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Income Segregation: Understanding the Underlying Processes through Political and Structural Forces

DISSERTATION

submitted in partial satisfaction of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

in Urban and Environmental Planning and Policy

by

Jongho Won

Dissertation Committee:
Professor Victoria Basolo, Chair
Professor Scott A. Bollens
Associate Professor Jae Hong Kim

2020

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Vita

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FIELD OF STUDY

Urban Inequality, Residential Segregation, Affordable Housing

Abstract of the Dissertation

Income Segregation: Understanding the Underlying
Processes through Political and Structural Forces

by

Jongho Won
Doctor of Philosophy in Urban and Environmental Planning and Policy
University of California, Irvine, 2020
Professor Victoria Basolo, Chair

Income segregation is not merely a physical separation between income groups, but is a core driving force that perpetuates inequality. Existing research indicates that people in affluent neighborhoods are likely to benefit from many social advantages—including safety, quality of public resources and private services, job opportunities, and social networks—often referred to as the "geography of opportunities." On the other hand, poverty can be transmitted to the next generation, as poor neighborhoods often present fewer opportunities. However, scholars have approached income segregation mostly from the market-oriented perspective, which limits our understanding on the full picture of income segregation. By focusing on structural and political factors, this three-essay dissertation presents the persistence of neighborhoods in terms of economic status and the inequality among municipalities within U.S. metropolitan areas in terms of their resource availability. This work analyzes data from multiple sources including the GeoLyticss Neighborhood Change Database, ReferenceUSA, and National Land Cover Database by utilizing quantitative methods, including k-means clustering and multilevel regression models.

The first essay shows that neighborhoods within the 105 largest U.S. metropolitan areas were likely to maintain their economic status from 1980 to 2010, and the neighborhood change toward either greater affluence or poverty were spatially clustered. This research focuses on the changing trends of neighborhood-level economic status and explores their spatial structure as well as longitudinal transition by utilizing a decomposition of income segregation, which cannot be specified by using the traditional global measures.

The second essay investigates the mechanisms of affluent and poor neighborhoods' persistence in their economic status between 2000 and 2010. The results show that affluent neighborhoods, which often have advocacy groups with many economic resources and political connections to powerful elites, tend to enter the redevelopment stage earlier than poor neighborhoods. Consequently, economic polarization of neighborhoods is intensified as affluent neighborhoods are more effective in resisting decline or negative neighborhood change, compared to poor neighborhoods. While literature in the field traditionally has focused on the natural process of neighborhood change based on the ecological perspective, this research contributes by showing how neighborhoods with varying economic statuses experience change, especially decline generated by ecological and economic forces.

The third essay explores the relationship between the hierarchy of economic status across municipalities within the greater Los Angeles region and the unequal distribution of community resources. By conducting a cross-sectional cluster analysis in 2010, this research shows how high-income and economically homogeneous municipalities have better access to community amenities and resources, such as foods, schools, healthcare

facilities, cultural amenities, parks, and social services, compared to poorer municipalities, which may reinforce their economically homogeneous environments.

As a whole, this dissertation focuses on the underlying mechanisms of income segregation. The results generally indicate that income segregation will be intensified not only because of the rise of income inequality but also due to the structural and political factors that fortify the initial economic hierarchy of places, suggesting the necessity for policy intervention to address the consequent inequalities.

Introduction

Background

Income segregation is increasingly becoming a topic of importance to urban scholars and policy makers. Income segregation, defined as the geographical separation between different income groups within a given area, is not merely an issue of the physical concentration of specific classes or the spatial expression of social distance between sub-groups, as originally suggested by the Chicago School; it is a strong force, emphasizing and exacerbating a myriad of inequality issues. As Massey (1996) asserted, "a new age of inequality in which class lines will grow more rigid" comes from the process of residential segregation (p. 395). That is, segregation results from and in spatial inequalities, such as the unequal distribution of resources, populations, and the physical conditions (e.g., natural amenity, pollution level), which then reinforce social inequalities (Maloutas & Fujita, 2012). The deleterious effects on disadvantaged families of living in segregated areas, such as high crime rates, significant unemployment, low public service quality, and a lack of role models for children, have been documented by social scientists (DeLuca & Rosenbaum, 2003; Massey & Denton, 1993; Popkin et al., 2004; Sharkey, 2010; South & Crowder, 1997; Wilson, 2012). These negative influences affect the disadvantaged residents' current and future opportunities because of their inability to leave their poor neighborhoods; thus, they can become stuck in distressed areas (Jargowsky, 2002; South & Crowder, 1997). With extensive academic research on the detrimental effects of concentrated poverty, policymakers have strived to provide better environments for low-income people to broaden and enhance their social networks and to provide access to resources. The

scholars and the policy makers believe that this can lead to increased social contact and relations between the poor and the affluent, and upward social mobility for those who experience distress from a poor neighborhood environment (Sanbonmatsu et al., 2011). Investigating residential segregation is crucial, given a shrinking middle class and widening gap between the poor and the wealthy.

This three-essay dissertation is built upon a set of theories from two conceptual frameworks—urban ecology and political economy—that explain residential segregation. These theories highlight that a living environment is not a single, independent entity but a constituent element nested within an urban system. Therefore, this dissertation project approaches residential segregation by exploring how the change of local communities and their spatial attributes shape the rise and reinforcement of income segregation at the regional level.

The concept and measuring income segregation

Income segregation is defined as "the degree to which families with different incomes live in the same neighborhood [community] or are sorted by income among neighborhoods [or cities] within a city or metropolitan area" (Owens, 2015, p. 99). Income is a decisive factor in determining an individual's capacity to afford housing, and the housing market is a domain in which income inequality is spatially distributed (Jargowsky, 1996). Residents not only pay for housing quality (e.g., housing size, maintenance, and amenities) but also for public services and locational amenities, which closely correspond to housing prices. Theories suggest that regional housing markets are geographically segmented into several smaller housing submarkets based on housing prices, defined as

"geographic areas where the price per unit of housing quantity is constant" (Goodman & Thibodeau, 1998, p. 121). The affluent are willing to pay more for high-quality housing located in desirable places. Therefore, increasing income inequality will widen the physical distance between rich and the poor through the residential market. As Reardon and Bischoff (2011) described, "there could be no income segregation because all individuals would have the same income and thus all neighborhoods would have the same income distribution" without income inequality, which is primarily decided by either the labor market or by global economic forces (p. 1102). Therefore, among the many factors that promote income segregation, income inequality is the most fundamental.

However, the conceptual difference between income segregation and income inequality is not clearly identified in some research. In fact, many scholars examining income segregation combine the two concepts, as they consider income segregation as a mere geographical expression of income inequality (e.g., Davidoff, 2005; Jargowsky, 1996; Wheeler, 2006). However, a high level of income inequality may not always imply a high degree of residential segregation by income, As Maloutas and Fujita (2012) argue, "segregation is a context-bound concept, [therefore], the form of varied urban setting around the world [generate] multiple versions of segregation" (p. 3). This suggests that income inequality is not the only factor that influences income segregation (Reardon & Bischoff, 2011).

The basic measurement difference between income inequality and income segregation is whether each concept considers the "subunit" in its analysis. The Gini coefficient is the most popular method used to measure the level of income inequality (Chitiga et al., 2015; De Maio, 2007). This index is based on the Lorenz curve, which plots

the cumulative percentage of income earned as a function of the income percentile of the population from the bottom of the income distribution (Deininger & Squire, 1996). The Gini coefficient of income inequality is measured by first calculating the area which lies between the 45-degree line, which represents perfect equality, and the Lorenz curve. Then calculating the proportion of that area to the area which consists of three edges: the 45-degree line, the horizontal axis, and the vertical axis. Perfect inequality is defined when a Lorenz curve is completely lied with the two latter lines, the horizontal axis and the vertical axis. A value of 0 indicates "perfect equality", where each individual earns the same amount of income, while a value of 1 represents "maximum inequality", where only one individual of a large population takes the whole income. The Gini coefficient is calculated with the equation below.

$$\mathrm{G} = 1 - \sum_{i=1}^{N} (x_i - x_{i-1})(y_i - y_{i-1})$$

G refers to the Gini coefficient, x_i refers to cumulated proportion of the population at the horizontal axis, and y_i refers to cumulated proportion of the income at the vertical axis. The main advantage of the Gini coefficient is that it allows one to compare the level of income inequality between countries and different time points because the Gini has several desirable properties, such as mean independence and population size independence (Chitiga et al., 2015; Haughton & Khandker, 2009). The Gini coefficient also satisfies the criteria of symmetry and Pigou-Dalton Transfer sensitivity, which implies that the transfer of income from rich to poor reduces measured inequality (Haughton & Khandker., 2009). The main weakness of the Gini coefficient is that it is unable to capture different types of income inequality. For example, even though two nations have different Lorenz curves,

which implies the different income distributions between the nations, the Gini coefficient of each nation can show similar values (De Maio, 2007). Moreover, the Gini index is not decomposable, which means that the Gini coefficient of the total population cannot be obtained by simply summing the Gini coefficients of its sub-units (Haughton & Khandker, 2009).

Segregation explores residential distribution based on income and race among sub-units (e.g., census tracts) within a larger unit (e.g., a metropolitan area). On the other hand, inequality concerns the distribution of the characteristics within a larger unit—an entire population—without considering the sub-units. Thus, inequality measures do not focus on the geographical distribution of relevant characteristics between the sub-units (Kim & Jargowsky, 2005). Here, we can examine one extreme example. If a municipality, which consists of several neighborhoods, such as census tracts, has households at the same income level, there would be no income inequality in the municipality. However, at a more macro level, when each municipality, which is economically homogenous, in a metropolitan area has different income levels based on jurisdictional boundaries, then each municipality would be considered perfectly segregated within the metropolitan area; this is because each municipality would consist of households with identical income levels, different from other municipalities within the metropolitan area. This example also shows the importance of choosing sub-units in segregation research.

Massey and Denton (1988), in a notable effort to measure segregation, introduced five dimensions of residential segregation between unordered categorical groups—evenness, exposure, concentration, centralization, and clustering—which can be reduced into two dimensions: evenness and exposure (Brown & Chung, 2006). Evenness refers to

"the differential distribution of two social groups among areal units in a city" (Massey & Denton, 1988, p 283). A variety of segregation measures are based on the evenness dimension. The most well-known index of evenness is the Dissimilarity Index. In terms of income segregation, this index measures unevenness and represents the percentage of low-income households that need to move from one neighborhood to another to have an equal share of low-income households across all neighborhoods (Pendall & Carruthers, 2003). The formula of the Dissimilarity Index is as follows:

$$\mathrm{D} = \frac{1}{2}\sum_{i=1}^{n} \left| \frac{x_i}{X} - \frac{y_i}{Y} \right|$$

In the formula, x_i denotes the number of low-income households in *i* neighborhood, y_i denotes the number of high-income households in *i* neighborhood, *X* represents the total population of low-income households at the metropolitan area, *Y* denotes the total population of high-income households at the metropolitan area, and *n* refers to the total number of neighborhoods in the metropolitan area. Theoretically, the value of the index ranges from 0 to 1. The value of 0 implies perfect evenness, where no low-income household must move to other sub-units to achieve evenness. The value of 1 indicates that each sub-unit is occupied with a single population group, such as low-income households, which shows complete segregation (Massey & Denton, 1988; Pendall & Carruthers, 2003).

Fischer (2003) applied the Entropy index, developed by Theil (1972), which measures the difference between the average tract-level entropies to the whole city's entropies, which is also a measure of evenness. In order to compute the Entropy index, the entropy score has to be calculated in advance. The formula of entropy or diversity of a tract, from Fischer (2003), is computed as follows:

$$E_t = \sum_{r=1}^{n} P_{r*t} * \log\left(\frac{1}{p_{r*t}}\right)$$

In this formula, E_t denotes an entropy score of a tract, p_{r*t} represents the proportion of families or households who belong to a certain income group *r* in tract *t*, and *n* refers to the total number of census tracts in a city or a metropolitan area. The higher score implies more diversity in a tract. When all income groups in each census tract have the same proportion across a city or a metropolitan area, the entropy score is maximized to 1. If, however, each census tract is occupied by only one income group, the entropy score would be minimized to 0. However, this score does not show the segregation level since the distribution of income groups across a city or a metropolitan area is not considered (Iceland, 2004).

The Entropy index (or the Theil Index), which is different from measuring just entropy scores, is "the weighted average deviation of each unit's entropy from the metropolitan-wide entropy, expressed as a fraction of the metropolitan area's total entropy" (Iceland, 2004, p. 8). The entropy index is calculated as follows:

$$\mathrm{H} = \sum_{i=1}^{n} \frac{w_i(E_m - E_i)}{WE_m}$$

In this equation, w_i refers to population of tract *i*, W represents the population of metropolitan area *m*, *n* is the number of tracts in metropolitan area *m*, and E_m and E_i refers to the entropy of tract *i* and metropolitan area *m*, respectively. The entropy index *H* ranges from 0 to 1. If the composition of income groups in each tract is identical to the overall composition of income groups in a metropolitan area, the index will show a value of 0

indicating “complete integration.” Conversely, the index will be maximized to a value of 1 when each census tract contains only one income group indicating “complete segregation.”

Jargowsky’s (1996) Neighborhood Sorting Index (NSI) measures income segregation by calculating the ratio of the between-neighborhood median/mean income variance/standard deviation to the total households’ median/mean income variance/standard deviation. the ratio of two standard deviations: a standard deviation of the mean income of neighborhoods in a metropolitan area and a standard deviation of all household’s income in the metropolitan area. The NSI measures the difference between neighborhood means normalized by the total income variance or controlled by the total income inequality in a larger area, such as MSA (Kim & Jargowsky, 2005). The formula of the index is

$$\text{NSI} = \frac{\sigma_N}{\sigma_H} = \frac{\sqrt{\frac{\sum_{n=1}^{N} h_n\,(\,\overline{y_n} - \bar{y})2}{H}}}{\sqrt{\frac{\sum_{i=1}^{H}\,(\,y_i - \bar{y})2}{H}}}$$

In this formula, *y* refers to household income, *i* denotes households, *n* represents neighborhoods, h_n signifies the number of households in neighborhood *n*, and *N* and *H* refer to the total number of households and neighborhoods, respectively. The index puts more weight on the units that have a larger difference from the mean by multiplying the number of households in a neighborhood in the numerator. If all neighborhoods have the same mean income, which implies complete integration, the between-neighborhood standard deviation would be 0, and NSI will be 0. However, if each neighborhood consists of households which have an identical income to each other and that respective income level is unique in an MSA, which implies perfect income segregation, NSA would show 1.0.

This result is from the between-neighborhood's standard deviation being equal to the standard deviation of the total households' standard deviation. The NSI is insensitive to the change of the income distribution's mean and variance, distinct from other categorical-based measures, such as the Dissimilarity Index, which breaks income distribution into arbitrary groups. The NSI also does not require the income data in categorical groups (Jargowsky, 1996).

However, estimating the total variance of income in an MSA level is not possible based on the reported income data since it does not contain exact income information for each household (Kim & Jargowsky, 2005; Pendall & Carruthers, 2003). As a result, several assumptions in the households' distribution in each income category are required to estimate the overall households' income variance. Moreover, because the actual income is used for the index, the NSI is not independent from the income inequality (Reardon & Bischoff, 2011). In this vein, the NSI is also affected by macroeconomic shocks (Pendall & Carruthers, 2003). Although it is a necessary condition for income segregation, income inequality is not the only factor that contributes to income segregation.

Reardon et al. (2006) introduced the rank-order information theory index H^R, the ratio of within tract variation of the income rank of households to total income rank variation of the metropolitan area. Calculating the rank-order information theory index H^R involves several steps. First, we decide a specific value of percentile rank p which divides the income distribution into two groups: one group whose income ranks are greater or equal to p and the other group whose income ranks is less than p. Next, the entropy of the population, $E(p)$, when the income distribution is divided into two groups based on income rank p, is calculated as follows:

$$E(p) = p\ log_2 \frac{1}{p} + (1-p) log$$

and *E(p)* is applied to calculate *H(p),* the traditional entropy index or the Theil Index, which measures the segregation between two population groups. *H(p)* can be written as

$$\mathrm{H(p)} = 1 - \sum_{j=1}^{n} \frac{t_j E_j(p)}{TE(p)}$$

where T is the population of the metropolitan area and t_j is the population of tract j. The rank-order information theory index (H^R), then, is calculated as

$$H^R = 2\ln(2) \int_0^1 E(p)H(p)dp$$

Theoretically, the rank-order information theory index varies from 0, which implies perfect income integration, to 1, which represents perfect income segregation. Similar to CGI, this index only uses the percentile rank of households; therefore, it is independent from the income distribution. This advantage allows one to compare the degree of income segregation between different time points. However, this index also has a limitation: the income distribution of the wealthiest households in the highest income categories has to be estimated. Moreover, this index is not intuitive since the index calculates overall income segregation by considering all income groups at each income percentile rather than measuring segregation between dichotomous groups.

The exposure dimension is defined as "the degree of potential contact, or the possibility of interaction, between minority and majority group members within geographic areas of a city" (Massey and Denton, 1988, p. 287). Exposure considers the population size of the study groups relative to the total population. The most widely used index to measure exposure is the isolation index P*. This index measures the average

likelihood of residential contact between two income groups. The simple physical exposure of one group, such as the low-income group, to one another, such as the high-income group, within a neighborhood is measured through this index (Massey & Egger, 1990). The equation of the exposure index P* is as follows:

$$P^* = \sum_{i=1}^{n} (\frac{x_i}{X})(\frac{y_i}{Y})$$

In this equation, x_i denotes the number of low-income households in *i* neighborhood, y_i represents the number of high-income households in *i* neighborhood, *X* refers to the total population of low-income households at the metropolitan area, *Y* is the total population of high-income households at the metropolitan area, and *n* refers to the total number of neighborhoods in the metropolitan area (Pendall & Carruthers, 2003). Unlike the dimension of evenness, the exposure index strives to consider the real experience of physical contact between different income groups.

In sum, the measures of segregation concern the relative distribution of characteristics among sub-units to the population distribution. With these measures numerous studies have explored the influential factor for income segregation at the regional level—such as income inequality, occupational structure, suburbanization, and zoning (e.g., Jargowsky, 1996; Massey and Rothwell, 2010; Reardon & Bischoff, 2011; Yang & Jargowsky, 2006).

Understanding income segregation through the market perspective

Two predominant theoretical approaches in urban segregation—urban ecology and neoclassical economics—theorize residential stratification as an outcome of natural processes based on the free market mechanism. In other words, residential stratification is

a result of aggregated apolitical decisions by rational individuals in a neutral political context (Bollens, 2006; Fossett, 2006).

The urban ecology framework, introduced by the Chicago School in the early 20th century, argues that socioeconomic variables are influential for understanding the residential segregation between groups within cities (Massey, 1979). This ecological framework emphasizes several mechanisms, such as economic competition, population influx and outflow, and social distance, which generate residential segregation in the free housing market. The theory asserts that the mechanisms, which are distinct from one another, but not mutually exclusive, are reinforced by the increased income inequality (Fossett, 2006).

The early ecological approach viewed urban spatial patterns as a "natural process," applying the concept of biology to urban sociology. Urban spatial organization evolves through an adaptive and competitive process, which is the basic principle in natural ecosystems. This approach conceived of human nature as encompassing biotic and cultural dimensions, and as an influential factor in urban spatial patterns (Gottdiener, 2010). Park, Burgess, and McKenzie (1925) argued that competition for survival, related to the biotic nature of humans within a limited space, resulted in division of labor, and subsequently in a range of occupations in an urban area. Meanwhile, the cultural dimension of human nature contributed to the stratification of the urban space, where diverse economic groups intermingle because of the economic divisions of labor. A local-specific "moral order" of a cultural dimension formed by social interactions that develop over time made each section of a city unique. Since the moral order is a kind of shared identity of a spatial boundary, shaped through symbolic exchanges and mutual exchanges between a myriad of

individuals, gradually, the moral order becomes specific to the location (Gottdiener, 2010). As a result, cultural contexts, combined with the force for survival through economic competition, may contribute to creating a segregated residential pattern within a city (Park, Burgess, & McKenzie, 1925).

Later, urban ecology began to focus more on economic factors, rather than cultural factors, for explaining urban spatial structures. Since cultural values are extremely diverse between communities—and even within communities—focusing on economic competition and personal preference frameworks provides a more universal explanation of the urban spatial organization. As a result, urban ecology theories began to rely excessively on economic factors for explaining urban spatial structures. Researchers specifically investigated economic competition within the urban spaces in unregulated land markets (Form, 1953; Gottdiener, 2010). For instance, Burgess (1928) used the concentric zone model, providing a theoretical basis for residential segregation by class within cities. Burgess understood an urban area as a series of concentric circles that spread out from a central business district to the city suburbs. The center of the city is a space in which economic competition is high due to its spatial position, and the increase of population in this area causes both centralization and decentralization of the population simultaneously. That is, the city expands because competition brings about the relocation of economic functions from the central city to the suburban areas. During this process, there are "zones in transition," which are spaces filled with the urban poor or immigrants, and these are created just next to the central business district as an outcome of economic competition. These areas are followed by residential rings and commuter zones, in which more affluent residents reside. Therefore, the model predicts that the growth pattern of a city can be

represented as five concentric circles—the central business district, the zone in transition, the zone of working people's homes, the zone of better residences, and the commuters' zone—with the more disadvantaged areas near the city center and the affluent areas at the periphery (Etienne, 2008; Harris & Ullman, 1945). In this case, the rich, who wish to enjoy the ample space found in the periphery at the expense of long commuting distances, leave their previous living areas, which are then filled with low-income groups or immigrants (Maloutas, 2004).

Another important mechanism of the spatial separation between population groups emphasized by the Chicago School is "social distance." The idea of social distance refers to the extent to which people or groups are socially similar to each other on the basis of income, education, cultural contexts, or family circumstances (Musterd et al., 2016). This idea maintains that households with low "social distance" will share a common culture—similar interests, tastes, and so on. Ceteris paribus, most households would prefer to have low social distance between them and other nearby households. On the other hand, when households have high social distance, they would be expected to put greater physical distance between their homes to minimize physical interaction (Fossett, 2006). Therefore, social distance between population groups defined by different income levels can strengthen residential segregation, since most people tend to prefer to live in a community of households with a similar socioeconomic background. Income inequality plays a central role in this theory because economic competition is the main mechanism that allows the upper strata to live in high-quality housing and in the neighborhoods they desire. The lower strata, on the other hand, are not able to afford the higher standards of living, resulting in them having to reside in more disadvantaged environments.

In part, urban economics overlaps with the classical urban ecology in its explanation of residential segregation (Bollen, 1986; Fossett, 2006). As Fossett (2006) argued, "there is more than a passing similarity between 'social distance' effects in human ecological theory and the effects of individual preferences in economic theory" (p. 189). The theoretical framework of urban economics emphasizes individual preferences, associated with income level, on residential decisions in deregulated housing markets.

From an urban economics point of view, the monocentric city model developed by Alonso (1964), Mills (1972), and Muth (1969) provides the theoretical grounds for explaining income segregation by suggesting that higher-income groups are more likely to purchase housing or land in central urban areas due to their higher-value commuting time; this is based on the postulation that city centers are the most desirable place to live because of their high accessibility to workplaces. In this model, people choose an option that maximizes their utility in the free land market. The trade-off between the land cost and the commuting cost, expressed as a so-called bid-rent curve, is an important theoretical basis of the model.

While the monocentric city model allows us to analyze the distribution of a population in an urban space, the assumption of the agglomeration of economic functions in city centers has been criticized widely because most cities have become polycentric. The main assumption of the monocentric city model, which has most of the jobs concentrated in a single area such as a central city, is not realistic (Kraus, 2006). Moreover, the model cannot explain why the poor would reside in the central city, rather than in the suburbs.

In an attempt to complement the monocentric model, which is unable to explain suburbanization in the U.S., Becker (1965) extended the model by postulating that higher-

income population groups have higher income elasticity of demand for land. He assumed that the affluent groups are more willing to pay for large open space as their incomes rise, while the desire of low-income groups to live in large spaces increases modestly. As the transportation system in the country developed, the accessibility of land on the periphery has improved accordingly. As a result, the rich, who desired to enjoy the ample space found in the periphery at the expense of a long commute, have left their previous neighborhoods, which were then filled with low-income groups or immigrants who could not afford the expensive commuting and periphery housing costs. This argument explains suburbanization in the U.S. by highlighting that increasing inequality encourages the rich to move from the central city and into the suburbs, thus resulting in income segregation. The suburbanization process, which intensifies residential sorting by income, reflects the willingness of the affluent to enjoy more space which the poor cannot afford (Wheeler, 2006).

To sum up, both the urban ecology and the urban economics frameworks suggest that income segregation are shaped by individuals' preferences and the free market mechanisms. As Logan (1978) stated, "Assuming free competition for space, resolved according to the relative marginal utility of particular locations for competing land users, ecologists of the Chicago School [and neoclassical study] could assert that the final highly differentiated ordering of space would be the most effective for the population" (p. 405; see also Harding & Blokland, 2014). Thus, these theories view spatial inequalities as an efficient outcome through the market mechanisms.

Understanding income segregation through the political economy perspective

The ecological perspective theorizes residential segregation is shaped by individual preferences and free market mechanisms (Bollens, 1986). Political economy, however, focuses on social and power relations between economic and political actors to explain residential patterns. Political economists conceptualize the growth of a city as primarily driven by powerful elites, including landowners, developers, and institutional leaders, who can accumulate capital from property revitalization and development (Molotch, 1976). One strand of study based on Marxist theory argues powerful elites pursue exchange value and view urban areas as a "growth machine" for leverage for financial gain while non-elites pursue use value and consider urban areas necessary for daily life (Harvey, 1973; Lefebvre, 1974). The inherent conflict between exchange and use values—rent gap—motivates powerful elites to pursue investment and redevelopment (Smith, 1979). Herein, elite coalitions exploit spaces for capital accumulation without considering disadvantaged groups (Logan and Molotch, 1987).

In addition to the role of powerful elites on residential segregation, political boundaries also provide a clear sense of identity and information, as many common goals and political actions are generated at the jurisdictional level shape jurisdictions' own legal, social, and economic features (Lichter et al., 2015). Logan (1978) emphasized political boundaries, in which collective actions based on interests of place, such as neighborhood or municipality, are aggregated from diverse components within the political boundaries, to explain residential segregation by class. The aim of collective action from coalitions of local interest within a political boundary is to compete with other political units to preserve or enhance their "relative position in the hierarchy of place" (p. 409). Through political action, property owners strive to influence the development process because the property prices

in their neighborhoods or communities affect not only the residents' current well-being but also their future opportunities. Moreover, local elites or organizations from different political jurisdictions compete with each other for high-income households and high-value commercial activities to strengthen their fiscal health. As a result, political actors intervene in the local housing market, and their efforts, in turn, influence individuals' residential opportunities. For example, local governments can regulate or intervene in the housing market through land use regulation. That is, local-level policies, such as zoning and other land-use regulations, can be used to exclude a particular type of housing or population, distorting the free market mechanisms by suppressing market demands. According to Rolleston (1987), the motives behind zoning were to influence the size of a local tax base and the demand for local public services, as well as to maintain a community's homogeneous characteristics by excluding particular populations. Specifically, zoning contributes to the exclusion of low-income households who may harm homeowners' property values, thereby protecting local residents' property rights (Fischel, 1987; Levine, 2010). The courts have viewed this exclusionary nature of zoning as a valid property right (Nelson, 1979), and that the "general welfare" of the municipalities should reflect the current residents' needs rather than the potential ones' needs (Fischel, 1978). As a result, legally tied with local residents' interests, municipal land-use regulations do not have to consider general public demand, such as providing affordable housing for all population groups (Aloi & White, 1969; Morgan, 1995). Moreover, fiscal zoning is utilized to encourage developments which would attract households who can contribute to the local tax base more than their public service consumption, or to discourage developments favorable to households whose consumption of public services exceed their contributions to the local

tax base (Branfman et al., 1973; Fischel, 1978; Morgan, 1995). This also indicates that zoning often restricts the spatial mobility of low-income households (Ganong & Shoag, 2017). Zoning reduces the supply of rental and multi-family housing, resulting in limited housing options that low-income households can choose in a regional housing market (Pendall, 2000). As a result, economically disadvantaged people theoretically cannot necessarily move based on their residential preferences.

In this sense, Lefebvre argues that

> "Space has become for the state a political instrument of primary importance. The state uses space in such a way that it ensures its control of places, its strict hierarchy, homogeneity of the whole and the segregation of the parts. It is thus an administratively controlled and even policed space" (1979, p. 288).

Therefore, political economy theories explain how political actors or institutions intervene in the local housing market and distort the natural process of residential segregation suggested by urban ecology and neoclassical economics (Bollens, 1986).

Research Goals and questions

The research goals of this dissertation, which consists of three essays, are to explore the mechanisms of generating or reinforcing income segregation in U.S. metropolitan areas and identify urban inequality related to the phenomenon. The literature review regarding the measures of income segregation suggests that the majority of studies that explore income segregation utilize the city or metropolitan area as the unit of analysis, while often defining the subunit as neighborhoods, which are often proxied by census tracts. These studies have contributed to the literature by providing meaningful results that income

segregation between neighborhoods within a metropolitan area or city has increased. Moreover, the regional-level measures allow researchers and policy makers to compare the variation of the segregation levels among regions and to identify the influential factors for causing such variations. One of the main limitations of this literature is that they often neglect the neighborhood-level information which was used to derive a single value for each city or metropolitan area. As a result, the diverse transitions at the neighborhood level cannot be revealed through the regional-level analysis. Scholars and practitioners have been interested in identifying the mechanisms through which neighborhoods transform socioeconomically given the influence of neighborhood contexts on people's opportunities in life. Therefore, in Essay 1, I explore the unique path that each neighborhood can undergo by developing a neighborhood typology based on the change of neighborhood economic status. Specifically, this essay examines the following questions:

(1) Which types of economic trajectories have neighborhoods experienced from 1980 to 2010 in the 105 largest U.S. metropolitan areas? And how do they vary by location within an MSA?
(2) How does the intra-variation of the trajectories define the spatial forms of the MSAs?
(3) What are the spatial structures of the trajectories?
(4) How do the longitudinal trajectories vary by the location and initial income status of a neighborhood?

Answering these questions contributes to the literature by identifying the underlying mechanisms of income segregation which cannot be revealed through the

regional-level analysis. In general, the results of this essay highlight the continuous polarization of neighborhoods' economic status over recent decades in the United States.

The literature review regarding the theoretical perspectives on residential segregation—urban ecology and political economy perspectives—suggests that income segregation is a product of the interactions between individuals' economic and social behaviors, and the broader scale of political and structural forces. Given the significant influence of urban ecology in the neighborhood literature, the research traditionally has focused on the neighborhood boundary as a mechanism of residential sorting. Scholars theorize that residential decisions for neighborhoods are mainly driven by market forces, which are significantly influenced by individuals' preferences for particular housing, local amenities, and access to work based on their socioeconomic and life-cycle factors. Moreover, scholars often suggest a cyclical process of neighborhood economic status that occurs naturally in many neighborhoods. However, given the rise of between-neighborhood inequality in the last several decades as shown in Essay 1 and other studies, the ecological view does not fully explain neighborhood polarization, which describes how affluent neighborhoods are becoming more segregated (i.e. more affluent) and poor neighborhoods are becoming more segregated (i.e. poorer). To expound the neighborhood polarization in terms of economic status, Essay 2 asks the following questions.

(1) Are affluent and poor neighborhoods stable in their economic status between 2000 and 2010?

(2) Are there ecological and economic factors that differentially impact the neighborhood economic change of affluent and poor neighborhoods?

This study contributes to urban neighborhood change scholarship by integrating different theoretical perspectives from the social science literature to understand why neighborhoods at the extremes of the income distribution are likely to persist in their economic status. The results of this research indicate that affluent neighborhoods have better capacity to resist the natural force of economic decline than poor neighborhoods, suggesting different paces for the cyclical process of neighborhood change.

