2	40.0	6.3	0.6
Fringe Areas	75.8	20.8	2.7	0.7	41.7	51.9	0.0	6.4	74.0	22.4	2.6	1.0

Note: Urbanized Areas refer to the census designated urbanized area of 1990 and it exclude the infill areas. Fringe areas refer to the areas outside the census designated urbanized area of 1990.

Table 4-5. Housing types by location and neighborhood types from 1990 to 2009 (unit:%)

Locations	New Construction				Renovation				Total			
	single	multi	condo	other	single	multi	condo	other	single	multi	condo	Other
Lower income	37.9	57.8	2.5	1.9	13.2	83.7	0.0	3.1	28.5	67.6	1.5	2.4
Gentrifying	25.3	68.0	6.8	0.0	17.6	82.0	0.0	0.4	22.3	73.4	4.1	0.2
Middle income	55.6	36.2	7.7	0.5	46.6	52.4	0.2	0.8	54.1	39.0	6.4	0.5
Declining	55.7	36.3	7.4	0.6	56.4	42.8	0.0	0.9	55.9	38.3	5.1	0.7
Higher income	87.1	4.9	7.8	0.2	92.8	7.2	0.0	0.0	88.5	5.4	6.0	0.2
Sum of Infill Areas	55.1	37.6	6.5	0.7	42.5	56.1	0.0	1.4	51.6	42.8	4.7	0.9
Urbanized Areas	57.8	37.7	4.0	0.5	83.4	14.3	0.6	1.6	60.3	35.4	3.7	0.6
Fringe Areas	76.3	20.2	2.5	1.0	50.9	39.6	0.3	9.2	75.0	21.2	2.3	1.5

Note: Urbanized Areas refer to the census designated urbanized area of 1990 and it exclude the infill areas. Fringe areas refer to the areas outside the census designated urbanized area of 1990

Table 4-6. Mean values of size and price for single family housing by location

Neighborhood locations	New construction 1990s			Renovation 1990s			New construction 2000s			Renovation 2000s		
	Lot Size (acres)	Floor area (ft^2)	JV ($)	Lot Size (acres)	Floor area (ft^2)	JV ($)	Lot Size (acres)	Floor area (ft^2)	JV ($)	Lot Size (acres)	Floor area (ft^2)	JV ($)
Lower income	0.190	1552	106866	0.225	1463	98894	0.203	1667	105766	0.257	1660	131132
Gentrifying	0.189	1955	208475	0.242	2042	229846	0.164	2172	238901	0.224	2479	294933
Middle income	0.220	2061	176656	0.287	1918	182435	0.193	2585	281246	0.367	2472	307550
Declining	0.189	1801	123165	0.234	1711	111142	0.245	2257	203176	0.254	1729	141466
Higher income	0.352	2587	272565	0.385	2414	281348	0.366	3163	468711	0.372	2706	418870
Sum of Infill Areas	0.232	2009	168517	0.276	1888	163307	0.240	2508	282514	0.313	2198	266553
Urbanized Areas	0.251	2187	186472	0.301	1974	170828	0.240	2425	212436	0.339	2171	251851
Fringe Areas	0.468	2480	205923	0.936	2425	236134	0.329	2712	223850	0.733	2381	208108

Note: JV refers the appraised property value in 2010 based on the property tax roll. Urbanized Areas refer to the census designated urbanized area of 1990 and it exclude the infill areas. Fringe areas refer to the areas outside the census designated urbanized area of 1990.

Table 4-7. Share of subsidized rental housing units among multifamily infill units

Neighborhood types	Average of median household incomes of 1990	Multifamily housing units	Subsidized units	Ratio of subsidized units
Lower income	$ 20,294 (65% AMI)	10,605	5,961	56.2%
Gentrifying	$16,365 (52% AMI)	2,442	308	12.6%
Middle income	$ 30,720 (98% AMI)	7,526	921	12.2%
Declining	$ 34,910 (112% AMI)	7,728	3,248	42.0%
Higher income	$ 52,360 (168% AMI)	473	0	0%
Sum of Infill Areas	$ 31,694 (101% AMI)	28,774	10,438	36.3%

Source: Assisted Housing Inventory from the Shimberg Center for Housing Studies at the University of Florida

Table 4-8. Attributes of infill housing by neighborhood types during the 1990s

Neighborhood types	QIF			NEWR			DIF			MULTIR		
	Mean	Std. Dev	Max.	Mean	Std. Dev	Max.	Mean	Std. Dev	Max.	Mean	Std. Dev	Max.
Lower income	0.342	0.534	2.968	0.552	0.384	1.000	0.196	0.206	0.777	0.336	0.384	1.000
Gentrifying	0.271	0.409	1.952	0.333	0.392	1.000	0.240	0.215	0.546	0.284	0.343	1.000
Middle income	0.255	0.355	2.266	0.617	0.341	1.000	0.115	0.166	0.582	0.085	0.209	1.000
Declining	0.333	0.464	1.923	0.510	0.357	1.000	0.158	0.222	0.761	0.150	0.279	1.000
Higher income	0.218	0.223	1.224	0.596	0.344	1.000	0.040	0.111	0.493	0.022	0.125	0.896
Sum of Infill Areas	0.291	0.422	2.968	0.550	0.366	1.000	0.142	0.196	0.777	0.169	0.303	1.000

Note: As most minimum values are zero, the minimum values are not reported.

Table 4-9. Attributes of infill housing by neighborhood types during the 2000s

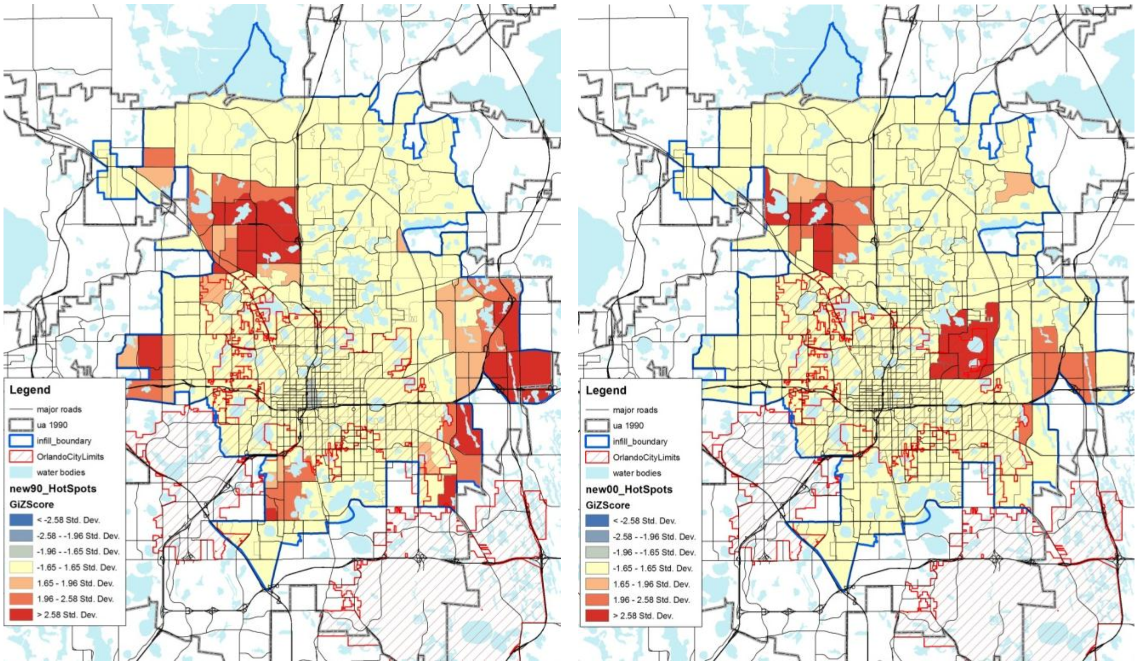
Neighborhood types	QIF			NEWR			DIF			MULTIR		
	Mean	Std. Dev	Max.	Mean	Std. Dev	Max.	Mean	Std. Dev	Max.	Mean	Std. Dev	Max.
Lower income	0.278	0.810	6.816	0.671	0.378	1.000	0.145	0.213	0.779	0.184	0.347	1.000
Gentrifying	0.864	1.797	7.790	0.713	0.331	1.000	0.291	0.269	0.780	0.305	0.368	0.996
Middle income	0.274	0.452	3.214	0.769	0.288	1.000	0.155	0.209	0.736	0.122	0.271	0.962
Declining	0.127	0.197	0.929	0.623	0.362	1.000	0.109	0.196	0.785	0.136	0.295	1.000
Higher income	0.160	0.163	0.654	0.782	0.266	1.000	0.041	0.138	0.731	0.012	0.069	0.484
Sum of Infill Areas	0.265	0.706	7.790	0.707	0.335	1.000	0.132	0.209	0.785	0.136	0.293	1.000

Note: As most minimum values are zero, the minimum values are not reported.

Table 4-10. Attributes of infill housing by neighborhood types from 1990 to 2009

Neighborhood types	QIF			NEWR			DIF			MULTIR		
	Mean	Std. Dev	Max.	Mean	Std. Dev	Max.	Mean	Std. Dev	Max.	Mean	Std. Dev	Max.
Lower income	0.619	1.194	9.783	0.618	0.341	1.000	0.234	0.210	0.680	0.344	0.383	1.000
Gentrifying	1.135	1.763	7.790	0.566	0.360	1.000	0.381	0.257	0.811	0.392	0.323	0.996
Middle income	0.529	0.620	3.216	0.670	0.302	1.000	0.202	0.223	0.788	0.148	0.262	0.991
Declining	0.460	0.540	2.317	0.556	0.332	1.000	0.198	0.235	0.864	0.198	0.310	0.959
Higher income	0.378	0.321	1.480	0.684	0.291	1.000	0.051	0.135	0.575	0.024	0.118	0.804
Sum of Infill Areas	0.555	0.897	9.783	0.624	0.324	1.000	0.197	0.227	0.864	0.207	0.318	1.000

Note: As most minimum values are zero, the minimum values are not reported.



A B

Figure 4-7. Spatial clustering of new construction within infill areas of the Orlando MSA. A) new construction during the 1990s. B) new construction during the 2000s.

