INTRA-URBAN SEGREGATION CHANGES: AN EVALUATION OF THREE SEGREGATION FRAMEWORKS WITH A CASE STUDY OF COLUMBUS OHIO MSA, 1990 and 2000

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
The Degree Doctor of Philosophy in the Graduate School of
The Ohio State University

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ABSTRACT

There are three major frameworks on segregation changes: spatial assimilation, place stratification, and resurgent ethnicity. Previous efforts to evaluate the significance of each framework, dominantly relying on cross-urban metrics, fall short in shedding light on underlying processes of segregation changes within a city, providing only circumstantial evidences for each framework. The author diagnoses that this shortcoming is a result of neglecting variability of segregation at the neighborhood level. Accordingly, this dissertation argues that more attention should be given to local segregation measures and proposes a set of local segregation measures corresponding to two spatial dimensions of segregation: the Location Quotient (LQ) for concentration-evenness and Local Moran’s I (LM-I) for clustering-exposure. Using these local measures, the dissertation examines segregation change at the neighborhood level in terms of residential patterning of race/ethnicity and neighborhood characteristics of racial/ethnic clustering/segregation in the Columbus Ohio MSA, 1990 and 2000. The overall findings strongly support resurgent ethnicity as the most relevant of the three frameworks.

Keyword: race, ethnicity, segregation, neighborhood, spatial assimilation, place stratification, resurgent ethnicity
Dedicated to my parents, Yo-Sam Chung and Bok-Soon Choi,

my sister, Hyun-Soo, my brother, Su-Dong

and my wife, Hoi-Ok
ACKNOWLEDGMENT

I thank my advisor, Dr. Lawrence A. Brown, for his support and endorsement. He is not only a mentor but also a wonderful person who I owe a lot in my stay at the Ohio State University. This dissertation would not have been possible without his mentoring insights and patience.

I am also grateful to other committee members. My special thanks go to Dr. Edward Malecki for invaluable comments and suggestions.

I thank Dr. Kevin Cox for guiding me to the world of geographic thoughts and Dr. Eugene McCann for his encouragement at the early stage of this research.

I am also grateful to the faculty members in Department of Geography in Seoul National University, Dr. Young-Han Park, Dr. Inn Kim, Dr. Woo-Kung Huh, Dr. Sam-Ock Park, Dr. Keun Bae Yu, and Dr. Jeongman Lee. My special thanks go to Dr. Woo-ik Yu who encourages me to study geography.

I am indebted to a group of mentors that made my life in Columbus possible, Dr. Jiyeong Lee, Dr. Bae-Gyoon Park, Dr. Sang-il Lee, Dr. Changjoo Kim. Also, I thank my friends, Wook Lee and Ho-Seop Cha.

I would like to express special thanks to my wife, Hoi Ok Jeong, who is the most wonderful and loveliest woman in the world.
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Despite people’s affinity for living close to their group members, residential segregation has been often considered to be a social problem under the notion that residential location impacts accessibility to socio-economic resources such as jobs, stores, educational and government facilities, and welfare system benefits. The spatial mismatch hypothesis, for instance, holds that the relocation of job opportunities to suburbs could disadvantage groups concentrated in inner city areas, resulting in economic dislocation (Wilson 1987). Social networking based on one’s neighborhood community also could handicap segregated groups in accessing new economic opportunities (Mouw 2002). School segregation combined with residential segregation could disadvantage groups in developing human capital (Taylor 1997). In short, barriers to residential integration along racial/ethnic lines are believed to hinder residents from accessing resources, entailing socio-economic inequities (Massey and Denton 1993; Taeuber and Taeuber 1965).