As discussed in the literature review on the political economy perspective, the locus of income segregation within metropolitan areas also lies at the municipality level (in addition to the neighborhood-level residential sorting mechanisms through the political-based actions of municipalities). A clear political boundary, which has its own economic and social functions, will be an essential factor for understanding residential segregation. That is, individuals decide their residential location based not only on neighborhood features but also on a municipality's characteristics, such as the availability of public services or resources. Even though residential segregation represents individual-level features, such as social interactions or everyday life activities, this level of concern does not reflect the inequalities of public resources or private services. The literature suggests that residential inequality becomes more severe since initial advantages of affluent jurisdictions, often translated into political power, can be used to maintain the existing economic hierarchy of jurisdictions by shaping the spatial structure of community resources in a way that reflect their interests (Logan, 1978). On the other hand, a municipality that lacks households who can bring a stable tax base and devote much time to political participation cannot sustain organizations or local institutions, resulting in a relocation of those resources to other affluent municipalities.

Therefore, in Essay 3, I explore the unequal distribution of community resources, including food, recreation, cultural amenities, health, civic organizations, and education, across municipalities based on economic status within Southern California. The core question of this study is

(1) Are community resources unequally distributed across municipal boundaries based on economic status within a region?

Theories suggest that each municipality can have its own unique residential characteristics and profile through its authority to design a spatial development pattern using zoning or other land-use regulations. Based on this theoretical ground, I test two potential hypotheses. First, I hypothesize that affluent municipalities will likely contain most of the beneficial community resources. Second, I also hypothesize that affluent municipalities will have higher levels of resources than other municipalities when incorporating the resources in adjacent municipalities. In other words, only specific resources or services are likely to be present in affluent and economically homogeneous municipalities, while other resources, which are also important for everyday life, will be located in adjacent poorer municipalities that affluent residents can access. By examining these hypotheses, the primary goal of this study is to understand the disparities in the distribution of community resources across municipalities that differ by income levels. The findings, in general, suggest that affluent municipalities have focused on specific resources within municipal boundaries possibly to protect their property values, while having access to other resources related to retail or other private sector activities in adjacent municipalities.

As a whole, this dissertation, synthesizes different, yet related, sets of literature to understand the underlying mechanisms of the rise of income segregation: local-level segregation, neighborhood change, neighborhood polarization, economic hierarchy of place, and unequal distribution of resources. While having their own completed structure as an independent study, the three essays are connected by the larger themes of inequality and the geography of opportunity. Collectively, the three essays expand the explanations of why income segregation across local communities in the U.S. metropolitan areas has intensified.

Essay 1. Exploring the Underlying Mechanisms of Income Segregation by Utilizing Decomposed Elements of a Global Index

Introduction

Residential segregation by income has continuously intensified in the United States' metropolitan areas since the 1970s (Reardon & Bischoff, 2011). People living in affluent neighborhoods are likely to benefit from many social advantages, such as safety, quality of public resources and private services, job opportunities, and social networks, often referred to as the "geography of opportunity" (Galster & Killen, 1995). On the other hand, poor neighborhoods are often associated with fewer opportunities, with poverty being transmitted to the next generation. The deleterious effects of living in disadvantaged neighborhoods—unemployment, low public service quality, and a lack of role models for children—are well documented by scholars (Crane, 1991; Wilson, 2012). Therefore, the growing trend of income segregation is a rising concern within cities and regions.

Scholars have explored income segregation at the metropolitan area level or city level, based on global measures, which provide a single number for the regional segregation level (e.g., Jargowsky, 1996; Lens & Monkkonen, 2016; Reardon & Bischoff, 2011). Commonly used indices include the dissimilarity index (Duncan & Duncan, 1955), Theil index (Theil, 1972), neighborhood sorting index (Jargowsky, 1996), and information theory index (Reardon & Bischoff, 2011). These indices, in general, consider two levels of geography: the subunits often defined as neighborhoods and the regional areas in which these subunits are located (Joassart-Marcelli, Wolch, Alonso, and Sessoms, 2005).

Therefore, the global indices reflect residential segregation between neighborhoods, and aggregate all of the decomposed elements at the neighborhood level to derive a single segregation value for a metropolitan statistical area (MSA) as the unit of analysis. With these indices, scholars have reported the increasing trend of income segregation for several decades and investigated MSA-level factors, such as income inequality, zoning, and occupational structure, that contribute to income segregation (Jargowsky, 1996; Lens and Monkonnen, 2016; Reardon and Bischoff, 2011).

Global indices, however, abandon their very source of calculation: the massive information of decomposed elements (Johnston, Poulsen, and Forrest, 2009). As a result, an aggregated analysis at the MSA level, which only can show a regional-level temporal change, cannot explore the diverse paths that a neighborhood can take over time in terms of economic status (Joassart-Marcelli et al., 2005; Wong, 2008). For example, specific neighborhoods could have added either poor or affluent people over time, contributing to an increasing trend of regional-level income segregation, while other neighborhoods could become more mixed-income over time. Moreover, the heterogeneous structures of MSAs in terms of residential patterns which have been documented in recent studies cannot be captured through the traditional segregation indices. The evidence indicates that the spatial forms of U.S. metropolitan areas have evolved from the traditional "poor central city to affluent suburbs" structure into more diverse patterns due to suburban poverty and 'back-to-the-city movement' by upper-income households (Holliday & Dwyer, 2009; Lee & Leigh, 2007).

This study explores the local dimension of income segregation, in other words, the contribution of each neighborhood to a regional-level measure of segregation. Specifically,

this study utilizes the decomposition of the Delta Index (DI), one of the regional-level indices that measures the concentration dimension of segregation (Massey & Denton, 1988): the Local-level Delta Index (LDI). Following the approach of Bailey, Wouter, and Musterd (2017), LDI is derived by calculating the difference between the ratio of a neighborhood's total household income to the total household income of an MSA and the ratio of a neighborhood's household number to the total household numbers of the MSA in 1980, 1990, 2000, and 2010, in the 105 largest U.S. MSAs, having a population of more than 500,000 in 2010. Then, I develop a neighborhood typology based on the decadal change of LDI, which defines the trajectories of neighborhood income concentration. With this neighborhood typology, this study examines the following questions:

(1) Which types of economic trajectories have neighborhoods experienced from 1980 to 2010 in the 105 largest U.S. metropolitan areas? And how do they vary by location within an MSA?
(2) How does the intra-variation of the trajectories define the spatial forms of the MSAs?
(3) What are the spatial structures of the trajectories?
(4) How do the longitudinal trajectories vary by the location and initial income status of a neighborhood?

By answering these questions, this research reveals the intra-MSA location, clustering patterns, and longitudinal trajectories of the change in neighborhood income concentration (especially for the neighborhoods evolving toward either greater affluence or poverty), which cannot be revealed through a regional-level analysis. Identifying the

underlying mechanisms of the neighborhood economic transition by conducting fine-grained analysis is crucial since the geographical separation between different income groups along neighborhood boundaries has a significant potential to exacerbate several social problems (Reardon & Bischoff, 2011; Wilson, 2012).

The remainder of this paper is organized as follows. I begin with a literature review on residential segregation. Then I discuss the research questions and describe the data and analytical strategies. Next are presented the results of the empirical analyses. In the final section, I discuss the major findings of this study and provide a suggestion for future research.

Literature Review

The literature has documented a growing tendency of increased income segregation among neighborhoods in U.S. metropolitan areas during the last four decades. To be specific, investigators have found that income segregation between neighborhoods increased in the 1970s and 1980s, stabilized or marginally decreased in the 1990s, and then rose again during the 2000s (Brinegar & Leonard, 2008; Jargowsky, 1996; Lens & Monkkonen, 2016; Massey & Fischer, 2003; Reardon & Bischoff, 2011).

The simplest ways of studying income segregation are to calculate the proportion of the population whose income is lower than the poverty threshold in a given area or to assign levels to neighborhoods on a scale of poor to rich based on selected poverty rates. Bischoff and Reardon (2014), for example, measured income segregation by calculating the proportions of families in high-, moderate-, and low-income neighborhoods out of the total families in a particular metropolitan area. The study compared the median family income

of each census tract to the median income of the metropolitan area, and then used the ratio to classify neighborhoods into six types, ranging from poor (a ratio less than 0.67) to affluent (a ratio greater than 1.5). Next, Bischoff and Reardon calculated the proportion of families in each neighborhood to the whole families in the metropolitan area. The study thus measured income segregation by adding up the proportions of families residing in poor and affluent neighborhoods. In a metropolitan area with a high level of income segregation, most families would be concentrated in poor and affluent neighborhoods, rather than in middle-income neighborhoods.

Scholars have also documented the trends of income segregation at the metropolitan area level or city level based on various segregation measures. Due to the extensive attention to racial–ethnic segregation by many researchers, most income segregation work has relied on racial–ethnic segregation indices to measure residential segregation by income. In their seminal work, Massey and Denton (1988) introduced five dimensions of residential segregation between unordered categorical groups: evenness, exposure, concentration, centralization, and clustering. Later, Brown and Chung (2006) argued that the dimensions could be reduced to just two: evenness and exposure. The evenness dimension, which measures the level of uneven spatial distribution of specific income groups within a regional area, appears to be the most common dimension for measuring income segregation. Perfect evenness—which would be complete integration—is accomplished when all subunits, like census tracts, have equal proportions of low-income households and high-income households across a city. On the other hand, if each subunit is completely homogeneous with a single group, the city has minimal evenness and maximum segregation. Commonly used indices of evenness include the dissimilarity index

(e.g., Abramson, Tobin, and VanderGoot, 1995), Theil index (e.g., Fischer, Stockmayer, Stiles, and Hout, 2004), neighborhood sorting index (e.g., Jargowsky, 1996; Yang & Jargowsky, 2006), and information theory index (e.g., Reardon & Bischoff, 2011).

The exposure dimension refers to "the degree of potential contact, or the possibility of interaction, between minority and majority group members within geographic areas of a city" (Massey and Denton, 1988, p. 287). While evenness only compares the relative proportion of minorities in each neighborhood to the regional proportion of minorities, exposure suggests that the relative size of the minority-to-majority equation is important. For example, even when low-income households are distributed evenly across a city, if the size of the low-income group relative to the high-income group is large, this suggests a small level of exposure to high-income households. On the other hand, if the relative size of the low-income group to the high-income group is small, this suggests a high level of exposure of the low-income group to high-income households. The isolation index is an index widely used to consider exposure in the literature (e.g., Abramson et al., 1995; Massey, Rothwell, and Domina, 2009).

Since these traditional evenness and exposure measures at the city level are aspatial, several scholars have advanced the indices by incorporating the spatial dimension (Catney, 2018; Dawkins, 2013; Wong, 2002). Such efforts have considered the adjacent neighborhoods within a specific distance of the focal neighborhoods. This approach can "capture the potential of spatial interaction among population groups across enumeration-unit boundaries" (Wong, 2008, p. 459).

Regional-level analyses based on a single value of MSAs are useful for developing region-wide policies, as well as for providing comparisons between regional areas (Wong,

2008). However, one limitation of previous studies is that each neighborhood's economic status has been discarded after being used to calculate a single value of regional-level segregation measure (Johnston et al., 2009). The income segregation value for each neighborhood, which indicates its contribution to the single value of segregation at the MSA level, varies across neighborhoods and also changes over time for the same neighborhood. Jargowsky (1996) documented the mean level of income segregation for Whites for all metropolitan areas with 10,000 or more households for 1970, 1980, and 1990 using NSI, calculating NSI figures of 0.310, 0.343, and 0.374, respectively. These numbers clearly show an increasing trend of income segregation among Whites for all metropolitan areas in the U.S. during that period, but it cannot identify diverse trajectories for each neighborhood.

This research, therefore, investigates the unique path that each neighborhood can undergo in terms of economic status. Specifically, I utilize a local component of a regional-level income segregation index. Based on the decadal change of neighborhood-level economic status, this study consists of three analyses, in general: (1) exploring the intra-variation of the trajectories within the U.S. MSAs and identifying the spatial forms of the U.S. MSAs based on the trajectories, (2) investigating the spatial structure of the trajectories, and (3) identifying the longitudinal trajectories and how they vary by location and income status.

Data and Methodology

Data

This research relies on the Neighborhood Change Database (NCDB) from GeoLytics. This database provides census tract's economic and demographic data for each decade since 1970. The boundaries of the census tracts are normalized to that of 2010, allowing direct comparison for the changes over time at the tract level. In this study, census tracts serve as a proxy for neighborhoods which is consistent with most of the studies of U.S. neighborhood change. This study will use the data for 1980, 1990, 2000, and 2010 to measure income segregation.[1] The data from 1980 to 2010 will allow one to explore the longitudinal changes of neighborhood-level economic status within the 105 largest U.S. MSAs; in other words, MSAs with a population of 500,000 or more in 2010. The definitions of an MSA vary over time. This research uses the metropolitan area definitions reported in December 2009 for a consistent comparison between time periods. Therefore, the spatial definition of MSAs in 1980, 1990 and 2000 will be modified to fit the 2010 areas. To measure income segregation at the regional level using the Delta Index (DI) and economic status at the neighborhood level using the Local-level Delta Index (LDI) (these measures are discussed later in this section), I obtained the aggregated household income and the total number of households in the census tracts for each decennial year.

Another aim of this study is to identify the intra-variation in the trajectories of neighborhoods' economic statuses. Therefore, I define each census tract's location within an MSA: the central cities, inner suburbs, and outer suburbs. Since the U.S. Census Bureau does not provide a uniform definition of suburban geographies, the definitions of suburbs vary across the literature. This study follows the place-level definition of Hanlon & Vicino (2007) which classifies suburbs into inner and outer suburbs based on their location and the age of housing stock. Following the literature, Hanlon and Vicino (2007) viewed inner

suburbs as adjacent to the city and as the oldest suburbs among suburbs in the metropolitan area (areas are formed in the first phase of suburbanization). Hanlon and Vicino (2007), therefore, define inner suburbs in two ways. First, the inner suburbs are those which share a boundary with the central city. In addition, the other suburbs that are adjacent to the inner suburbs, specified in the first step, are also defined as inner suburbs if they contain more than 50% of the housing stock built before 1970. As NCDB provides the code of Census Place, defined in 2010, for each census tract, I was able to assign census tracts to the central cities and inner suburbs. Lastly, the rest of the census tracts are classified as outer suburbs.

Measuring neighborhood-level economic status

DI is one of the regional segregation indices that measures the concentration dimension of segregation. Concentration measures how the physical distribution of space in a region is unequal across each neighborhood's population (Massey and Denton, 1988). Instead of utilizing the data of the physical area, Bailey et al. (2017) applied the income data in calculating DI to measure the unequal distribution, among each neighborhood's population, of the city's total income. DI is an aggregation of local elements, which I term as the Local-level Delta Index (LDI). In this study, LDI (see equation 1), each neighborhood's contribution to DI, calculates the difference between the share of a neighborhood's total household income to the total household income of an MSA and the share of a neighborhood's household number to the total household number of the MSA, to measure income segregation. LDI, then, indicates the extent to which the total household income of an MSA is concentrated in a neighborhood compared to the distribution of the total

household number within an MSA. The formula for LDI is as follows.

$$LDI_{mi} = \frac{k_{mi}}{K_m} - \frac{h_{mi}}{H_m} \quad (1)$$

where, k_{mi} refers to total household income of neighborhood *i* within MSA *m*, K_m refers to total household income of MSA *m*, h_{mi} represents total number of households of neighborhood *i* within MSA *m*, and H_m denotes total number of households of MSA *m*. As a positive LDI at a certain time point indicates that households in a neighborhood have a higher income, on average, than the mean of the MSA's household income, I define such neighborhoods as an upper-income neighborhood. On the other hand, a neighborhood which has a negative LDI at a certain time point is defined as a lower-income neighborhood as households in such neighborhood would have lower household income, on average, than the mean of the MSA's household income. An increase in LDI in either upper- or lower-income neighborhoods is caused by an in-migration of a household whose income is higher than the mean household income of MSA *m* or an out-migration of a household whose income is lower than the mean household income of MSA *m*, and vice versa for a decrease in LDI. Therefore, regardless of their initial economic status, an increase in LDI in each neighborhood indicates that the neighborhood becomes more affluent, on average, while a decrease in LDI suggests that the neighborhood becomes poorer, on average (Bailey et al., 2017). Since individual-level information is not available in census tract data, whether the change of LDI is caused by an outflow or an influx of different income groups cannot be identified. To avoid confusion, this study identifies an increase of LDI as *neighborhood economic ascent* and a decrease of LDI as *neighborhood economic decline* regardless of the possible processes.

When the absolute values of LDI_{mi} are summed for all census tracts within an MSA m and divided by two, DI for an MSA m is derived.

$$DI_m = \frac{1}{2}\sum \left| \left[\frac{k_{mi}}{K_m} - \frac{h_{mi}}{H_m} \right] \right| \quad (2)$$

DI can be interpreted as the share of households' income that needs to shift for accomplishing an equal distribution of income across neighborhoods within an MSA. A higher level of DI implies a higher level of income segregation across neighborhoods within an MSA.

Neighborhood typology

This research specifically explores the decadal change of LDI. When presenting the intra-variation of segregation levels across neighborhoods at a certain time, the decomposed elements at the neighborhood level simply indicate the relative contribution of a neighborhood to the regional-level index (Brown and Chung, 2006). In other words, there is no inherent meaning of the value of the decomposed elements, indicating that LDIs in different MSAs cannot be compared to one another. Moreover, the direct comparison among LDIs across neighborhoods within the same MSA is not easy to interpret. This is because LDI is not based on one variable, such as income, but is the combination of two dimensions: total income and total households in a neighborhood. Therefore, solely focusing on the value of LDI would make it difficult to interpret the results. Last but not least, one of the main purposes of this study is to reveal the trajectories of neighborhoods in terms of economic status and their spatial structures. While many studies have explored the trend of income segregation and the region- or city-level factors associated with the increasing trend of income segregation, investigating the transition of the neighborhoods'

economic statuses is also crucial for understanding the underlying mechanism of income segregation. Therefore, this study focuses on the change of LDI during a decade. NCDB provides normalized boundaries of neighborhoods across decades, allowing one to investigate the changing paths of LDI for each neighborhood over time.

To explore the transitions of the neighborhood-level economic status, I develop a neighborhood typology, in which each neighborhood is classified into one of six groups based on their decadal changes in LDI (see Figure 1), which is similar to the work of Bailey et al. (2017) who grouped neighborhoods into two types: polarizing neighborhoods and reordering neighborhoods. Classifying neighborhoods based on the decadal change of LDI, rather than relying on cross-sectional information, also allows one to identify an important facet of neighborhood change as different changing paths of neighborhoods can be detected through this approach. Let us suppose that one specific neighborhood, A, was poor in the preceding time point, t_1, and then became affluent in the subsequent time point, t_2, while the other neighborhood, B, was affluent in both t_1 and t_2. Both neighborhoods can be categorized as affluent neighborhoods at t_2. However, when considering the economic status of the neighborhoods at t_1, it is clear that they have experienced different paths of economic change.

This work establishes three possible options for neighborhood change: 'upgrading,' 'stability,' and 'decline' (Temkin & Rohe, 1996). For upper-income neighborhoods and lower-income neighborhoods, I apply the three possible paths, creating six categories based on the decadal change of LDI. For example, upper-income neighborhoods at t_1 can be classified as upper-upgraded-upper neighborhoods (UUU), upper-stabilized-upper neighborhoods (USU), and upper-declined-lower neighborhoods (UDL) at t_2, which indicate

upgrading, stability, and decline respectively between t_1 and t_2. Lower-income neighborhoods at t_1 can be termed as lower-upgraded-upper neighborhoods (LUU), lower-stabilized-lower neighborhoods (LSL), and lower-declined-lower neighborhoods (LDL) at t_2, which indicate upgrading, stability, and decline respectively between t_1 and t_2.

The first neighborhood group, UUU (upper-upgraded-upper neighborhoods), is one where the LDI was positive in t_1, and the LDI increased from t_1 to t_2. UUUs, already concentrated with higher-income residents, became occupied with a larger share of higher-income households than before, on average. The second group, LDL (lower-declined-lower neighborhood), is one where the LDI was negative in t_1, and the LDI decreased from t_1 to t_2. LDLs became even poorer or were occupied by a larger share of lower-income households than before, on average. These two types of neighborhoods indicate neighborhoods that are transitioning to either greater affluence or poverty during a decade (Bailey et al., 2017).

The third group, USU (upper-stabilized-upper neighborhoods), is one where the LDI was positive in t_1, and then decreased from t_1 to t_2, but still maintained a positive value of LDI. USUs experienced neighborhood decline, but households' income is still higher than the mean household income of an MSA, on average. The fourth group, LSL (lower-stabilized-lower neighborhoods), is one where the LDI was negative in t_1, and increased from t_1 to t_2, but still had a negative value in t_2. Even though LSLs experienced economic ascent, households in such neighborhoods, on average, have a lower income than the mean household income of an MSA, at t_2.

The fifth group of neighborhoods, UDL (upper-declined-lower neighborhoods), is one where the LDI was positive in t_1, and the LDI decreased from t_1 to t_2, becoming negative. Therefore, the average household income in UDL became lower than the mean

household income of an MSA during a decade. The sixth group of neighborhoods, LUU (lower-upgraded-upper neighborhoods), represents those in which the LDI was negative in t_1, and became positive in t_2. The average households' income in LUU became higher than the mean household income of an MSA during a decade. These two types of neighborhoods present that the sign of LDI was reversed during a decade. The adoption of both cross-sectional and change-over-time approaches to recognize neighborhood types allows a researcher to identify the multiple ways a neighborhood can change in economic status. Figure 1 shows the concepts of the neighborhood typology.

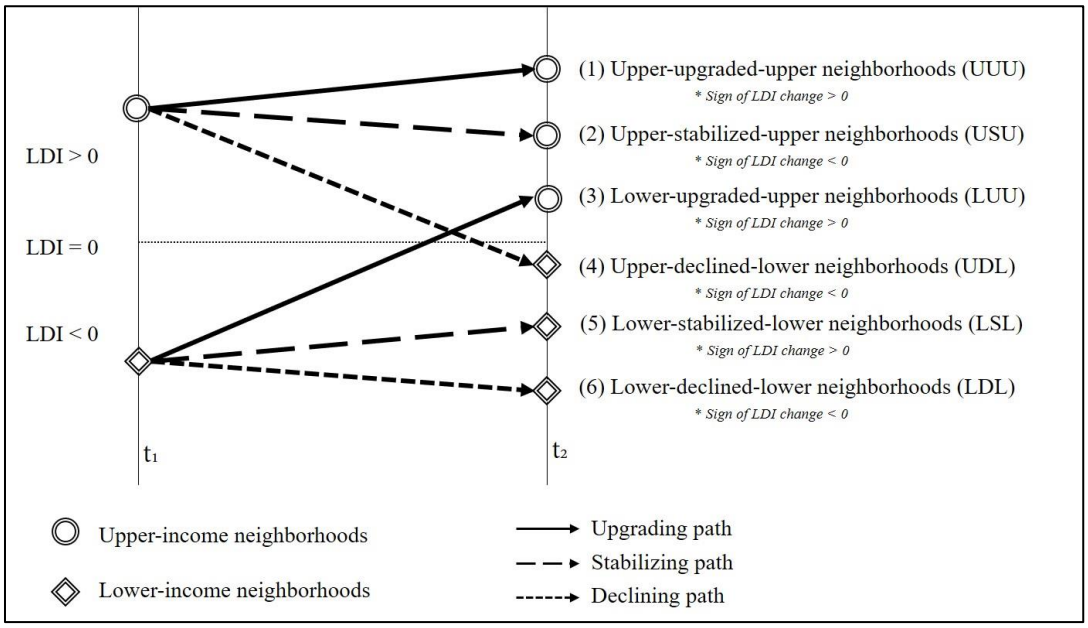

Figure 1. The concepts of neighborhood typology based on LDI change.

Figure 1 aims to provide the concept of neighborhood typology. The horizontal location of the end arrow does not imply a fixed order of the LDI values by neighborhood types. For example, LDI in t_2 can be higher in LUU than that of UUU or USU. Based on the neighborhood typology, this research consists of three analyses, in general. First, I calculate the percentages of the neighborhood types (e.g., UUU, USU, LUU, LDL, LSL, and UDL) for

each location (e.g., the central city, inner suburbs, and outer suburbs) within an MSA, indicating that each MSA has a total of 18 variables regarding neighborhood types. Moreover, this research applies k-means clustering to classify the 105 MSAs, based on the percentages of the neighborhood types in each location for 1990, 2000, and 2010, identifying the spatial forms of income segregation. k-means clustering is the most popular method of partitioning total observations into a number of clusters. As a first step, I investigate 2–10 different cluster solutions by pre-specifying the number of clusters, k. Next, I calculate the total within-cluster sum of squares and the average silhouette width to obtain the optimal number of clusters. Lastly, I decide the number of groups after exploring the mean value of variables for each cluster solution.

Second, this research investigates the spatial structure of the changes of LDI during the 1980s, 1990s, and 2000s. This research creates a binary weighting matrix that assigns the value of 1 to census tracts j ($i \neq j$) that share common boundaries or vertices with census tract i while a value of 0 is assigned to nonadjacent units. I, then, calculate each proportion of neighborhoods which belongs to one of six types based on the neighborhood typology for 1990, 2000, and 2010.

Third, I focus on longitudinal trajectories by presenting all possible sequences that a neighborhood can take from 1980 to 2010, and how the sequences vary across locations and based on a neighborhood's initial income status. To analyze the longitudinal trajectories of neighborhood-level economic status, I assign numbers, from 1 to 6, to each neighborhood type: 1 for UUU, 2 for USU, 3 for LUU, 4 for UDL, 5 for LSL, and 6 for LDL. This approach allows every neighborhood to have a three-digit sequence. For example, a sequence "111" indicates that a neighborhood was classified as UUU in 1990, 2000, and

2010, suggesting that such neighborhood continuously experienced neighborhood economic ascent from 1980 to 2010.

Results

The trend of MSA-level income segregation

This study, first, investigates the trend of income segregation at the MSA level, following the previous literature. In general, the results exhibit a similar trend as those documented by scholars: income segregation within U.S. metropolitan areas increased in the 1980s, stabilized or marginally decreased in the 1990s, and then rose again in the 2000s. More specifically, among the 105 MSAs, 95 MSAs experienced an increase in the level of income segregation during the 1980s. In the 1990s, on the other hand, the number of MSAs with increased income segregation dropped to 62. Then, in the 2000s, the number of MSAs increased once again to 103. Moreover, about 36% of (38/105) MSAs experienced an increase in DI in the 1980s, a decrease in DI in the 1990s, and a rise of DI in the 2000s. However, more than half of the MSAs (54/105) experienced the continuous increasing trends in income segregation from 1980 to 2010 while none experienced continuously decreasing trends. The national mean of income segregation increased, decade to decade, from 1980 to 2010 (0.121, 0.134, 0.137, and 0.150 for 1980, 1990, 2000, and 2010, respectively). These results confirmed that, income segregation in the MSAs has generally increased in the last several decades.

To show the limitation of using global indices for studying residential segregation, in Figure 2 and Figure 3, I map the spatial distribution of LDI in the Phoenix and Baltimore metropolitan areas from 1980 to 2010 as they have presented similar levels and changing

trends of DI during the time (see Table 1). The maps show that neighborhood household income is not evenly distributed across neighborhoods within a region (a higher height implies a higher level of neighborhood income concentration). Moreover, its spatial pattern presents different landscapes. To be specific, while in the Phoenix MSA, neighborhood income has been concentrated in the central area, in the Baltimore MSA, it is clearly shown that household income has been concentrated in the suburbs. This result goes far beyond the global index by capturing the unique profiles of each neighborhood within a region and the spatial structure of MSAs.

Table 1. The level and trend of the Delta Index from 1980 to 2010 in Phoenix and Baltimore MSAs

	DI				Change of DI		
	1980	1990	2000	2010	1980-1990-	1990-2000-	2000-2010-
Phoenix MSA	0.129	0.154	0.161	0.167	+	+	+
Baltimore MSA	0.128	0.150	0.153	0.163	+	+	+

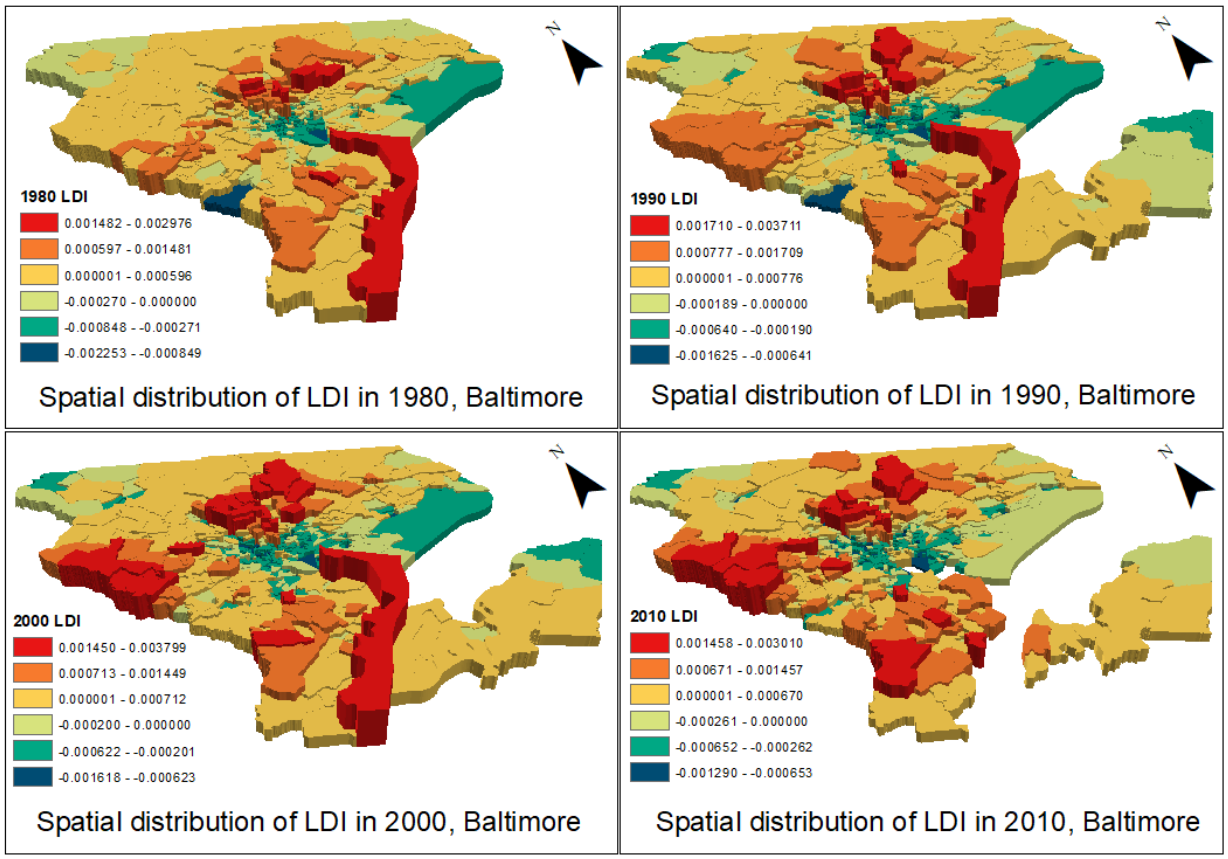

Figure 2. The spatial distribution of LDI in the Baltimore MSA from 1980 to 2010

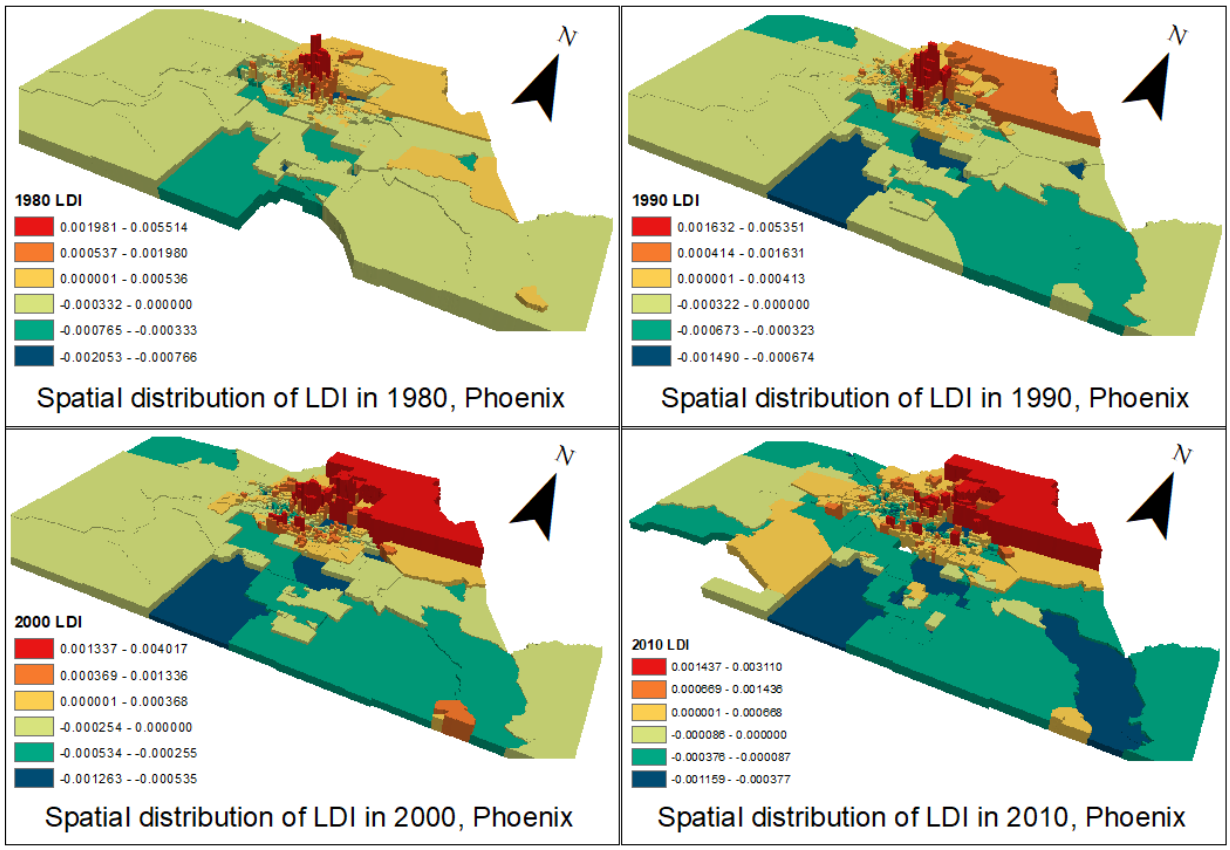

Figure 3. The spatial distribution of LDI in the Phoenix MSA from 1980 to 2010

The intra-variation of the trajectories and the urban spatial forms

Based on the neighborhood typology, Table 2 presents the trends of LDI, classified by spatial location and decades. By focusing on all neighborhoods in the study areas, one interesting finding that emerges is the proportion of LSL, which increased significantly from 1990 to 2000 (from 18.2% to 26.0%). LSL indicates that even though a neighborhood experienced economic ascent during a decade, household income is still lower than the mean household income of an MSA, on average. The result of LSL may be in line with previous works (e.g., Galster, Quercia, Cortes, and Malega, 2003; Gould Ellen & O'Regan, 2008) in that a considerable number of high-poverty neighborhoods moved out of the high-poverty category, and that the population living in high-poverty neighborhoods was significantly reduced in the 1990s. However, scholars have noted that the reduction of high-poverty neighborhoods was a residential relocation that reduced the distance between the poor and the near-poor, and not the distance between the poor and the affluent (Dwyer, 2012). These results are also suggested by the marginal increase of LUU (lower-upgraded-upper neighborhoods) from 1990 to 2000 (from 4.1% to 4.2%).