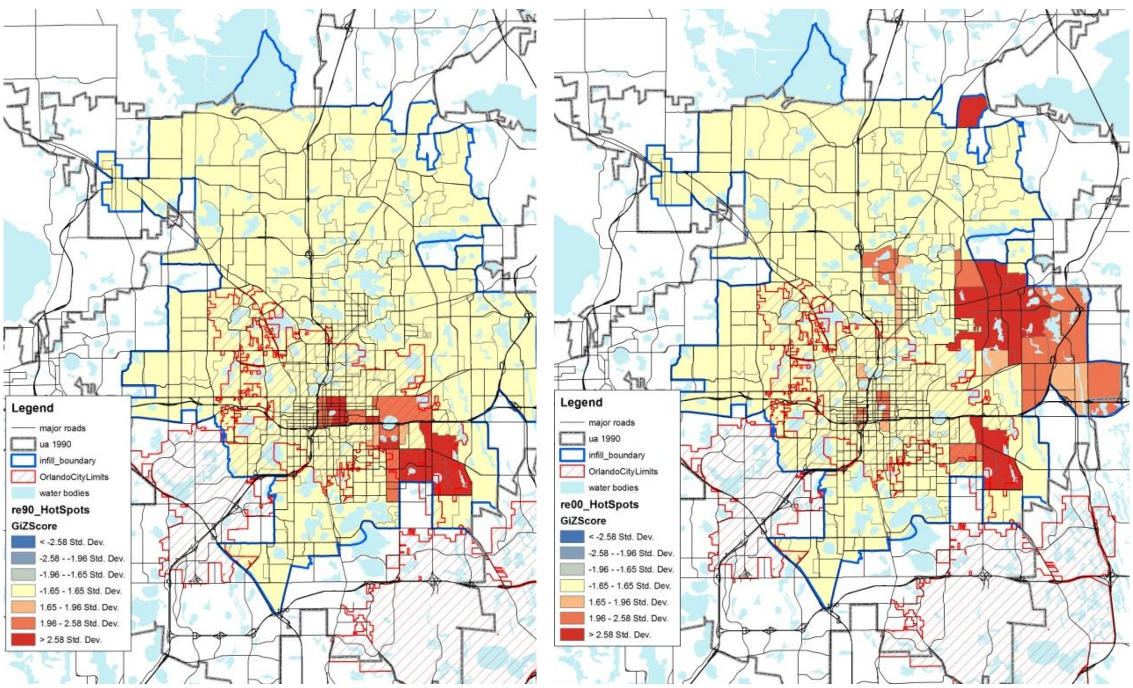


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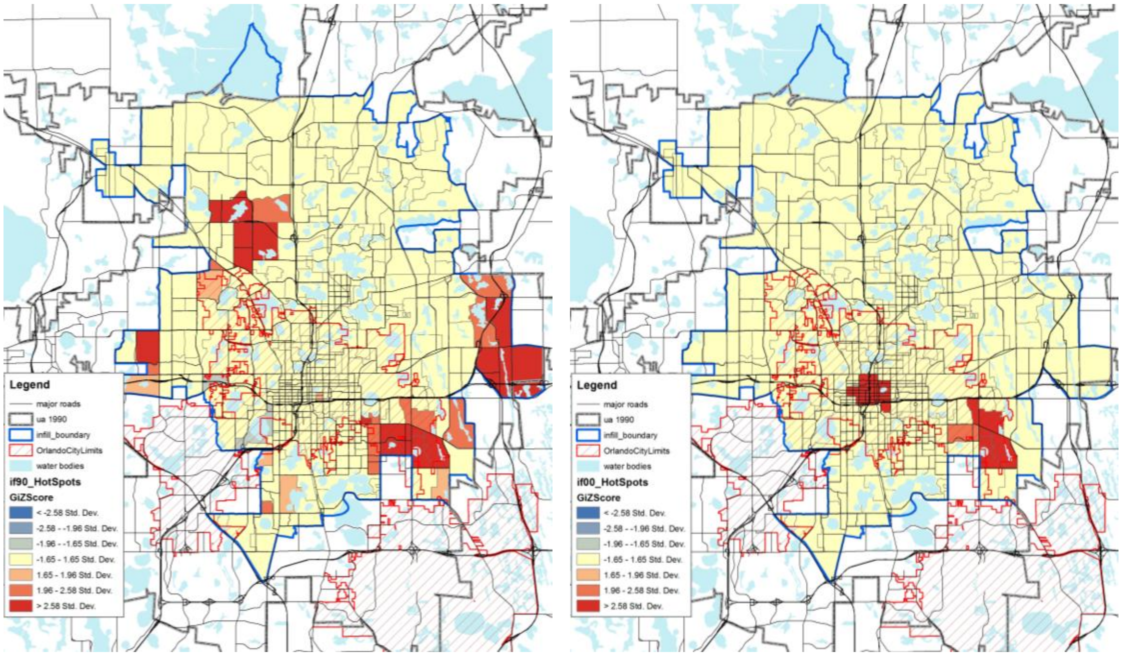
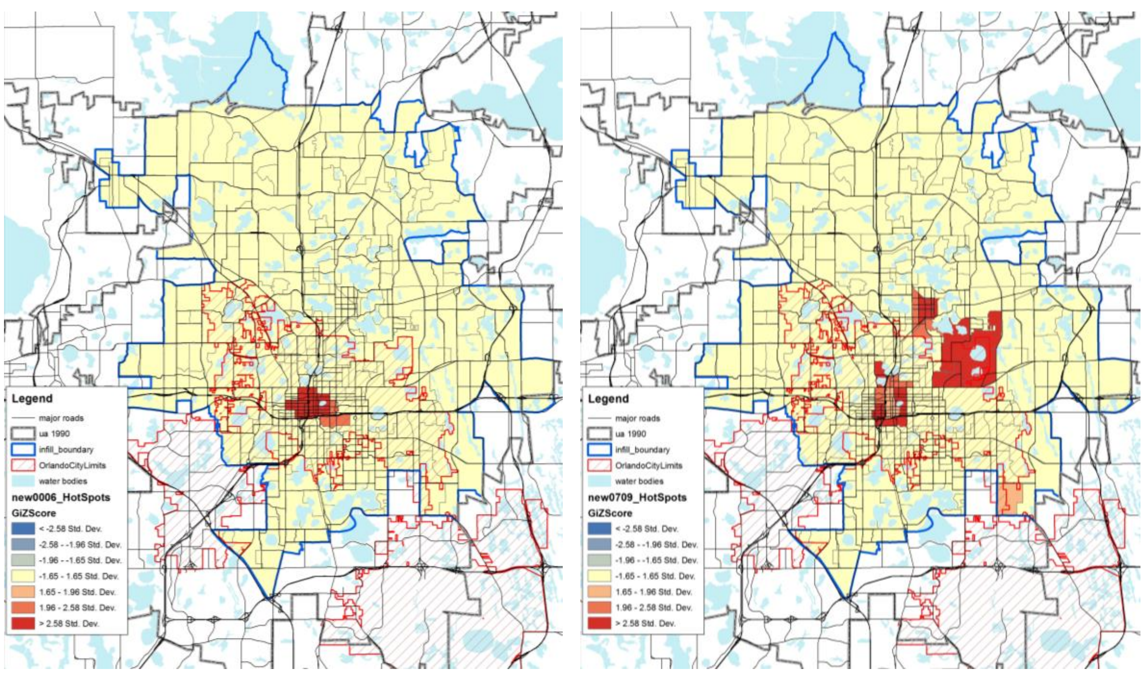
Figure 4-8. Spatial clustering of renovation within infill areas of the Orlando MSA. A) renovation during the 1990s. B) renovation during the 2000s.



A B

Figure 4-9. Spatial clustering of quantity of infill housing within infill areas of the Orlando MSA. A) quantity of infill housing during the 1990s. B) quantity of infill housing during the 2000s.



A B

Figure 4-10. Spatial clustering of new construction within infill areas of the Orlando MSA by housing market condition. A) new construction from 2000 to 2006. B) new construction from 2007 to 2009.

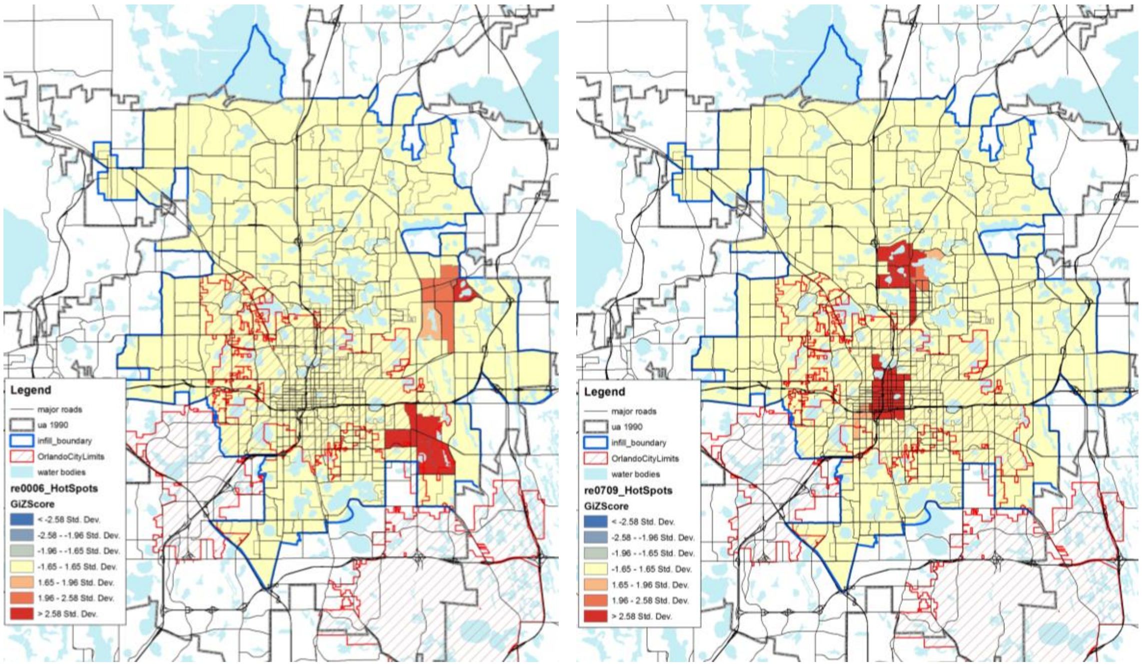


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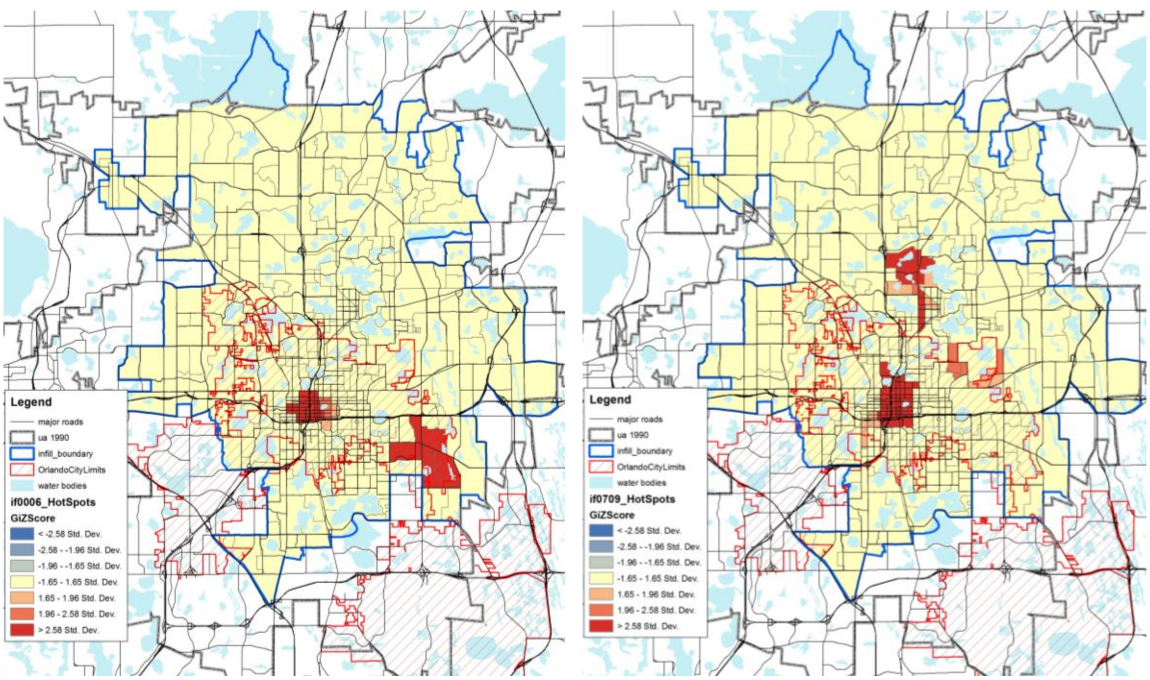
Figure 4-11. Spatial clustering of renovation within infill areas of the Orlando MSA by housing market condition. A) renovation from 2000 to 2006. B) renovation from 2007 to 2009.