There have been at least three competing theoretical frameworks on segregation change. The spatial assimilation framework attributes high segregation to low cultural and structural assimilation of individuals or groups (Gordon 1964; Massey 1985). The place stratification framework emphasizes structural forces such as discriminatory
practices in housing and banking that impede racial/ethnic minorities from translating their acquired social resources to residential upward mobility (Logan and Molotch 1987; Yinger 1995, 1996, 1998). The *resurgent ethnicity* framework focuses on the role of co-ethnicity in residential choices that yields (re-)segregation even after residential integration is socio-economically feasible and housing discrimination has been abated (Logan, Alba, and Zhang 2002).

Previous efforts to evaluate the significance of the frameworks, predominantly relying on cross-urban comparison metrics, fall short in shedding light on underlying processes of segregation changes with a city, providing only circumstantial evidence for each framework (Alba, Logan, and Stults 2000; Clark and Blue 2004; Farley and Frey 1994, 1998; Logan, Stults, and Farley 2004; Massey 2000, Massey and Denton 1993; Poulsen, Johnston, and Forrest 2002a, 2002b; Wilkes and Iceland 2004). The researcher diagnoses this shortcoming as the result of neglecting local variability of segregation within a metropolitan area. Accordingly, this dissertation argues that more attention should be given to local segregation measures and proposes a set of local segregation measures corresponding to two spatial dimensions of segregation: the Location Quotient (LQ) for *concentration-evenness* and Local Moran’s I (LM-I) for *clustering-exposure*. The dissertation then accesses segregation at the neighborhood level by utilizing these local measures and examines spatial patterning of race/ethnicity and neighborhood characteristics of racial/ethnic clustering/segregation. The examination refers to the four major racial/ethnic groups – African American, Asian, Caucasian, and Hispanic - in the Columbus Ohio MSA, 1990 and 2000. Unveiling intra-urban segregation allows us to
make a thorough evaluation of the segregation frameworks and have better understanding of underlying processes in the current U.S. racial/ethnic geography.

The dissertation proceeds as follows: **Chapter 2** reviews two urban ecology models on neighborhood changes that have explicit implications for the racial/ethnic geography of a city: *invasion-succession* and *neighborhood life cycle*. Their geographical manifestations are summarized with three urban form models: *concentric, sectoral*, and *multinuclei*. Second, as an alternative view on urban growth, postmodern urbanism of the Los Angeles School is reviewed. Attention then turns to the three conceptual frameworks on segregation change: *spatial assimilation, place stratification, and resurgent ethnicity*. Finally, the research tasks and hypotheses are presented.

**Chapter 3** reviews segregation measures and argues that more attention should be paid to the local. The chapter begins with a critical review of the dissimilarity index and its modifications through a controlled experiment that demonstrates their shortcomings in understanding racial/ethnic patterning with a city. The need to access local variability of segregation requires local measures of segregation at the neighborhood level. The chapter proposes to use a set of local segregation measures corresponding to the two spatial dimensions of segregation: the Location Quotient (LQ) for *concentration-evenness* and Local Moran’s *I* (LM-I) for *clustering-exposure*.

**Chapter 4** presents the research design for an empirical study. Four census-defined racial/ethnic groups in Columbus Ohio MSA in 1990 and 2000 are investigated using boundary-matched decennial Population and Housing Census data: Caucasians, African Americans, Asians, and Hispanics. In the course of evaluating the three
segregation frameworks, the empirical study examines residential patterning of racial/ethnicity and socio-economic neighborhood characteristics of racial/ethnic clustering/segregation. The chapter presents variable selection for socio-economic characteristics of neighborhoods and analytic approaches to testify the hypotheses of each framework.

Chapter 5 examines spatial patterning of race/ethnicity in the study area with respect to the three frameworks: spatial assimilation, place stratification, and resurgent ethnicity. The chapter begins by investigating segregation change at a global level utilizing the dissimilarity index and the global Moran’s I. And then, the investigation moves toward a local perspective, using LQ and LM-I. Relative significance of the three frameworks for each racial/ethnic group is then discussed.