Focusing on the neighborhoods by their location within an MSA, the result, in general, shows the traditional dichotomy between the poor central city and affluent suburbs. To be specific, upper-income neighborhoods evolving toward greater affluence (e.g., UUU) were likely to concentrate in the suburbs while lower-income neighborhoods declining toward deeper poverty (e.g., LDL) were likely to locate in the central cities.

One interesting finding is that the percentages of UDL, in which neighborhoods became lower-income neighborhoods from upper-income neighborhoods during a decade, in the inner and outer suburbs, were higher than in the central cities for all three decades.

This finding may support the propositions about the ongoing evolution of urban spatial structure in U.S. metropolitan areas, from the traditional "poor central city to affluent suburbs" structure into more diverse patterns of suburban stratification suggested in the suburban poverty literature. As the outward expansion of suburbs occurs continuously, the suburbs experience a simultaneous decline due to the invasion of new population groups (Holliday & Dwyer, 2009).

Table 2. The percentages of neighborhood types for each location within an MSA

		UUU	USU	LUU	UDL	LSL	LDL	Total
Total	1990	21.53% (9,469)	16.47% (7,243)	4.11% (1,806)	10.85% (4,772)	18.20% (8,005)	28.84% (12,684)	100% (43,979)
	2000	17.94% (7,891)	16.65% (7,322)	4.24% (1,863)	7.53% (3,311)	26.01% (11,439)	27.63% (12,153)	100% (43,979)
	2010	17.66% (7,768)	15.14% (6,657)	5.00% (2,199)	6.03% (2,650)	24.78% (10,899)	31.39% (13,806)	100% (43,979)
Central cities	1990	12.36% (1,801)	11.37% (1,656)	3.21% (468)	8.85% (1,289)	29.26% (4,262)	34.95% (5,091)	100% (14,567)
	2000	8.78% (1,279)	11.53% (1,680)	2.94% (428)	6.64% (967)	37.66% (5,486)	32.45% (4,727)	100% (14,567)
	2010	10.27% (1,496)	8.79% (1,280)	4.24% (617)	4.19% (611)	34.87% (5,079)	37.65% (5,484)	100% (14,567)
Inner suburbs	1990	19.33% (1,781)	19.80% (1,825)	3.41% (314)	12.93% (1,192)	15.21% (1,402)	29.32% (2,702)	100% (9,216)
	2000	15.84% (1,460)	18.37% (1,693)	3.32% (306)	8.33% (768)	24.72% (2,278)	29.42% (2,711)	100% (9,216)
	2010	16.11% (1,485)	15.07% (1,389)	4.26% (393)	6.33% (583)	24.25% (2,235)	33.97% (3,131)	100% (9,216)
Outer suburbs	1990	29.15% (5,887)	18.63% (3,762)	5.07% (1,024)	11.34% (2,291)	11.59% (2,341)	24.22% (4,891)	100% (20,196)
	2000	25.51% (5,152)	19.55% (3,949)	5.59% (1,129)	7.80% (1,576)	18.20% (3,675)	23.35% (4,715)	100% (20,196)
	2010	23.70% (4,787)	19.75% (3,988)	5.89% (1,189)	7.21% (1,456)	17.75% (3,585)	25.70% (5,191)	100% (20,196)

* The numbers of the neighborhoods are in the parentheses.

Based on the percentages of neighborhood types for each location, a cluster analysis was conducted to identify the spatial forms of MSAs. Specifically, the pooled MSA-level data of 315 observations (105 observations for 1990, 2000, and 2010) was partitioned by utilizing k-means clustering. The classification solution was selected by not only computing diagnostic statistics but also considering whether the result was theoretically meaningful. A three-cluster solution which consists of three groups—*weak suburbia*, *inner-ring suburbia*, and *extended suburbia*—was selected (see Table 3).

In the weak suburbia cluster, the percentage of UUU, upper-income neighborhoods evolving to greater affluence, in the central cities (17.1%) and that of LDL, lower-income neighborhoods experiencing further economic decline, in the outer suburbs (29.0%) are the highest compared to the same locations in other clusters. On the other hand, the percentages of UUU in the outer suburbs (18.5%) and that of LDL in the central cities (25.8%) are the lowest compared to the same locations in other clusters. When comparing within an MSA, the percentage of LDL also marks the highest in the outer suburbs (25.8% in the central cities, 25.0% in the inner suburbs, and 29.0% in the outer suburbs). These results suggest that weak suburbia has a relatively stronger central city and weak suburban areas than other clusters in terms of income status.

Inner-ring suburbia has the highest percentage of UUU (40.4%) and the lowest percentage of LDL (12.1%) in the inner suburbs compared to the inner suburbs of other clusters. These results can be applied also when comparing other locations within an MSA (e.g., the central cities and outer suburbs). Moreover, about 69.2% (40.4% + 24.4% + 4.4%) of the neighborhoods in the inner suburbs are upper-income neighborhoods, higher than 31.1% (13.0% + 15.4% + 2.7%) and 42.2% (25.2% + 13.7% + 8.3%) in the central cities

and outer suburbs, respectively. These results suggest the strong income status of inner suburbs in this cluster.

In the extended suburbia, the percentage of UUU in the outer suburbs (30.6%) and that of LDL in the central cities (39.8%) and the inner suburbs (35.9%) are the highest compared to the same locations in other clusters. On the other hand, the percentages of UUU in the central cities (5.5%) and the inner suburbs (11.9%) were the lowest compared to the same locations in other clusters. Moreover, about 56.3% (30.6% + 20.3% + 5.4%) of neighborhoods in the outer suburbs are upper-income neighborhoods, higher than 14.6% (5.5% + 6.6% + 2.5%) and 32.8% (11.9% + 18.0% + 2.9%) in the central cities and outer suburbs, respectively. These results indicate that the neighborhoods in the outer suburbs are likely to have a strong economic status, while those in the central cities have a lower economic status.

Table 3. Mean centers for three-cluster scheme of neighborhood types

Variables	Cluster 1: Weak Suburbia	Cluster 2: Inner-ring Suburbia	Cluster 3: Extended Suburbia
Central cities			
UUU	17.1%*	13.0%*	5.5%*
USU	17.2%	15.4%	6.6%*
LUU	4.9%*	2.7%	2.5%
UDL	9.5%	10.1%	3.8%*
LSL	25.5%	28.2%	41.7%*
LDL	25.8%*	30.5%*	39.8%*
Total	100%	100%	100%
Inner suburbs			
UUU	19.3%*	40.4%*	11.9%*
USU	15.1%*	24.4%*	18.0%*
LUU	5.6%	4.4%	2.9%*
UDL	8.8%	10.9%	9.7%
LSL	22.9%*	7.9%*	19.6%*

LDL	25.0%*	12.1%*	35.9%*
Total	100%	100%	100%
Outer suburbs			
UUU	18.5%*	25.2%*	30.6%*
USU	12.0%	13.7%	20.3%*
LUU	7.4%	8.3%	5.4%*
UDL	9.0%	9.0%	8.4%
LSL	24.1%*	20.5%*	13.8%*
LDL	29.0%*	23.3%	21.6%
Total	100%	100%	100%
Total number of MSAs in each cluster	77	93	145

The results of the cluster analysis also reveal how the 105 MSAs have evolved over time in terms of their spatial structure (see Table 4). The majority of MSAs (84 out of 105; 24 for weak suburbia cluster, 19 for inner-ring suburbia cluster, and 41 for extended suburbia cluster) maintained their spatial structure in all three decades. These results confirmed that the suburbanization of upper-income groups was the dominant spatial pattern in the U.S. MSAs. Moreover, among the MSAs that have changed their spatial form in terms of income segregation, about 57% (12 out of 21) became extended suburbia in 2010, while the rest (9 out of 21) became weak suburbia in 2010. None of MSAs was transformed into inner-ring suburbia, which has a strong economic status in the inner suburbs, conforming the literature's finding that inner-ring suburban areas are experiencing economic decline.

Table 4. The transition of the 105 MSAs' spatial structures based the neighborhood typology

	Spatial structure in 1990	Spatial structure in 2000	Spatial structure in 2010	N
1	Weak Suburbia	Weak Suburbia	Weak Suburbia	24 (22.9%)
2	Inner-ring Suburbia	Inner-ring Suburbia	Inner-ring Suburbia	19 (18.1%)

3	Extended Suburbia	Extended Suburbia	Extended Suburbia	41 (39.0%)
4	Weak Suburbia	Weak Suburbia	Extended Suburbia	3 (2.9%)
5	Inner-ring Suburbia	Extended Suburbia	Extended Suburbia	5 (4.8%)
6	Inner-ring Suburbia	Weak Suburbia	Extended Suburbia	1 (1.0%)
7	Inner-ring Suburbia	Inner-ring Suburbia	Extended Suburbia	3 (2.9%)
8	Extended Suburbia	Weak Suburbia	Weak Suburbia	1 (1.0%)
9	Extended Suburbia	Extended Suburbia	Weak Suburbia	2 (1.9%)
10	Inner-ring Suburbia	Weak Suburbia	Weak Suburbia	4 (3.8%)
11	Inner-ring Suburbia	Inner-ring Suburbia	Weak Suburbia	2 (1.9%)
Total				105

Spatial structure of the patterns of segregation

This section explores the spatial patterns of the neighborhood groups during the 1980s, 1990s, and 2000s, classified by the decadal changes of LDI. Tables 5–7 presents the spatial structure of neighborhood typology for three decades. In general, the results show that in most cases for all three decades, a neighborhood is likely to be surrounded by neighborhoods that experienced the same changing pattern of LDI. In other words, the largest proportion of the neighborhoods that surround a focal neighborhood is the same neighborhood group with the neighborhood.

Interestingly, neighborhoods changing towards either the poor or the affluent (e.g., UUU and LDL) were more likely to cluster compared to other neighborhood types (e.g., USU, LSL, LUU, and UDL) in 1990 and 2010. To be specific, if an upper-income (lower-income) neighborhood experienced an increase (decrease) in LDI during a decade, the percentages of neighborhoods that experienced the same tendency were mostly higher than the cases of other types of neighborhoods in 1990 and 2010. The result also shows that UUU in 2000 were likely to clustered than other types of upper-income neighborhoods in 2000. Moreover, the results in Table 5 and 7 also show that in 1990 and 2010, UUU and

LDL were more likely to be surrounded by the same types of neighborhoods, UUU and LDL, respectively, than other neighborhood types for all locations. However, in 2000 (see Table 6), about 62.2% and 50.4% of the LSL's surrounding neighborhoods were also LSL in the central cities and outer suburbs, respectively, while 52.6% and 50.3% of the LDL's surrounding neighborhoods were also LDL in the central cities and outer suburbs, respectively.

Moreover, neighborhoods which experienced a reordering trend of LDI (e.g., LUU or UDL) were likely to be surrounded by neighborhoods with diverse changing patterns of LDI compared to the other types of neighborhoods. The clustering patterns of neighborhoods either to greater poor or affluence and the relatively weak clustering patterns of reordering neighborhoods indicate that segregating patterns were more likely to occur beyond neighborhood boundaries than other changing paths.

Table 5. The percentages of spatially adjacent neighborhoods by neighborhood types, 1990

Central cities						
	spatially adjacent neighborhoods					
	UUU	USU	LUU	UDL	LSL	LDL
UUU	**57.1%**	16.9%	4.0%	6.6%	7.7%	7.7%
USU	17.7%	**46.7%**	3.4%	10.7%	8.1%	13.3%
LUU	15.0%	12.5%	**29.1%**	6.1%	21.3%	16.0%
UDL	10.3%	16.5%	2.4%	**38.1%**	9.4%	23.3%
LSL	4.2%	4.4%	2.7%	3.3%	**58.7%**	26.7%
LDL	3.7%	6.2%	1.8%	6.9%	22.2%	**59.1%**
Inner Suburbs						
	spatially adjacent neighborhoods					
	UUU	USU	LUU	UDL	LSL	LDL
UUU	**60.1%**	17.4%	3.8%	6.4%	5.2%	7.2%
USU	18.6%	**48.6%**	2.4%	11.5%	6.0%	12.9%
LUU	18.3%	12.3%	**36.5%**	5.8%	12.2%	14.9%
UDL	10.2%	17.7%	1.9%	**40.3%**	7.3%	22.6%
LSL	6.4%	6.8%	3.0%	5.6%	**49.9%**	28.3%
LDL	4.9%	8.7%	2.0%	9.9%	15.8%	**58.7%**
Outer Suburbs						
	spatially adjacent neighborhoods					
	UUU	USU	LUU	UDL	LSL	LDL
UUU	**64.0%**	15.4%	3.7%	6.0%	4.1%	6.8%
USU	23.2%	**49.5%**	2.8%	9.3%	4.7%	10.5%
LUU	20.0%	9.8%	**38.4%**	6.6%	9.8%	15.3%
UDL	14.9%	15.4%	3.2%	**42.1%**	6.9%	17.5%
LSL	10.3%	7.7%	4.7%	6.6%	**46.5%**	24.3%
LDL	8.7%	8.6%	3.8%	8.6%	12.8%	**57.5%**

Table 6. The percentages of spatially adjacent neighborhoods by neighborhood types, 2000

Central cities						
	spatially adjacent neighborhoods					
	UUU	USU	LUU	UDL	LSL	LDL
UUU	**48.7%**	21.8%	4.3%	6.9%	9.2%	9.0%
USU	17.9%	**46.2%**	2.9%	8.3%	11.0%	13.7%
LUU	14.3%	11.6%	**27.0%**	5.8%	23.2%	18.1%
UDL	11.5%	16.6%	2.8%	**31.1%**	14.7%	23.4%
LSL	3.0%	4.8%	2.2%	3.2%	**62.2%**	24.6%
LDL	3.7%	7.2%	2.1%	5.9%	28.5%	**52.6%**
Inner Suburbs						
	spatially adjacent neighborhoods					
	UUU	USU	LUU	UDL	LSL	LDL
UUU	**52.3%**	21.1%	4.0%	6.3%	7.5%	8.8%
USU	20.3%	**46.9%**	2.8%	8.5%	8.9%	12.7%
LUU	17.0%	12.6%	**28.4%**	6.2%	16.7%	19.1%
UDL	12.0%	18.6%	2.6%	**31.7%**	12.5%	22.4%
LSL	5.2%	6.5%	2.6%	4.4%	**52.1%**	29.2%
LDL	5.6%	8.2%	2.4%	6.5%	25.0%	**52.3%**
Outer Suburbs						
	spatially adjacent neighborhoods					
	UUU	USU	LUU	UDL	LSL	LDL
UUU	**57.1%**	19.1%	4.6%	5.6%	6.3%	7.3%
USU	26.1%	**46.0%**	3.7%	6.4%	7.2%	10.6%
LUU	19.2%	11.2%	**32.0%**	5.1%	15.7%	16.9%
UDL	18.8%	15.3%	4.4%	**31.6%**	12.0%	17.9%
LSL	8.8%	6.9%	5.3%	4.7%	**50.4%**	23.8%
LDL	8.6%	8.6%	5.1%	6.2%	21.3%	**50.3%**

Table 7. The percentages of spatially adjacent neighborhoods by neighborhood types, 2010

Central cities						
	spatially adjacent neighborhoods					
	UUU	USU	LUU	UDL	LSL	LDL
UUU	**43.7%**	20.9%	5.3%	6.7%	11.3%	12.2%
USU	24.6%	**40.5%**	3.5%	7.1%	9.8%	14.5%
LUU	15.2%	9.4%	**23.8%**	5.2%	24.4%	22.0%
UDL	16.2%	15.6%	4.4%	**24.8%**	14.6%	24.4%
LSL	4.7%	3.8%	3.3%	2.6%	**51.3%**	34.3%
LDL	4.7%	4.8%	2.7%	3.8%	29.7%	**54.3%**
Inner Suburbs						
	spatially adjacent neighborhoods					
	UUU	USU	LUU	UDL	LSL	LDL
SUN	**46.6%**	22.3%	4.5%	7.0%	8.2%	11.4%
USU	25.9%	**41.0%**	3.8%	7.5%	8.2%	13.6%
LUU	16.5%	11.2%	**23.0%**	6.2%	19.3%	23.8%
UDL	18.2%	16.1%	4.0%	**25.4%**	12.4%	23.9%
LSL	6.1%	5.2%	3.9%	3.5%	**45.7%**	35.6%
LDL	6.3%	6.2%	3.4%	5.1%	25.5%	**53.5%**
Outer Suburbs						
	spatially adjacent neighborhoods					
	UUU	USU	LUU	UDL	LSL	LDL
SUN	**49.0%**	23.0%	4.5%	6.5%	7.0%	9.9%
USU	29.9%	**42.9%**	4.0%	6.4%	6.7%	10.1%
LUU	17.8%	11.9%	**26.8%**	5.9%	15.6%	22.0%
UDL	21.8%	16.2%	5.3%	**25.9%**	11.7%	19.1%
LSL	9.8%	7.0%	5.9%	5.0%	**42.8%**	29.5%
LDL	9.8%	7.6%	6.1%	5.7%	21.8%	**49.0%**

Longitudinal trajectories of neighborhood-level economic status

Based on the neighborhood typology developed in this study, this section identifies all the longitudinal pathways that a neighborhood could experience, based on the LDI changes from 1980 to 2010. First, Table 8 presents all the possible trajectories by locations and provides their proportion within the locations. Second, in Figure 4, I also exhibit how the trajectories differ based on the initial income status defined as per the 1980 LDI.

Table 8 presents the longitudinal trajectories of neighborhood-level economic status from 1980 to 2010 in a descending order. Table 8 shows that there is a total of 54 trajectories within each location (e.g., central cities, inner suburbs, and outer suburbs) that a neighborhood could experience from 1980 to 2010 based on the decadal LDI changes. The results generally indicate the persistence of neighborhood economic status, especially for lower-income neighborhoods in which the value of LDI is lower than 0. First, about 70% of the total neighborhoods (30,760 out of 43,979) did not experience any change of LDI's sign over 30 years. In other words, neighborhoods which experienced a reordering trend (e.g., 3 and 4) at least once during the three decades, account for about 30% of the total neighborhoods (13,219 out of 43,979). About 82% of the lower-income neighborhoods in 1980 (18,520 out of 22,488) maintained their economic status as lower-income neighborhoods in 1990, 2000, and 2010. Considering the location, 89% of the lower-income neighborhoods in 1980 (8,713 out of 9,820) in the central cities continued

Table 8. Longitudinal sequences of LDI changes in all neighborhoods within the 105 U.S. MSAs

	Central city		Inner suburbs		Outer Suburbs	
	The longi-tudinal Sequ-ences	Number of neighborhoods	The longi-tudinal Sequ-ences	Number of neighborhoods	The longi-tudinal Sequ-ences	Number of neighborhoods
1	656	1,512 (10.4%)	656	794 (8.6%)	111	1,599 (7.9%)
2	555	1,331 (9.1%)	665	671 (7.3%)	112	1,442 (7.1%)
3	665	1,191 (8.2%)	666	628 (6.8%)	656	1,325 (6.6%)
4	655	1,126 (7.7%)	655	476 (5.2%)	665	1,116 (5.5%)
5	666	1,074 (7.4%)	466	448 (4.9%)	121	1,075 (5.3%)
6	556	997 (6.8%)	111	393 (4.3%)	666	1,070 (5.3%)
7	565	868 (6.0%)	122	376 (4.1%)	122	943 (4.7%)
8	566	614 (4.2%)	112	368 (4.0%)	466	747 (3.7%)
9	466	520 (3.6%)	556	351 (3.8%)	655	717 (3.6%)
10	122	369 (2.5%)	121	338 (3.7%)	212	660 (3.3%)
11	246	358 (2.5%)	246	323 (3.5%)	211	645 (3.2%)
12	121	353 (2.4%)	221	305 (3.3%)	221	585 (2.9%)
13	111	348 (2.4%)	565	302 (3.3%)	222	534 (2.6%)
14	112	339 (2.3%)	222	300 (3.3%)	556	483 (2.4%)
15	465	318 (2.2%)	555	288 (3.1%)	566	480 (2.4%)
16	222	290 (2.0%)	465	282 (3.1%)	565	479 (2.4%)
17	221	256 (1.8%)	566	270 (2.9%)	465	467 (2.3%)
18	553	191 (1.3%)	212	216 (2.3%)	246	444 (2.2%)
19	456	189 (1.3%)	211	208 (2.2%)	555	357 (1.8%)
20	224	178 (1.2%)	224	199 (2.2%)	224	300 (1.5%)
21	212	151 (1.0%)	456	183 (2.0%)	456	274 (1.4%)
22	211	147 (1.0%)	245	114 (1.2%)	311	273 (1.4%)
23	124	138 (0.9%)	124	106 (1.2%)	124	268 (1.3%)
24	531	133 (0.9%)	243	82 (0.9%)	146	228 (1.1%)
25	245	125 (0.9%)	146	80 (0.9%)	653	219 (1.1%)
26	146	123 (0.8%)	214	79 (0.9%)	243	209 (1.0%)
27	311	122 (0.8%)	311	73 (0.8%)	245	195 (1.0%)
28	346	97 (0.7%)	463	68 (0.7%)	214	191 (0.9%)
29	243	91 (0.6%)	553	56 (0.6%)	431	190 (0.9%)
30	653	78 (0.5%)	531	55 (0.6%)	434	186 (0.9%)
31	434	68 (0.5%)	312	54 (0.6%)	531	159 (0.8%)
32	214	61 (0.4%)	434	54 (0.6%)	312	151 (0.7%)
33	431	59 (0.4%)	346	52 (0.6%)	463	146 (0.7%)
34	312	56 (0.4%)	653	50 (0.5%)	346	140 (0.7%)

35	563	54 (0.4%)	431	49 (0.5%)	634	138 (0.7%)
36	463	52 (0.4%)	114	47 (0.5%)	631	136 (0.7%)
37	143	49 (0.3%)	455	46 (0.5%)	114	127 (0.6%)
38	534	46 (0.3%)	143	39 (0.4%)	321	125 (0.6%)
39	321	45 (0.3%)	145	34 (0.4%)	143	122 (0.6%)
40	345	45 (0.3%)	453	34 (0.4%)	534	117 (0.6%)
41	114	41 (0.3%)	534	34 (0.4%)	553	113 (0.6%)
42	145	41 (0.3%)	321	33 (0.4%)	663	105 (0.5%)
43	343	38 (0.3%)	631	32 (0.3%)	563	104 (0.5%)
44	663	36 (0.2%)	432	28 (0.3%)	432	94 (0.5%)
45	634	35 (0.2%)	563	25 (0.3%)	453	94 (0.5%)
46	455	34 (0.2%)	314	22 (0.2%)	455	93 (0.5%)
47	631	33 (0.2%)	343	22 (0.2%)	145	87 (0.4%)
48	324	30 (0.2%)	345	22 (0.2%)	343	77 (0.4%)
49	453	28 (0.2%)	324	21 (0.2%)	345	74 (0.4%)
50	532	28 (0.2%)	532	21 (0.2%)	314	65 (0.3%)
51	322	21 (0.1%)	634	21 (0.2%)	324	64 (0.3%)
52	432	21 (0.1%)	663	17 (0.2%)	632	60 (0.3%)
53	314	14 (0.1%)	322	15 (0.2%)	322	55 (0.3%)
54	632	5 (0.03%)	632	12 (0.1%)	532	49 (0.2%)
		14,567 (100%)		9,216 (100%)		20,196 (100%)

to be lower-income neighborhoods, which is higher than those in the inner suburbs (3,780/4,417 = 85%) and the outer suburbs (6,027/8,251 = 73%). Of the upper-income neighborhoods in 1980, about 57% (12,240 out of 21,491) maintained their upper-income status for 30 years. Considering the location, upper-income neighborhoods in the outer suburbs, defined in 1980, were more likely to present the continuous higher-income status (7,483/11,945 = 63%) than those in the inner suburbs (2,504/4,799 = 52%) and the central cities (2,253/4,747 = 47%).

Second, while diverse trajectories are revealed (as most of all the pathways do not exceed 10%), the top frequent trajectories in the central cities and inner suburb are mostly related to the pathways that a lower-income neighborhood can take (e.g., 5 and 6), while pathways related to higher-income neighborhoods (e.g., 1 and 2) were predominant in the

outer suburbs. The only trajectory that includes reordering trends (e.g., 3 or 4) within the top ten frequent trajectories is 466, which indicates a continuous decrease in LDI from 1980 to 2010, with a higher-income neighborhood in 1980 becoming a lower-income neighborhood in 1990, and continuously experiencing neighborhood economic decline in 2000 and 2010. These results, therefore, generally suggest that neighborhoods, in general, are persistent in their economic status, regardless of their location within an MSA.

Further, Figure 4 shows how the trajectories vary based on the initial income status. As the value of LDI is influenced not only by household income but also by the number of households, I normalize the 1980 LDI by the number of households in a certain neighborhood within each MSA to solely consider the income status. I then define the low-, moderate-, middle-, and high-income neighborhoods which fall below the first quartile, between the first and second quartile, between the second and third quartile, and above the last quartile of the normalized LDI, respectively.

The flowchart shows that neighborhoods at both extremes of the income distribution (low- and high-income neighborhoods) in 1980 were likely to be classified as neighborhoods moving into either deeper poverty or greater affluence (either UUU or LDL) throughout the time periods. Moreover, the 92% (10,083/10,930) of low-income neighborhoods and 81% (8,934/11,079) of high-income neighborhoods did not change their sign for LDI. On the other hand, the flowchart (Figure 4) also shows that relatively middle-class neighborhoods were more likely to experience diverse pathways, compared to low- and high-income neighborhoods. As a result, the numbers of affluent and poor neighborhoods were likely to remain the same or even increase and that of middle-class

neighborhoods was likely to decrease, indicating why income segregation has generally increased over the last several decades.

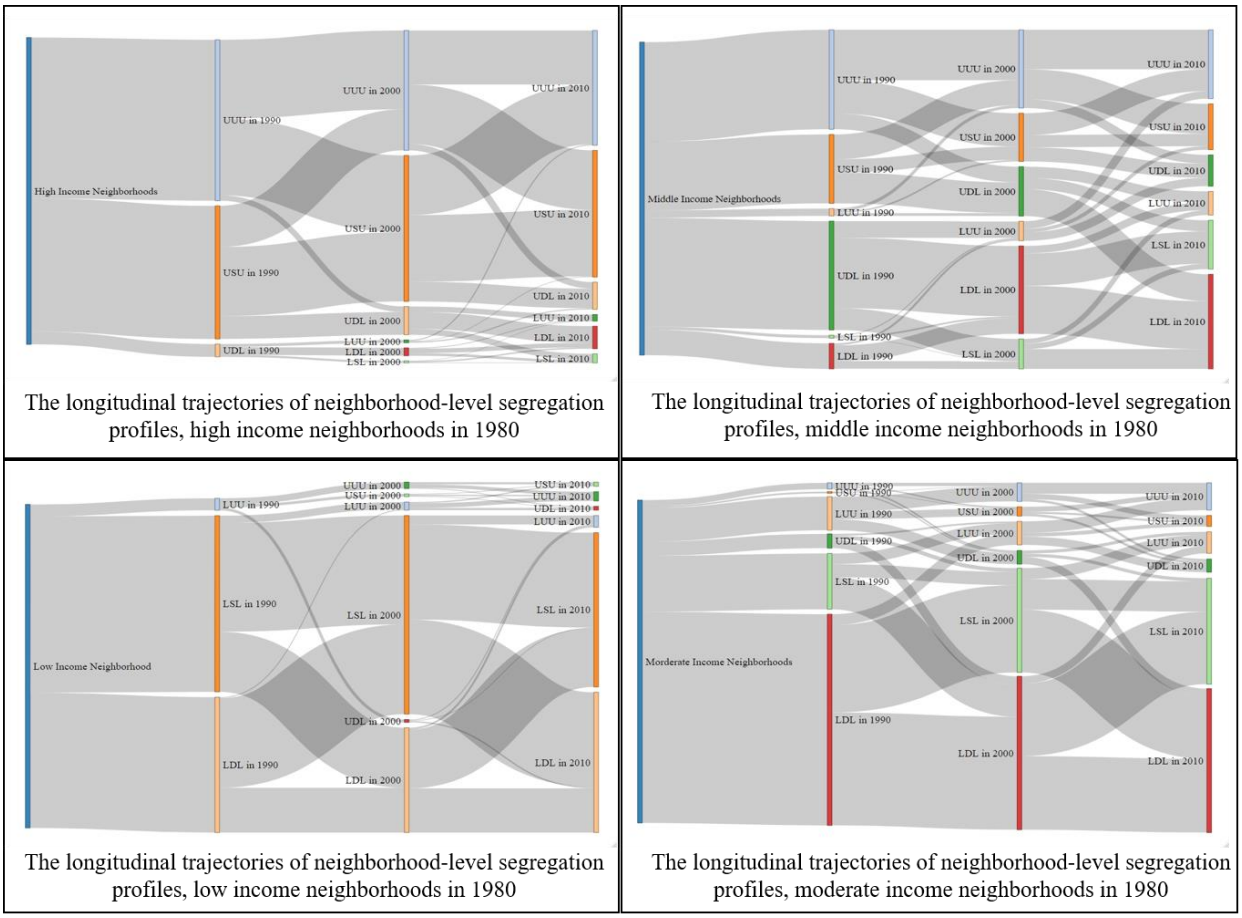

Figure 4. The longitudinal trajectories of neighborhood-level economic status, by income status in 1980

One interesting finding is that a significant share of low-income neighborhoods that experienced neighborhood ascent during the 1990s again experienced neighborhood decline during the 2000s. This result is a similar to the finding of previous studies (e.g., Galster et al., 2003; Galster, 2005; Gould Ellen & O'Regan, 2008). These studies argued that the general decrease in high-poverty neighborhoods during the 1990s does not suggest

that such neighborhoods advanced to low-poverty neighborhoods. Instead, it indicates the expansion of moderate-poverty neighborhoods where poverty begins to create adverse effects, which implies why a significant share of low-income neighborhoods in 1980 experienced economic decline during the 2000s.