A B

Figure 4-12. Spatial clustering of quantity of infill housing of the Orlando MSA by housing market condition. A) quantity of infill housing from 2000 to 2006. B) quantity of infill housing from 2007 to 2009.

Table 4-11. Descriptive Statistic

variables	mean	St.Dev	Min	max
Income Diversity: Entropy Index (EI) 1990	0.868	0.126	0.369	0.997
Income Diversity: Entropy Index (EI) 2000	0.863	0.127	0.250	0.987
Income Diversity: Entropy Index (EI) 2005-2009	0.823	0.149	0.130	0.990
Quantity of infill housing (QIF) 1990s (units/acre)	0.291	0.422	0	2.968
Quantity of infill housing (QIF) 2000s (units/acre)	0.265	0.706	0	7.790
Quantity of infill housing (QIF) 1990-2009 (units/acre)	0.555	0.897	0	9.783
Higher income neighborhoods * QIF 1990s	0.038	0.124	0	1.224
Higher income neighborhoods * QIF 2000s	0.028	0.090	0	0.654
Higher income neighborhoods * QIF 1990-2009	0.065	0.195	0	1.480
Lower income neighborhoods * QIF 1990s	0.088	0.308	0	2.968
Lower income neighborhoods * QIF 2000s	0.071	0.427	0	6.816
Lower income neighborhoods * QIF 1990-2009	0.159	0.661	0	9.783
Gentrifying neighborhoods * QIF 1990s	0.020	0.131	0	1.952
Gentrifying neighborhoods * QIF 2000s	0.065	0.533	0	7.790
Gentrifying neighborhoods * QIF 1990-2009	0.085	0.560	0	7.790
Declining neighborhoods * QIF 1990s	0.079	0.266	0	1.923
Declining neighborhoods * QIF 2000s	0.030	0.110	0	0.929
Declining neighborhoods * QIF 1990-2009	0.109	0.327	0	2.317
Raito of new construction (NEWR) 1990s	0.550	0.366	0	1.000
Ratio of new construction (NEWR) 2000s	0.707	0.335	0	1.000
Ratio of new construction (NEWR) 1990-2009	0.624	0.324	0	1.000
Diversity of infill housing types (DIF)1990s	0.142	0.196	0	0.777
Diversity of infill housing types (DIF) 2000s	0.132	0.209	0	0.785
Diversity of infill housing types (DIF) 1990-2009	0.197	0.227	0	0.864
Share of multifamily housing (MULTIR)1990s	0.169	0.303	0	1.000
Share of multifamily housing (MULTIR)2000s	0.136	0.293	0	1.000
Share of multifamily housing (MULTIR)1990-2009	0.207	0.318	0	1.000
Housing density (HDEN)1990 (units / acre)	2.638	1.443	0.024	9.308
Housing density (HDEN) 2000 (units / acre)	2.764	1.530	0.020	10.339
Job density (JDEN)1990 (workers / acre)	4.000	6.556	0.041	65.819
Job density (JDEN)2000 (workers / acre)	4.224	8.006	0.040	87.025
Median household income (INC)1990 ($1,000)	31.694	12.679	6.710	75.936
Median household income (INC) 2000 ($1,000)	43.335	19.815	9.574	174.169
Change in median household income (CHINC)1990s	1.390	0.337	0.607	2.897
Change in median household income (CHINC) 2000s	1.236	0.407	0.296	5.573
Change in median household income (CHINC) 1990-2009	1.703	0.627	0.253	5.141
Poverty rate (POVR) 1990	0.119	0.120	0	0.600
Poverty rate (POVR) 2000	0.129	0.120	0	0.634
Share of old housing (OLDR)1990 (40 years or more)	0.120	0.164	0	0.721
Share of old housing (OLDR) 2000 (40 years or more)	0.304	0.256	0	0.966

Table 4-12. The estimation for the effects of infill housing on neighborhood income diversity without consideration of neighborhood types

	1990s				2000s				All			
	OLS	SAR	SEM	SCM	OLS	SAR	SEM	SCM	OLS	SAR	SEM	SCM
Intercept	0.4009***	0.1225	0.4019***	0.1609	-0.0035	-0.1185	-0.0065	-0.0953	0.2451**	0.1124	0.2392	0.1293
EI	0.5929***	0.5132***	0.5933***	0.4924***	0.8418***	0.7938***	0.8424***	0.7802***	0.6476***	0.6128***	0.6502***	0.5949***
QIF	-0.0029	-0.0078	-0.0029	-0.0085	0.0127	0.0133	0.0125	0.0139	0.0153*	0.0145	0.0153	0.0141
NEWR	0.0042	0.0033	0.0046	0.0105	0.0745***	0.0754***	0.0748***	0.0732***	0.0402*	0.0362	0.0385*	0.0405*
DIF	0.0743***	0.0701***	0.0743***	0.0626***	-0.0085	-0.0114	-0.0082	-0.0135	0.0687**	0.0633**	0.0670**	0.0669**
MULTIR	-0.0230	-0.0209	-0.0229	-0.0148	0.0041	0.0086	0.0042	0.0083	-0.0518*	-0.0478	-0.0511*	-0.0488
HDEN	0.0015	0.0034	0.0015	0.0026	0.0059	0.0057	0.0059	0.0057	0.0086*	0.0087	0.0086	0.0085*
JDEN	-0.0012	-0.0004	-0.0012	-0.0004	0.0005	0.0005	0.0005	0.0006	0.0001	0.0003	0.0001	0.0005
INC	-0.0027***	-0.0018	-0.0027**	-0.0021**	-0.0001	0.0001	0.0000	-0.0001	-0.0018*	-0.0014	-0.0017	-0.0016
CHINC	0.0538***	0.0516**	0.0536**	0.0465**	0.0387**	0.0409**	0.0392**	0.0374**	0.0364***	0.0386*	0.0374*	0.0351
POVR	-0.2851***	-0.1687	-0.2886**	-0.2196**	0.0052	0.0361	0.0096	0.0116	-0.1970*	-0.1419	-0.1870	-0.1662
OLDR	-0.1324***	-0.1017**	-0.1319***	-0.0901***	-0.0640***	-0.0473*	-0.0637**	-0.0481*	-0.2279***	-0.2112***	-0.2301***	-0.2019***
Rho		0.3436***		0.3452***		0.1676*		0.1715*		0.1704		0.1815
Lambda			-0.0205	-0.3963**			0.0257	-0.1606			0.0525	-0.1859
R2	0.6335	0.6598	0.6467	0.6586	0.5683	0.5840	0.5838	0.5835	0.4990	0.5186	0.5170	0.5179
Moran's I Z-score (p-value)	0.581 (0.561)	-2.931 (0.003)	0.776 (0.438)	0.222 (0.824)	0.272 (0.785)	-1.222 (0.222)	0.043 (0.965)	0.068 (0.946)	0.652 (0.514)	-1.062 (0.288)	0.125 (0.900)	0.529 (0.596)

Note: *,**,*** refers statistical significance at 10%, 5%, 1%, respectively.

Table 4-13. The estimation for the effects of infill housing on neighborhood income diversity with consideration of neighborhood types

	1990s				2000s				All			
1990s	OLS	SAR	SEM	SCM	OLS	SAR	SEM	SCM	OLS	SAR	SEM	SCM
Intercept	0.4258***	0.1250	0.4305***	0.1651	0.0078	-0.1138	0.0075	-0.0889	0.2494**	0.1300	0.2466	0.1416
EI	0.5830***	0.4992***	0.5839***	0.4714***	0.8246***	0.7753***	0.8246***	0.7603***	0.6674***	0.6354***	0.6690***	0.6187***
QIF	-0.0138	-0.0067	-0.0155	-0.0176	0.0152	0.0160	0.0151	0.0161	0.0028	0.0045	0.0031	0.0030
Hi-QIF	-0.0175	-0.0200	-0.0164	-0.0098	-0.0872	-0.0699	-0.0872	-0.0683	-0.0275	-0.0228	-0.0268	-0.0258
Low-QIF	-0.0066	-0.0189	-0.0054	-0.0119	-0.0206	-0.0235	-0.0206	-0.0244	-0.0079	-0.0108	-0.0083	-0.0092
Gen-QIF	0.0998**	0.0699***	0.1040***	0.0858***	0.0111	0.0124	0.0111	0.0138	0.0558***	0.0527***	0.0556***	0.0528***
Dec-QIF	0.0184	0.0021	0.0212	0.0185	0.0368	0.0374	0.0367	0.0407	0.0180	0.0139	0.0173	0.0171
NEWR	0.0064	0.0041	0.0080	0.0126	0.0688***	0.0689***	0.0688***	0.0659***	0.0350*	0.0309	0.0340	0.0354*
DIF	0.0628**	0.0614**	0.0621**	0.0487**	-0.0070	-0.0102	-0.0070	-0.0123	0.0719**	0.0667**	0.0711**	0.0694**
MULTIR	-0.0157	-0.0146	-0.0150	-0.0050	-0.0013	0.0034	-0.0013	0.0038	-0.0493*	-0.0457	-0.0491*	-0.0454**
HDEN	0.0011	0.0035	0.0008	0.0021	0.0074*	0.0074**	0.0074**	0.0073**	0.0086*	0.0088*	0.0087	0.0083*
JDEN	-0.0018**	-0.0008	-0.0018	-0.0010	0.0001	0.0000	0.0001	0.0001	-0.0011	-0.0009	-0.0011	-0.0009
INC	-0.0027***	-0.0017	-0.0028**	-0.0021**	0.0001	0.0002	0.0001	0.0001	-0.0014	-0.0011	-0.0014	-0.0012
CHINC	0.0448***	0.0427	0.0439	0.0363	0.0390**	0.0407**	0.0390**	0.0368**	0.0219*	0.0234	0.0223	0.0217
POVR	-0.2840***	-0.1565	-0.2963**	-0.2070*	0.0099	0.0433	0.0104	0.0168	-0.2033*	-0.1532	-0.1986	-0.1710
OLDR	-0.1325***	-0.1017**	-0.1302***	-0.0839**	-0.0665***	-0.0490*	-0.0664**	-0.0492**	-0.2005***	-0.1862***	-0.2021***	-0.1768***