Chapter 6 examines neighborhood characteristics of racial/ethnic clustering/segregation. It begins with zero-order correlation analyses of the degree of racial/ethnic clustering (LM-I) against a set of socio-economic variables on neighborhood characteristics. The chapter also presents results from multiple-regression analyses to understand how neighborhood characteristics covariate with racial/ethnic clustering. Noticing neighborhoods wherein African Americans clustering is not sufficiently explained by the regression models, the researcher scrutinizes their spatial and socio-economic characteristics. The chapter ends with a broad discussion on the relative roles of the three frameworks in segregation change: spatial assimilation, place stratification, and resurgent ethnicity for each racial/ethnic group.
CHAPTER 2
LITERATURE REVIEW

Studies on *intra*-urban segregation, as a spatial phenomenon, require examination of geographic manifestations and characteristics of racial/ethnic neighborhoods within a city. This chapter reviews two urban theories with explicit implications for racial/ethnic neighborhoods: urban ecology of the Chicago school and post-modern urbanism of the Los Angeles school. First, the urban ecology is reviewed with its two models on spatial processes of neighborhood change: *invasion-succession* and *neighborhood life cycle*. The spatial patterns implied by the models are summarized with three urban form models: *concentric, sectoral*, and *multinuclei*. Second, as an alternative view on urban growth, postmodern urbanism of the Los Angeles School is reviewed. Attention then turns to three theoretical frameworks on segregation change: *spatial assimilation, place stratification*, and *resurgent ethnicity*. Finally, the research tasks and questions are presented.

2.1. Racial/ethnic Neighborhoods and Urban Growth

Alongside income level and family structure, race/ethnicity has been one of the factors that articulate residential space, shaping an urban form (Berry and Kasarda 1977;
Massey 1985). This section reviews two schools of urban study, focusing on their different approaches to racial/ethnic neighborhoods and urban evolution: urban ecology of the Chicago school and postmodern urbanism of the Los Angeles School.

### 2.1.1. Urban Ecology of the Chicago School

The urban ecology proposed by the Chicago school envisions residential space in a city as a constellation of neighborhoods, so-called ‘natural areas’, with distinguishable territories holding unique populations in terms of a mix of socio-economic status, race, ethnicity, age composition, and life style (Park 1925; Schirian and Mesch 1993).

1 The concept of neighborhood as natural area includes four aspects that differentiate a neighborhood from the others. The first aspect is geographic area with distinct environment that makes it distinguishable from its adjacent areas. The second is a population with different social, economic, demographic, or racial/ethnic composition from others. The third aspect is a social system or organization with rules and norms that control social interaction patterns. The last aspect is aggregated or collective behavior or lifestyle that distinguishes the area from others (Park 1952). It is believed that changes in any one of the aspects bring about neighborhood change.

Notwithstanding, the empirical studies prioritize population composition under the assumption that it reflects other elements (Schirian 1983). For instance, inflow of new immigrant group into a neighborhood results in landscape changes, introduction of new norms and rules, and lifestyle changes. Logan and Molotch (1987) provide a different conceptualization of a neighborhood as a ‘commodity’. They envision a neighborhood as a commodity can be sold and purchased just like in ordinary goods under capitalism. Furthermore, neighborhood has two kinds of values: use value in that neighborhood satisfies residents’ routine daily needs such as food, education, and childcare and exchange value in that neighborhood is a tool of investment and storage of individual property. The use value, advocated by community organization of residents, and the exchange value, advocated by business elites and real estate, often give rise to conflict, resulting in neighborhood change. More recently, social constructionists broaden the concept of neighborhood. Neighborhood is defined as social space (or social area) in the sense that just like knowledge, space is relative by its social setting (Gotham 2002). In this regard, neighborhood is redefined a place where social reproduction occurs as it is perceived and used by social groups (Martin, 2003). In short, neighborhood is an area occupied by homogeneous group population not only in terms of their socio-economic
Efforts to preserve neighborhoods make them not only homogenous with certain characteristics, but also differentiated from others. Concerning neighborhood change, the school proposes two models: *invasion-succession* and *neighborhood life cycle*. This section reviews the two spatial process models and summarizes the implied geographical manifestations with three urban models: concentric, sectoral, and multinuclei.