Moreover, the analysis reveals that once a neighborhood experienced a reordering trend, it is likely to maintain its new economic status. To be specific, once a neighborhood turns into a lower-income neighborhood from a higher-income neighborhood, it is relatively difficult for it to recover its upper-income status. Among neighborhoods which changed into lower-income neighborhoods from higher-income neighborhoods at least once during the 1980s or 1990s (e.g., 4XX or X4X), 80% (6,490/8,082) were classified as lower-income neighborhoods in 2010. The force of the declining process was the weakest in the outer suburbs (2,935/3,867 = 76%) compared to those in the central cities (1,918/2,256 = 85%) and the inner suburbs (1,637/1,959 = 84%). Once a neighborhood improved to a higher-income neighborhood from a lower-income neighborhood at least once during the 1980s or 1990s (e.g., 3XX or X3X), 62% of such neighborhoods (2324/3,737 = 62%) were defined as higher-income neighborhoods in 2010. The force of the ascending process was the weakest in the inner suburbs (394/688 = 57%) compared to those in the outer suburbs (1,369/2,153 = 64%) and the central cities (561/896 = 63%).

The economic persistence of neighborhoods over decades is also in line with the literature of neighborhood typology in two ways. First, research that classifies neighborhoods based on various socio-economic variables found that most neighborhoods maintained their characteristics over several decades, indicating that neighborhood change is a long-term process that occurs at a slow pace. Second, neighborhoods at the highest and

lowest ends of the socioeconomic scale are likely to sustain their status (Delmelle, 2017; Wei & Knox, 2014).

The analysis also provides some evidence of the economic decline of inner suburbs. This research defines three types of neighborhoods which have experienced reordering trend from upper to lower-income status and continuous economic decline for three decades: 224, 246, and 466. Table 8 shows that the percentage of such neighborhoods was the highest in the inner suburbs. To be specific, among 54 trajectories, the percentages of the three pathways were 7.2%, 10.5%, and 7.3% in the central cities, the inner suburbs, and the outer suburbs, respectively. Moreover, as mentioned, the force of the ascending process was weaker in the inner suburbs compared to other locations within an MSA. These results suggest that inner suburban areas have been vulnerable to poverty or economic decline.

Discussion and Conclusion

Using the census tract-level data as a proxy for neighborhood data from 1980 to 2010 in the 105 largest MSAs in the U.S., this research focuses on local components of an MSA-level income segregation index, which indicates the economic status of a neighborhood. The aim of this research is to understand the underlying dynamics of income segregation, which cannot be revealed through a regional-level only analysis. When income groups are not evenly distributed across a region, the global indices are unable to capture the unique attribute of each neighborhood and identify its own distinct change trajectory of neighborhood-level economic status.

Therefore, this research focuses on LDI, a decomposed element of DI, and develops a neighborhood typology based on the decadal change of LDI. The neighborhood typology sets three possible paths a neighborhood can experience: upgrading, stability, and decline. As a result, a total of six groups were established: three for upper-income neighborhoods (UUU, USU, and LUU) and three for lower-income neighborhoods (LDL, LSL, and UDL), respectively.

With this neighborhood typology, the research identifies the diverse paths in which a neighborhood can evolve, in terms of economic status. First, the analysis shows the intra-variation of the paths within an MSA and investigates how urban spatial forms can be classified from 1990 to 2010 based on the diverse paths by utilizing k-means clustering. This study specifies three spatial structures of MSAs: *weak suburbia*, *inner-ring suburbia*, and *extended suburbia*. The clustering scheme also reveals that MSAs, in general, sustain their spatial structure for the three decades. If an MSA experienced a change of its spatial structure, it was either changing to *weak suburbia* or *extended suburbia* and not *inner-ring suburbia*, implying the decline of inner suburban areas in the U.S. metropolitan areas.

Second, this study reveals that evolving patterns of neighborhoods either to greater affluence or poverty are spatially clustered. On the other hand, neighborhoods that experienced a reordering trend were relatively more surrounded by diverse pathways. The result indicates that income segregation is not only an issue of individual neighborhoods but also a spatially dependent phenomenon or a macro-level phenomenon that requires greater attention by scholars and policymakers. Therefore, when introducing a local-level measure of segregation, it would be crucial to consider spatially adjacent neighborhoods.

Third, this study presents all the longitudinal trajectories that a neighborhood could experience in their economic status from 1980 to 2010. The results, in general, indicate that the economic status of neighborhoods has been consistent. Especially, neighborhoods at the extreme ends of the neighborhood income distribution present a more polarizing tendency toward either greater affluence or poverty, than middle-class neighborhoods. In other words, more affluent and poorer neighborhoods are likely to continue to be persistent in their economic status, while middle-class neighborhoods are relatively more volatile. These results demonstrate that an increase in income segregation is accompanied by a combination of the loss of mixed- and middle-income neighborhood and the concentration of income extreme in a neighborhood (Bischoff & Reardon, 2014).

This research provides a guide for future research. First, as the results from this study indicate, the clustering pattern of polarizing paths compared to that of reordering paths necessitates the development of a spatially sensitive measure of segregation at the local level. With the local measure of segregation, one can explore the spatial scales by which income segregation generates variations based on regional or locational contexts. Identifying the spatial scale of residential segregation would advance the understanding of the mechanism behind the phenomenon. Better understanding of income segregation as related to neighbourhood dynamics also would support more refined policymaking aimed at reducing inequality.

Notes

1. Due to changes by the Census Bureau, it should be noted that 2010 data is based on the American Community Survey 5-year estimates 2006-2010.

Essay 2. Exploring the Economic Persistence of Affluent and Poor Neighborhoods and Factors Associated with These Shifts, 2000–2010

Introduction

Exploring the dynamics of neighborhood change is a longstanding and fundamental topic of urban studies and a vital concern given the significant influence of neighborhood environments on individuals' social, economic, and physical well-being. The spatial separation between the haves and the have-nots along neighborhood boundaries, as argued in many studies, is a core mechanism of class structuration, underlying many aspects of inequality in urban areas (Logan, 1978; Reardon & Bischoff, 2011). Recently, such neighborhood inequality has been perpetuated with scholars documenting an increasing number of affluent and poor neighborhoods and the fall of middle-income neighborhoods (Bischoff & Reardon, 2014; Taylor & Fry, 2012; Owens, 2012; Reardon & Bischoff, 2011; Sampson, 2016; Solari, 2012). Affluent and poor neighborhoods, scholars have demonstrated, tend to remain so, while middle-class neighborhoods present relatively diverse neighborhood economic changes either in upgrading or downgrading (Owens, 2012; Sampson, 2016). The findings of scholars suggest that understanding why and how affluent and poor neighborhoods sustain or change in their economic status is timely to address inequalities within urban areas.

This research, therefore, explores the change of affluent and poor neighborhoods in their economic status between 2000 and 2010 within the 100 largest U.S. metropolitan

statistical areas (MSAs) based on 2010 population size. Though some studies (e.g., Solari, 2012; Wei & Knox, 2014) have documented the stability or persistence of neighborhoods with extremes of socioeconomic status (SES), either highly advantaged or highly disadvantaged, they were limited in describing the trends and did not explain why neighborhoods in either socioeconomic extremes are likely to sustain their socioeconomic status. Moreover, the literature of neighborhood change has been concentrated on poor neighborhoods, possibly because such areas are the traditional focus of policy and scholarly discussions (Solari, 2012). Gentrification or other neighborhood ascent studies have also focused on neighborhoods that are subject to gentrification, often identified as neighborhoods with lower SES status (Hwang & Sampson, 2014; Timberlake & Johns-Wolfe, 2017). However, understanding the increasing spatial separation between affluent and poor neighborhoods would be difficult without considering their process of neighborhood change or persistence processes (Solari, 2012).

This research, first, begins by discussing the longstanding theories of neighborhood change from the ecological and economic perspectives, followed by a review of the literature that documents the rise of affluent and poor neighborhoods and the fall of middle-class neighborhoods in recent decades. This study hypothesizes that there are heterogeneous effects of ecological and economic variables on neighborhood economic changes between affluent and poor neighborhoods. That is, affluent neighborhoods have a better capacity to resist decline related to ecological and economic forces, compared to poor neighborhoods. This argument suggests reasons why the economic status of neighborhoods at the extremes of the neighborhood income spectrum is likely to remain over time and may further explain the reason of neighborhood economic polarization.

Therefore, the study asks two research questions: (1) Are affluent and poor neighborhoods stable in their economic status between 2000 and 2010? (2) Are there ecological and economic factors that differentially impact the neighborhood economic change of affluent and poor neighborhoods?

In the analysis section, the trend of neighborhoods' economic status during the 2000s within the 100 largest U.S. metropolitan statistical area (MSA) is presented descriptively. Then, employing multilevel logistic regression, the analysis examines ecological and economic factors, at the neighborhood- and MSA-levels, posited to influence the variation in neighborhood change between wealthy and poor neighborhoods. This study contributes to urban neighborhood change scholarship by integrating different theoretical perspectives from the social science literature to understand why neighborhoods at the extremes of the income distribution are likely to persist in their economic status.

Literature review on neighborhood change

Classical theories of neighborhood change

The mechanisms of neighborhood change have been a central topic in urban research since the early 1920s when the Chicago School first developed urban ecology for studying residential patterns within cities. The invasion/succession model of early urban ecology (Park, 1925), describes a sequential process whereby a new social group or land use invades an area, increasing competition among limited resources. This invasion is followed by an out-migration of original residents or the replacement of previous land use, to adjust to the conflict. When the newcomers become a dominant population in the area,

succession is completed. Subsequently, the original groups relocate themselves in places that are more desirable. This natural process of neighborhood change has informed subsequent models, such as filtering, racial transformation, and suburbanization (Temkin & Rohe, 1996).

The filtering model suggests that the quality of housing, highly dependent on the age of homes, is a critical factor in neighborhood change (Hoyt, 1933). In this view, property owners reduce investments in aging properties because of the higher costs of maintenance. Generally, such deterioration in housing quality leads to both an exodus of high-income residents, who can afford better homes, and the filtering down of the aged housing to low-income residents. The neighborhood life cycle theory (Hoover & Vernon, 1959) supplements the filtering model by adding a neighborhood renewal stage, thereby creating a cyclical process consisting of five phases: development, transition, downgrading, thinning out, and renewal. At a certain point during the neighborhood decline process, a neighborhood will often begin to ascend because investors view such neighborhoods as investment opportunities and develop new housing with higher values (Rosenthal, 2008). Collectively, these models suggest that neighborhoods with larger proportions of both newer and older housing stock are likely to experience neighborhood ascent, while those with larger amounts of middle-aged housing stock are expected to economically decline (Galster et al., 2003; Ellen & O'Regan, 2008; Rosenthal, 2008). The former contains improved physical amenities, and the latter implies a sign of demolition of the old housing and the redevelopment of new housing. However, the existence of middle-aged housing stocks, not only physically dilapidated but also in need of more time for investors' decisions on redevelopment, is associated with neighborhood decline (Rosenthal, 2008).

The border model (Bailey, 1959) and the tipping model (Schelling, 1971) focused on racially biased preferences: minorities tend to be more tolerant to live near whites, while the latter tends to have stricter rules for their surrounding racial compositions (Bobo & Zubrinsky, 1996; Owens & Candipan, 2019). According to the border model, relatively lower housing prices in black neighborhoods increase and relatively higher housing prices in white neighborhoods decrease until they meet at the border area of both neighborhoods (Myers, 2004). In Schelling's (1971) tipping model, the racial transition of a white neighborhood occurs when a "recognizable" number of black residents—a level above the white residents' tolerance level—move there. The literature also suggests that such transitions occur not only through racial compositions but also by the distance to black neighborhoods and through white household attitudes, suggesting that there is no universal tipping point (Galster, 1990). Card et al. (2008) found tipping points varying from 5% to 20% minority population for white outmigration. Recent studies have expanded the literature by looking at the role of racial/ethnic composition not only on the racial transition but also on the economic status of neighborhoods. This strand of studies, in general, showed that a higher share of blacks leads to the subsequent decline of neighborhood economic status (Ellen & O'Regan, 2008; Galster & Mincy, 1993; Galster et al., 2003; Jun, 2016; Rosenthal, 2008; Timberlake & Johns-Wolfe 2017), while some studies found the positive association between the share of Hispanic residents and neighborhood economic status (Ellen & O'Regan, 2008; Owens & Candipan, 2019).

Models of urban spatial structure (Alonso, 1964; Muth, 1969) focus on residential consumption for housing amenities, such as housing size and location, which would vary based on residents' incomes and life cycles. Specifically, affluent groups prefer to move to

less dense areas and in larger homes on the peripheries as their income and family size rise, even though they experience longer commuting distance to work. This phenomenon had been facilitated by the construction of highways and the decentralization and deindustrialization of occupations, promoting neighborhood decline, especially in the central cities (Baum-Snow, 2007; Wilson, 2012). However, recently, the change of preferences on diverse factors—such as marriage, having children, living in the suburbs—combined with the decrease in urban crime rates and the congestion of suburban highways has generated diverse paths of neighborhood change (Landis, 2016). For example, urban amenities such as historical (McCabe & Ellen, 2016) and natural amenities (Lee & Lin, 2018) contribute to the persistence of urban neighborhood status.

From an ecological perspective, neighborhoods are considered not as single entities but as local communities nested within an urban system (Logan, 1978), indicating that besides neighborhood-level attributes, the fate of neighborhoods would also depend on external factors at the broader level. Therefore, population or economic change in the MSA-level would likely influence the economic status at the neighborhood level. Wilson (2012) documented the concentrated poverty of blacks in the urban core during the 1970s by showing that upper- and middle-class blacks left their former homes in the city centres and began moving to suburban areas. He attributed the segregation of the poor in the central cities to the shortage of low-skilled jobs. For instance, the globalization of the U.S. economy has brought about an upgrade on the labour market by requiring a high number of educated employees in the inner cities, while job opportunities for manufacturing industries and for entry-level jobs to service the industries have grown outside of city centres. Therefore, low-income individuals with less education who live in central urban

areas have faced difficulties in finding jobs because industrial jobs and entry-level jobs have decreased in the urban core. Consequently, the concentration of poverty for minorities, in turn, creates persistent poverty, as the public services and social connections are lacking in the poverty-stricken areas. Wilson's work suggests that bifurcation of occupation at the regional level impacts on neighborhoods' economic status.

Jargowsky (1996) focused on the structural transformation of the economy as a factor feeding into income segregation. The author found that the level of income segregation would increase if the share of jobs in the manufacturing sector were to decline. The decline of the share of occupations in the manufacturing sector would encourage new firms to locate themselves in a more dispersed pattern, which would then be accompanied by the residential patterns of manufacturing employees. Tamer et al. (2015) found that the occupational structure of a city is a crucial factor influencing socioeconomic segregation, which significantly increased in the 2000s in the thirteen European global cities these scholars studied. These studies suggest that bifurcation of occupation into high-end jobs and low-end jobs with a loss of middle-wage jobs will strengthen the spatial separation of affluent and poor.

Given the significant influence of ecological perspective in the neighborhood change literature, many empirical works of neighborhood economic change were built upon this perspective, which argues that neighborhoods continuously decline by following a well-defined sequence and enter into redevelopment stage after a certain period (Galster et al., 2003; Ellen & O'Regan, 2008; Jun, 2013; Rosenthal, 2008). These studies, in general, found that advantageous characteristics—homeownership, the presence of high-educated residents, non-Hispanic whites, and new housing—were associated with neighborhood

economic gain. However, the presence of disadvantaged contexts—renter households, minorities, immigrants, and middle-aged housing predict neighborhood economic decline—were usually related to neighborhood decline.

The persistence of neighborhood poverty/affluence in urban areas

Considering the rise of neighborhood inequality reported by several scholars, the ecological view may not fully explain neighborhood polarization or persistency in their economic status, which describes how affluent neighborhoods maintain their affluence or even are becoming more concentrated with the affluent and how poor neighborhoods continue to be occupied with the poor.

Recently, studies have reported an increasing trend that poor and affluent neighborhoods sustain their previous economic status while middle-class neighborhoods are the least likely to remain so over time. As a result, the number of neighborhoods at the extreme of neighborhood income distribution rises, while the presence of middle-class neighborhoods has diminished. Bischoff and Reardon (2014) compared the median family income of each census tract to the median income of the metropolitan area and then used the ratio to classify neighborhoods into six types, ranging from poor (a ratio less than 0.67) to affluent (a ratio greater than 1.5). They showed that the proportion of families living in middle-class neighborhoods has declined, while those in affluent and poor neighborhoods have consistently increased since 1970 in the U.S. metropolitan areas with population above 500,000.

Sampson (2016) showed that neighborhoods at the extremes of the neighborhood income distribution maintained their economic status from 1990 to 2010 by focusing on

the Chicago and Los Angeles areas. More than 75 percent of poor neighborhoods, whose median income is located in the bottom quintile based on all neighborhoods in U.S. metropolitan areas, and affluent neighborhoods, whose median income is located in the top quintile, sustain their economic status during the decades. The result also highlighted the volatility of middle-income neighborhoods for sustaining their original status.

Solari (2012) descriptively examined whether neighborhood affluence persist over time by focusing on neighborhoods in all MSAs in the U.S. According to the author's work, about 70 percent of poor neighborhoods—the bottom 10 percent of neighborhoods in the neighborhood income distribution within each MSA—and affluent neighborhoods—the top 10 percent—maintain their economic status in every decade since 1970.

Possible heterogenous effects of ecological and economic factors on neighborhood change

Urban scholars have stressed that communities are not only determined by external actors, but also by community-based attributes. This is one of the driving forces in urban political processes that affect the opportunities available to communities (DeFilippis, 2001; Hays & Kogl, 2007; Putnam, 1993; Wichowsky, 2019). Temkin and Rohe (1998) argued that neighborhoods have different capacities for responding to ecological forces based on their socioeconomic contexts.

Based on their discussion, Temkin and Rohe (1998) suggested that neighborhood-level resources that cope with the forces of downward change due to the ecological factors should be considered in neighborhood change. For example, a higher level of trust enables residents to better discuss issues concerning their neighborhoods with each other. Therefore, Temkin and Rohe suggested that the force of change, generated from housing

stocks, economic and population change, has heterogeneous effects on neighborhoods based on the level of social capital. It is expected that a neighborhood with a higher level of social capital will have a higher potential for resisting an unwanted decline and promote stability, while neighborhoods with a lower level of social capital lack such capacity to resist decline. Temkin and Rohe measured the concept of social capital based on a survey of 5,896 heads of households across all Pittsburgh neighborhoods in 1980. In their study, social capital consisted of two components: sociocultural milieu, which describes the informal identity of place assessed by residents, and institutional infrastructure, which represents the capacity of formal organizations in the neighborhood. This research empirically found that neighborhoods with high levels of social capital were unlikely to decline. However, they did not conclude that it is solely the presence of social capital that stabilizes neighborhoods from decline.

Temkin and Rohe (1998) also emphasized "neighborhood groups" who work with public officials, bankers, private agents, and other powerful elites to address possible threats on behalf of residents. These powerful elites have the discretion to choose where developments will be made within the city, indicating their influence on neighborhood outcomes (Molotch, 1976). Therefore, Temkin and Rohe suggested that an effective collective action, leveraged by residents' strong social capital and formed by representative neighborhood groups, stabilizes neighborhoods in the face of potential downward succession. Similarly, Arnstein (1969) suggested that the presence of "community leaders" with information, economic, and political resources would be influential in neighborhood change as they can effectively organize collective action and form a partnership with external powerful elites. Communities with capable neighborhood leaders are effective in

managing social capital, organizing collective actions, and participating in the main political processes for improving neighborhoods. Conversely, communities with a lack of capable community leaders, especially in disadvantaged areas, have fewer opportunities; their neighborhoods seem less attractive to powerful elites due to the lack of political advocacy groups. In this sense, residential inequality becomes more severe since initial advantages of certain communities, often converted into political power, can be used to fortify the existing hierarchy of places (Logan, 1978; Logan & Molotch, 1987).

Built upon the previous discussions by Temkin and Rohe (1998), I assume that affluent neighborhoods are expected to respond effectively against the changing forces and maintain their economically advantageous contexts by utilizing their economic resources and political connection to the powerful elites. Contrastingly, poor neighborhoods are expected to be less resilient against the changing forces and would tend to experience economic decline. These different processes may explain the persistence of affluent and poor neighborhoods in their economic status over time. Therefore, this research asks three questions as follow: (1) Are affluent and poor neighborhoods stable in their economic status between 2000 and 2010? (2) Are there ecological and economic factors that differentially impact the neighborhood economic change of affluent and poor neighborhoods?

Methodology

Data

This study focuses on census tracts within the 100 largest U.S. MSAs across the conterminous United States based on 2010 population size.[1] Census tracts serve as a proxy

for neighborhoods which is consistent with most of the studies in neighborhood change. From the GeoLytics' Neighborhood Change Data Base (NCDB), I use census tract-level data of the 2000 Decennial Census and the 2006–2010 American Community Survey (ACS) Five-year estimates from the U.S. Census Bureau, which proxies for 2010. NCDB reports decennial census data over several decades—1970, 1980, 1990, and 2000—at the census tract level, normalized to 2010 tract boundaries which provides consistent boundaries over time.

This research views an MSA as a 'region' that constitutes a regional housing market and incorporates a wide income distribution range (Mikelbank, 2011). I assumed that housing consumers do not consider neighborhood options nested in different MSAs, but they do compare neighborhoods within the same MSA when they look for houses (Galster, 2001; Owens, 2012). In the analyses, the boundaries of MSAs in 2000 is also fixed to 2010, defined by the Office of Management and Budget in 2009, for a consistent comparison between time periods.

Dependent variable

To measure the dependent variable, this study, first, measures the economic status of a neighborhood by utilizing the ratio of average household income in the census tract to that of the metropolitan area, following several studies (e.g., Ellen & O'Regan, 2008; Rosenthal, 2008). This measure of neighborhood economic status considers the different living costs by MSAs (Ellen & O'Regan, 2008). Then, I classify neighborhoods into five quintile groups based on relative household income: 0 – 20%, 20 – 40%, 40 – 60%, 60 – 80%, and 80 – 100%. In this study, I specifically focus on the bottom quintile

neighborhoods, defined as poor neighborhoods, and the top quintile (80 – 100 %) neighborhoods, which refers to affluent neighborhoods. Every MSA has neighborhoods assigned to one of five income categories, indicating that relatively poor MSAs will have their own affluent neighborhoods, and vice versa.

Based on the classification, this study measures the neighborhood economic change in a dichotomous manner: whether a neighborhood experienced economic prosperity or not between 2000 and 2010. Specifically, for affluent neighborhoods in 2000, if such neighborhoods remained in the top quintile in 2010, they are assumed to experience economic prosperity during the 2000s (coded as 1). For affluent neighborhoods which moved down to any of lower quintiles (the fourth, third, second, and bottom quintiles) during the 2000s are posited to experience economic deterioration (coded as 0). For poor neighborhoods in 2000, if such neighborhoods escaped from the bottom quintile and move upward to at least the next quintile, there are assumed to experience economic prosperity during the 2000s (coded as 1). Poor neighborhoods in 2000 which are still classified as poor neighborhoods (the bottom quintile) in 2010 are assumed to experience economic deterioration between 2000 and 2010 (coded as 0).

Independent variables

The previous works on neighborhood change (Ellen & O'Regan, 2008; Galster & Mincy, 1993; Galster et al., 2003; Jun, 2016; Landis, 2016; Temkin and Rohe, 1998) posit that the initial characteristics of neighborhoods at the starting point of a time period largely predict the future change of the neighborhoods during the time period, while this approach is not completely independent from the issue of endogeneity. Therefore, at the

neighborhood level, I include several housing, demographic, and SES variables in 2000 to predict whether a neighborhood experienced economic prosperity between 2000 and 2010.

Based on the filtering hypothesis, a set of housing variables at the neighborhood level includes a series of housing stock variables differentiated by housing age in terms of percentage of housing built: within the last 10 years; between 11-20 years; between 21-30 years; between 31-40 years; between more than 40 years but after 1940; and before 1940. This study differentiates housing built between more than 40 years before but after 1940 and housing built before 1940 because the literature emphasizes the importance of pre-war housing for neighborhood ascent (Lucy & Phillips, 2006). In this analysis, the percentage of housing stock built 21-30 years prior, defined as middle-aged housing, is set as the reference variable. I also include the percentage of residents who lived in a same house less than 5 years, which is a proxy for the instability of residents in a neighborhood.

To account for neighborhood externalities that drive neighborhood change, several sociodemographic variables are included (Rosenthal, 2008). Three advantaged contexts—homeownership rate, the percentage of the population with education higher than a bachelor's degree, and percentage of the working-age population (between 19 and 64 years of age)—are hypothesized to predict neighborhood economic prosperity. Homeowners are more likely to participate in community activities or tend to vote for policies which pursue local interests and preserve their properties at a higher quality (Rohe & Stewart, 1996). The presence of highly-educated population and working-age population promote positive spillover effects on neighborhood by bringing financial and human capital into the neighborhoods. These types of populations, therefore, would promote positive

neighborhood externalities (Rosenthal, 2008). The percentages of blacks, Hispanic, and foreign-born populations are included to test whether the presence of minorities is associated with neighborhood economic change. In addition, poverty rate; unemployment rate; the percentage of foreign-born population; and natural logged residential density (proxying congestion and the risk of crime) are factors that are expected to predict neighborhood decline as they would not promote positive externalities and would not attract higher-status residents. In addition, relative income of a neighborhood in 2000 and a dummy variable of whether a neighborhood is located within the central cities is included to consider the neighborhoods' initial economic conditions and location.

This research also considers the influence of the MSA-level factors on neighborhood economic change. To consider the influence of occupation restructuring at the MSA level—bifurcation of occupation into high-end and low-end jobs with a loss of middle-wage jobs—on neighborhood change, I calculate the percent change of manufacturing jobs which proxies for middle-paid jobs (Long et al., 1977), high-end jobs[2], and population growth between 2000 and 2009.[3] I expect that an increase in manufacturing jobs will decrease the likelihood of affluent neighborhoods remaining as affluent neighborhoods since the chance of middle-income residents with secured financial resources to move into affluent neighborhoods would increase. Moreover, the rise of manufacturing jobs will increase the likelihood of poor neighborhoods to experience economic prosperity because low- and middle-class residents will have secured financial resources. For the growth of high-end jobs, I expect that the percent change will have a positive sign in affluent neighborhoods, but will present a negative sign in poor neighborhoods. The rise of high-end jobs accompanies an increase in low-end jobs to support high-skill peoples' basic needs.

Therefore, economic restructuring and the resultant income inequality from the labor market may strengthen the spatial inequalities, as affluent and high-skill workers will likely position themselves in affluent neighborhoods, while poor and low-skill workers will likely live in poor neighborhoods. I also include the metropolitan population growth measured by the percent change between 2000 and 2009 as a factor in the analysis. It is expected that as the population of MSA grows, neighborhoods within such MSA will likely experience economic prosperity, as the growth of the metropolitan population promotes the development (Landis, 2016). However, it is also possible that affluent neighborhoods in a growing MSA may not experience economic prosperity. In a growing city, developers can easily accommodate the change of consumer preferences by constructing new housing (Watson, 2006). Affluent residents usually have sufficient information and financial resources to find and move to places in which their preferences are met, leading to the outflow of affluent residents from their original place of residence. Table 1 reports the descriptive statistics of the variables used in this study.

Analytic method

As theories and the data indicate a multilevel structure within neighborhoods (level 1) nested within MSAs (level 2), this study employs multilevel logistic regression analyses.[4] This method estimates the parameters in the model while considering the non-independence of observations within higher-level clusters (MSA-level in this study). As theories conceptualize that neighborhoods are nested within a metropolitan structure, it is highly possible that standard errors will be underestimated without using a multilevel model. Ignoring the multilevel structure of data can cause statistical bias which shows

coefficients are statistically significant when they are not.

To answer the second research question, this study focuses on the log of the odds of a neighborhood experienced economic prosperity during the 2000s for both affluent and poor neighborhoods. I employ a level-2 random intercept model where all neighborhood-level and MSA-level variables consist of the fixed part and the intercept is allowed to vary across the 100 MSAs (level-2). Equation (1) describes the neighborhood-level model (level-1 equation). Equation (2) indicates the MSA-level model (level-2 equation), which is nested in the intercept of the level-1 equation.

$$\text{Level 1: Logit}\frac{P(Y_{ij,2010}=1)}{(1-P(Y_{ij,2010}=1))} = \beta_{0j} + \beta_1 X_{ij,2000} + e_{ij} \quad (1)$$

$$\text{Level 2: } \beta_{0j} = \gamma_{00} + \gamma_{01} M_{j,2000\text{-}2009} + \upsilon_{0j} \quad (2)$$

where $Y_{ij,2010}$ refers to the binary variable which indicates whether a neighborhood *i* in MSA *j* experienced economic prosperity during the 2000s or not; $X_{ij,2000}$ represents neighborhood-level variables which include sociodemographic and housing variables in 2000; $M_{j,2000\text{-}2010}$ indicates MSA-level variables changed between 2000 and 2009; β_1 is a set of neighborhood-level variable coefficients; e_{ij} indicates neighborhood-level residual; γ_{00} refers to an intercept; γ_{01} represents MSA-level variable coefficients; and υ_j refers to MSA-level residual.

Table 9. Descriptive statistics and variables

		Poor neighborhoods				Affluent neighborhoods			
	Variables	Mean	S.D.	Max.	Min.	Mean	S.D.	Max.	Min.
Level 1 (neighborhood-level characteristics in 2000)	% housing built within 10 years	7.19	9.18	89.53	0.00	27.78	25.91	100.00	0.00
	% housing built between 11—20 years	9.77	10.58	70.11	0.00	19.31	15.38	92.49	0.00
	% housing built between 31—40 years	15.21	9.47	78.54	0.00	11.77	11.77	85.95	0.00
	% housing built above 41 years ago but after 1940	28.20	15.23	87.05	0.00	14.56	16.77	92.43	0.00
	% housing built before 1940	24.74	21.43	89.38	0.00	9.65	16.43	94.55	0.00
	% black	35.58	34.60	100.00	0.00	3.78	6.74	96.26	0.00
	% Hispanic	25.13	28.03	99.78	0.00	5.43	7.95	91.98	0.00
	% homeownership	38.24	21.76	98.55	0.00	82.66	15.49	100.00	0.31
	% population who earned bachelor's degrees or above	12.15	10.18	94.86	0.00	49.28	15.04	91.17	3.66
	% working population (aged 16-64 years old)	60.40	8.26	99.27	9.41	62.60	6.06	97.49	18.93
	% unemployment rate	11.79	6.83	65.52	0.00	2.97	2.18	64.41	0.00
	% poverty rate	27.54	12.32	88.24	2.20	3.70	2.78	33.64	0.00
	% foreign-born population	18.68	18.31	83.78	0.00	9.78	7.97	63.60	0.00
	% residents who lived in the same house less than five years	51.20	13.67	99.80	9.35	45.34	14.07	100.00	15.19
	log(density) (population per sq. miles)	8.77	1.43	12.18	-0.69	7.33	1.28	12.18	0.59
	Central city (binary variable, 1 = yes, 0 = no)	0.59	0.49	1.00	0.00	0.20	0.40	1.00	0.00
	Relative income in 2000	0.55	0.11	0.84	0.14	1.67	0.49	6.12	1.13
Level 2 (MSA-level characteristics)	% change in manufacturing jobs (2000—2009)	-2.38	1.09	-0.22	-7.07	-2.38	1.10	-0.22	-7.07
	% change in high-end jobs (2000—2009)	1.01	0.69	3.04	-0.36	1.00	0.69	3.04	-0.35
	% change in population growth (2000—2009)	8.63	8.25	36.57	-12.36	8.61	8.26	36.57	-12.36

Descriptive analysis

This section assesses whether a change of neighborhood economic status during the 2000s was similar across all types of neighborhoods based on economic status. Table 10 presents the neighborhood economic change for neighborhoods within 100 largest U.S. MSAs between 2000 and 2010. In brief, the result shows that affluent and poor neighborhoods were likely to remain in their economic status during the 2000s, while other relatively middle-income neighborhoods presented more diverse economic transitions.