Table 4-13. Continued

	1990s				2000s				All			
1990s	OLS	SAR	SEM	SCM	OLS	SAR	SEM	SCM	OLS	SAR	SEM	SCM
Rho		0.3665 ***		0.3780 ***		0.1777*		0.1832**		0.1564		0.1669
Lambda			-0.0740	-0.4590 ***			0.0030	-0.1896			0.0290	-0.1611
R2	0.6389	0.6652	0.6565	0.6627	0.5701	0.5914	0.5912	0.5909	0.5234	0.5471	0.5467	0.5464
Moran's I Z-score (p-value)	0.003 (0.997)	-3.382 (0.001)	0.623 (0.533)	-0.280 (0.779)	0.103 (0.918)	-1.487 (0.137)	0.076 (0.939)	0.012 (0.990)	0.429 (0.668)	-1.054 (0.292)	0.158 (0.874)	0.229 (0.819)

Note: *,**,*** refers statistical significance at 10%, 5%, 1%, respectively.

Table 4-14. Summary of regression results

Model	Global model			Neighborhood types model			
	1990s	2000s	Total	NH	1990s	2000s	total
Quantity of Infill (QIF)	(-)	(+)	(+)	QIF	(-)	(+)	(+)
				Hi	(-)	(-)	(-)
				Low	(-)	(-)	(-)
				Gen	(+)***	(+)	(+)***
				Dec	(+)	(+)	(+)
Ratio of new construction (NEWR)	(+)	(+)***	(+)*		(+)	(+)***	(+)*
Diversity of housing types (HDIV)	(+)***	(-)	(+)**	All	(+)**	(-)	(+)**
Ratio of multifamily housing (MULTIR)	(-)	(+)	(-)*		(-)	(+)	(-)**

Note: *,**,*** refers statistical significance at 10%, 5%, 1%, respectively. Statistical significance is based on the most significant case among three spatial model specifications.

Table 4-15. Neighborhood characteristics of Holden- Parramore

Neighborhood attributes	1990	2000	2005-09
Population	4,601	4,004	2,324
Number of households	1,879	1,696	1,258
Number of housing units	2,100	1,853	1,517
Percentage African American	92.2%	86.8%	89.5%
Median household income	$11,477	$15,586	$19,147
Poverty rate	51.5%	55.4%	54.5%
Ratio of renter occupied housing	88.1%	87.8%	93.8%
Vacancy rate	10.5%	8.5%	17.1%
Housing density (units/acre)	4.426	3.906	3.198
Job density (workers/acre)	11.441	9.654	2.936

Source: U.S. Census 1990, 2000, ACS 2005-2009. Values are calculated based on information from six census block groups (Federal Information Processing Standard (FIPS) census block group code: 120950104002, 120950104001, 120950105002, 120950105001, 120950106002, 120950106003).

Table 4-16. Residential infill development in Holden and Parramore

Years	1990s	2000s	Total (1990 to 2009)
New construction	52	546	598
Renovation	26	79	105
Total	78	625	703

Source: property tax rolls, FDOR

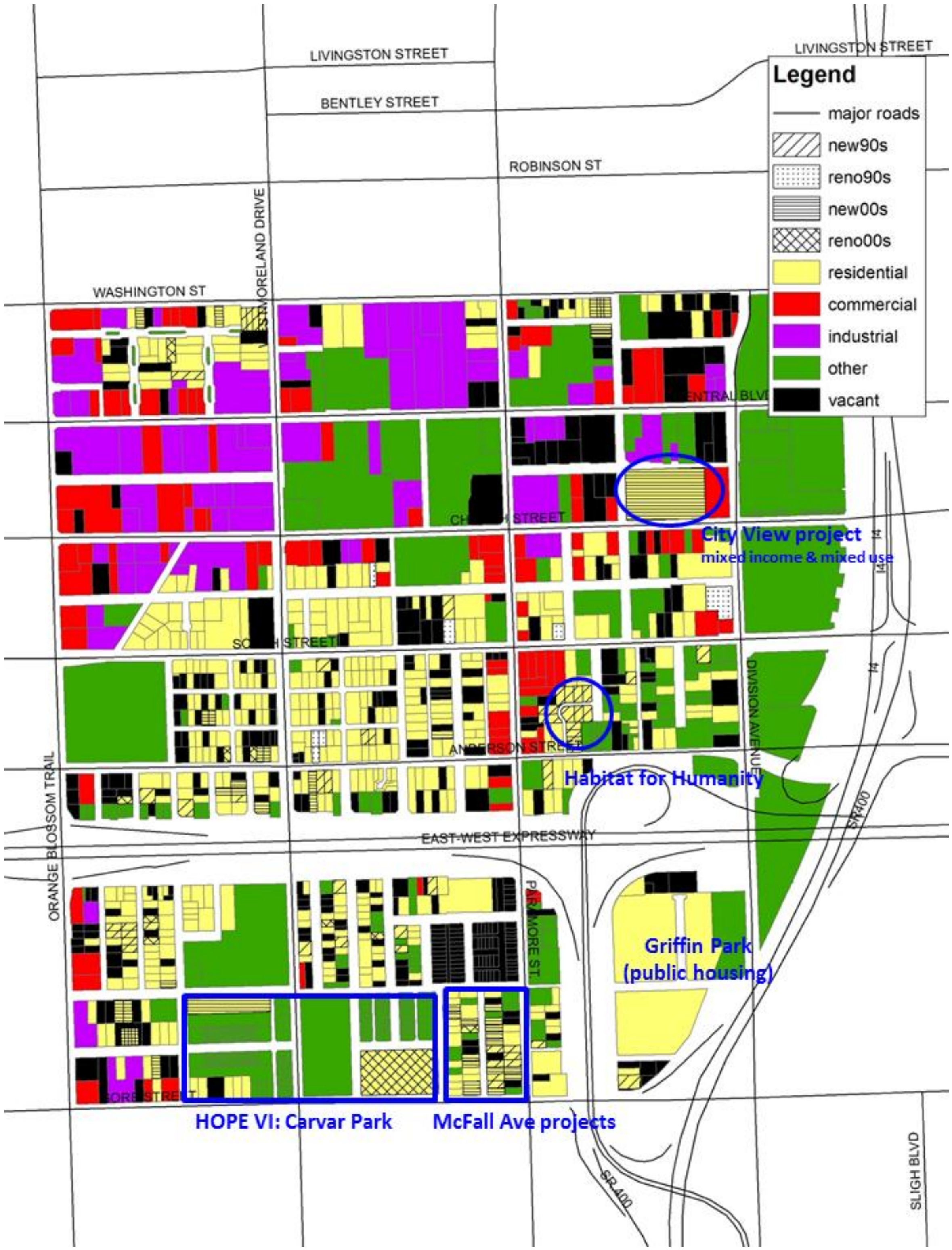


Figure 4-13. Land uses and residential infill development in Holden-Parramore. Note: In the legend, new90s, reno90s, new00s, and reno00s refer to new construction during the 1990s, renovation during the 1990s, new construction during the 2000s, and renovation during the 2000s, respectively.

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Table 4-17. Mix of housing types in Carver Park HOPE VI project

Housing types	homeownership	rental	Total
Single family detached	11	0	11
Elderly multifamily	0	64	64
Townhouse with garages	38	0	38
Townhouse without garages	20	20	40
Duplexes	14	0	14
Fourplexes	0	36	36
total	83	120	203

Note: Among homeownership unit, only one model unit was completed.

Table 4-18. Mix of tenure and income in Carver Park HOPE VI project

Tenure	Total	affordable	Market rate	Public housing	Project based section 8	% of units
Homeownership	83	30	53	0	0	41%
Rental	120	16	10	64	30	59%
total	203	46	63	64	30	100%

Figure 4-14. Public housing building for the elderly in the Carver Park. Source: A picture taken by the author.


Figure 4-15. City View, Source: Orange County Property Appraiser (2012).

Table 4-19. Types, sizes and value of infill housing in Holden-Parramore

Housing characteristics		Existing units	Total	Infill units 1990s New	Infill units 1990s Renovation	Infill units 2000s New	Infill units 2000s Renovation
Housing types (DW)	Single family	279	107	52	2	45	8
	Multifamily	557	596	0	24	501	71
	Condominium	0	0	0	0	0	0
	Other	1	0	0	0	0	0
	Sum	837	703	52	26	546	79
Mean size of single family houses (square feet)		1,165	1,315	1,220	1,318	1,455	1,141
Mean of appraised value of single family houses in 2010 ($)		27,921	63,192	53,152	93,194	73,993	67,692

Note: DW refers to dwelling unit. The number of multifamily housing units is calculated based on the assumption that one dwelling unit per each 1,000 square feet.

Table 4-20. Profiles of income groups in Holden-Parramore

Neighborhood attributes	1990	2000	2005-09
Median family income	$11,477	$15,586	$19,147
Poverty rate	51.5%	55.4%	54.5%
% of very low income households	65.0%	68.5%	62.2%
% of low income households	20.1%	13.6%	18.3%
% of moderate income households	4.8%	9.2%	9.2%
% of high moderate income households	4.8%	2.0%	1.2%
% of high income households	2.2%	2.1%	4.7%
% of very high income households	3.1%	4.5%	4.5%
Entropy index	0.605	0.586	0.648

Table 4-21. Neighborhood characteristics of Colonialtown South

Neighborhood attributes	1990	2000	2005-09
Population	1,695	1,336	1,396
Number of households	870	757	864
Percentage African American	5.3%	3.6%	4.9%
Percentage Hispanic	12.0%	5.6%	7.1%
Median household income	$17,242	$39,665	$63,705
Poverty rate	20.6%	7.7%	6.4%
Ratio of renter occupied housing	59.1%	53.0%	55.7%
Vacancy rate	7.1%	6.4%	7.6%
Housing density (units/acre)	2.859	2.471	2.856
Job density (workers/acre)	18.581	13.089	17.451

Source: U.S. Census 1990, 2000, ACS 2005-2009. Values are calculated based on information from two census block groups (FIPS census block group code: 120950109001, 120950109002).