2.1.1.1. Invasion-succession Model

The invasion-succession model illustrates one way that neighborhood change takes place, resulting in residential segregation. A social group with lower socio-economic status *invades* a residential area where another social group with higher socio-economic status is dominant and finally *succeeds* despite *resistance* arising from the perception that invasion is a threat to the status of the latter group. As a spatial result, there are few socially mixed residential areas, hence generating high segregation since there is still a dominant group in the place that the previously dominant group leaves (Park 1952; Massey and Mullan 1984).

Regarding racial/ethnic segregation, most post-WWII applications of the model address residential outcomes with a cross-urban and temporal metric. Given the analytic metric, most findings involve two questions: which city or region is more or less segregated; and whether or not the segregation of a city increases over time. Nonetheless, two *intra*-urban studies are instructive in understanding the historical spatial patterns of and demographic characteristics but also their shared values, perception and attitudes, generating distinguishable social practice pattern.
change from invasion-succession: contiguous expansion of racial/ethnic neighborhoods.

Rose (1970) examined the role of race on retail structure change in the City of Milwaukee, Wisconsin, 1950-65. He found the downgrading of commercial activities is associated with expansion of African American neighborhoods, implying racial transition and neighborhood deterioration occurs simultaneously. In addition, Berry (1976) inquired the relationship between ghetto expansion and single-family housing price with a case study of Chicago from 1968 to 1972. He found there is a downward housing filtering process from racial majority to minorities that is measured by housing price: highest in peripheral Caucasian neighborhoods, decreasing in ‘threatened’ Caucasian neighborhoods, a moderate increase in the zone of minority expansion, and lowest within traditional ghettos. Also, he found that there is a racial differential in price change: the decrease of price level in the face of Hispanic neighborhood expansion is less dramatic than that in the face of African American expansion.

Both researchers reached a conclusion that the expansion of minority neighborhoods is perceived as a threat to majority neighborhoods, generating contiguous racial turnover and maintaining high segregation. The invasion-succession model suggests that the spatial pattern of segregation change is a contiguous expansion of racial/ethnic neighborhoods driven by an aversion of the majority towards minorities.

2.1.1.2. Neighborhood Life Cycle Model

The invasion-succession model, as a key component in the urban ecological approach to residential transition and segregation, has been extended over time. An
example is the *neighborhood life cycle* model provided by Hoover and Vernon (1959). It envisions that a neighborhood has a life cycle as with five stages: (1) ‘residential development’ in single-family houses, (2) ‘transition’ with a new construction of apartments, (3) ‘downgrading’ in which the houses become old and there is little new construction, (4) ‘thinning-out’ through increasing vacancy, and (5) ‘renewal’ with the replacement of obsolete housing with new multifamily housing.

The neighborhood life cycle model was later modified by Anthony Downs (1981). He envisions that neighborhoods change in terms of housing value along a continuum reflecting health and viability. In this regard, five stages are suggested: (1) ‘stable and viable’ wherein property values rise, (2) ‘minor decline’ as the result of physical obsolescence, (3) ‘clear decline’ which is indicated by renters replacing owners, (4) ‘heavily deteriorated’ wherein most structures needs major repairs, and (5) ‘unhealthy and nonviable’ which is characterized by massive abandonment.

Compared to Hoover and Vernon’s model, major change in Downs’ model is to recognize the replacement of owners by renters in stage 3 as an indicator of neighborhood decline. He also, for all stages, opens the possibility of neighborhood resurrection. Both models are stage-oriented like the invasion-succession framework and imply that a neighborhood inevitably *declines* and eventually requires renewal through public intervention. This provides a logic for *redlining*, favoring new suburban neighborhoods in giving financial loans and thus exacerbating spatially disproportional growth in metropolitan areas (Metzger, 2000).