To be specific, about 80 percent of neighborhoods in the bottom and top quintiles of neighborhood income distribution in 2000 maintain their economic status in 2010. Less than three percent of the top quintile neighborhoods in 2000 moved to the bottom three quintiles neighborhoods in 2010. Similarly, less than four percent of the bottom quintile neighborhoods in 2000 moved to the above of the 60th percentile of neighborhood income distribution. Consistent with previous literature, these results present that upward and downward economic mobility of the poor and affluent neighborhoods was very rare during the 2000s. It is also found that the other middle-income neighborhoods (second, third, and fourth quintile neighborhoods) experienced relatively diverse paths of economic change between 2000 and 2010. Specifically, about 50 percent of the third quintile neighborhoods in 2000 sustained their previous status in 2010, which is the lowest number among the neighborhood groups who maintain their economic status during the 2000s. In sum, the general trend shows the persistence of affluent and poor neighborhoods in their economic status and the fluidity of the relatively middle-income neighborhoods in their economic status during the 2000s.

Table 10. Neighborhood economic change between 2000—2010 by quintiles

		2010 relative income quintiles					
		1	2	3	4	5	Total
2000 relative income quintiles	1	**7276 (79.12%)**	1645 (17.89%)	171 (1.85%)	32 (0.35%)	2 (0.02%)	9196 (20.18%)
	2	1481 (16.31)	5184 (57.11%)	2044 (22.51%)	322 (3.55%)	47 (0.52%)	9078 (19.92%)
	3	221 (2.43%)	1852 (20.38%)	4551 (50.08%)	2198 (24.19%)	265 (2.92%)	9087 (19.93%)
	4	35 (0.39%)	306 (3.37%)	2091 (23.03%)	4828 (53.18%)	1818 (20.03%)	9078 (19.92%)
	5	19 (0.21%)	48 (0.53%)	256 (2.80%)	1780 (19.49%)	**7030 (76.98%)**	9133 (20.04%)
Total		9032 (19.82%)	9035 (19.83%)	9113 (20.00%)	9160 (20.10%)	9162 (20.10%)	45572 (100%)

Regression results

I begin by fitting a null model which has only an intercept and MSA effects (see Table 11). This analysis explores whether differences in the dependent variable is dependent on MSA clusters. The null model of the affluent neighborhoods shows that the log-odds of whether affluent neighborhoods and poor neighborhoods experienced economic prosperity during the 2000s is 1.32 and -1.20 with MSA-level variance of 0.03 and 0.02, respectively. The null hypothesis for both models that the MSA-level variance is zero is rejected as the likelihood ratio statistics are 19.34 and 4.35 for affluent and poor neighborhoods, respectively. These tests indicate that there is a variation in the incidence of experiencing economic prosperity across MSAs in both models.

Table 11 presents the results of multilevel logistic regression models predicting affluent and poor neighborhoods' odds of experiencing economic prosperity during the 2000s. First, the results of housing-age variables in both affluent and poor neighborhoods indicate, in general, the cyclical process of neighborhood change, consistent with the filtering and neighborhood-life cycle hypotheses. The likelihood of experiencing economic prosperity in both affluent and poor neighborhoods is positively associated with having larger percentages of the newest (aged within 10 years) and oldest (built before 1940) housings compared to those of housing age between 21 and 30 years, as expected. While the coefficients of housing aged 11 to 20 years and 31 to 40 years were not statistically significant in both neighborhoods, the results generally indicate the U-shaped curve in which the vertex was centered on middle-aged housing in both affluent and poor neighborhoods. Another interesting finding is that the coefficient of old housing (above 40 years, but built after 1940) was positive and statistically significant in affluent neighborhoods, while that was not the case in poor neighborhoods. Based on the neighborhood-cycle hypothesis, one possible interpretation of this result is that the redevelopment process may occur at an earlier stage in affluent neighborhoods than poor neighborhoods. Neighborhood groups in affluent neighborhoods may utilize their economic resources and political connection with external powerful elites to redevelop old housing (above 40 years but built after 1940) in such areas. Therefore, it is possible that developing projects would be disproportionately concentrated in more affluent communities, leading to the endurance of affluent neighborhoods in their economic status over time. It is also possible that property owners in affluent neighborhoods are more

efficient for sustaining the quality of the properties and surrounding neighborhoods at a higher standard.

The influence of racial composition on neighborhood economic change also provide interesting results as shown in Table 11. First, the percentage of blacks was negatively associated with the log-odds of both affluent and poor neighborhoods experiencing economic prosperity between 2000 and 2010. However, the presence of Hispanic population increases the likelihood of affluent neighborhoods experiencing economic prosperity, while the coefficient in the poor neighborhood model was not statistically significant. This result may support spatial assimilation theory, which states that racial and ethnic spatial structure is less stratified in higher income neighborhoods than lower income neighborhoods, especially for Hispanic and Asian populations (Iceland & Wilkes, 2006). In other words, residents tend to sort into neighborhoods by income rather by race in affluent neighborhoods, strengthening their economic status not confounded by racial composition.

Results from the advantaged contexts—homeownership rate, the percentage of highly educated populations who earned bachelor's degrees or above, and the percentage of working-age populations—are also reported in Table 11. Having advantaged population groups increases the likelihood of experiencing economic prosperity for both affluent and poor neighborhoods, as expected. For affluent neighborhoods, one percent increase in homeowners, high-educated population, and working population increases the likelihood of affluent neighborhoods maintaining their top quintile status from 2000 to 2010 by 2.6%, 5%, and 2%, respectively. For poor neighborhoods, one percent increase in such variables

increases the likelihood of poor neighborhoods in 2000 escaping their poor status and move up to at least the next quintile in 2010 by 1.1%, 5%, and 2.5%, respectively.

Table 11 presents the results of disadvantaged contexts—poverty rate, unemployment rate, density, foreign-born population. Focusing on poor neighborhoods, a higher percent of the poverty rate and residents who lived in the same house less than five years decreases the likelihood of poor neighborhoods in 2000 moving upward to upper economic status by 2010, as expected. Focusing on affluent neighborhoods, a higher percent of foreign-born population and residents who lived in the same house less than five years decrease the likelihood of affluent neighborhoods in 2000 moving up to the upper economic status in 2010, as expected. However, interestingly, a higher level of poverty rate was positively associated with the likelihood of experiencing economic prosperity in affluent neighborhoods. One possible interpretation of this result is that neighborhood groups in affluent neighborhoods effectively form a partnership with external actors, and lead them to view poor residential area in affluent neighborhoods as a subject of future redevelopment. Another mechanism could be that poor residents in affluent neighborhoods cannot afford high-priced housing, and are replaced by higher-income residents.

The influences of MSA-level factors—the percent change of manufacturing and high-end jobs, and population—are also displayed in Table 11. For poor neighborhoods, an increase in high-end jobs is negatively associated with the log-odds of poor neighborhoods moving upward to the upper economic status in 2010. An increase in high-end jobs the MSA level indicates the corresponding increase in low-end jobs for supporting high-end job workers' basic needs. Those low-income residents with low-end jobs will likely to move

into poor neighborhoods in which affordable housing is available. For affluent neighborhoods, an increase in high-end jobs at the MSA level is positively associated with the log odds of experiencing economic prosperity as expected. People with high-end jobs are able to afford housing in affluent neighborhoods, reinforcing the economic status of such places. An increase in manufacturing jobs decreases the likelihood of experiencing economic prosperity for affluent neighborhood as expected, while the coefficient of the variable was not statistically significant for poor neighborhoods. Because manufacturing jobs provide financial resources for middle-class residents, it might be possible that housing in affluent neighborhoods is financially approachable to middle-class residents. Metropolitan population growth was negatively associated with experiencing neighborhood economic prosperity in affluent neighborhoods during the 2000s, while it was not statistically significant for poor neighborhoods. In a growing MSA, powerful elites can accommodate the changing residential preferences by constructing new housing (Watson, 2006). Therefore, it is possible that affluent residents choose neighborhoods which contain housing compatible with their residential preferences, leading to the outflow of affluent residents from their original place.

To supplement the results of this study, I also conduct multilevel logistic regression analysis for neighborhoods in the second, third, and fourth quintiles of the neighborhood income distribution, which is provided in table 12.[5] The model for the fourth quintile (60—80%) presents a very similar result, compared to affluent neighborhoods. However, the models for third and second quintiles (40—60% and 20—40%, respectively) show similar results with the model of poor neighborhoods.

Table 11. Multilevel logistic regression analysis of experiencing economic prosperity 2000—2010 for affluent and poor neighborhoods

	Affluent neighborhoods				Poor neighborhoods			
VARIABLES	Null model		Model 1		Null model		Model 2	
	β	(SE)	β	(SE)	β	(SE)	β	(SE)
Fixed effects								
Intercept	1.323***	(0.036)	-10.669***	(0.784)	-1.208***	(0.031)	-5.960***	(0.699)
% housing built within 10 years			0.007**	(0.003)			0.022***	(0.005)
% housing built between 11—20 years			-0.0006	(0.003)			0.00006	(0.0056)
% housing built between 31—40 years			0.0008	(0.004)			0.007	(0.005)
% housing built above 41 years ago but after 1940			0.007**	(0.003)			0.004	(0.003)
% housing built before 1940			0.017***	(0.004)			0.019***	(0.003)
% blacks			-0.026***	(0.004)			-0.006***	(0.002)
% Hispanic			0.011**	(0.005)			0.001	(0.002)
% working population (aged 16-64 years old)			0.019***	(0.007)			0.025***	(0.005)
% homeownership			0.027***	(0.003)			0.011***	(0.003)
% who earned bachelor's degrees or above			0.048***	(0.004)			0.049***	(0.004)
% unemployment rate			-0.018	(0.016)			-0.007	(0.008)
% poverty rate			0.039***	(0.014)			-0.013***	(0.005)
% foreign-born population			-0.027***	(0.005)			-0.005*	(0.003)
% lived in the same house less than 5 years			-0.010**	(0.004)			-0.017***	(0.004)
Central city (binary variable, 1 = yes, 0 = no)			-0.043	(0.095)			0.114	(0.074)
log(density) (population per sq. miles)			-0.095***	(0.032)			-0.222***	(0.031)
Relative income in 2000			4.944***	(0.246)			8.373***	(0.577)

	Affluent neighborhoods				Poor neighborhoods			
VARIABLES	Null model		Model 1		Null model		Model 2	
	β	(SE)	β	(SE)	β	(SE)	β	(SE)
% change in manufacturing jobs			-0.099**	(0.045)			0.082	(0.066)
% change in high-end jobs			0.186**	(0.080)			-0.253**	(0.120)
% change in population growth			-0.024***	(0.007)			-0.010	(0.010)
Random effects								
Variance of random effects	0.035		0.146		0.020		0.517	
ICC	0.01		0.04		0.006		0.135	
Log Likelihood	-4538.1099		-3412.5258		-4883.7057		-4039.126	
Observations	9,043				9,050			
Number of groups	100				100			

*** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses.

Table 12. Multilevel logistic regression analysis of experiencing economic prosperity 2000—2010 for middle-classes neighborhoods

VARIABLES	60—80% percentile neighborhoods		40—60% percentile neighborhoods		20—40% percentile neighborhoods	
	β	(SE)	β	(SE)	β	(SE)
Fixed effects						
Intercept	-12.430***	(0.870)	-12.652***	(0.821)	-11.169***	(0.773)
% housing built within 10 years	0.012***	(0.003)	0.017***	(0.003)	0.020***	(0.004)
% housing built between 11—20 years	-0.003	(0.004)	-0.006	(0.004)	-0.010**	(0.005)
% housing built between 31—40 years	0.002	(0.005)	0.003	(0.004)	-0.001	(0.005)
% housing built above 41 years ago but after 1940	0.010***	(0.003)	0.004	(0.003)	0.0005	(0.003)
% housing built before 1940	0.018***	(0.003)	0.016***	(0.003)	0.010***	(0.003)
% blacks	-0.012***	(0.003)	-0.007***	(0.002)	-0.013***	(0.002)
% Hispanic	0.001	(0.004)	0.004	(0.003)	-0.002	(0.002)
% working population (aged 16-64 years old)	0.009	(0.006)	0.032***	(0.006)	0.031***	(0.005)
% homeownership	0.009***	(0.003)	0.017***	(0.003)	0.024***	(0.003)
% who earned bachelor's degrees or above	0.037***	(0.004)	0.050***	(0.004)	0.061***	(0.004)
% unemployment rate	0.008	(0.015)	-0.013	(0.012)	-0.013	(0.010)
% poverty rate	0.058***	(0.011)	0.003	(0.008)	0.012*	(0.006)
% foreign-born population	-0.014**	(0.005)	-0.012***	(0.004)	0.0003	(0.003)
% lived in the same house less than 5 years	0.004	(0.005)	-0.009**	(0.004)	-0.015***	(0.004)
Central city (binary variable, 1 = yes, 0 = no)	0.253***	(0.092)	0.190**	(0.079)	0.15272**	(0.075)
log(density) (population per sq. miles)	-0.303***	(0.029)	-0.267***	(0.024)	-0.23615***	(0.026)
Relative income in 2000	8.517***	(0.471)	9.765***	(0.629)	10.84822***	(0.680)

VARIABLES	60—80% percentile neighborhoods		40—60% percentile neighborhoods		20—40% percentile neighborhoods	
	β	(SE)	β	(SE)	β	(SE)
% change in manufacturing jobs	0.004	(0.040)	-0.006	(0.054)	0.08439	(0.066)
% change in high-end jobs	0.034	(0.072)	-0.063	(0.098)	-0.27182**	(0.119)
% change in population growth	-0.011*	(0.006)	-0.005	(0.008)	-0.01238	(0.010)
Random effects						
Variance of random effects	0.093		0.308		0.537	
ICC	0.028		0.086		0.14	
Log Likelihood	-3451.2687		-4241.3652		-4414.9608	
Observations	8,997		9007		8,997	
Number of groups	100		100		100	

*** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses.

Discussion and Conclusion

Identifying the mechanisms by which neighborhoods transform socioeconomically over time has been one of the main lines of inquiry by many scholars and policymakers because it is thought a neighborhood's quality has a fundamental influence on people's opportunities in life. Therefore, this study aims to understand how and why affluent and poor neighborhoods tend to sustain in their economic status over time, consequently leading to neighborhood-level income segregation.

The literature on neighborhood change which flourished following the work of the Chicago School's ecological perspective theorizes neighborhood change as a cyclical process that occurs inevitably and naturally no matter what the neighborhoods' SES was. To expand the previous findings, this study posits that affluent neighborhoods have a better capacity to resist neighborhood decline compared to poor neighborhoods. In other words, declining forces generated by ecological and economic factors will influence neighborhood change differently for affluent versus poor neighborhoods.

By employing multilevel regression models, this study finds that several influential factors at the neighborhood- and MSA-level have heterogeneous effects on neighborhood economic change based on the initial economic status of neighborhoods. In general, the results indicate that affluent neighborhoods tend to respond effectively against the decline process generated by ecological and economic forces than poor neighborhoods. First, the results show that affluent neighborhoods are likely to experience economic prosperity in an earlier stage than poor neighborhoods. Moreover, a higher level of poverty rate in the initial year of a decade increases the likelihood of affluent neighborhoods experiencing economic prosperity during the decade. One possible interpretation of these results is that

affluent neighborhoods are effective in organizing collective actions to bring resources via their privileged economic and political power in order to respond effectively to the decline process and maintain their economic advantages. Another possible interpretation for the persistence of affluent neighborhoods could be associated with the property owners' effort to maintain the quality of their properties and lack of affordable housing for poor residents in affluent neighborhoods. Last but not least, this research finds that affluent neighborhoods were less influenced by racial structure than poor neighborhoods, as the presence of Hispanic population predicts the likelihood of affluent neighborhoods maintaining their top quintile status.

This research finds that advantaged contexts—homeowners, highly-educated and working population—in the initial year of a decade were positively associated with the economic prosperity of the neighborhood during the decade. The result indicates implementing policies of promoting homeownership is appropriate for revitalizing poor neighborhoods and maintaining the economic prosperity of affluent neighborhoods. This is corroborated by the result that a higher level of population who resided in a same house less than five years is associated with neighborhoods experiencing economic deterioration for both types of neighborhoods. However, it should be noted that because the homeownership rate is significantly higher in affluent neighborhoods compared to poor neighborhoods (as shown in table 1), the unequal distribution of human resources may lead to the persistence of affluent and poor neighborhoods in their economic status. This study also finds that occupation restructuring—the polarization of jobs into high-end jobs and low-end jobs, and the decline of manufacturing industries—contributes to spatial inequality in urban areas.

The main finding of this study is that some of economic variables have heterogeneous effects on neighborhood economic change based on the initial economic status of neighborhoods, while urban ecology theorizes the decline force of neighborhood change can be applied to all neighborhoods regardless of their baseline contexts. That is neighborhoods would have different capacities, varied by economic or social status, of resisting from the neighborhood decline process. Therefore, policy makers should strive to address this gap. For example, lowering political and structural barriers that hinder disadvantaged neighborhoods from participating in the broader political arenas can minimize inequality. This suggests that efforts to promote social networks/interactions by providing social organization or civic center, especially in poor neighborhoods, would contribute to increasing the economic resiliency of socioeconomically disadvantaged neighborhoods. As the result of this study also suggests that a higher level of homeownership is related to economic ascent, promoting homeownership would also improve social capital between residents.

This study has a limitation which can be improved in future studies. This research posits that higher-income neighborhoods have higher levels of social capital than poorer neighborhoods, which consequently promotes neighborhood-level participation in urban political processes. Including a data which can proxy the level of social capital, such as the existence of a neighborhood organization, can improve the findings of this research. Moreover, not all types of within-neighborhood social capital based on SES guarantee the neighborhood-level participation. For example, one study showed that poor neighborhoods display equal participation in political activities as the affluent neighborhoods (Perkins et al., 1990). This highlights the importance of considering the political economy perspectives

in the analysis (Temkin and Rohe, 1996). This research primarily focuses on the internal neighborhood-level efforts to cope with the changing forces, while positing a relatively less active role of powerful elites on neighborhood change. However, urban political economists conceptualize the transformation of a city is also driven by powerful elites or institutional actors who can allocate limited resources through the uneven development throughout an urban area (Molotch, 1976). Therefore, the interplay between neighborhood-level and institutional-level actions would be crucial for determining the long-term neighborhood change (Temkin and Rohe, 1996). However, the majority of studies in neighborhood change mostly rely on ecological and economic perspectives. As a result, an important question of how neighborhood/community-level outcomes vary with the political economic structure still remains unanswered.

Notes

1. Following previous studies (e.g., Ellen & O'Regan, 2008; Jun, 2013), census tracts with more than 50% of their populations institutionalized are not considered in the study.
2. High-end jobs include occupations from industries of finance, insurance, real estate, rental and leasing, professional, scientific, management, administrative, and waste management services.
3. Using one-year lag variables is to consider the possible mutual causal relationships. While this approach does not solve the endogeneity problem, Galster and Mincy (1993) assumed that one-year lag variables at the MSA-level can be used for predicting the next year's neighborhood economic change. The data of jobs are obtained from 2000 SF3 Sample Data and 2005—2009 ACS 5-year estimates at the county level distributed from the U.S. Census Bureau. I, then, aggregate county-level data to corresponding MSAs.
4. I used Stata's xtmelogit algorithm to perform multilevel logistic model.
5. If fourth quintile neighborhoods in 2000 became affluent neighborhoods in 2010, it was coded as 1, otherwise 0. If third quintile neighborhoods in 2000 became either affluent or fourth quintile neighborhoods, it was coded as 1, otherwise 0. If second quintile neighborhoods in 2000 became one of affluent, fourth, and third quintile neighborhoods, it was coded as 1, otherwise 0.

Essay3. Disparities in the Spatial Distribution of Community Resources across Municipalities by Economic Status

Introduction

Income segregation indicates that "households have unequal abilities to live in places with good opportunities," often determined not only by socioeconomic contexts but also by the access to community resources (Van Zandt & Mhatre, 2009, p. 491). Community resources—establishments that provide opportunities for accessing services and quality goods—are essential resources of individuals' life chances and well-being. Through their physical presence, individuals can meet other crucial partners and build social networks, promoting social capital within a community (Freeman Anderson, 2017; Galaskiewicz et al., 2013; Small and McDermott, 2006). This perspective suggests that community-level contexts are influential for individuals' behaviors and outcomes. For example, access to green spaces is positively related to attention skills (Wells and Evans, 2003); educational resources influence parenting skills (Brotman et al. 2011; Gutman and McLoyd 2000); recreational resources reduce violent crime rates in very poor neighborhoods (Krivo and Harris, 2000). Therefore, the unequal distribution of community resources is assumed to be an indicator of social exclusion and consequently, an influential factor in the disparities between individuals' economic, social, and health outcomes (Haan et al., 1987; Scott and Horner, 2008). In his seminal work, *The Truly Disadvantaged*, William Julius Wilson (2012) argued that it is the concentration of low-income minorities in isolated and poor neighborhoods in inner cities that limits job opportunities and social networks for them. He emphasized the interplay between the out-migration of upper- and middle-class Blacks

from their former residential location in the center of the cities and concentrated poverty, followed by the rise of income segregation and exodus of local resources. The lack of basic community resources in segregated areas leads to perpetuated poverty and social exclusion. On the other hand, people in affluent neighborhoods are likely to benefit from many social advantages—including safety, quality of public resources and private services, job opportunities, and social networks—often referred to as the "geography of opportunities." This indicates that the disparities of access to resources and services are the core driving forces of perpetuated inequality by residential segregation. In this sense, the rising trend of income segregation within metropolitan areas which hinders disadvantaged groups from accessing high-opportunity living environments increases attention on the disparities in resource distribution to address social inequality (Reardon and Bischoff, 2011). A crucial part of analyzing the "black box" of the relationship between living environments and life chances is understanding the distribution of organizational resources and the effect of resource accessibility (Freeman Anderson, 2017; Small and McDermott, 2006).

An extensive body of research has focused on the spatial distribution or accessibility of community resources across neighborhoods and how they vary by socioeconomic and racial contexts. In general, the literature has theoretically assumed and empirically demonstrated that beneficial resources are more prevalent in affluent and White neighborhoods compared to low-income and minority neighborhoods, especially in the U.S. context.

However, there are limited studies that focus on municipal contexts related to the distribution of community resources. Fischer et al. (2004) argued that the rising income

segregation of the affluent was more prominent between municipalities than between neighborhoods. Theories, such as public choice developed by Tiebout (1957) and the political economy perspective advanced by Logan (1978), which explain residential segregation along political boundaries, suggest that access to beneficial services and resources is not only influenced by neighborhood-level socioeconomic and racial contexts, but also determined at the local jurisdiction level. Affluent jurisdictions often strive to strengthen their tax base, enticing high-income residents by providing organizational resources through their economic resources and legal authorization. Poor jurisdictions, however, may experience population loss due to the lack of community resources, generating the vicious cycle of place polarization. Many articles suggest that income segregation at the municipal level leads to the disparities in the distribution of community resources, perpetuating urban inequality (Hill, 1974; Jimenez, 2014; Neiman, 1976).

This research, therefore, explores the unequal distribution of community resources across 179 suburban municipalities within the greater Los Angeles region, which consists of five counties: Los Angeles, Orange, Riverside, San Bernardino, and Ventura Counties. This area is "an ideal laboratory for studying the political forces that shape urban areas (Hogen-Esch, 2011, p. 1). Specifically, the research question explored is: Are community resources unequally distributed across municipalities by economic status? This research contributes to the literature by examining municipal-level factors to understand the unequal distribution of resources. Specifically, this research conducts a unique investigation of disparities in the distribution of community resources. The majority of previous studies have explored the accessibility or distribution of resources—such as supermarkets, grocery stores, recreational facilities, educational facilities, and healthcare

facilities—independently at the neighborhood or household level. A comprehensive picture of community resources, however, has received less attention. By focusing on municipal boundaries in which the local governments have the authority to decide what types of resources will be provided, this research develops a municipal typology based on economic and racial attributes, and the diverse types of community resources—foods, recreational resources, healthcare facilities, civic organizations, and educational facilities—by utilizing the k-means clustering method. This study examines two competing hypotheses, which are built upon a theoretical argument that the interaction between residential segregation and the distribution of community resources at the jurisdictional level perpetuate inequality. First, to attract higher-income residents, affluent municipalities will strive to secure all types of beneficial community resources, while poor municipalities will have less community resources. Second, affluent municipalities will focus on specific community resources, which are assumed to protect their tax base and property values, within their boundaries, while the other important community resources will be located in the adjacent municipalities. This suggests that affluent municipalities will have higher levels of community resources than other municipalities when incorporating those in spatially adjacent municipalities. The result of this study will provide meaningful evidence that will help to develop policies that promote the equity of the spatial dimension of opportunity by identifying what type of community resources are limited in socioeconomically distressed municipalities.

The geography of community resources

The literature on epidemiology, public health, sociology, and urban planning have contributed to developing knowledge of the relationship between community resources and individual outcomes related to economic, social, and health opportunities. One strand of the literature has focused the spatial distribution or accessibility of community resources—foods, recreational facilities, green spaces, educational, healthcare facilities, and social organizations. This section reviews the literature that examines the distribution or accessibility to community resources across neighborhoods or communities that differ by socioeconomic and racial contexts.

Foods

An extensive body of research has investigated the relationship between the racial and socioeconomic status of neighborhoods and their accessibility to healthy foods. A better access to healthy foods indicates a variety of food options that increases dietary quality. Moreover, access to fresh foods is crucial for reducing the risk of cardiovascular disease and obesity (He et al., 2004; Hung et al., 2004). Therefore, "food deserts," which refer to areas that have limited access to healthy food have been the main topic of this area of study. The literature has emphasized the presence of supermarkets or large size grocery stores for improving health because they offer a wide range of healthy foods such as fruit and vegetables at lower prices than small stores. They also contain a wide range of services such as pharmacies, daily necessities, and other retail goods (Helling and Sawicki, 2003; Horowitz et al., 2004). The general finding is that economically distressed and minority neighborhoods, especially African American neighborhoods, have lower access to healthy food resources (Moore and Diez Roux, 2006; Morland et al., 2002; Powell et al., 2007; Raja

et al., 2008; Zenk et al., 2005), even in affluent African American neighborhoods compared to affluent White neighborhoods (Helling & Sawicki 2003). Studies have also shown that small stores mostly serve urban neighborhoods, which indicates that urban residents are more likely to be exposed to poor quality foods with higher costs because smaller grocery stores are less likely to provide healthy food compared to the larger grocery stores or supermarkets at the same price (Chung and Myers 1999; Raja et al., 2008). When locational setting is considered, mixed results have been reported. One study found that in rural areas, low-income and minority neighborhoods have higher access to food stores than high-income and White neighborhoods (Sharkey et al., 2010). However, in another study, in neighborhoods far from the central area of Portland, travel time to supermarkets by residents in poor neighborhoods were longer than nonpoor neighborhoods (Mckenzie, 2014).

Unlike supermarkets, fast-food stores are strongly associated with unhealthiness, such as being overweight and obesity (Li et al., 2008). Scholars have found that African American neighborhoods have more fast food outlets than White neighborhoods, which may result in a higher level of obesity in African Americans (Moore and Diez Roux, 2006; Powell et al., 2007; Satia et al., 2004). Other scholars also pointed out that the density of fast-food outlets was associated with lower median household income (Hurvitz et al., 2009). Moreover, studies have suggested that convenience stores are more likely to be present in economically deprived and minority neighborhoods with higher African American and Hispanic populations, than affluent neighborhoods with lower levels of minorities (Block et al., 2004; Galvez et al., 2008; Kwate et al., 2009; Lee et al., 2010; Lewis et al., 2005; Lisabeth et al., 2010; Sharkey et al., 2009; Sharkey and Horel, 2008).

Recreational resources and park

Scholars have demonstrated the positive association between neighborhood recreational facilities and the level of physical activity (Mujahid et al., 2007; Sallis et al., 1990). Physical activity is crucial for improving health, which highlights the access to recreational facilities, such as parks and sports facilities. Such recreational resources may not only provide opportunities to improve the physical shapes of residents but may also positively influence mental health (Macintyre, 1993). Based on socioeconomic and racial contexts, the location of recreational facilities is not equally allocated across communities, resulting in disparities in public health (Gordon-Larsen et al., 2006). By analyzing the data at the census tract level in a single Midwestern U.S. city, Estabrooks et al. (2003) showed that physical activity resources were less likely to be found in low-socioeconomic (SES) neighborhoods compared to high-SES neighborhoods. By focusing on census tracts in North Carolina, New York, and Maryland, Moore et al. (2008) found that recreational facilities are more likely to be located in White neighborhoods compared to African American and Hispanic neighborhoods, while the distribution of parks is more equally allocated across neighborhoods. The evidence from Powell et al. (2004) suggested that communities with higher levels of poverty and higher percentages of African Americans have significantly fewer parks and green spaces. By focusing on 409 communities across the U.S., Powell et al. (2006) discovered that commercial physical activity resources were less likely to be located in low-SES and African American neighborhoods. Vaughan et al. (2013) found that good quality parks are less likely to be present in low-income and minority census tracts. In general, the literature has reported the unequal distribution of recreational facilities and park across neighborhoods by socioeconomic and racial contexts.

Healthcare facilities

Disparity in the access to healthcare facilities by socioeconomic and racial statuses of neighborhoods or communities also indicates urban inequality. Lack of healthcare resources in socioeconomically distressed areas may serve as an additional stressor for residents who are already stressed by deprived local contexts (Macintyre et al., 1993). Moreover, poor access to primary healthcare facilities or acute care hospitals can cause late diagnosis, thereby increasing the risk of diseases (Jones et al., 1999; Wang et al., 2008). The probability of late diagnosis is higher for economically disadvantaged and minority populations (Wang et al., 2008). The access to healthcare services is significantly influenced by the distance to healthcare providers, indicating a relationship between social inequality and the spatial distribution of healthcare resources (Guagliardo et al., 2004). Guagliardo et al. (2004) found that lower-income and African American neighborhoods have lower levels of accessibility to primary care providers for children. By interviewing residents in lower-income communities in Columbus, Ohio, Hawthorne and Kwan (2012) measured the perceived distance for lower-income communities to high-quality healthcare facilities. Due to the lower level of perceived care quality in economically disadvantaged communities, residents in such areas felt that they have a lower level of accessibility to quality healthcare facilities. Freeman Anderson (2017) explored whether minority neighborhoods are less likely to have health-related resources compared to White neighborhoods. The result of this study demonstrates that a tighter clustering of African Americans at the zip code level is associated with a lower level of health-related resources. However, several studies outside of the U.S. provide the opposite finding. One study from New Zealand (Pearce et al., 2007) found that the travel time to health-related community

resources—such as recreational, shopping, educational, and health amenities—is shorter in deprived neighborhoods. Adams and White (2005) demonstrated that deprived areas, measured by employment, education and income status, in the northeast England, have closer proximity to health services than affluent communities, in both urban and rural settings. A study focused on areas in Glasgow found that middle-class areas have better access to health-related resources than working-class areas (Macintyre, 1993).

Civic and social assistance organizations

Civic and social assistance organizations are beneficial for residents. Their presence assists in building social relationships among residents and promotes the organization of collective civic events which aim to address residents' needs and increases the possibility of receiving grants from outside the community (Sampson and Graif, 2009; Sampson, 2012; Small, 2006). Civic engagement, promoted by the presence of organizational resources, aims to change the neighborhood conditions so it meets residents' demands, thereby, improving the quality of neighborhoods (Gilster, 2017). One study examined whether the access to organizational resources encourages the participation of residents in civic life. By focusing on the Chicago area, Gilster (2017) found that individuals are more likely to engage in the civic movement if they live in neighborhoods that have more neighborhood-level organizational resources. Moreover, the spatial pattern of organization resources within Chicago was not randomly distributed, but clustered in either advantaged or disadvantaged neighborhoods. Similarly, Joassart-Marcelli and Wolch (2003) examines the spatial distribution of antipoverty organizations across southern California cities. They

found that nonprofit social services are more clustered in higher-income and older inner-ring suburbs than lower-income and inner-ring suburbs.