Table 4-22. Residential infill development in Colonialtown South

Years	1990s	2000s	Total (1990 to 2009)
New construction	5	124	129
Renovation	60	12	72
Total	65	136	201

Source: property tax rolls, FDOR

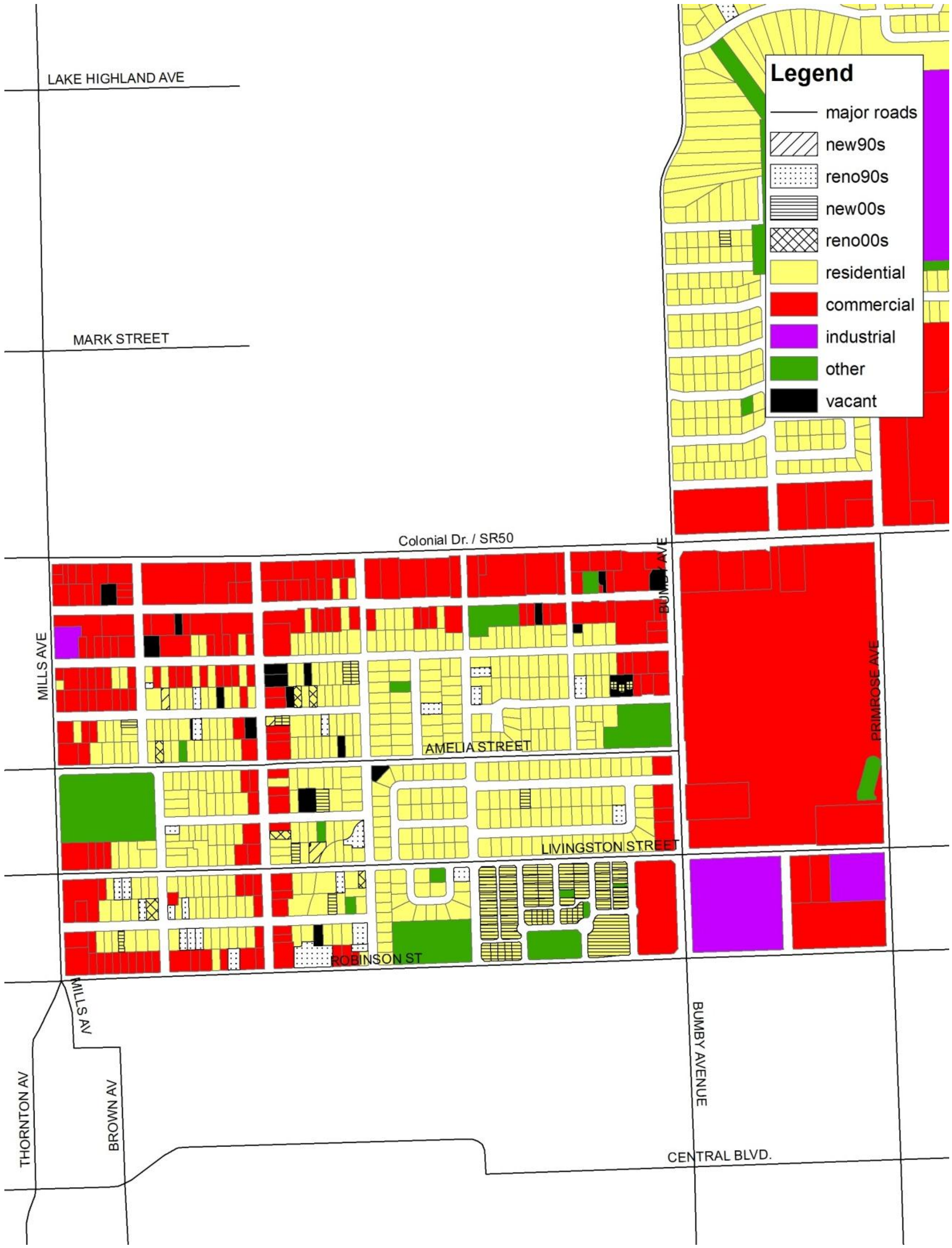

Figure 4-16. Land uses and residential infill development in Colonialtown South

Table 4-23. Types, sizes and value of infill housing in Colonialtown South

Housing characteristics		Existing units	Total	Infill units			
				1990s		2000s	
				New	Renovation	New	Renovation
Housing types (DW)	Single family	428	103	1	27	70	5
	Multifamily	82	89	3	33	46	7
	Condominium	0	9	1	0	8	0
	Other	0	0	0	0	0	0
	Sum	510	201	5	60	124	12
Mean size of single family houses (square feet)		1,452	1,961	1,488	1,887	1,952	2,658
Mean of appraised value of single family houses in 2010 ($)		164,506	230,552	165,052	231,117	225,396	334,038

Note: DW refers to dwelling unit. The number of multifamily housing units is calculated based on the assumption that one dwelling unit per each 1,000 square feet.

Figure 4-17. Single family homes in the Hampton Park. Source: Orange County Property Appraiser (2012).

Figure 4-18. Public housing building for the elderly in the Hampton Park. Source: Orange County Property Appraiser (2012).

Table 4-24. Profiles of income groups in Colonialtown South

Neighborhood attributes	1990	2000	2005-09
Median family income	$17,242	$39,665	$63,705
Poverty rate	20.6%	7.7%	6.4%
% of very low income households	41.7%	25.9%	23.8%
% of low income households	18.6%	16.4%	13.8%
% of moderate income households	12.0%	8.5%	6.5%
% of high moderate income households	7.3%	7.8%	3.7%
% of high income households	7.9%	13.3%	9.7%
% of very high income households	12.5%	28.1%	42.5%
Entropy index	0.884	0.937	0.840

Table 4-25. Neighborhood characteristics of Audubon Park and Baldwin Park

Neighborhood attributes	Audubon Park			Baldwin Park
	1990	2000	2005-09	2005-09
Population	2,734	2,993	3,123	3,716
Number of households	1,252	1,465	1,441	1,653
Percentage African American	0.6%	1.7%	3.3%	2.0%
Percentage Hispanic	4.3%	6.8%	6.0%	11.8%
Median household income	33,419	45,129	62,829	91,756
Poverty rate	4.2%	6.7%	5.5%	4.4%
Ratio of renter occupied housing	25.4%	34.5%	38.4%	43.1%
Vacancy rate	3.6%	3.6%	3.7%	18.0%
Housing density (units/acre)	1.953	2.283	2.250	2.422
Job density (workers/acre)	13.152	12.228	9.884	1.983

Source: U.S. Census 1990, 2000, ACS 2005-2009. Values are calculated based on information from four census block groups for Audubon Park (FIPS census block group code: 120950129001, 120950129002, 120950129003, 120950129004). The FIPS of Baldwin Park is 120950130021.

Table 4-26. Development plan of Baldwin Park

Land Use		Amount	Acreage
The Great Park	Linear Parks	146 acres	217 acres
	Sports Parks	50 acres	
	Neighborhood Parks	21 acres	
Village Center	Retail	350,000 sq.ft.	40 acres
	Professional Office	200,000 sq.ft.	
	Multi-family housing	550 units	
Office	Free-standing office buildings	1,300,000 sq.ft.	50 acres
Housing		3,158 units total	265 acres
	Single family	788 units (216 acres)	
	Multifamily	1,820 units (139 acres)	
Swing Space	Office or multifamily housing		30 acres
Civic facilities	Primary school	17 acres	34 acres
	Relocated middle school	6 acres	
	Community facilities	11 acres	
Existing facilities to return	VA Clinic	44 acres	79 acres
	Water Supply Treatment Plant	14 acres	
	Others	21 acres	
Infrastructures	Streets		125 acres
Total land area			840 acres
Lakes			253 acres
Total Site area			1,093 acres

Source: Orlando NTC Partners, LLP (1998)

Figure 4-19. Conceptual Plan of Baldwin Park. Source: Orlando NTC Partners, LLP (1998).

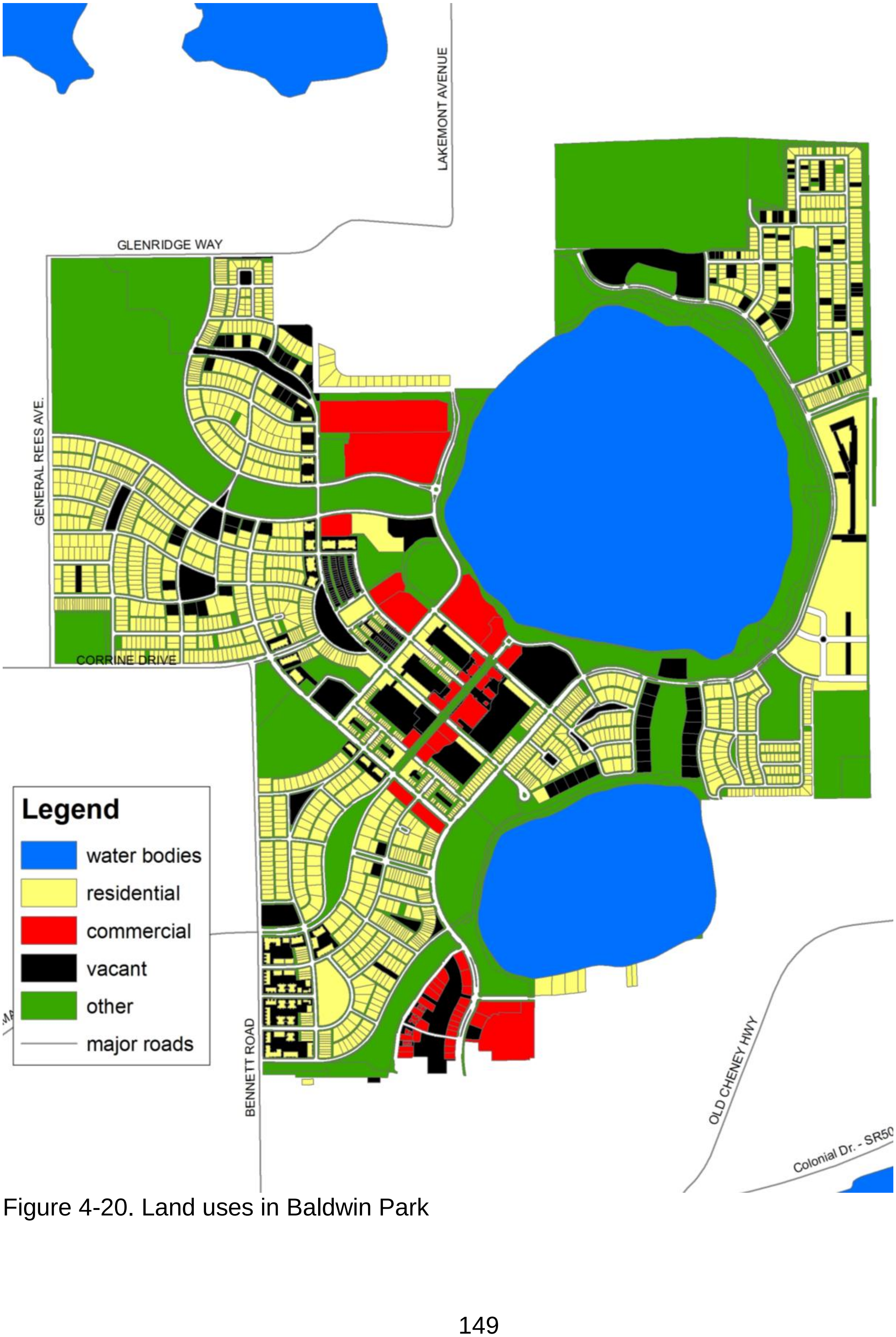

Figure 4-20. Land uses in Baldwin Park

Figure 4-21. New multifamily housing at the Colonial Town Center in Audubon Park. Source: Orange County Property Appraiser (2012).