Post-WWII gentrification increased complexity in racial/ethnic geographies.
Historically, the construction of public housings as a part of gentrification has two impacts on the intra-urban patterns of racial/ethnic neighborhoods. On one hand, public housing re-concentrates the inner-city poverty, most of which are minority dominant. On the other hand, they generate new racial/ethnic neighborhoods, a so-called ‘second ghetto’ (Hirsh 1983; Chandler 1992; Massey and Kanaiaupuni 1993; Kaplan and Holloway 1998). In short, public housing relocates traditional racial/ethnic neighborhoods mostly with low socio-economic status from inner-city area to other places in the urban area.

Holloway, Bryan, Chabot, Rogers, and Rulli (1998) examined the role of public housing in poverty concentration with a case study of Franklin County, Ohio in the 1980s. They found that public housing concentrates poverty, even though more recent public housing is constructed away from the established inner-city poverty areas. Also, they found there is racial difference in the impact of public housing: more concentration of the African American poor than of the Caucasian poor. By and large, public housing accommodates less affluent racial/ethnic group, resulting in racial/ethnic neighborhoods and devaluation of the surrounding housing market. In addition, McNulty and Holloway (2000) found a distance decay effect in crime rate away from public housing.

Studies on gentrification and public housing provide another spatial aspect of racial/ethnic neighborhood change over urban space. Post-war urban renewal programs, endorsed by central city governments, required affordable housing for the poor, many of whom are minority. Public housing, designed to meet the need, relocated the inner-city poverty concentrations and generated decentralized new ones at the end. Likewise,
racial/ethnic minority neighborhoods relocate and decentralize, implying that the spatial pattern of racial/ethnic neighborhood change could be *leap-frog-style* expansion.

### 2.1.1.3. Geographical Manifestations of Segregation: Three Urban Form Models

The urban ecology of the Chicago school envisions spatial pattern as an outcome from a variety of social processes, deserving analyses to understand some of the processes. Efforts to understand spatial organizations of human activities in a city yield three urban form models: concentric, sectoral, and multinuclei.

Basic is the concentric model provided by Burgess (1925), which the later models are derived from. Diverse human activities compete with each other in order to occupy limited places advantaged by high accessibility. Accordingly, an urban form at a moment is viewed at ‘equilibrium’ as a result of the competition. Burgess (1925) argues that the equilibrium takes a concentric form with distinct zones under the assumptions of a uniform land surface, even accessibility from any direction to a mono-centric city, free competition for space, and continuous inflows of migrants to the city. At the urban core is the Central Business District (CBD), which expands as the city receives more immigrants. The CBD is surrounded by a so-called ‘zone in transition’, where mobile social groups, including new immigrants, reside. Subsequently, the transitional zone is surrounded by a zone of ‘independent workingmen’s homes’, which accommodates industrial workers who have escaped from the transitional zone but who desire to live with easy access to work. The workingmen’s zone is subsequently succeeded to a zone of better residences where middle class families live and a zone of commuters, where the
most affluent people live. Despite its broad generalization, Burgess’s model suggests that
urban populations are spatially sorted out in their residence from the urban core
depending on their socio-economic status and level of assimilation.

Hoyt (1939) extended the concentric model by proposing a sectoral model. In his
analysis of housing values in 143 U.S. cities, Hoyt suggests that cities grow in a star-
shaped form with discrete sectors rather than concentric form, due to radial transportation
routes from the urban core. In other words, distinguishable concentrations of similar-
valued housings extend from the urban core along a transportation route, forming a sector
like a slice of cake. His contribution is the recognition of spatial inertia, or path-
dependency, in urban growth in that a type of land use arisen nearby the urban core tends
to persist as the city expands, determining future growth.