According to the literature, childcare centers are also crucial social assistance resources. The lack of childcare services may increase stress and worsen mental health for residents due to the difficulties of balancing time and effort between work and family (Young, 2015). Childcare centers not only reduce childcare demand, but also provide an arena in which mothers can socially interact with each other and communicate with organizations (Small, 2009). The results on the location of childcare services are mixed. Fuller and Liang (1996), in a study of Massachusetts, found that working-class and middle-income families have lower access to preschools compared to high- and low-income families at the zip code level. However, they also found that communities with a higher level of single parents, as well as poor communities have limited access to childcare services. Other studies also reported a similar result that communities with a high concentration of low-income families and neighborhoods that are socioeconomically disadvantaged have fewer childcare centers (Queralt and Witte, 1998; Siegel and Loman, 1991). Small and Stark (2005), however, showed that the probability of having public childcare centers in a neighborhood increases as poverty rate increases, while vice versa for private childcare centers.

Education

The location of educational facilities creates crucial interrelationship between home, school, and community in the spatial dimension. Therefore, education services have the potential to result in in equities (Talen, 2001). When it comes to choosing a residential

locality, one of the most important factors for families with children is the presence of public education (Brunner, 2003). After Oates' (1969) seminal paper, which argued that a high expenditure on public education increases housing values, there were several efforts to explore the link between the demand for housing and the quality of public education. Boustan (2013) discovered there was a high demand for living in affluent municipalities due to the low property tax rates and high-quality public education. Based on block-level data, the author compared the housing prices at jurisdictional borders on either side of the city-suburban divide of U.S. metropolitan areas, revealing that low property tax rates and high-quality public education account for the high demand for living in an affluent jurisdiction, measured by higher housing prices. In addition, the author revealed that richer municipalities tended to have larger housing units. Therefore, the existing "residential-based assignment systems" of public education can strengthen the relationship between the quality of public schools and the overall income levels of municipalities, as housing prices would reflect the greater demand for high-quality public education, thus reflecting public school quality in housing prices. Housing in good school districts has a premium, as it is natural that people would demand quality public education for their children (Brunner, 2013).

Nechyba (2003) argued that the quality of public schools has a positive relationship with income segregation based on a general equilibrium model. For example, it is highly expected that an affluent neighborhood would have greater funding resources for its public schools because of its larger tax base than that of a poorer neighborhood. This makes it possible for a higher-income neighborhood to have higher-quality teachers and educational

facilities, which provides an incentive for higher-income households to concentrate in that area.

Education training facilities are also crucial for enabling urban mobility. Murphy and Wallace (2010) found that educational resources—which includes junior colleges, business and secretarial schools, computer training, cosmetology and barber schools, or other technical or trade schools—are more present in urban poor neighborhoods than suburban poor neighborhoods.

Considering municipal boundaries for resource distribution

The availability of amenities, resources or services has been empirically tested mostly at the neighborhood level, which may be due to the influence of the ecological theories developed by the Chicago School (Park, Burgess and McKenzie, 1925). The ecological perspective is a deterministic model that views a neighborhood as a "natural space," created from social interactions and economic competition between individuals, and neighborhoods within an urban area. When new residents, who differ by race/ethnicity and class, enter or 'invade' a neighborhood, competition for limited resources and spaces intensifies conflict between original residents and the "invaders," disrupting the equilibrium. A new equilibrium will be established when the less dominant population group leaves and the dominant population group stays in the neighborhood. Wilson (2012) found that the out-migration of upper- and middle-class residents leads to the exodus of community resources. Therefore, theoretically, it is assumed that White and high-income neighborhoods will have higher access to resources and services than ethnically heterogenous and low-income neighborhoods which tend to have limited

economic stability and lower levels of social ties among residents (Temkin and Rohe, 1998; Wichowsky, 2019). Based on this perspective, studies of resource and organization distribution across neighborhoods have mostly been built upon an assumption that the market force determines the spatial allocation of the exodus of local resources (Small and Stark, 2005).

Theory suggests that the contexts of municipal governments, which have received relatively less attention in the literature, should be considered to advance knowledge related to resource distribution across communities. Within the tradition of the ecological theory which emphasizes individual preferences to understand urban spatial patterns, Tiebout's (1957) public choice theory argues that each municipality provides a unique set of services and tax rates, resulting in heterogeneous local governments across a region. Thus, theoretically, a region is similar to a competitive market, and households are assumed to be economically rational; therefore, households maximize their utility by choosing a jurisdiction in the region that provides their preferred set of services and tax rates. Thus, people "vote with their feet," according to their preferences for the local public services and private goods in the regional market. Municipalities are viewed almost as firms in a regional marketplace and the unequal distribution of community assets or resources across municipalities might be considered a natural outcome of free market mechanisms. Tiebout sorting postulates that the fragmentation of jurisdiction-based services and resources is an efficient and natural outcome of free market mechanisms without considering political inequalities (Bollens, 1986; Ioannides & Seslen, 2002). As a result, jurisdictional homogeneity has been less considered in the Tiebout model (Heikkila, 1996).

Urban sociologists, moreover, have asserted that urban spatial structure is not only a natural outcome of aggregated individuals' decisions and the market force but is also a consequence of organized action by political units. That is, local governments are not passive respondents to the marketplace, but actually active agents that play an important role in developing policies which encourage business and local resources (Bollens, 1986; Logan and Molotch, 1987). Therefore, they view the spatial structure of the city as not naturally occurring, but rather influenced by government action, serving as a reproducer of inequalities (Harding and Blokland, 2014; Logan, 1978). Gottdiener (2010) contended that spatial organization "represents the hierarchy of power," and further, that spatial design "is a political instrument of social control which the state uses to further its own administrative interests." (p. 126). In this sense, Tiebout's major assumption of zero spillover effect was challenged (Howell-Moroney, 2008). Tiebout's public choice theory suggested that each person maximizes one's own utility and eventually leads to the maximized total social welfare, with the assumption that there is no spillover effect between locals. However, it is highly possible that municipal-level decisions not only affect their communities, but also influence neighboring municipalities. This is because the gap in the capacities among municipal governments to provide better public services and resources will be widened as the devolution of federal responsibilities to local governments proceeds (Lobao, 2004). Affluent municipalities can offer highly demanded services based on their fiscal strength. Only those local governments with good public services can benefit from the expansion of land values and an attraction of the affluent, which leads to the increase of the tax base of the municipalities and to a homogeneous environment occupied by the wealthy. Similarly, Logan's (1978) political model emphasized that political

inequality, often decided by the difference in tax bases between jurisdictions, as a result of residential sorting, reproduces residential inequality.

Zoning is an ideal example to illustrate the role of local governments on resource distribution. Zoning is a powerful tool for local governments to influence the supply-side of the housing market and to manage their spatial landscape. Each municipality can have its own unique residential characteristics and profile through its authority to design a spatial development pattern using zoning or other land-use regulations. By determining zoning and land-use regulations, local governments exercise their legal powers to achieve the goals of reducing fiscal pressures and protecting their property tax base by excluding "undesirables" (Nelson, 1979, p 715). Zoning encourages developments that can attract households who can contribute to the local tax base more than their public service consumption, and inversely, to discourage developments that would be favorable to households whose consumption of public services would exceed their contributions to the local tax base (Branfman et al., 1973; Fischel, 1978; Morgan, 1995; Rolleston, 1987).

Research questions and hypotheses

A common question regarding the literature on the distribution or access to community resources has been whether socioeconomically disadvantaged neighborhoods also are disadvantaged in accessing to community resources. Several theories highlight the importance of considering municipal contexts, which have been mostly overlooked, to fully understand the unequal distribution of community resources across spaces within an urban area.

Based on the theoretical proposition that income segregation occurs at the municipal level and the distribution of community resources is influenced by municipal governments, the core research question of this study is: Are community resources unequally distributed across municipalities based on economic status within their region? If the municipal boundary is influential for the distribution of community resources as theories hold, two hypotheses, which potentially compete, can be put forth. First, I hypothesize that affluent municipalities will likely contain most of the beneficial community resources. According to Tiebout's model, municipalities compete with each other within a regional area, similar to the private market. Moreover, residents are rational, they maximize their location to satisfy the best set of services and resources for them. In this perspective, a municipality is socially and economically seen as an independent entity. Affluent municipalities, therefore, have fiscal incentives to provide a set of services and resources to attract well off residents, while poor municipalities would have difficulty attracting businesses and resources, leading to disparities in resource accessibility among municipalities.

Second, I hypothesize that affluent municipalities will have higher levels of resources than other municipalities when incorporating the resources in adjacent municipalities. In other words, only specific resources or services are likely to be present in affluent and economically homogeneous municipalities, while other resources, which are also important for everyday life, will be located in adjacent municipalities that affluent residents can access. A municipal boundary is essentially invisible without physical barriers or "toll", so it is easily crossed by residents within and outside the municipality, often on a daily basis. This movement allows residents to expand their social networks

beyond their immediate locale. Furthermore, when considering the spillover effects of a municipal decision on adjacent municipalities based on the urban political economy perspective, affluent municipalities may focus on specific resources that can protect their tax base. For example, land-use regulations such as zoning are often developed to control negative externalities, which include congestion, traffic, noise, lack of light, poor air quality, fire risk, and illness, thereby enhancing public welfare while protecting property values (Fischel, 1987; Morgan, 1985; Nelson, 1979; Pogodzinski, 1991). In other words, the existence of zoning or land-use regulations could imply that there is a market demand for a denser development with services from developers who usually seek to challenge the traditional low-density zoning to maximize their profits (Levine, 2010; Mitchell, 2004). In this way, retail shops or other resources related to private services can be excluded from affluent municipalities. Such resources, related to retail and other personal services, require more customers to maintain the business, serving as a pull factor for relatively lower-income residents. However, low-income households are fiscally burdensome for affluent local governments because they yield a relatively small amount of tax-base increase compared with their consumption of local services, such as public education or parks. Typically, for low-density areas, allowing more people and greater density can cause diseconomies of scale in the supply of public services (Rothwell, 2009). Therefore, affluent municipalities will utilize zoning or land-use regulations to protect the rights of affluent residents who want to maintain a homogenous community and exclude outsiders to avoid any possible negative outcomes that could lower their property values (Fischel, 1999; Nelson, 1979). As a result, several private services which necessarily generate a certain level of congestion could be located in poorer and adjacent areas. From this perspective,

affluent municipalities provide services and resources for higher-income households at the expense of lower-income households, maximizing the efficiency of providing services.

Methodology

Study area

This research focuses on the 179 suburban municipalities[1] within the greater Los Angeles region, which consists of five counties: Los Angeles, Orange, Riverside, San Bernardino, and Ventura Counties (see Figure 5). The greater Los Angeles region would be an interesting area for exploring the fragmentation of municipalities along economic lines and the distribution of community resources. Heikkila (1996) found evidence that a municipal boundary in Los Angeles County provides a place in which spatial clustering of census tracts based on urban characteristics, ethnicity, household type, and economic class can be reinforced. Given this finding, this study contributes to the literature by extending the study area and considering the resource distribution across municipalities.

Data

The primary aim of this research is to identify the relationship between the economic hierarchy of municipalities and the disparities in community resource distribution across the municipalities. To examine the level of community resources within each municipality, I have utilized several secondary data sets from multiple resources: Reference USA data, U.S. census data, National Land Cover Database, and the Smart Location Database.

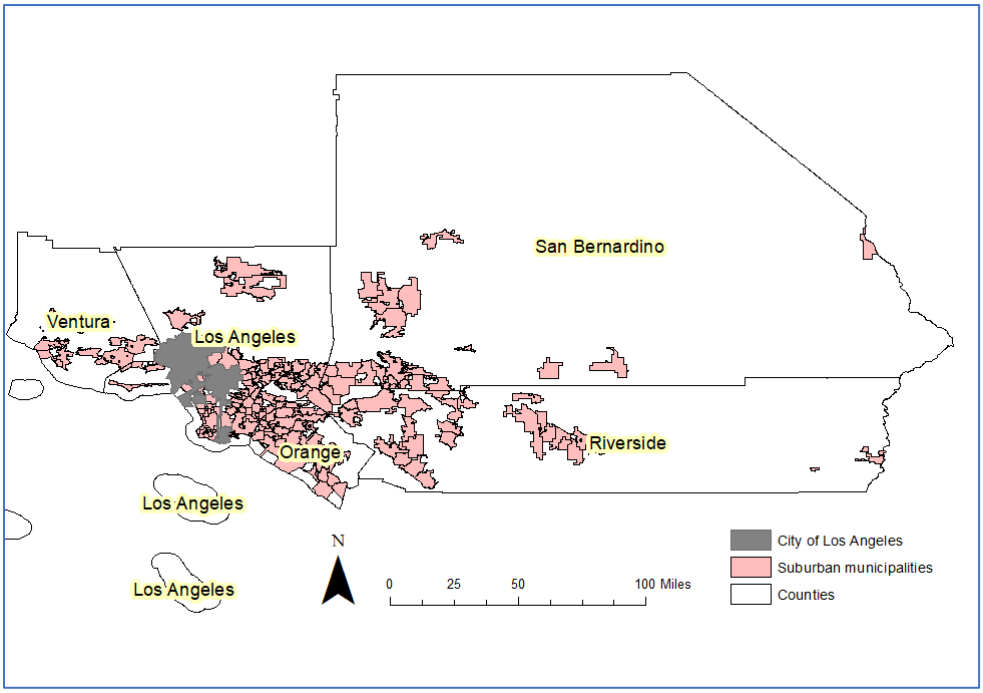

Figure 5. Suburban municipalities in the greater Los Angeles area

Community resources

This study focuses on nine community resources within seven domains: food, recreation, cultural amenities, health, civic organizations, and education. Data on these community resources within the five counties of Southern California, measured in 2010, were obtained from the ReferenceUSA database which contains the location and employment size of each business. Based on the North American Industry Classification System (NAICS) code, which identifies the type of organization or business, this study was able to classify the seven community resources within the six domains. To measure the availability of community resources within each municipality, this research utilizes the size of employment, aggregated at the municipal level, and calculates the number of workers in each domain per 1000 residents. While some studies used the count of resources within a given area, I use the number of workers to consider the size of resources. Since this study

only included community resources that are assumed to be positive to life chances as the literature in the previous section suggests, a higher value of a variable indicates more availability of community resources within a municipality.

For food, supermarket and other grocery stores (445110) were considered. For recreation, amusement and recreational industries (713900), which is an aggregation of golf courses and country clubs (713910), skiing facilities (713920), marinas (713930), fitness and recreational sports center (713940), bowling centers (713950), and all other recreational facilities (713960) are included. For cultural amenities, the employment size of performing art companies (711100)—which includes theater companies, dinner theaters, musical groups, and dance companies—and that of independent artists, writers, and performers (711510) is examined. For health care facilities, I considered the employment size of pharmacies and drug stores (446110) and that of physicians (621111). For civic and social organizations, I consider child care services (624410) and religious facilities (813110). For educational services, I explored the data on elementary and secondary schools (611110). To measure the availability of educational resources, I considered the school district boundary. To be specific, I first assigned each municipality into a specific school district boundary (either elementary or unified school districts), and calculated the total employers and the population of 5- to 17-year-olds within each school district. Then, I derived the number of employees in elementary and secondary schools per population aged between 5- to 17-years-olds. The level of employees per 5- to 17-years-olds population in the school facilities calculated at the school district level was assigned to the municipalities. For municipalities that are crossed by multiple school districts, I used the mean of the level of employees per 5- to 17-years-olds population. This study assumes

that a higher number of employees per younger population indicates a better quality of educational services.

Open space

In addition to the community resource variables, this research also measured the area of open space or park within a municipality by utilizing the National Land Cover Database (NLCD). To obtain the area of open space or park, I first "clip" the NLCD data with the boundaries of the five counties in this study by utilizing geographic information systems (GIS). Then the clipped raster data were transformed into a polygon feature. Each observation in the polygon feature has its own value of "gridcode" which indicates the types of land cover that define the polygon feature. There are total of 20 categories within 8 classes: Water, Developed, Barren, Forest, Shrubland, Herbaceous, Planted/Cultivated, and Wetlands. To measure the area of open space within a municipality, this study selected observations which have the value of 21, "Developed, Open Space."[2] After selecting polygons by attributes whose gridcode is 21, the area of open space, measured by sq. miles, was calculated at the municipality level.

Economic, racial, and housing market variables

To examine the distribution of community resources across municipalities and to identify whether disparities exist based on the economic contexts of municipalities, I obtained economic, racial, and housing market variables from the 2006-2010 American Community Survey (ACS) 5-year estimates at the place level. The variables include median household income, the count of household income within 16 categories, race and ethnic compositions, homeownership rate, poverty rate, families with their own children,

population density, and population. With the household income data, I calculate income diversity within a municipal boundary by using the index of ordinal variation (Kvålseth, 1995). Because income data within 16 categories is ordinal data, I believe this index will measure the income diversity better than a diversity measure based on nominal definition. The ordinal variation index is defined as follows.

$$H = \frac{1}{k-1}\sum_{k=1}^{k-1} 4C_k\,(1 - C_k) \quad (1)$$

k is the number of income groups and C_k is the cumulative proportion of the total household at income level of k or lower. The lowest number of the index of ordinal variation is obtained when all households are assigned evenly across the income categories. The maximum number of the index (one) is reached when all of the households are evenly divided into either the lowest- or the highest-income category.

Job-housing balance

This research also measures the job environment of municipalities by relying on the Smart Location Database (SLD) provided by the U.S. EPA Smart Growth Program (Ramsey and Bell, 2014). The SLD provides demographic, employment, and built environment variables at the 2010 Census block group (CBG) level throughout the nation by combining multiple data sets: U.S. Census data, InfoUSA, NAVSTREETS dataset, TOD Database, Protected Areas Database13, and General Transit Feed Specification. Specifically, the data consists of diverse variables that measure density, land use diversity, design of the built environment, access to transit, and destination accessibility. In this research, I utilize one of the variables in this data set: jobs per household, measured at 2010. Because the data is provided at the CBG level, I calculate the mean of the variable within each municipality.[3]

Composite measure of resources

For the second hypothesis which suggests that affluent municipalities will have higher levels of resources when incorporating the resources in adjacent municipalities, several composite variables were calculated. To be specific, I create a queen contiguity spatial matrix, d(.), and calculate the level of resources potentially related to private establishments (which does not include open space and educational service) and population that incorporate adjacent municipalities' contexts. The d(.) is a binary function that assigns the value of 1 to municipality *j* ($i \neq j$) that share common boundaries or vertices with municipality *i* while a value of 0 is assigned to non-adjacent municipalities. Therefore, the new set of composite resource variables measures the employment size of establishments per 1,000 residents, which not only focusing on the focal municipality but also considering the adjacent municipalities (defined by a queen contiguity matrix). The variables are calculated as follows.

$$Composite\ resource_{mi} = \left[\frac{CR_{mi}}{CP_m}\right] \text{ x } 1000 \quad (2)$$

where R_{mi} refers to the total size of employments of *i* resource in municipality *m*, P_m refers to total population of municipality *m*, $CR_{mi} = \sum_i^n d(R_{mi})$, and $CP_m = \sum_i^n d(P_m)$.

k-means clustering

Most of the previous studies have used the level of community resources or the accessibility at the neighborhood level as dependent variables, and explored what type of neighborhoods with specific socioeconomic contexts have higher or lower access to resource opportunities. While this approach has provided valuable findings, it provided a limited picture of resource distribution as they mostly focused on a single variable. As

theories suggest, this research conceptualizes a municipality as a provider of a set of services and resources based on the local interests. To provide a comprehensive picture of organization distribution, this research clusters municipalities based on community resources, economic, and racial contexts by applying non-hierarchical k-means clustering (MacQueen, 1967; Hartigan and Wong, 1979). As an initial effort to explore the distribution of resources in a holistic perspective, it is useful to utilize this method to classify municipalities based on the resource availability. Therefore, the two hypotheses are examined by conducting two cluster analyses.

Among diverse clustering algorithms, k-means clustering is the most popular method of partitioning data. Based on a predetermined number of clusters, the k-means clustering method minimizes the within-class sum of squares through an iterative process. A k-means clustering starts from partitioning the observations, selected randomly, into the predetermined number of clusters. When the mean of each cluster's center is calculated, each observation, then, is evaluated and assigned to the nearest cluster in which the smallest Euclidean distance between the observation and the cluster's center is found. In each step, the centroids of the clusters are recalculated until all of the observations are assigned to their nearest clusters (Lorr, 1983).

There is no definitive answer for choosing the optimal number of clusters. Deciding the optimal number of clusters could be subjective as it is fundamentally based on 'academic insights and experiences' (Wei and Knox, 2014). Before I assess whether a cluster solution is theoretically meaningful, several statistical methods were used to select the candidates for the optimal model: the within-cluster sum of square (WSS), Silhouette analysis, and the Calinski/Harabasz statistic. After deciding the optimal cluster solution, I

conducted a discriminant analysis to confirm the quality of classification and to explore the relative importance of variables that define the clusters.

Municipal typology based on economic, racial, and community resources

This section reports the results of cluster analysis by utilizing k-means clustering. The analysis consists of two sections. In the first sections, the first hypothesis, which states that affluent municipalities will have a higher level of resources than other lower-income municipalities for all resources, will be explored by utilizing variables measured within each municipality. In the second section of the analysis, another k-means clustering will be conducted to test whether affluent municipalities have higher levels of resources when considering their adjacent municipalities by including the composite variables.

Do affluent municipalities have all community resources within their boundaries?

The list of the variables used in the analysis is summarized in Table 13. The variables include 9 community resource variables and 10 socioeconomic and racial variables measured at 2010 (2011 for open space variable) in 179 suburban municipalities in the greater Los Angeles region. Before introducing the final cluster solution, I present several diagnostic statistics that can support the decision on the number of clusters. The first statistic is the total within-cluster sum of square (WSS), which measures how the observations within each cluster vary. A lower level of the total WSS is preferable because higher values of the total WSS indicate that observations within the cluster have a greater variability. One could select the number of clusters until adding additional cluster does not significantly reduce the total WSS (Mikelbank, 2001). Figure 6 plots the curve WSS based

on the number of clusters. I chose the top three cases for reduction of WSS—2, 3, and 4—which I set as the final candidates for the cluster solution.

Table 13. Descriptive statistics of variables used in the first cluster analysis

	Mean	Std. Deviation	Minimum	Maximum
Sociodemographic variables				
% of White	41.86	25.48	0.61	92.70
% of Hispanic	38.10	25.43	4.13	97.50
% of Black	4.46	6.10	0.00	42.77
% of households with children	40.12	11.80	0.32	71.75
% of homeownership	62.51	16.17	17.87	98.90
% in poverty rates	8.76	5.62	0.76	24.15
Density (population per miles)	5404.99	4422.60	160.28	23349.29
Jobs per household	27.72	220.81	0.19	2862.73
Index of income diversity	0.61	0.06	0.32	0.73
Median household income	71008.39	31179.48	31226.00	250001.00
Resource variables[a]				
Educational resources[b]	0.13	0.10	0.04	0.92
Open space (per sq. Miles)	0.07	0.12	0.00	0.93
Recreational facilities	5.78	14.46	0.00	177.23
Cultural facilities	1.21	2.77	0.00	23.81
Child day care services	2.32	2.13	0.00	15.36
Religious facilities	3.87	2.88	0.00	20.10
Pharmacies and drug stores	2.40	2.32	0.00	15.90
Physicians	14.80	37.62	0.00	431.84
Grocery store	9.14	21.32	0.00	282.05

a. Resource variables (except for educational resource) are measured as employees per 1,000 population.

b. Educational resources are measured by dividing the number of employees in elementary and secondary schools by the number of persons, age 5 to 17 years.

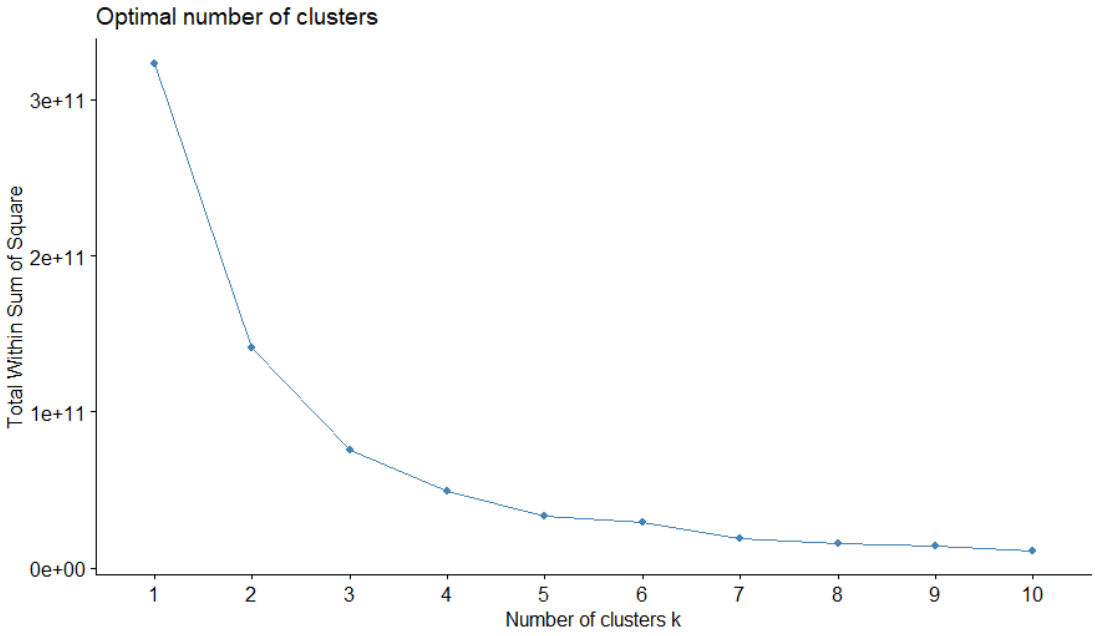

Figure 6. The total within-cluster sum of square (WSS) by each cluster solution

Second, I checked average silhouette to assess the quality of each clustering solution (Kaufman and Rousseeuw, 2009). Based on this approach, a higher value of average silhouette width is preferred. That is, the optimal cluster solution is the one when the average silhouette is maximized. Figure 7 shows that the average silhouette is maximized when k=2, and the value, in general, consistently decreased as the number of clusters increases.

Third, I also checked the Calinski/Harabasz statistic (Calinski and Harabasz 1974), which can be defined by Equation (X).

$$C(g) = \frac{\frac{trace(\boldsymbol{B})}{(g-1)}}{\frac{trace(\boldsymbol{W})}{(n-g)}} \quad (3)$$

Where trace(W), total WSS, indicates the variation within clusters, trace(B), total between-group sum of squares, presents the variation between clusters, g is the number of clusters, and n is the number of observations. Having a higher level of the index, caused by the maximization of trace(B) and minimization of trace(W), is preferable because it suggests a distinct clustering. Table 14 shows that the Calinski/Harabasz statistic is highest when k=3, among the final candidates of the cluster solutions.

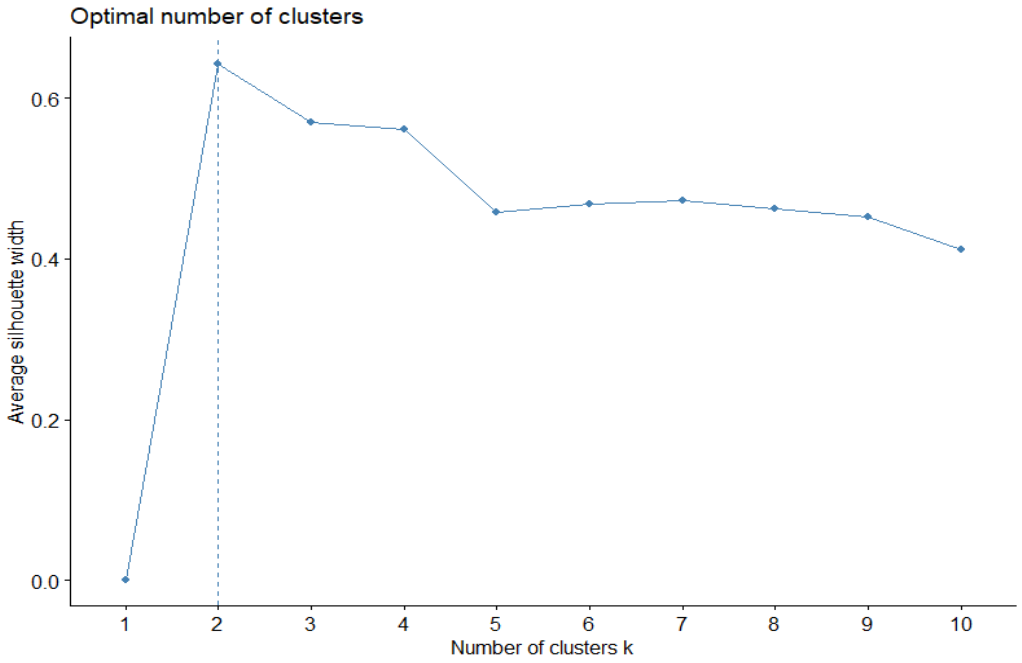

Figure 7. The average silhouette by each cluster option

Table 14. The Calinski/Harabasz statistic

Number of Clusters	Calinski/Harabasz statistic
2	188.79
3	305.9085
4	255.7975

Based on the descriptive results, I decided to choose the k=3 solution. Before I defined the clusters, I conducted a discriminant analysis to explore how well the municipalities are classified. In other words, I examined the driving factors that distinguish the municipalities into the clusters (Wei and Knox 2014).

In the discriminant analysis, the outcome variable is "the clusters" and the independent variables are the same variables that were used in the k-means clustering. This analysis explores how well the three-cluster solution classified municipalities based on the economic, racial, and resource variables. While the analysis is similar to linear regression, using a categorical variable as the outcome variable is the biggest difference using discriminant analysis. The discriminant analysis groups observations into the predetermined classifications based on the predictor variables by creating several canonical discriminant functions. In each function, the differences between groups are maximized, while the subsequent canonical discriminant functions have no correlation with previous functions in any case. One advantage of the discriminant analysis is that I can explore the percentage of municipalities that were correctly assigned to the groups developed by the cluster analysis, which refers to a hit rate (Marcoulides and Hershberger, 1997). While the canonical discriminant functions reveal the relative importance of variables that influence the cluster distinction, the hit rate is also informative since it provides a preliminary picture of the variables' contributions.

Table 15. Percentage of municipalities correctly classified into the clusters from the clustering analysis (compared with the results of the discriminant analysis).

	Cluster 1	Cluster 2	Cluster 3	Overall hit rate
Sociodemographic variables				
% of White	0%	65.6%	79.4%	69.8%
% of Hispanic	0%	82.0%	82.2%	77.1%
% of Black	0%	78.7%	80.4%	74.9%
% of households with children	18.2%	80.3%	86.9%	80.4%
% of homeownership	36.4%	88.5%	84.1%	82.7%
% in Poverty rates	36.4%	93.4%	91.6%	88.8%
Density (population per miles)	63.6%	91.8%	92.5%	90.5%
Jobs per household	63.6%	91.8%	92.5%	90.5%
Index of income diversity	54.5%	90.2%	92.5%	89.4%
Median household income	90.9%	93.4%	98.1%	96.1%
Resource variables[a]				
Educational resources[b]	9.1%	0%	98.1%	59.2%
Open space	45.5%	0%	98.1%	61.5%
Recreational facilities	45.5%	1.6%	97.2%	61.5%
Cultural facilities	45.5%	3.3%	94.4%	60.3%
Child day care services	45.5%	6.6%	93.5%	60.9%
Religious facilities	45.5%	4.9%	93.5%	61.5%
Pharmacies and drug stores	45.5%	9.8%	95.3%	63.1%
Physicians	45.5%	11.5%	95.3%	63.7%
Grocery store	45.5%	11.5%	95.3%	63.7%
N	100.0%	93.4%	100.0%	97.8%

Table 15 shows that clusters 2 and 3 were strongly defined by the racial compositions. Interestingly, the racial contexts did not define the cluster 1. The hit rate significantly increased for clusters 1 when adding the variable of median household income, implying the importance of the income variable in defining the clusters. For community resource variables, the hit rate of the cluster 3, in general, was high among

other clusters. For cluster 2, the hit rate did not increase significantly. When all variables were included the hit rate presents about above 98%.

Exploring the canonical discriminant functions provides more detailed information about the clusters. Table 16 presents the eigenvalues of each function, which indicates the share of variance explained (Wei and Knox, 2014). According to the Table 16, while there are two discriminant functions, the first discriminant function mostly explains the total variances (88.4%). This indicates that the first function is useful to understand the group differences.