Table 4-27. Residential infill development in Audubon Park

Years	1990s	2000s	Total (1990 to 2009)
New construction	227	2	229
Renovation	16	5	21
Total	243	7	250

Source: property tax rolls, FDOR

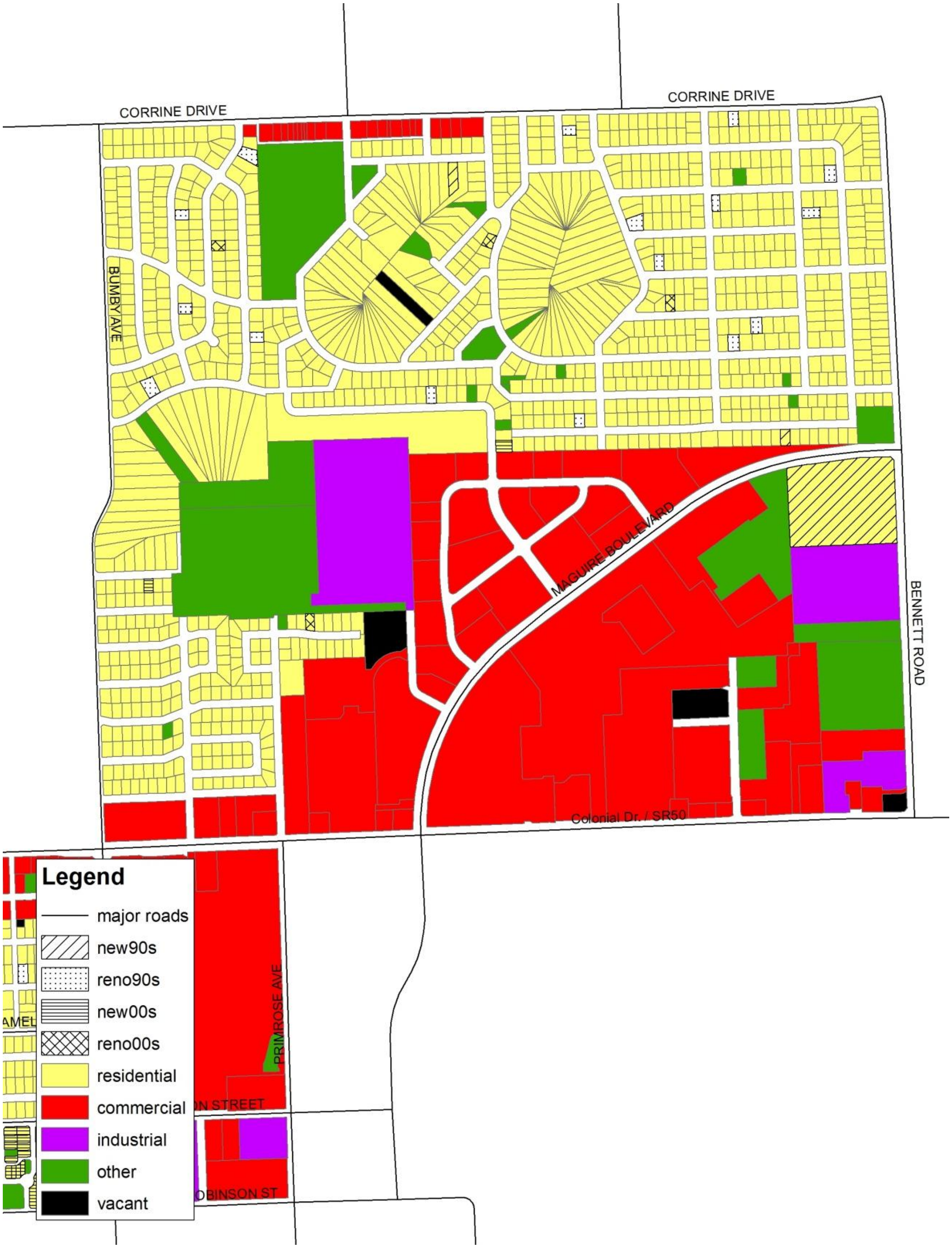

Figure 4-22. Land uses and residential infill development in Audubon Park

Table 4-28. Types, sizes and value of infill housing in Audubon Park

Housing characteristics		Existing units	Total	Infill units 1990s New	1990s Renovation	2000s New	2000s Renovation
Housing types (DW)	Single family	1,059	25	2	16	2	5
	Multifamily	1	225	225	0	0	0
	Condominium	2	0	0	0	0	0
	Other	0	0	0	0	0	0
	Sum	1062	250	227	16	2	5
Mean size of single family houses (square feet)		1,525	1,788	1,878	1,494	2,499	2,569
Mean of appraised value of single family houses in 2010 ($)		142,671	195,218	205,193	171,688	226,860	268,528

Note: DW refers to dwelling unit. The number of multifamily housing units is calculated based on the assumption that one dwelling unit per each 1,000 square feet.

Table 4-29. Profiles of income groups in Audubon Park and Baldwin Park

Neighborhood attributes	Audubon Park 1990	Audubon Park 2000	Audubon Park 2005-09	Baldwin Park 2005-09
Median family income	33,419	45,129	62,829	91,756
Poverty rate	4.2%	6.7%	5.5%	4.4%
% of very low income households	14.1%	18.7%	18.5%	6.0%
% of low income households	17.4%	14.5%	12.6%	9.1%
% of moderate income households	14.3%	15.9%	9.2%	7.3%
% of high moderate income households	13.4%	11.8%	9.5%	3.2%
% of high income households	17.3%	11.1%	13.7%	11.0%
% of very high income households	23.5%	28.0%	36.4%	63.3%
Entropy index	0.989	0.970	0.925	0.681

Table 4-30. Neighborhood characteristics of Engelwood Park

Neighborhood attributes	1990	2000	2005-09
Population	11,740	12,034	13,427
Number of households	4,329	4,501	4,523
Percentage African American	5.6%	9.1%	9.5%
Percentage Hispanic	24.5%	44.0%	60.1%
Median household income	$28,251	$34,741	$34,548
Poverty rate	10.5%	14.8%	19.0%
Ratio of renter occupied housing	49.4%	47.9%	58.8%
Vacancy rate	7.2%	4.4%	8.0%
Housing density (units/acre)	4.057	4.094	4.273
Job density (workers/acre)	1.214	1.413	0.825

Source: U.S. Census 1990, 2000, ACS 2005-2009. Values are calculated based on information from four census block groups (FIPS census block group code: 120950134022, 120950134031, 120950134032, 120950134041).

Figure 4-23. Camellia Pointe, a LIHTC project. Source: Orange County Property Appraiser (2012).

Figure 4-24. Pendelton Park Villas apartment. Source: Orange County Property Appraiser (2012).

Figure 4-25. Royal Isles apartment. Source: Orange County Property Appraiser (2012).

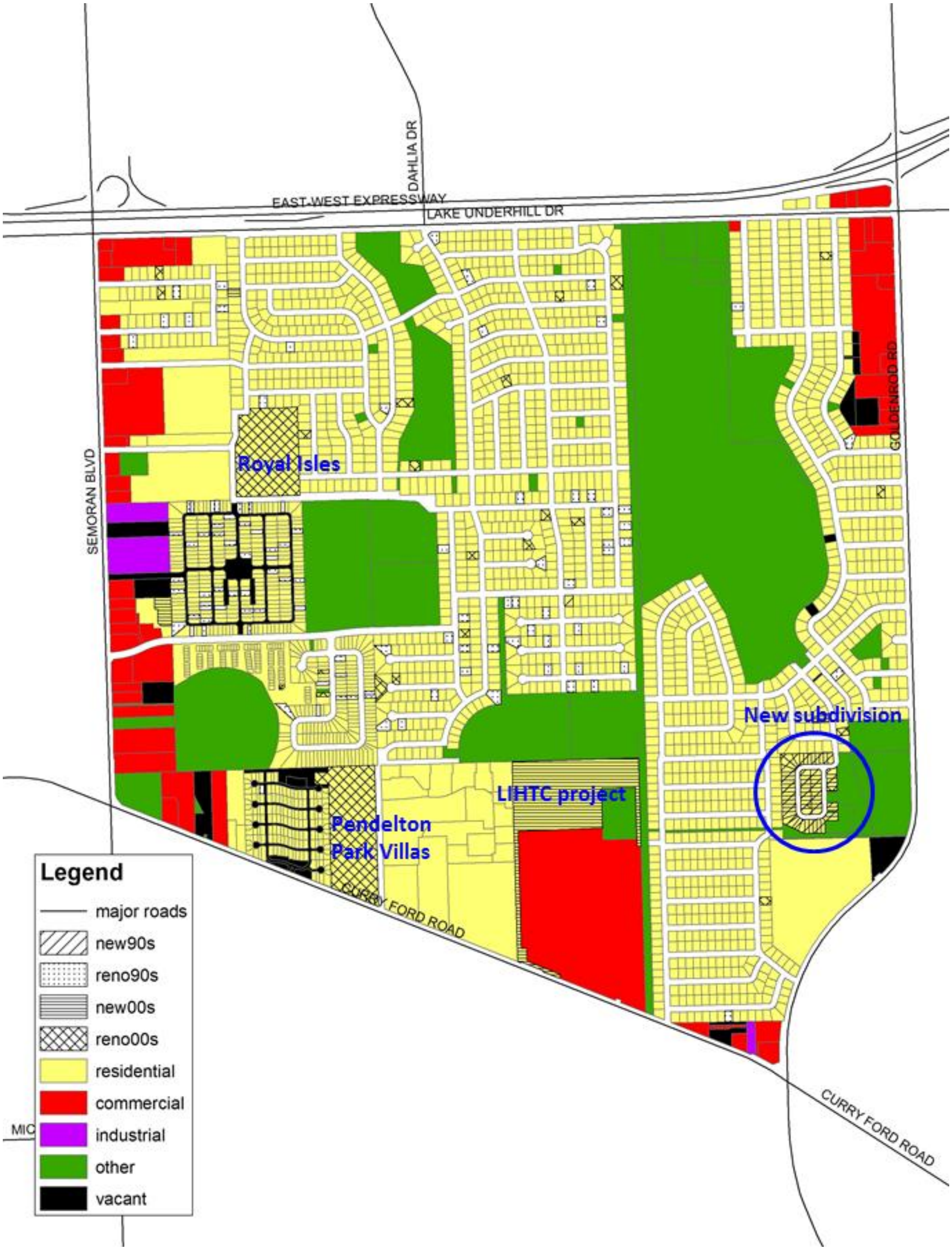

Figure 4-26. Land uses and residential infill development in Engelwood Park

Table 4-31. Residential infill development in Engelwood Park

Years	1990s	2000s	Total (1990 to 2009)
New construction	62	184	246
Renovation	105	475	580
Total	167	659	826

Source: property tax rolls, FDOR

Table 4-32. Types, sizes and value of infill housing in Engelwood Park

Housing characteristics		Existing units	Total	Infill units 1990s New	Infill units 1990s Renovation	Infill units 2000s New	Infill units 2000s Renovation
Housing types (DW)	Single family	2,467	192	62	103	2	25
	Multifamily	911	633	0	2	181	450
	Condominium	23	1	0	0	1	0
	Other	0	0	0	0	0	0
	Sum	3,401	826	62	105	184	475
Mean size of single family houses (square feet)		1,361	1,379	1,280	1,413	1,667	1,457
Mean of appraised value of single family houses in 2010 ($)		55,272	69,857	67,792	65,727	101,292	90,861

Note: DW refers to dwelling unit. The number of multifamily housing units is calculated based on the assumption that one dwelling unit per each 1,000 square feet.