A further extension is made by Harris and Ullman (1945) to explain the
complexity of real-world urban structures. They propose a multiple nuclei model, noting
that spatial organization of a city is similar to cellular structure with several sub-centers
remote from the CBD. They also suggest that the CBD is not the only factor that
determines urban structure, i.e. there could be many factors other than the economic. For
instance, there is a strong tendency of similar populations to cluster that could be
attributed to ethnicity, culture, and history.

Underpinning spatial processes in all the urban form models are homogenization
and differentiation. A population with similar socio-economic status and/or degree of
assimilation inclines to cluster, thereby homogenizing their space and, at the same time,
differentiating it from others. The same is true of the invasion-succession and
neighborhood life cycle models. The difference is that the urban form models present intra-urban patterns at a particular time as an equilibrium of the spatial processes.

Concerning segregation and its change, Burgess’s (1925) concentric model describes racial/ethnic minority neighborhoods as ‘zone in transition’ in the sense that they are subject to be occupied by expanding CBD and abandoned by the current residents as their socio-economic statuses improve. This logic yields the spatial assimilation framework on segregation change, as discussed later in this chapter. A series of turnovers from one concentric zone to another, inspired by expansion of CBD, is generally consistent with the downward filtering of housing emphasized by Hoyt’s (1939) sectoral model, implying racial/ethnic neighborhood expands contiguously. In addition, the sectoral model suggests that racial/ethnic neighborhoods incline to make radial expansion, owing to spatial inertia or path-dependency. On the other hand, post-WWII efforts to revitalize CBDs, which were incorporated in the neighborhood life cycle model, generate a number of urban renewal and redevelopment projects with public housing. At least historically, the public housing re-concentrates the inner-city poverty, many of which is minority dominant, and yield new racial/ethnic neighborhoods, acting as a nucleus in the manner of Harris and Ullman’s (1945) multinuclei model.

Since the urban ecology models were proposed some time ago, there have been a number of attempts to improve and/or critiques on the models. The driving force of urban ecology models is an aversion of majority toward minorities, which is a reflection of their emphasis on individual subjectivity and personal choice in the explanation of urban conditions. However, there has been a growing notion of structural factors that also
influence the geographical manifestations of racial/ethnic neighborhood change. For instance, Gotham (2002) identified rapid, channeled, and directional racial transition that cannot be easily interpreted with the invasion-succession model in Kansas City Missouri, 1950-70. He argues that the barrier toward contiguous expansion should be attributed to discriminatory school boundary decisions by school boards and blockbusting by real estate agencies. This is not to deny the role of aversion and contiguity of racial transition argued by the invasion-succession model. Rather, Gotham shows that there are institutional and structural factors that accelerate or prevent racial transition from taking place in a contiguous manner. This recognition of institutional and structural factors is highlighted in the place stratification framework on segregation change, discussed in the latter part of this chapter.

In addition, there have been significant changes in the socio-economic status of African Americans and immigrant groups. In fact, empirical evidence for the urban ecology models is heavily indebted to European immigrants in early twentieth century. It assumes that African American and new immigrant groups have low socio-economic status, which is not always the case today. The improvement of African American socio-economic status, thanks to the Civil Rights Movement, and the inflows of skilled Asian and Hispanic immigrants since the Immigration Act of 1965, pose changes in minority neighborhoods and segregation. For instance, Logan, Alba, and Zhang (2002) found some Asian and Hispanic concentrations in more affluent suburbs in their analysis of racial/ethnic geography of New York and Los Angeles in 1990. This suggests that a racial/ethnic neighborhood, traditionally described as a temporary shelter for
impoverished new immigrants close to the urban core in the urban ecology, begins to change to be a desirable and preferred residential place to the recent immigrants.