Table 16. Statistics from the Canonical discriminant functions

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	5.578	88.4	88.4	0.921
2	0.731	11.6	100.0	0.650

In Table 17, the standardized score coefficients of the canonical discriminant functions are reported, which shows the relative contribution of each variable in defining the clusters. A higher level of coefficient (absolute value) indicates a greater contribution. It turns out that the highest standardized coefficient in Function 1 is the median household income, indicating median household income has the greatest importance in distinguishing the clusters. The share of Hispanic population, poverty rates, and the level of income diversity also show relatively greater contributions in developing municipal typologies. The results show that resource variables have a relatively marginal contribution for classifying municipalities. The most influential factor on the clusters was the level of recreational resources.

Table 17. Standardized Canonical Discriminant Function Coefficients

	1
Sociodemographic attributes	
% of White	0.122
% of Hispanic	-0.358
% of Black	-0.064
% of households with children	0.041
% of homeownership	0.154
% in Poverty rates	0.230
Density (population per miles)	0.169
Jobs per household	0.194
Index of income diversity	-0.340
Median household income	0.864
Resource variables	
Educational resources	0.259
Open space	-0.085
Recreational facilities	0.466
Cultural amenities	-0.262
Child day care services	0.146
Religious facilities	-0.117
Pharmacies and drug stores	0.121
Physicians	0.112
Grocery store	0.069

Based on the mean clusters of the three-cluster solution (see Table 18) and the results of the discriminant analysis, I defined the three clusters of the 179 municipalities within the greater Los Angeles region as follows: affluent and economically homogeneous, moderate-class, and economically disadvantaged and minorities.

Table 18. Mean centers for the three-cluster solution of municipal variables

	Cluster 1: Affluent & Economically homogeneous	Cluster 2: Moderate-class	Cluster 3: Economically disadvantaged & Minorities
Sociodemographic attributes			
% of White	71.23	57.19	30.09
% of Hispanic	6.94	20.82	51.15
% of Black	0.69	2.72	5.83
% of households with children	35.14	36.07	42.93
% of homeownership	88.97	69.87	55.60
% in Poverty rates	2.11	4.16	12.07
Density (population per miles)	2374.15	4296.67	6348.42
Jobs per household	1.00	64.19	9.67
Index of income diversity	0.50	0.60	0.63
Median household income	159142.36	87448.90	52575.26
Resource variables[a]			
Educational resources[b]	0.19	0.11	0.13
Open space	0.32	0.06	0.05
Recreational facilities	24.40	6.65	3.37
Cultural amenities	0.89	1.61	1.02
Child day care services	2.78	2.90	1.95
Religious facilities	4.09	3.88	3.84
Pharmacies and drug stores	2.26	2.74	2.22
Physicians	8.82	21.39	11.66
Grocery store	7.98	8.26	9.76
N	11	61	107

a. Resource variables (except for educational resource) are measured as employees per 1,000 population.

b. Educational resources are measured by dividing the number of employees in elementary and secondary schools by the number of persons, age 5 to 17 years.

The municipality typology, developed from k-means clustering, is presented in Table 18. The **Affluent and economically homogeneous** cluster consists of 11

municipalities with the highest levels of median household income, economic homogeneity, the share of White, homeowners, and the lowest share of minorities, density, and poverty rates. The results indicate that this type of municipality has the highest SES for all sociodemographic dimensions. Focusing on the community resource domain, this cluster has the highest level of educational, recreational resources, open space, and religious facilities compared to other cluster types. Moreover, the number of jobs per household was the lowest in this cluster, indicating that most of the areas are residential areas with open space and low density. Given the low level of jobs in this cluster, the levels of the other services—such as cultural amenities, child day care services, pharmacies and drug stores, physicians, and grocery store—are lower than other clusters.

The **moderate-class** cluster shows that all levels of the sociodemographic contexts—median household income, the share of White, Black, and Hispanic, homeownership rates, density, and poverty rates—were ranked at the 2nd place among the clusters. The highest level of jobs to household indicates that most of businesses in the region were located in the municipalities in this cluster. In terms of the organization domain, municipalities in this cluster have the highest availability of resources related to cultural amenities, child day care services, and health-related facilities.

The **economically disadvantaged and minorities** cluster presents the most disadvantaged context for all sociodemographic variables in this analysis. To be specific, municipalities in this cluster were likely to have the lowest level of median income, homeownership rates, the share of Whites and the highest levels of minority population, density, and poverty rates. Income diversity was also the highest among the clusters, which may suggest a low level of social ties among residents. In terms of food accessibility,

municipalities in this cluster contain the highest level of grocery stores. However, the municipalities have the lowest level of resources related to recreational, open space, child day care, religious facilities, pharmacies and drug stores. One interesting finding is that even though the share of households with children was the highest among other clusters, the level of educational resources is not the highest in this cluster. Considering the highest level of educational resources was in the affluent and economically homogeneous cluster, in which the share of households with children was the lowest, potential disparities in educational resources can be suggested.

Based on the three-cluster solution introduced in this section, the results do not appear to support the first hypothesis. That is, while the analysis found economic, social and racial, hierarchies of place among municipalities within the greater Los Angeles region; however, the higher income municipalities did not have the higher level of community resources for all dimensions.

First, the results indicate that municipalities were clearly differentiated not only by economic status but also by other racial attributes. In other words, municipalities in the greater Los Angeles region have a hierarchical socioeconomic structure. The level of socioeconomic advantages was the highest in the affluent and economically homogeneous cluster and got sequentially lower for other clusters—the moderate-class cluster and the economically disadvantaged and minorities cluster. The other way around, the order was completely reversed as far as the socioeconomic disadvantages are concerned. This tendency does not change even when reducing or adding more groups for k-means clustering. For example, for a given cluster solution, one cluster always has higher levels of

economic status, White, income homogeneity, homeownership, and lower levels of density, poverty rates, and minority population than the other clusters.

In terms of the community resources domain, higher-income municipalities had higher levels of resources in specific dimensions, not for all dimensions. That is, while the economic and racial hierarchy of place among municipalities was relatively apparent, there was limited resources in higher-income municipalities and some resources were highly present in lower-income municipalities. For example, the affluent and economically homogeneous cluster has the lowest level of cultural amenities, physicians, and grocery stores. Health-related facilities were highly present in the moderate-class cluster. The availability of grocery stores was higher in the economically disadvantaged and minorities cluster than the other clusters. However, it would be hard to conclude that lower-income municipalities have higher levels of community resources in specific domains than affluent municipalities. This is because a municipal boundary is not like a wall that physically divides the municipalities, so it is easily crossed by residents within and outside the municipality, often on a daily basis.

Do affluent municipalities exploit adjacent municipalities to secure community resources?

The results in the previous section suggest that the higher income municipalities do not have higher levels of resources in most domains. Therefore, in this section, I examine the hypothesis that affluent municipalities will have a higher level of accessibility to resources when considering their adjacent municipalities' resources. It is possible that other resources, which are also important for everyday life, will be located in adjacent municipalities in which affluent residents can access. I create composite resource variables

that consider the level of resources not only in the focal municipality but also in adjacent municipalities by using the queen contiguity spatial matrix. I specifically focus on resources, such as grocery stores, recreational facilities, cultural amenities, child day care services, pharmacies and drug stores, and physicians, that are assumed to be managed by the private sector (with the acknowledgement it is possible some of these establishments could be managed by the public sector). Therefore, the resources related to open space, religion, and education were not used to develop the composite resource variables. Table 19 presents the descriptive statistics of variables used in this analysis. There are 9 resource variables including six composite measures and 10 socioeconomic and racial variables measured in 2010 (2011 for open space variable) in 179 sub-urban municipalities in the greater Los Angeles region.

Table 19. Descriptive statistics of variables used in the second cluster analysis

	Mean	Std. Deviation	Minimum	Maximum
Sociodemographic variables				
% of White	41.86	25.48	0.61	92.70
% of Hispanic	38.10	25.43	4.13	97.50
% of Black	4.46	6.10	0.00	42.77
% of households with children	40.12	11.80	0.32	71.75
% of homeownership	62.51	16.17	17.87	98.90
% in Poverty rates	8.76	5.62	0.76	24.15
Density (population per miles)	5404.99	4422.60	160.28	23349.29
Jobs per household	27.72	220.81	0.19	2862.73
Index of income diversity	0.61	0.06	0.32	0.73
Median household income	71008.39	31179.48	31226.00	250001.00
Resource variables[a]				
Educational resources[b]	0.13	0.10	0.04	0.92
Open space	0.07	0.12	0.00	0.93
Composite recreational facilities	4.52	4.37	0.49	33.20

Composite cultural facilities	0.94	0.93	0.00	3.85
Composite child day care services	2.05	0.78	0.00	4.48
Religious facilities	3.87	2.88	0.00	20.10
Composite pharmacies and drug stores	2.03	0.66	0.00	4.29
Composite physicians	12.73	8.49	0.00	64.54
Composite grocery store	6.64	1.96	0.55	14.61

Before determining the optimal cluster solution, diagnostic statistics were tested for these data. The diagnostic statistics had a very similar result as the previous section. Based on Figure 8, I chose the cluster solutions of 2, 3, and 4, which are top three solutions regarding the reduction of WSS. Therefore, these numbers were selected as the final candidates again.

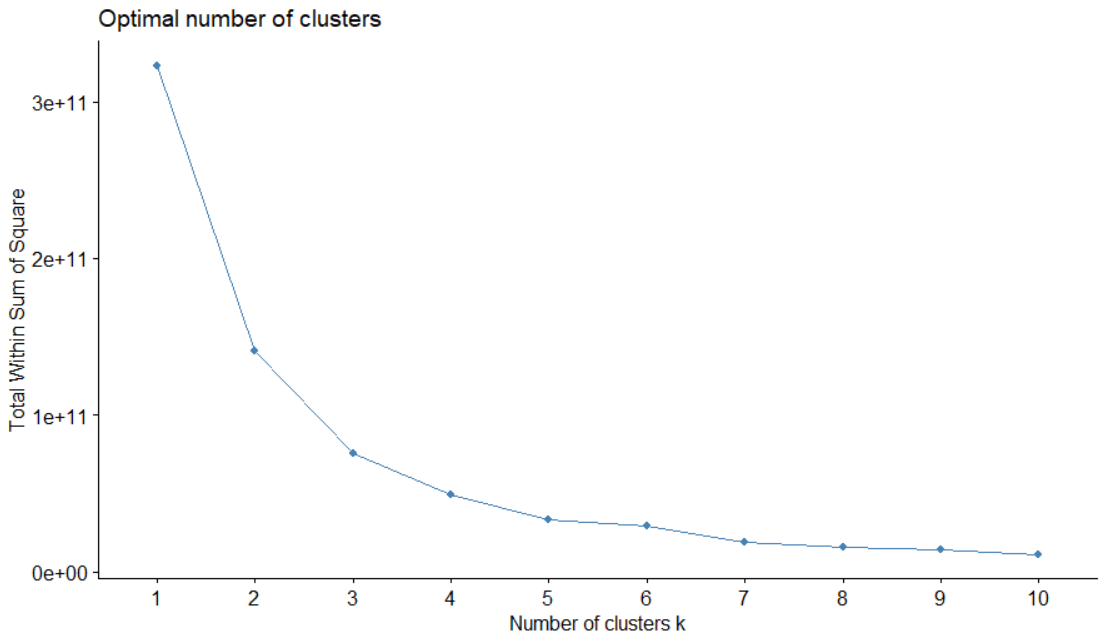

Figure 8. Total within sum of square with composite resource variables

Second, the average silhouette also presents a very similar result to this analysis in the previous section. Figure 9 shows the average silhouette is highest when k=2, and the value, in general, continuously reduced as the number of clusters increases. These results

are likely to be due to the significant influence of socioeconomic and racial variables on distinguishing the clusters, as shown in the discriminant analysis. Table 20 again shows that the Calinski/Harabasz statistic is highest when k=3, among the final candidates of the cluster solutions.

Table 20. The Calinski/Harabasz statistic

Number of Clusters	Calinski/Harabasz statistic
2	188.7908
3	289.1852
4	255.8004

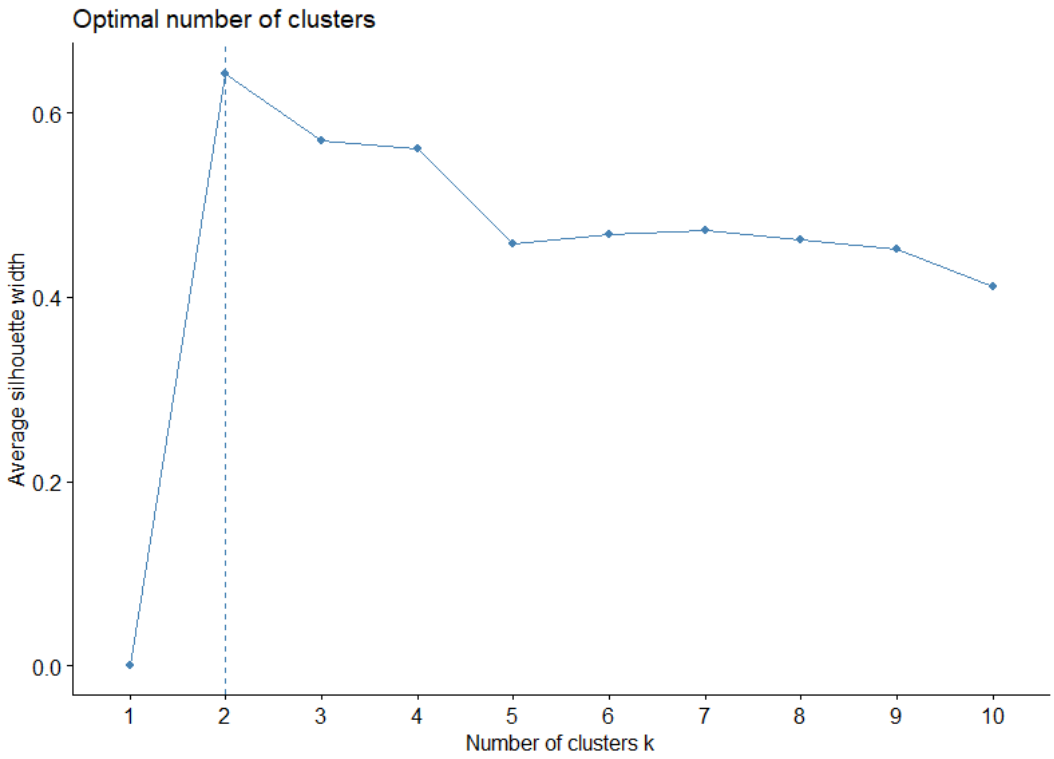

Figure 9. Optimal number of clusters based on average silhouette

After reviewing the diagnostic statistics and the meanings of the clusters, a k=3 solution was again selected. It turns out that the members of municipalities in each cluster

have not changed from the previous analysis. In other words, municipalities were clustered in the same way as the previous analysis. I also repeated the discriminant analysis before I named the clusters.

Table 21. Percentage of municipalities correctly classified into the clusters from the second clustering analysis (compared to the results of the discriminant analysis).

	Cluster 1	Cluster 2	Cluster 3	Overall hit rate
Sociodemographic variables				
% of White	0%	65.6%	79.4%	69.8%
% of Hispanic	0%	82.0%	82.2%	77.1%
% of Black	0%	78.7%	80.4%	74.9%
% of households with children	18.2%	80.3%	86.9%	80.4%
% of homeownership	36.4%	88.5%	84.1%	82.7%
% in Poverty rates	36.4%	93.4%	91.6%	88.8%
Density (population per miles)	63.6%	91.8%	92.5%	90.5%
Jobs per household	63.6%	91.8%	92.5%	90.5%
Index of income diversity	54.5%	90.2%	92.5%	89.4%
Median household income	90.9%	93.4%	98.1%	96.1%
Resource variables[a]				
Educational resources[b]	9.1%	0%	98.1%	59.2%
Open space	45.5%	0%	98.1%	61.5%
Composite recreational facilities	45.5%	16.4%	92.5%	63.7%
Composite cultural amenities	45.5%	13.1%	94.4%	63.7%
Composite child day care services	45.5%	37.7%	91.6%	70.4%
Religious facilities	54.5%	44.3%	91.6%	73.2%
Composite pharmacies and drug stores	54.5%	41.0%	88.8%	70.4%
Composite physicians	54.5%	42.6%	87.9%	70.4%
Composite grocery stores	54.5%	44.3%	87.9%	70.9%
N	90.9%	93.4%	97.2%	95.5%

For sociodemographic variables, Table 21 shows that the hit rate did not change compared to the results from the previous section. This is because each member of the clusters and the sociodemographic variables were not changed. In terms of resource variables, the hit rate increased as I added the composite measures of resources (from 63.7% in table 15 to 70.9%). A total 95% of municipalities were appropriately classified by adding all sociodemographic and community resource variables.

Table 22 presents the three discriminant functions. This result shows that the first discriminant function mostly explains the total variance (85.9%), suggesting that the first function was crucial for differentiating the groups.

Table 22. Statistics from the Canonical discriminant functions

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	4.801	85.9	85.9	0.910
2	0.785	14.1	100.0	0.663

In Table 23, I exhibit the standardized score coefficients of the canonical discriminant functions. Similar to the result in the previous section, the highest standardized coefficient in Function 1 is the median household income, indicating the dominant role of this variable in classifying groups. The share of Hispanics, poverty rates, homeownership, income diversity, and the level of composite recreational facilities also show greater contributions in developing the municipal typology than other variables.

Table 23. Standardized Canonical Discriminant Function Coefficients for the second cluster analysis

Variables	Function 1
Sociodemographic attributes	
% of White	0.149
% of Hispanic	-0.318
% of Black	-0.058
% of households with children	0.074
% of homeownership	0.203
% in Poverty rates	0.200
Density (population per miles)	0.176
Jobs per household	0.205
Index of income diversity	-0.240
Median household income	0.833
Resource variables	
Educational resources	0.152
Open space	-0.092
Composite recreational facilities	0.281
Composite cultural amenities	0.008
Composite child day care services	0.064
Religious facilities	0.070
Composite pharmacies and drug stores	-0.058
Composite physicians	-0.087
Composite grocery stores	0.061

Based on the mean clusters of the three-cluster solution (see Table 24) and the results of the discriminant analysis, I defined the three clusters of the 179 municipalities within the greater Los Angeles regions: privileged, moderate-class, and underprivileged. To be specific, the label of the affluent and economically homogeneous cluster was changed to the privileged cluster. Moreover, the name of the economically disadvantaged and minorities cluster was changed to the underprivileged cluster. The decisions on these changes are based on the change of the level of resource availability in these groups.

Table 24. Mean centers for the three-cluster solution of municipal variables in the second cluster analysis

	Cluster 1: Privileged	Cluster 2: Moderate-class	Cluster 3: Underprivileged
Sociodemographic attributes			
% of White	71.23	57.19	30.09
% of Hispanic	6.94	20.82	51.15
% of Black	0.69	2.72	5.83
% of households with children	35.14	36.07	42.93
% of homeownership	88.97	69.87	55.60
% in Poverty rates	2.11	4.16	12.07
Density (population per miles)	2374.15	4296.67	6348.42
Jobs per household	1.00	64.19	9.67
Index of income diversity	0.50	0.60	0.63
Median household income	159142.36	87448.90	52575.26
Resource variables[a]			
Educational resources[b]	0.19	0.11	0.13
Open space	0.32	0.06	0.05
Composite recreational facilities	8.88	5.69	3.40
Composite cultural amenities	1.53	1.05	0.82
Composite child day care services	2.68	2.34	1.83
Religious facilities	4.09	3.88	3.84
Composite pharmacies and drug stores	2.38	2.27	1.86
Composite physicians	16.52	12.50	12.47
Composite grocery stores	8.16	7.22	6.15
N	11	61	107

a. Resource variables (except for educational resource) are measured at employees per 1,000 population.

b. Educational resources are measured by dividing the number of employees in elementary and secondary schools by the number of persons age 5 to 17 years.

Compared to the results reported in Table 18, the results in Table 24, which used composite resource variables for private-related resources, offer interesting findings. First, because the members of each group have not changed, the economic and racial hierarchy of place among municipalities was re-confirmed. Second, higher-income and White municipalities were likely to have higher levels of resources in all dimensions.

The **privileged** cluster has the highest level of median income, income homogeneity, the share of White, homeowners, and the lowest level of minorities, poverty rates, and density. Moreover, most of the area in this cluster are likely to be a residential because the level of jobs per household was the lowest in the privileged cluster. Focusing on the community resources, this cluster has the highest level of community resources in all dimensions. Therefore, in terms of economic, racial, and community resources, this cluster has excellent access to opportunities.

The **moderate-class** cluster has the second level of SES. All of their SES status, defined by the economic, racial, and housing market contexts, is located between the privileged and the underprivileged clusters. Before considering the adjacent municipalities, their resource levels of cultural amenities, child care services, pharmacies and drug stores, physicians, and grocery stores were higher than the privileged cluster. However, when one considers the availability of the resources is not confined to residents who reside within a municipal boundary, unlike public service, the availability of the community resources becomes lower than the privileged cluster.

The **underprivileged** cluster has the most disadvantaged context in terms of economic and racial dimensions. Moreover, after considering the adjacent municipalities, the level of community resources for all domains became the lowest among other clusters.

For example, the level of grocery stores was the highest in this cluster without considering the adjacent municipalities' contexts. However, the levels of grocery stores became the lowest among the clusters after incorporating the adjacent municipalities. It is possible that grocery stores are mostly concentrated in municipalities that have a common boundary with upper-income municipalities, while municipalities that are spatially clustered with low-income municipalities have relatively lower availability of grocery stores. Municipalities in this cluster not only have socioeconomically disadvantaged contexts, but also limited availability to community resources.

The cluster analysis with socioeconomic, racial, and community resources (with several composite resource variables) seems to support the hypothesis that only specific resources or services are likely to be present in affluent and economically homogeneous municipalities, while other resources, which are also important for everyday life, will be located in adjacent municipalities that affluent residents can access. First, the socioeconomic hierarchy of municipalities found in the previous analysis was re-confirmed. Second, when considering the resources related to private business in the adjacent municipalities, the affluent municipalities will likely have a higher level of resources in all domains. One possible explanation is that municipalities in the privileged cluster have the economic and political capacity to secure public services such as educational resources, open space, or recreational services which increase housing prices (Brunner, 2013; Lutzenhiser and Netusil, 2001). However, resources related to retail and other private business could be restricted by the more affluent municipalities because of the possible decrease in the property values. For example, retail shops and other private business require enough customers to sustain their business. However, allowing more residents in

an affluent municipality increases density and congestion and causes fiscal burden due to the possible diseconomies of scale in the supply of public services (Rothwell, 2009). Through zoning, which constrains the developers' demand for development, affluent municipalities can focus on building environments in which affluent residents can physically enjoy, such as open space or parks. Consequently, other resources are located in adjacent municipalities.

Spatial patterns of municipal typology

In this section, I present the spatial patterns of the municipality topology developed by the cluster analysis based on composite variables. Figure 10 maps the distributions of municipalities based on their cluster types. The map reveals different types of municipal clusters are not likely to evenly distributed across space. To be specific, the moderate-class and underprivileged clusters are likely to cluster with each other. Moreover, the map also reveals that municipalities of the underprivileged cluster were significantly clustered with each other. Therefore, the map generally suggests the unequal distribution of resources across municipalities within the greater Los Angeles region.

One interesting finding is that none of the municipalities in the privileged clusters are isolated from any other municipalities, indicating the spatial dependence of municipalities. In other words, those municipalities have at least one municipality located near them. One possible explanation for this tendency could be that the privileged cluster utilize their adjacent municipalities for supporting community resources which they do not have. Therefore, the figures suggest that it would be hard to expect that a municipality can exist alone with a higher level of SES and resource availability.

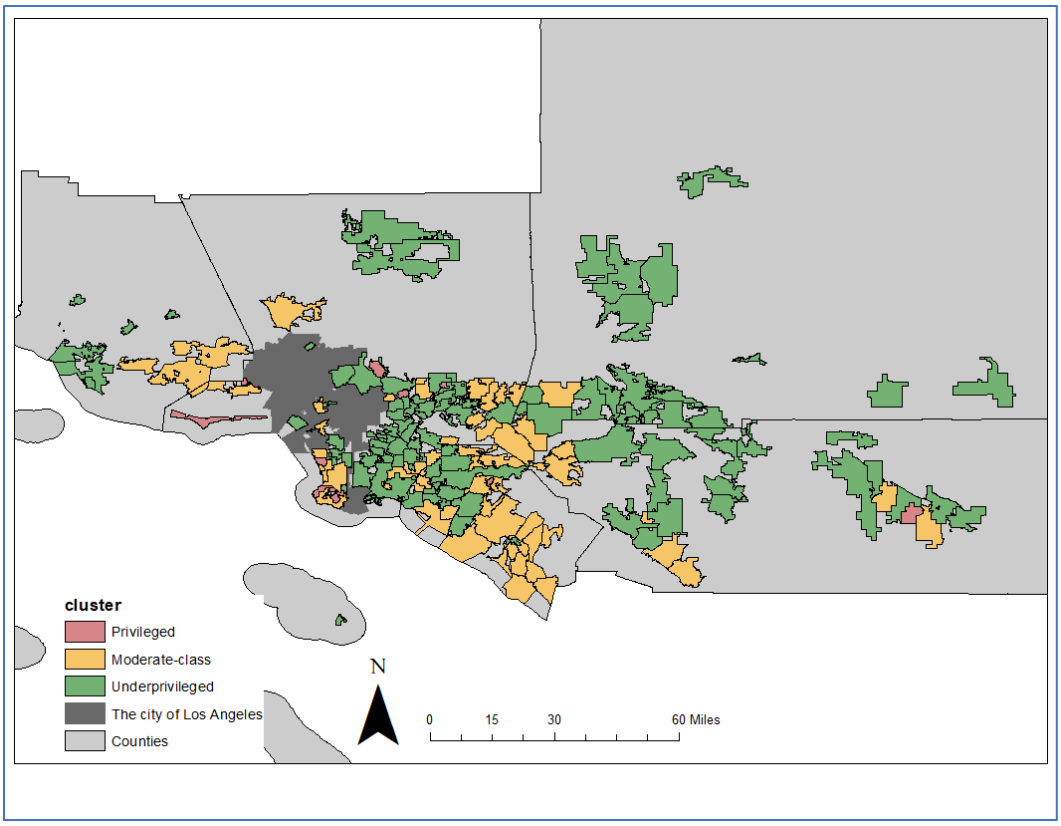

Figure 10. Spatial distribution the suburban municipalities in the greater Los Angeles region by the clusters

To provide more detailed information for the distribution of community resources across municipalities, I created several 3-D maps for community resources (Figure 11-19). The height of each map indicates the aggregated size of employees for each organization within a municipal boundary (not the value of composite variables). Through the 3-D maps (Figure 11-19), one can find how the municipalities in the privileged cluster are supported by other municipalities by having at least one municipality near them. The 3-D maps also provide a more detailed picture of the spatial clustering patterns of the underprivileged cluster. Therefore, these maps suggest that the distribution of community resource is unequal across municipalities within Southern California.