Table 4-33. Profiles of income groups in Engelwood Park

Neighborhood attributes	1990	2000	2005-09
Median family income	$28,251	$34,741	$34,548
Poverty rate	10.5%	14.8%	19.0%
% of very low income households	20.0%	26.0%	29.1%
% of low income households	21.7%	23.1%	26.2%
% of moderate income households	14.4%	14.3%	16.3%
% of high moderate income households	10.3%	11.0%	6.8%
% of high income households	13.3%	12.0%	9.7%
% of very high income households	20.4%	13.7%	11.8%
Entropy index	0.981	0.968	0.931

Table 4-34. Neighborhood characteristics of Spring Lake

Neighborhood attributes	1990	2000	2005-09
Population	879	901	948
Number of households	392	409	454
Percentage African American	1.5%	0.4%	0%
Percentage Hispanic	3.6%	3.1%	0%
Median household income	$66,524	$97,565	$160,000
Poverty rate	2.5%	0.6%	5.3%(ct)
Ratio of renter occupied housing	4.1%	2.7%	4.6%
Vacancy rate	5.1%	3.3%	2.8%
Housing density (units/acre)	0.517	0.530	0.585
Job density (workers/acre)	6.407	5.095	4.155

Source: U.S. Census 1990, 2000, ACS 2005-2009. Values are calculated based on information from a census block group (FIPS census block group code: 120950107011).

Table 4-35. Residential infill development in Spring Lake

Years	1990s	2000s	Total (1990 to 2009)
New construction	25	45	70
Renovation	46	49	95
Total	71	94	165

Source: property tax rolls, FDOR

Table 4-36. Types, sizes and value of infill housing in Spring Lake

Housing characteristics		Existing units	Total	Infill units 1990s New	Infill units 1990s Renovation	Infill units 2000s New	Infill units 2000s Renovation
Housing types (DW)	Single family	250	165	25	46	45	49
	Multifamily	0	0	0	0	0	0
	Condominium	6	0	0	0	0	0
	Other	1	0	0	0	0	0
	Sum	257	165	25	46	45	49
Mean size of single family houses (square feet)		3,332	3,006	3,304	2,972	3,548	2,440
Mean of appraised value of single family houses in 2010 ($)		332,497	364,194	373,429	329,465	514,006	260,737

Note: DW refers to dwelling unit. The number of multifamily housing units is calculated based on the assumption that one dwelling unit per each 1,000 square feet.

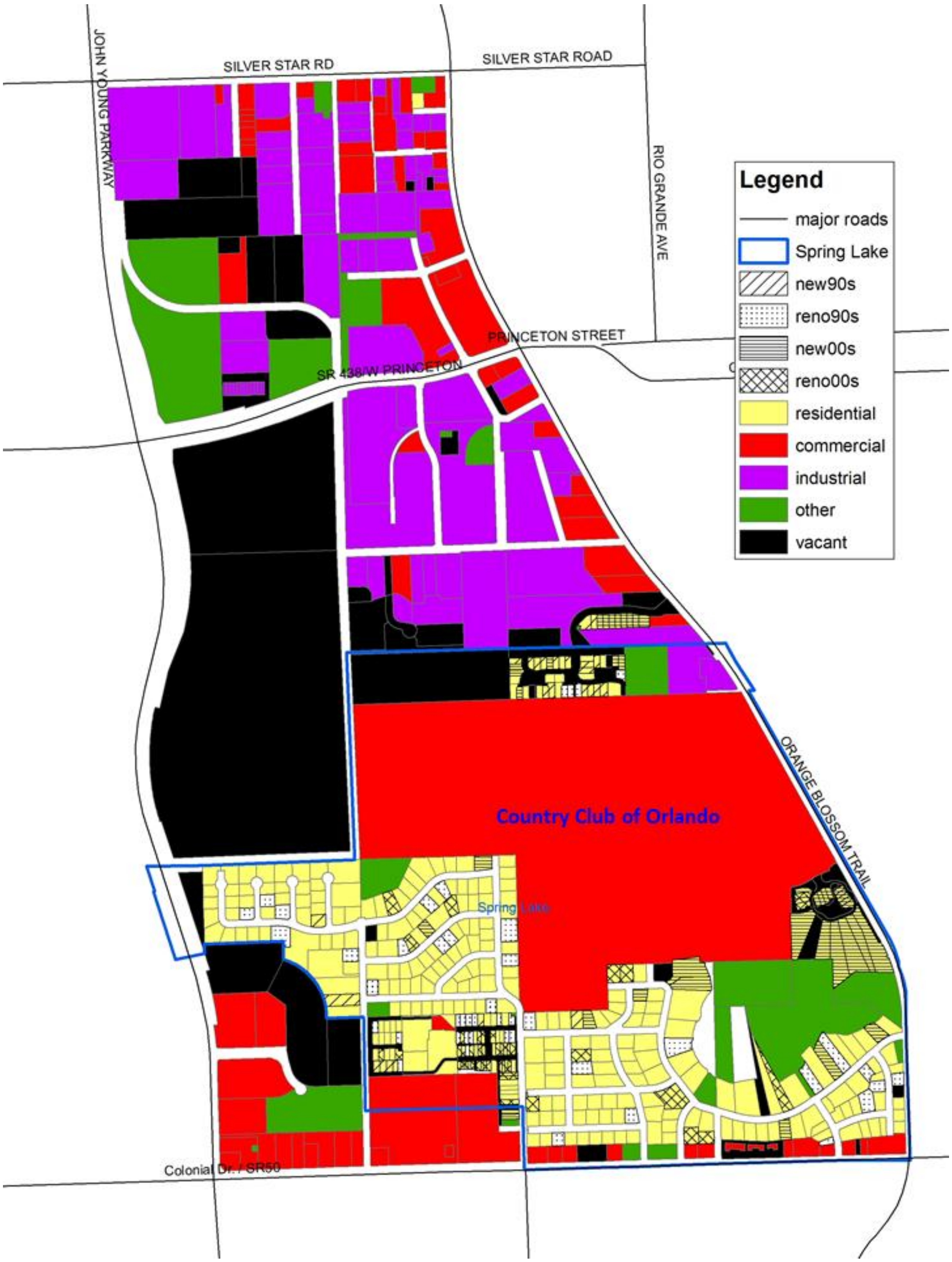

Figure 4-27. Land uses and residential infill development in Spring Lake

Figure 4-28. A gated community in Spring Lake. Source: Orange County Property Appraiser (2012).

Figure 4-29. Entrance of old Spring Lake community. Source: Google (2012).

Table 4-37. Profiles of income groups in Spring Lake

Neighborhood attributes	1990	2000	2005-09
Median family income	$66,524	$97,565	$160,000
Poverty rate	2.5%	0.6%	5.3%(ct)
% of very low income households	4.8%	6.1%	15.0%
% of low income households	4.6%	8.4%	0.0%
% of moderate income households	12.5%	10.4%	0.0%
% of high moderate income households	6.5%	6.1%	2.0%
% of high income households	6.0%	2.3%	4.8%
% of very high income households	65.7%	66.8%	78.2%
Entropy index	0.651	0.636	0.391

Table 4-38. Profiles of infill housing by neighborhood types

Neighborhood types		Lower	Gentrifying	Middle	Declining	Higher
Neighborhood name		Holden-Parramore	Colonialtown South	Audubon Park	Engelwood Park	Spring Lake
Mean property value and size of existing old homes (single family)		$27,921 (1,165sqf)	$164,506 (1,452sqf)	$142,671 (1,525sqf)	$55,272 (1,361sqf)	332,497 (3,332sqf)
Mean property value and size of infill homes (single family)		$63,192 (1,315sqf)	$230,552 (1,961sqf)	$195,218 (1,788sqf)	$69,857 (1,379sqf)	364,194 (3,006sqf)
infill units	1990s	78	65	243	167	71
	2000s	625	136	7	659	94
	total	703	201	250	826	165
existing old homes		837	510	1,525	3,401	257
Share of new construction among infill	1990s	66.7%	7.7%	93.4%	37.1%	35.2%
	2000s	87.4%	91.2%	28.5%	27.9%	47.9%
	Total	85.3%	64.2%	91.6%	29.8%	42.4%
Share of Multifamily housing among infill	1990s	30.8%	55.4%	92.6%	1.1%	0%
	2000s	91.5%	39.0%	0.0%	95.8%	0%
	Total	84.8%	44.3%	90.0%	76.6%	0%
Entropy Index	1990	0.605	0.884	0.989	0.981	0.651
	2000	0.586	0.937	0.970	0.968	0.636
	05-09	0.648	0.840	0.925	0.931	0.391
Housing programs		HOPE VI LIHTC	HOPE VI	Expensive multifamily housing	LIHTC NSP	No multifamily housing

Note: mean property value and size for existing old homes and infill homes are calculated only from single family housing units.

CHAPTER 5
CONCLUSION

This study addresses the relationship between infill development and subsequent neighborhood change in terms of income diversity. The findings of this study suggest important policy implications for socially sustainable infill development that can achieve mixed income communities. First, as infill development reflects neighborhood conditions, quantity of infill housing itself does not increase neighborhood income diversity except in gentrifying communities. The characteristics of infill housing in terms of size and price are similar to those of existing housing, so income groups similar to existing residents may be the potential residents of the new infill units. Consequently, neighborhood income diversity may not be promoted through infill. Even in gentrifying areas, large-scale redevelopment may negatively affect neighborhood income diversity by displacing lower income households as evident in the Colonialtown South case.

Instead of the quantity, the quality of infill housing is a much more important factor in promoting neighborhood income diversity. Here, the term “quality” refers to the attributes of residential infill development that are consistent with desired neighborhood character and promote neighborhood income diversity. The results of econometric analyses provide empirical evidence that the mix of housing types, higher ratio of new construction and lower ratio of multifamily housing among infill housing may promote neighborhood income diversity in the long term. The statistically more significant results in the long term model may result from the accumulation of positive effects of infill housing that have the potential to attract diverse income groups. In the case studies, the positive role of incremental infill development in maintaining or promoting neighborhood income diversity is confirmed. Accordingly, the necessary requirements of infill development as an effective tool for mixed income communities may include encouraging new construction, providing a variety of housing types, balancing the share of multifamily renter-occupied housing with single family owner-occupied housing, and incentivizing incremental infill development. In sum, in order to promote a mix of incomes through infill, policy should focus on qualifying infill housing rather than simply supplying infill housing.

The City of Orlando adopted infill development as a main strategy to discourage urban sprawl, to achieve a compact urban form, and to ensure social and economic diversity through its comprehensive plan. In practice, the City encourages traditional neighborhood designs through established standards in the areas located in the Traditional City. However, the design standards only focus on aesthetic aspects, such as building form and orientation, and do not address socio-economic aspects like social mixing. The City also has provided density and intensity bonuses to mixed use or affordable housing developments. The bonuses are definitely strong incentives for infill development. However, the location where density and intensity bonuses are provided is not limited to infill areas, implying that the bonuses are not designed to promote infill. The City of Orlando has not implemented conscious policy efforts to ensure mix of incomes through infill. Moreover, the City failed to take advantage of an opportunity to create a mixed income communities through a large-scale brownfield redevelopment in Baldwin Park by allowing a higher income residential development to locate there instead. As a result, infill development in Orlando neighborhoods does not successfully promote neighborhood income diversity consistent with the findings in this study.

Therefore, in order to make infill development effective in achieving mixed income communities, a more direct guideline or incentive program for infill, which can ensure quality of infill development, should be implemented. Based on the findings of this study, the infill strategy may include incentive programs for mixed income and mixed tenure projects. As applied in the HOPE VI program, guidelines to mix affordable housing with market rate rental housing and to achieve a balance between owner-occupied housing and renter-occupied housing should be developed concurrent with incentives. A mix of housing types should be encouraged, but a higher percentage of multifamily housing should be restricted. Since diverse housing types do not guarantee a mix of incomes, as the example of the Baldwin Park project shows, inclusionary zoning may be necessary to ensure introduction of affordable housing in middle and higher income neighborhoods. In particular, based on the fact that the current zoning system of the City of Orlando already allows higher density development across the city jurisdiction compared to other local governments in Central Florida (P. Lewis, personal communication, August 16, 2012), inclusionary zoning in the City of Orlando can be effective if it allows not only density or intensity bonuses but also other incentives such as expedited development review, design flexibility, and exceptions to related regulations and fees.

At the neighborhood level, encouraging incremental infill development, such as new single family housing construction on a vacant lot or renovation of existing units, through financial assistance to low- or moderate- income home buyers may contribute to protecting historic neighborhood fabric and promoting income diversity. And infill development strategies should be incorporated in a neighborhood plan that includes a future vision and current and future projects as a part of a community development strategy. In particular, financial support for incremental infill development, such as subsidies for home renovation loans and for low or moderate income homebuyers, may attract moderate and middle income households to economically distressed neighborhoods. Holden-Parramore can be an experimental target area of this strategy.

In the growth management plan, the City of Orlando planned the preservation of residential areas in Holden-Parramore. The policy stated:

> to protect the residential integrity of the Parramore Heritage neighborhood from the encroachment of non-residential use; to improve the physical appearance of the neighborhoods; and to increase the opportunities for neighborhood-serving retail development which does not encroach upon these residential neighborhoods (City of Orlando, 2012, p.LU-42).

However, the reality is that abandonment or demolition of housing units in Holden-Parramore has continued. In fact, the number of housing units decreased from 2,100 to 1,853 between 1990 and 2000, and 1,517 units remained with a 17.1% vacancy rate in 2005-2009 as shown in Table 4-15. Moreover, homeownership units planned in the Carver Park HOPE VI project have not been constructed yet due to the housing market crash. Although Orlando's Growth Management Plan and the Pathways for Parramore, an initiative to revitalize the historic Parramore community, planned to preserve the residential function in Holden-Parramore, the demand for housing in this area is not promising, and continued large-scale non-residential projects have taken an additional toll (City of Orlando, 2009b, 2012). Assisting incremental infill development and combining with other community development projects planned in the Pathways for Parramore, such as streetscape improvements and construction of a community park and children center, can improve neighborhood conditions in Holden-Parramore, and perhaps attract moderate income households.

In particular, providing financial assistance to low- or moderate- income home buyers who will purchase newly built or renovated single family houses can promote neighborhood income diversity. Since 2005, the City constructed 21 new homes and supported 17 qualified low income home buyers through the Pathways for Parramore (City of Orlando, n.d.). In addition to the 82 remaining homeownership units in the Carver Park HOPE VI project, the City can expand the homeownership assistance program for infill development in other residential areas in Holden-Parramore. Encouraging engagement of non-profit or non-government organizations, such as Habitat for Humanity, to develop infill housing can enhance neighborhood revitalization. Subsequently, a mix of incomes can be achieved. Like the Carver Park HOPE VI and the City View projects, a mixture of assisted housing and market rate rental housing should be recommended in all government supporting large scale infill projects in order to prevent the concentration of the poor. And guidelines for incentive programs to encourage infill development should be added as a community revitalization strategy into the Pathways for Parramore neighborhood plan.

In sum, the objective of this study is to understand how to promote social sustainability through infill by promoting mixed income communities. As noted earlier, the income diversity of neighborhoods can increase place vitality, economic health, social equity and social capital of the neighborhoods (Calthorpe & Fulton, 2001; Talen, 2006a). Specifically, from the planning perspective, the connection between neighborhood income diversity and socio-economic sustainability can be understood in terms of the geography of opportunity. In highly economically segregated cities, low income households have very limited opportunities for a high quality education, a safe community environment, healthy foods, and jobs due to the location of their homes in generally economically disadvantaged neighborhoods (Souza Briggs, 2005). However, achieving mixed income communities can provide a better geography of opportunity with low income households by providing decent homes in healthy and livable communities, implying that social equity is improved.

In practice, the federal housing programs to deconcentrate poverty, such as the HOPE VI and the housing voucher programs, intend to improve the geography of opportunity of low income households through social mixing to build sustainable communities (Popkin, Katz, Cunningham, Brown, Gustafson, & Turner, 2004). Planners tend to take a leading role in supporting incentives and inclusionary zoning as a tool to achieve the equity dimension of sustainability (Jepson, 2004). The Governors' Institute on Community Design supported by the Partnership for Sustainable Communities also recommends the adoption of fair share housing standards or inclusionary zoning that can promote the supply of low income housing and mixed income communities (Governors' Institute on Community Design, 2012). Of course, mixing of incomes itself does not automatically guarantee improved quality of life for low income households, so the effort to ensure social ties and interactions among residents within mixed income communities should be developed in order to realize actual social mixing (Joseph, 2006; Joseph, Chaskin, & Webber, 2007; Chaskin and Joseph, 2010; Popkin et al., 2004). Also, inclusionary zoning typically is less effective unless it is broadly adopted throughout the region and development pressure is sufficiently high to ensure its implementation. However, increased neighborhood income diversity implies the potential to live together with diverse income groups in healthy and livable communities or revitalizing communities, which is the starting point for further social mixing and integration for sustainable communities.

From the environmental perspective, more infill development can result in environmental sustainability by reducing land consumption and auto dependency. However, dense development within urbanized areas does not automatically guarantee increased social mixing in terms of income as found in this study. If an objective of infill policy is only to promote environmental sustainability, maintaining current infill development patterns, which can be characterized as “infill as a mirror of the neighborhood” could be effective. In fact, this approach minimizes community opposition to infill as evident in the Baldwin Park project. But, this kind of infill development could reinforce current income distribution across neighborhoods rather than promote a mix of incomes.

Therefore, in order to promote further sustainability goals, such as a creation of mixed income communities and revitalization of economically distressed communities, policy makers and planners should adopt specific guidelines for sustainable infill as suggested above. By adopting and implementing these infill strategies consistently, not only environmental but also socio-economic sustainability can be achieved through infill.

However, there are some limitations to this study. First, this study only analyzes residential infill development. In future research, the effects of other types of infill development and mixed developments can be examined by using more detailed land use data sets. Second, this study only addresses change in income diversity through infill. The impacts of infill development on other socio-demographic factors, such as race, ethnicity, and age, should be explored. Third, this study only analyzes the Orlando

MSA. Thus, the methodology, such as the density criteria to identify potential infill areas, and findings are only applicable to the Orlando MSA. For a more generalizable study, other MSAs with different urban contexts should be analyzed. Fourth, other factors that can affect infill development patterns and subsequent neighborhood change should be addressed. For instance, the role of land supply, age of the housing, different taxation and public investment decisions in determining the characteristics of infill development can be analyzed in a comparative study involving multiple metropolitan areas. Fifth, this study mainly relied on aggregated demographic and socio-economic data provided by the Census Bureau, so the methodology developed in this study only partially explains neighborhood change through infill in a real world. For instance, this study considers a census block group a neighborhood in the econometric models, but the census boundary may not reflect the actual boundaries of neighborhoods. Also, the spatial unit of aggregation, such as the census tract and the census block group, may result in different outcomes. Adoption of a more complicated spatial weighting matrix, such as high-order dependency among census block groups, may reduce the aggregation bias by addressing interactions among adjacent neighborhoods. Using census micro-data, quantitative analysis based on more reliable boundaries of neighborhoods can be conducted. This approach can provide a better connection between quantitative analysis and qualified case studies. The use of census micro-data also allows analysis about in- and out-migration of households as a response to infill development. It can provide a better understanding of neighborhood dynamics. Finally, the methodology adopted in this study only explains the causal relationship between infill development and neighborhood change. But, in the real world, the relationships between infill development and the neighborhood succession process are more complex. By applying various modeling techniques such as system dynamics and agent based modeling, more complex relationships such as feedback relationships between infill development and neighborhood change can be addressed.

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BIOGRAPHICAL SKETCH

Jeongseob Kim was born and raised in South Korea. He studied civil and urban engineering at the Seoul National University, and completed his master's degree with a specialization in urban planning in 2003. Upon graduation, Mr. Kim worked as a planner at a planning consulting firm for four years in Seoul, South Korea. Then, he moved to his hometown, Daegu, and worked as a research officer to support commissioners' legislation and policy evaluation activities in the Daegu Metroplitan Council. Also, he conducted research in the Daegu-Gyeongbuk Development Institute. He began pursuing a Ph.D. in urban and regional planning at the University of Florida in 2009, and worked as a research assistant more than two years. His research interests include smart growth, spatial segregation, neighborhood change, as well as, land use and transportation coordination using quantitative approaches with econometrics and GIS.