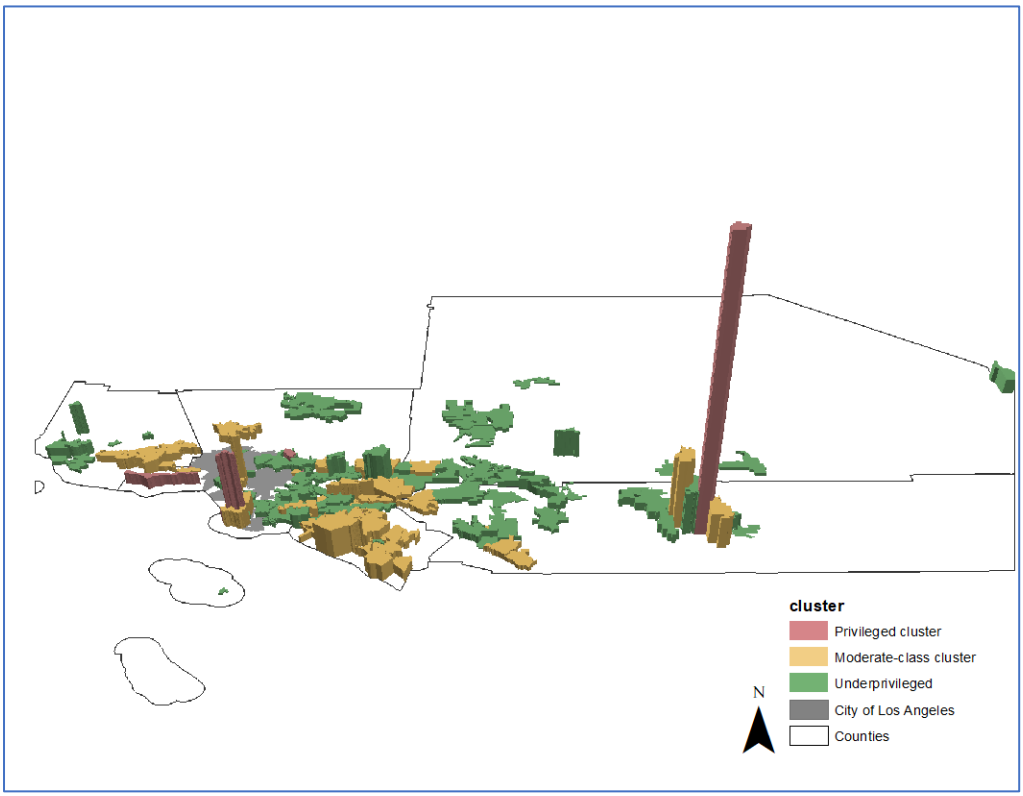

Figure 11. 3d map of the spatial distribution the recreational facilities

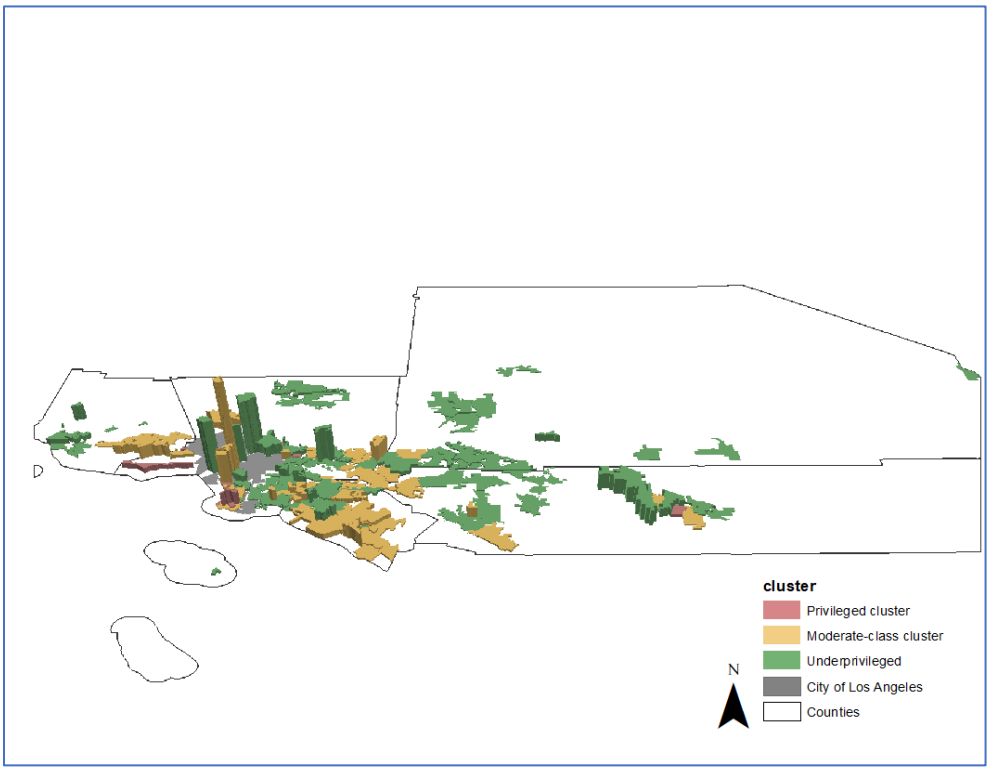

Figure 12. 3d map of the spatial distribution of cultural amenities

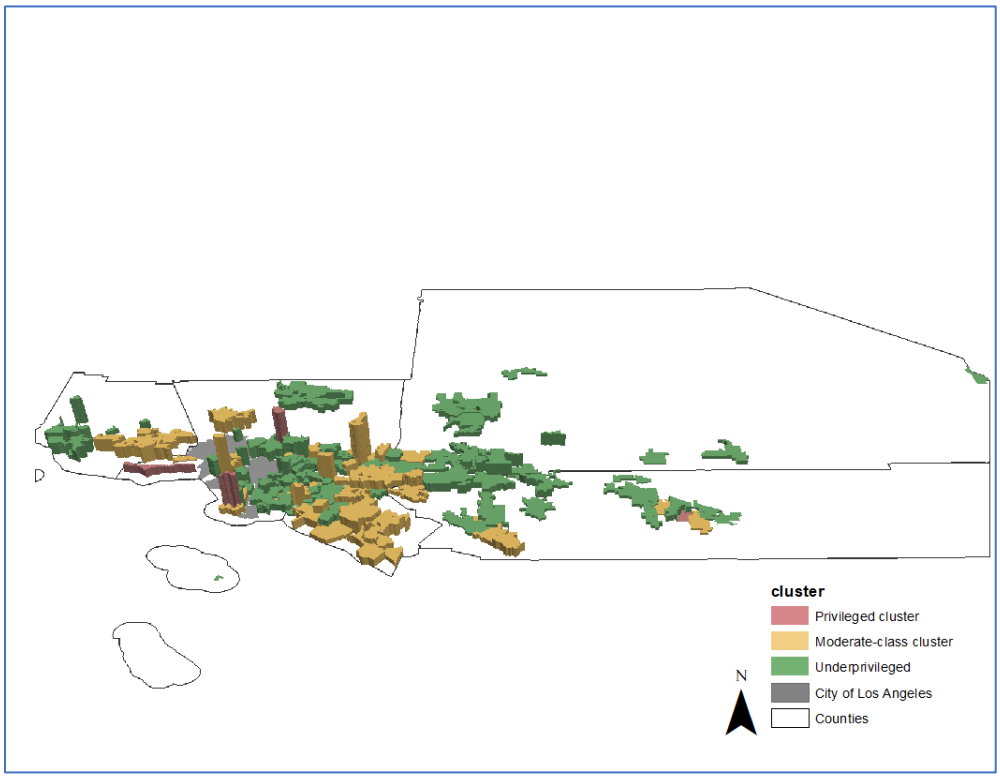

Figure 13. 3d map of the spatial distribution of child day care services

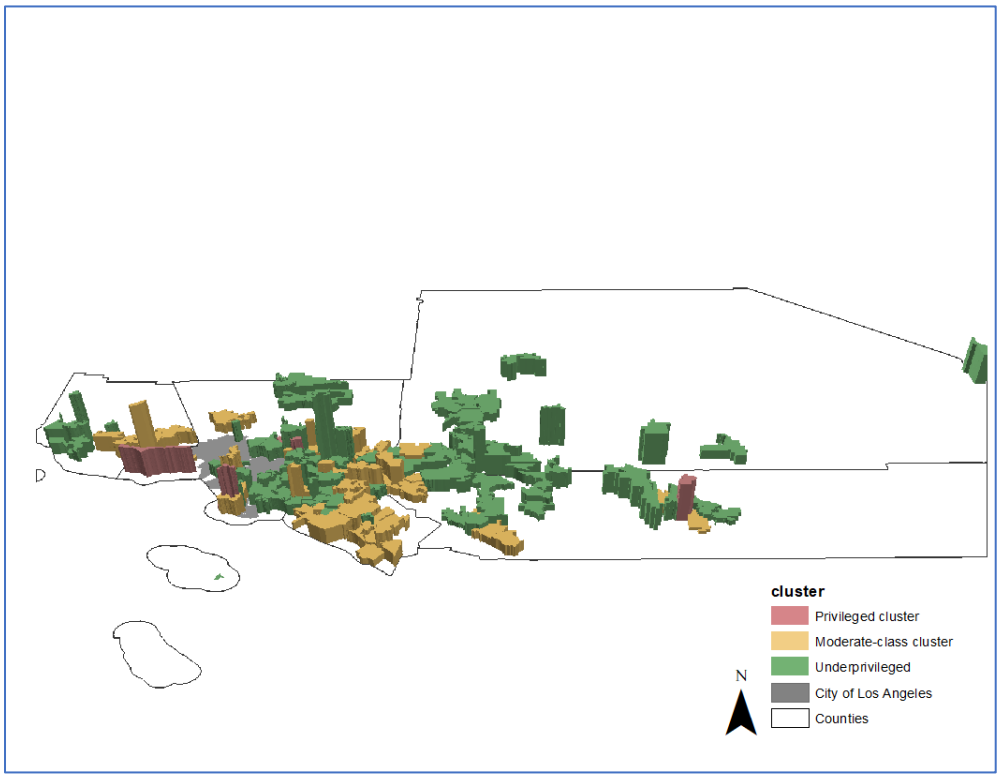

Figure 14. 3d map of the spatial distribution of religious facilities

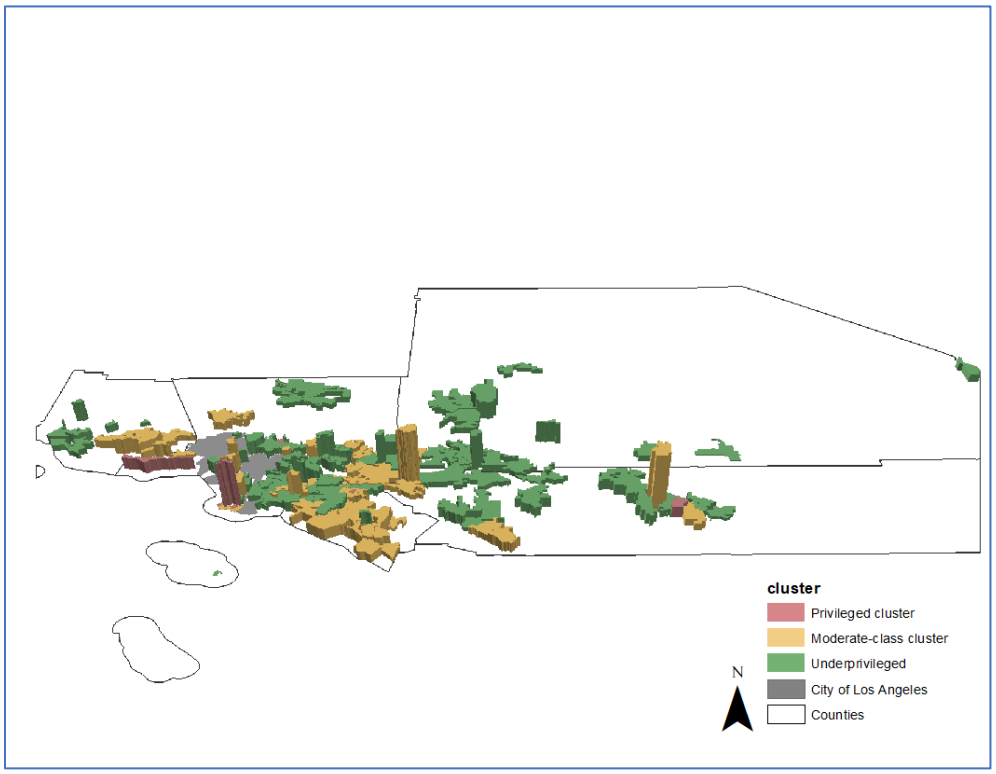

Figure 15. 3d map of the spatial distribution of pharmacies and drug stores

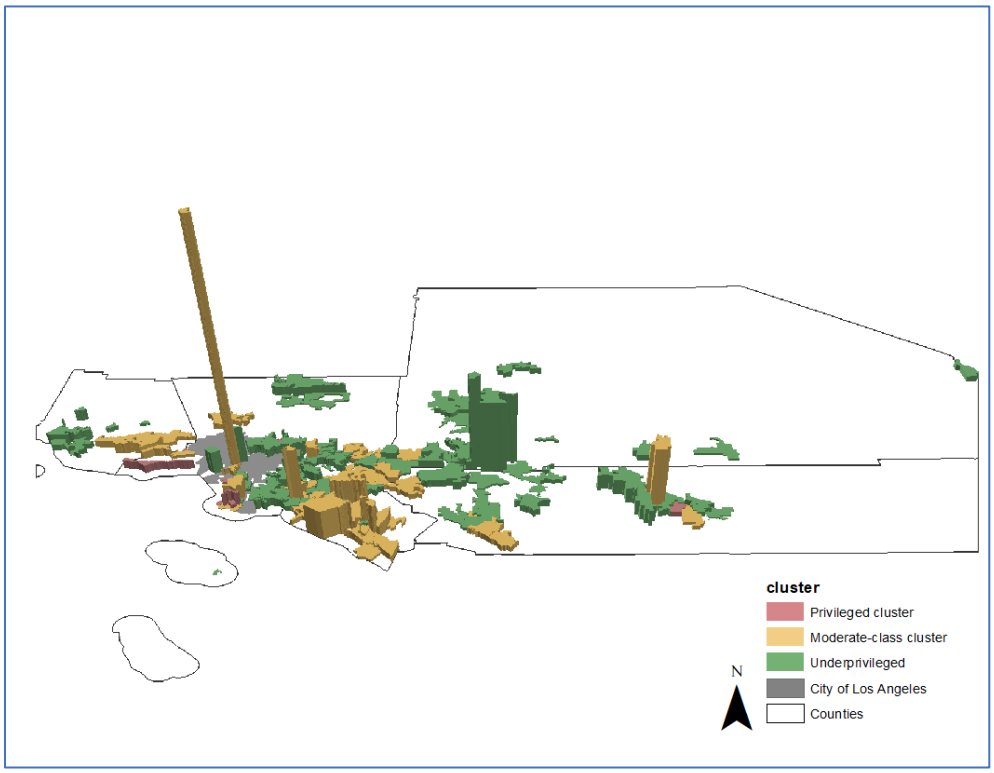

Figure 16. 3d map of the spatial distribution of physicians

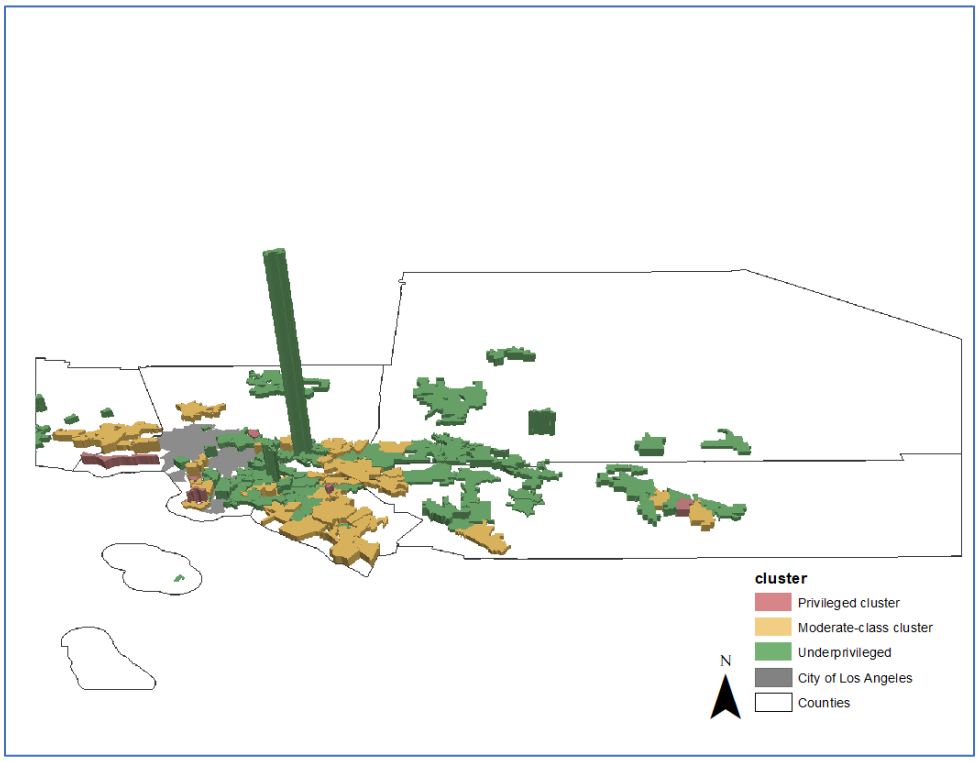

Figure 17. 3d map of the spatial distribution of grocery stores

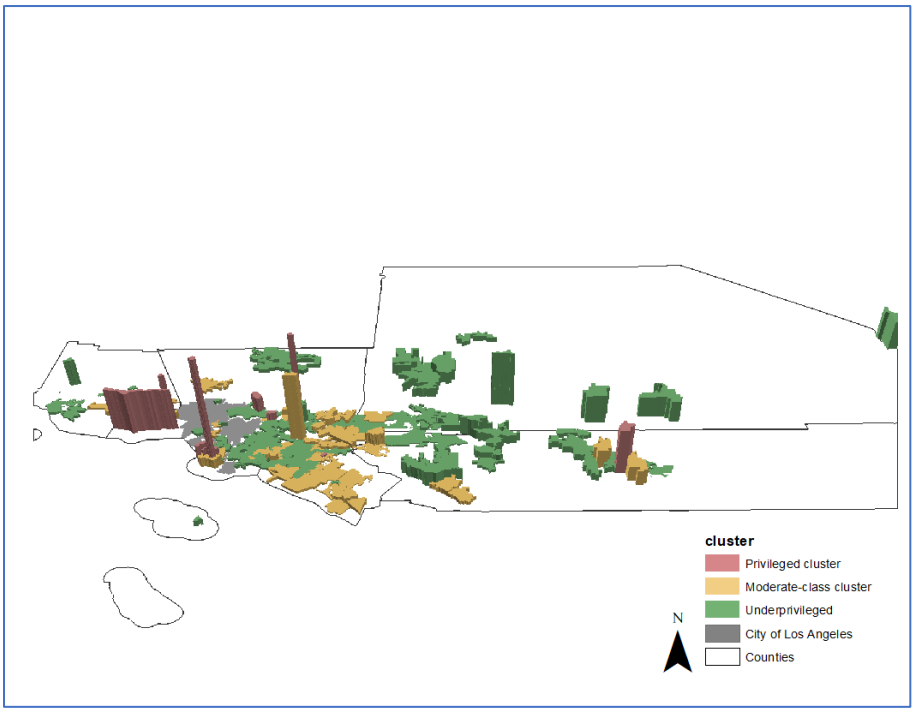

Figure 18. 3d map of the spatial distribution of open space

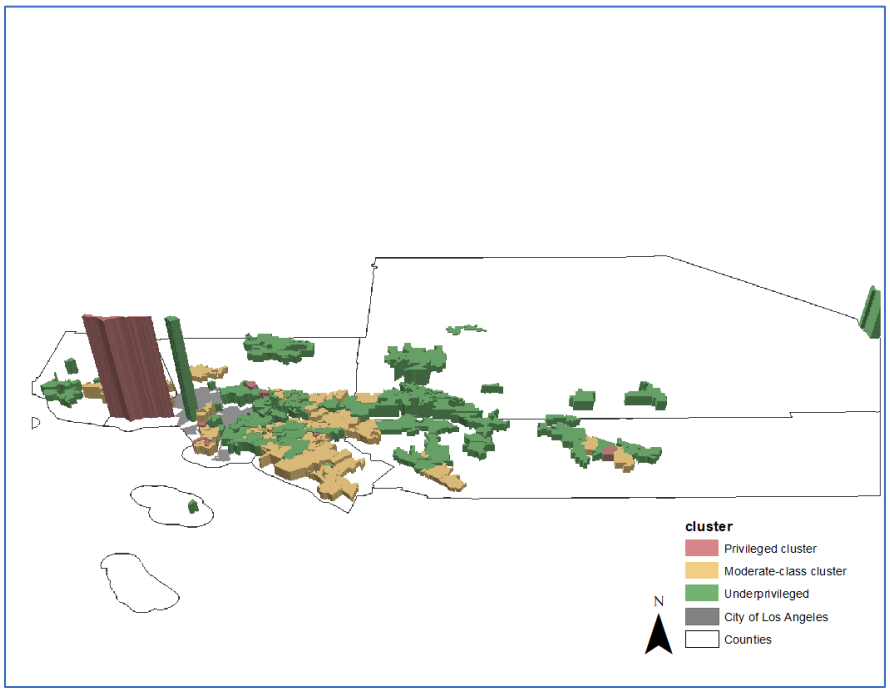

Figure 19. 3d map of the spatial distribution of educational facilities

Discussion and Conclusion

The spatial distribution of resources or community resources is a fundamental dimension of the geography of opportunity, which is closely related to income segregation (Dawkins, 2017). The literature suggests that disparities in access to community resources are one of the core driving forces that perpetuate inequality since they are not evenly distributed across space. Therefore, given the rise of residential segregation by income during the last several decades, the primary goal of this study is to understand the disparities in the distribution of community resources or resource across municipalities that differ by income levels. By focusing on the suburban municipalities in the greater Los Angeles regions, this study provides several contributions to the literature.

First, this research considers a municipal boundary as a mechanism for the distribution of community resources. Previous studies mostly have focused on the availability or accessibility of neighborhoods to resources. However, theories suggest that residential inequality becomes more severe because the initial advantages of affluent jurisdictions, often translated into political power, can be used to maintain the existing economic hierarchy of jurisdictions by securing or shaping the spatial structure of community resources in a way that reflect their interests (Logan, 1978). On the other hand, a municipality that lacks households who can bring a stable tax base and political clout cannot sustain resources or local institutions, resulting in a relocation of those resources to other better off municipalities. By conceptualizing the influence of municipal boundaries on resource distribution, this research examined two hypotheses: (1) Affluent municipalities will likely contain most of the beneficial community resources, while poor municipalities will have low levels of community resources. (2) Affluent municipalities will have higher

levels of resources than other municipalities when incorporating the resources in adjacent municipalities. In other words, only specific resources or services are likely to be present in affluent and economically homogeneous municipalities, while other resources, which are also important for everyday life, will be located in adjacent municipalities that affluent residents can access.

Second, as an initial effort, this research explores the distribution of resources in a holistic approach. By combining multiple data sets, I measured the levels of resource availability for nine community resources from diverse domains—foods, culture, recreation, health, education, and social assistance—within a municipal boundary. Then, I conducted k-means clustering to classify the suburban municipalities based on economic, racial, and community resource variables, which provides a comprehensive picture of the "geography of opportunity."

The cluster analysis creates three clusters: privileged, moderate-class, and underprivileged. The findings show that municipalities have a clear economic and racial hierarchy, but did not demonstrate that municipalities with the highest socioeconomic status also have the higher level of community resources in all domains. Instead, the findings suggest that residents in affluent municipalities have focused on specific resources to protect their properties within municipal boundaries, while having access to other resources such as retail or other private sector services in adjacent municipalities. It is possible that the excluded resources in affluent municipalities may harm homeowners' property values by causing congestion and crime and having other negative consequences, and their exclusion by local restrictions or zoning would thereby protect local residents' property values. Therefore, the developers' desire for higher density or mixed-use

developments, restrained by the local elites' interest in the affluent municipalities, could be realized in poorer municipalities that are adjacent to the affluent municipalities.

The spatial distribution of the municipal typology corroborates these findings that none of the municipalities in the privileged clustger are isolated. In other words, they have at least one municipality nearby them, probably for supporting a certain level of community resources. Because such community resources are often not limited to the residents of a specific municipality, the spatial dependence of community resources can further urban inequality.

The results of this study are crucial, not only for confirming the prestige of affluent municipalities on resource consumption, but also in highlighting the necessity for future research regarding the specific location of resources by municipalities to understand the detailed spatial structure of resource accessibility. That is, on the one hand, the location of recreational facilities or open space within affluent municipalities could possibly be located far from the boundaries that share with poorer municipalities to reduce access from residents of other municipalities. On the other hand, resources, such as supermarkets, full-service restaurants, and personal care facilities, which are positively related with individuals' quality of life, but not located in the affluent municipalities due to local interests, could be located near at the boundary between the affluent and poorer municipalities. This may suggest further disparities of access to resources. Future studies should explore how the access to resources is influenced by socioeconomic and racial contexts at the neighborhood level and also by municipal-level contexts.

Notes

1. Industry city and Vernon city were excluded from the sample because most of the area of the cities are assigned to industrial and commercial use rather than residential use.
2. According to the NLCD legend, Developed, Open space refers to “areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.”
3. The block groups which are assigned to multiple municipalities were excluded during the calculation.

Conclusion

The Findings from the research

This research started from the recognition that local communities in the U.S. are diverging spatially and economically (Massey, 1996; Reardon and Bischoff, 2011). The housing market serves as a platform in which income inequality formed in the labor market is spatially distributed across physical space (Jargowsky, 1996; Maloutas & Fujita, 2012). As the income inequality grows, the capacity gap between the affluent and the poor increases in the purchase of preferred neighborhood or housing amenities and resources. Such a rising disparity in both incomes and residential patterns is a crucial issue for our society, because it is fundamentally linked to further inequality in individuals' current and future opportunities and relatedly to the political exclusion of the poor. Residential segregation leads to excluding low-income households from access to the mainstream of society which provides opportunities for better life outcomes (Maloutas & Fujita, 2012). Therefore, the scholars in urban studies have strived to tackle the problem by exploring the root causes of residential segregation.

The primary focus of this three-essay research, therefore, was to investigate the underlying mechanisms generating and reinforcing the economic hierarchy of local communities--neighborhoods and municipalities--within U.S. metropolitan areas. By focusing on the structural and political factors that intensify income segregation, this research enhances the understanding of income segregation which has been traditionally approached from the perspective of urban ecology which emphasizes market forces and voluntary choices of individuals.

In Essay 1, I explore the longitudinal and spatial patterns of neighborhood-level economic status. The traditional literature that has investigated income segregation at the metropolitan area level using on global measures has limitations because the global indices cannot specify the intra-variation of segregation levels within a metropolitan area or identify the diverse changing trends of neighborhood economic status. This study, therefore, focuses on the decomposition of a global index, the Delta Index (DI): the Local-level Delta Index (LDI). LDI calculates the economic status at the neighborhood, indicating the relative contribution of each neighborhood to the regional-level segregation index. First, I divide neighborhoods into upper-income neighborhoods in which the LDI is above zero, indicating an overrepresentation of neighborhood income on average, and lower-income neighborhoods in which LDI is below 0, presenting an underrepresentation of neighborhood income on average, compared to other neighborhoods within an MSA. By setting three possible paths that each neighborhood can experience—upgrading, stability, and decline—I define six types of neighborhood change in terms of economic status. With the six-neighborhood typology, this study investigates the longitudinal path and spatial structure of neighborhood change within the 105 largest U.S. metropolitan statistical areas (MSAs) from 1980 to 2010. The analysis, through the intra-variation of the paths within the MSAs, reveals the three urban spatial forms based on these paths by utilizing k-means clustering: weak suburbia, inner-ring suburbia, and extended suburbia. In addition, the study shows that neighborhoods evolving toward greater affluence or deeper poverty over time are spatially clustered, while the neighborhoods that underwent a reordering process, in which upper-income neighborhoods become lower-income neighborhoods or vice versa, were surrounded by neighborhoods with relatively diverse pathways. The longitudinal

analysis indicates that affluent and poor neighborhoods were likely to change into either greater affluence or deeper poverty over time, while middle-class neighborhoods followed various courses. These results suggest that the share of neighborhoods at either end of the income distribution has increased, while that of middle-class (or relatively mixed-income) neighborhoods has decreased, as previous studies have maintained, leading to the rise of income segregation. The results of this study illustrate that the underlying dynamics of income segregation can be uncovered more fully by an analysis at the local or neighborhood level than by an analysis at the regional-level.

In Essay 2, I focused on the factors that are associated with neighborhood economic polarization. Scholars have recently reported the rise of neighborhoods at the extremes of the income distribution—both affluent and poor neighborhoods—and the decrease of middle- or mixed-income neighborhoods. The majority of the previous studies on neighborhood change have focused on the cyclical process of neighborhood change, especially in the poor- or disadvantaged-neighborhoods. This study, with a different perspective, investigates the mechanisms of persistence in their economic status over time for both neighborhoods of the affluent and the poor. This study hypothesizes that affluent neighborhoods resist decline and maintain their economically advantageous contexts by utilizing their economic resources and political power. Poor neighborhoods, however, are expected to be less able to avoid a negative trajectory and to experience an economic decline. Therefore, the bifurcated process explains the persistence of the economic status over time in neighborhoods of the affluent and the poor.

The research presented in Essay 2 involves two major accomplishments. First, affluent and poor neighborhoods within the 100 largest U.S. metropolitan statistical areas

were likely to remain in their initial economic status during the 2000s, while other relatively middle-income neighborhoods presented more diverse economic transitions. Second, by employing multilevel logistic regression models, this research finds that affluent neighborhoods tend to respond more effectively against the decline process generated by ecological and economic forces than poor neighborhoods. For example, the results show the coefficient of old housing (above 40 years, but built after 1940) was positive in the affluent neighborhoods while it was not statistically significant in the poor neighborhoods. Thus, affluent neighborhoods are likely to experience economic prosperity in an earlier stage than poor neighborhoods. Moreover, a higher level of poverty rate in the initial year of each decade increases the likelihood of affluent neighborhoods' experiencing economic prosperity during that decade while the poor neighborhoods get worse. In addition, a higher level of Hispanics in affluent neighborhoods increases the likelihood of experiencing economic prosperity, while the coefficient in the poor neighborhood model was not statistically significant. The result may indicate that racial and ethnic structure is less stratified in higher income neighborhoods compared to lower income neighborhoods. In other words, residents tend to sort into neighborhoods by income rather than race in affluent neighborhoods, strengthening their economic status (not confounded by racial composition). This study uncovers the persistence of economic status over time in affluent and poor neighborhoods and helps elucidate the reason why neighborhoods at the two extremes of the income distribution are likely to maintain their economic status.

In Essay 3, I investigate the relationship between the economic status of suburban municipalities within the greater Los Angeles region and the disparities in the resource availability at the municipal level by utilizing several secondary data sets from multiple

sources: ReferenceUSA, U.S. census data, the National Land Cover Database, and the Smart Location Database. This work is important because the inequality of residential segregation is perpetuated by the disparities of access to community resources and services. This research examines whether the affluent municipalities take advantage of community resources from diverse sectors within their jurisdictional boundaries. This research also tests whether the affluent municipalities have focused on specific community resources, which are assumed to have a positive influence on property values, while other community resources, excluded by affluent municipalities but still are important for everyday life, are located in their adjacent municipalities. That is, the affluent municipalities may inhibit developers from building multi-family housing or may restrict mixed land use where the demand for such projects is high to avoid congestion and depreciation of property values (Levine, 2010). This suggests that residents in affluent municipalities not only enjoy services or resources that protect their property values, but also benefit from other resources in adjacent municipalities. I conducted k-means clustering to create a municipal typology based on economic and racial characteristics, as well as the availability of community resources. Three clusters were defined on the basis of the spatial dependence between municipalities. First, the municipalities in the privileged cluster have the highest level of economic status and the highest level of availability of diverse community resources, such as open space, recreational facilities, cultural amenities, child day care services, pharmacies and drug stores, and clinics. Second, the municipalities in the moderate-class cluster have lower levels of community resources than the privileged cluster. Third, the underprivileged cluster has the most disadvantaged economic status and the lowest levels of availability of community resources. This result suggests that a clear

economic hierarchy exists among municipalities in which the affluent municipalities enjoy diverse community resources and thus protect the property values within their municipal boundaries. Most importantly, the spatial distribution of municipalities based on the typology suggests that community resources are unequally distributed across space. That is, spatial inequality is present among municipalities and thus municipal level inequality (not just MSA and neighborhood level) should be considered in discussions of the geography of opportunity.

Limitation and future studies

There are several limitations of this dissertation that can be addressed in future work. The finding of Essay 1 shows that neighborhoods evolving toward greater affluence or deeper poverty over time are spatially clustered, while neighborhoods experiencing a reordering trend are less clustered. Therefore, one can improve the present understanding of income segregation by introducing more advanced local measures which incorporate the spatial structure of neighborhoods. With the spatial local measures, future studies also can examine several hypotheses that emphasize the interrelationship between residential segregation and diverse opportunity contexts.

The results of Essay 2 suggest that affluent neighborhoods are likely to resist decline better than poor neighborhoods. One possible mechanism for this tendency is that affluent neighborhoods have higher levels of social capital and social networks among the residents compared to poor neighborhoods. Therefore, it is possible that collective action which aims to address residents' needs and increases the possibility of redevelopment could be more prominent in affluent neighborhoods. However, due to data limitation, this study could not

include variables that can measure social capital of a neighborhood. Future studies can address this issue by conducting a survey focusing on a specific area and/or employing a valid and reliable measure of social capital.

Additionally, while Essay 3 confirms the association between the economic status of municipalities and the availability of community resources, this study could not identify the factors that are generating such a relationship. For example, it is possible that lower-income municipalities adjacent to affluent municipalities will likely have higher levels of community resources than those which do not share the boundaries with affluent municipalities. Moreover, our understanding of resource distribution will be significantly promoted if we can identify the accessibility of neighborhoods to resources varied by socioeconomic contexts within the broader municipal contexts.

Policy implications

Under market pressure within capitalism, the increase of income segregation has been unavoidable since market effects, such as income inequality, play a significant role in the residential sorting mechanism (Reardon and Bischoff, 2011). If the decision on where to live only represented the households' preferences and their financial capacities and played the dominant force in the housing market, income segregation could be considered as a natural result rather than as an issue of social inequality. However, if residential segregation is a context-bound phenomenon that is related not only to income inequality but also to diverse contexts, such as historical, political, governmental or cultural contexts, scholars and planners should strive to lower the barriers so that the socioeconomically disadvantaged groups can gain better access to the housing market.

Collectively, this research suggests that development patterns are unequally distributed across space within a regional area due to structural and political factors. In other words, income segregation is not only determined via markets, but also shaped by structural constraints. For example, both neighborhoods of the affluent and the poor are likely to maintain their own economic status possibly due to the different capacity in resisting the force of economic decline. More affluent municipalities can deal with the potential difficulties more efficiently with higher levels of community resources available to them than the poorer municipalities without such amenities. The situation will be aggravated as the initial advantages of certain communities often get converted into political power only to fortify the existing economic hierarchy of places.

The findings of this dissertation—segregation patterns are spatially clustered and resource distribution is affected by the municipal level factors—also suggest that the segregation by income is not only an issue of individual neighborhoods but also a macro-level phenomenon that requires greater attention. The increasing spatial distance between higher-income residents and those with lower-incomes may bring about further disparities in providing public services and quality goods—including transportation, recreation, and utilities—that should benefit people all levels of income. In other words, the probability for lower-income residents to have access to high quality public services is likely to decrease as the spatial separation between the affluent and the poor occurs at a macro scale (Reardon and Bischoff, 2011).

This research also may indicate the importance of neighborhood groups or community leaders who can effectively organize a collective action and form a partnership with external, powerful elites. Any efforts to promote social networks or social capital

within communities, such as promoting homeownership or providing social service facilities, can improve the economic resilience of the disadvantaged communities. For example, with a higher level of social capital, local residents' efforts to sustain the quality of the properties and surrounding neighborhoods at a higher standard can lead to a successful result. Moreover, as the decision-making process of spatial resource and service allocation is profoundly affected by the political factors, lowering political and structural barriers that hinder disadvantaged neighborhoods from participating in the broader political arenas can also address the inequality caused by residential segregation.

Exploration to address the issue of inequality related to residential segregation is ongoing and new approaches such as "smart growth" principles have been proposed and implemented in some places. The proponents of smart growth argue that compact communities with a higher density, mixed-land use, widespread access to public transit, and good street connectivity are more environmentally and socially sustainable (Mason, 2010; Pearsall, 2017; Van Der Waals, 2000). Some innovative land use controls, such as inclusionary zoning or the density bonus, also have been implemented in order to remedy the influence of zoning on income segregation. For example, in 2018, Minneapolis took an even bolder step by ending single-family zoning and allowing multi-unit developments in areas previously restricted to single units to encourage economic integration.

Along with these ongoing efforts to address residential segregation, the findings of this dissertation can contribute to developing new policy measures to enhance disadvantaged groups' access to high-opportunity environments by enlightening the necessity of policy intervention to address income segregation.

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