2.1.2. Postmodern Urbanism of the Los Angeles School

The most concerted critique of the urban ecology is postmodern urbanism, provided by the Los Angeles school. The Los Angeles school accuses the urban ecology, whose models are largely based on industrializing Chicago in the early 20th century, of being outdated and attempts to present an alternative framework to capture the burgeoning post-industrial urban dynamics (Dear, 2003).

A common theme of the Los Angeles school is restructuring (Davis 1989; Dear and Flusty 2002a, 2002b). Economic restructuring, represented by deindustrialization and the transition from Fordism to post-Fordism production systems, leads to social polarization; that is, increased socio-economic gaps between skilled workers in high-tech and/or producer service industries and unskilled and/or deskillled workers engaged in informal economy and lower level consumer service. The former group, often racially affiliated with Caucasian, isolates itself from other groups in urban residential space, forming decentralized affluent settlements such as suburbs, edge cities (Garreau 1991), and Privatopia (McKenzie 1994). On the other hand, the unskilled and/or deskillled workers, largely recruited with immigrant workers through globalizing immigration networks, gradually increase in terms of the number and size of separate minority populations in a city. In sum, restructuring in the post-industrial cities generates more

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2 For more detail debate between Los Angeles School and Chicago School, see Dear 2002; Abbott 2002; Molotch 2002; and Sampson 2002.
identifiable and heterogeneous social groups with different class, family structure, race/ethnicity, culture, and political orientation who attempt to occupy their own space in a city as part of efforts to gain local autonomy, making urban space more specialized and fragmented (Hise, Dear, and Schockman 1996).

Consequent geographical manifestation from the specialization and fragmentation is described as so-called ‘keno capitalism’ (Dear and Flusty 1998). Occurrence of urbanization is random in principle and its manifestation in a city looks like a partitioned gaming board with a number of differentiated and disjointed parcels, noting that each space has equal opportunity to hold urban activities, facilitated by high connectivity through the information network. Hence, there is no virtual relationship between locations of activities in a city (Dear and Flusty 1998). In this context, the Los Angeles school considers the CBD less meaningful in urban evolution, whereas the Chicago school views it as a core that determines growth of the rest of a city (Dear 2002).

Empirical evidence for the decreasing importance of the CBD as a growth pole is found in Filion, McSpurren, Bunting, and Tse’s (2004) study on population density patterns in 3 Canadian and 12 U.S. metropolitan areas in 1990. They examined change of urban population density over the distance from the CBD, utilizing negative exponential and cubic polynomial models. They found that the decrease of the density away from the CBD is more attenuated than expected, reflecting decentralization of the urban population. This implies that the mono-centric urban form is no longer dominant in the contemporary metropolitan areas. Also, relevant is Gorden and Richardson’s (1996) examination of employment distributions in the Los Angeles metropolitan area in 1970,
1980, and 1990 (as indicated by trip generation rates). They found that the share of jobs in the CBD and sub-centers is small, accounting for only 12 percent of the metropolitan jobs in 1990. Also, the number of sub-centers and their roles in the proportion of jobs assigned to them declines over the time period 1970 through 1990. This implies that there is a trend towards a uniformly dispersed structure in employment and that even the multiple nuclei model needs to be re-considered.

In evaluating the perceptions of the Los Angeles school, a key question must be whether there is a new spatial process in post-industrial cities. Concerning neighborhood change, the alleged spatial processes that organize a city are homogenization and differentiation in the Chicago school and specialization and fragmentation in the Los Angeles school. The two pairs of forces, however, seem to be different sides of a coin, essentially generating an identical geographic manifestation in the form of segregation. A difference might be a matter of degree. The Los Angeles school proposes that postmodern cities are gradually more heterogeneous and fragmented. The empirical evidence, however, is not yet clear. For instance, Johnston, Poulsen, and Forrest (2003) compared residential pattern changes of four major racial/ethnic groups in four metropolitan areas (Chicago, New York, Los Angeles, and Miami), 1980-2000. They found there has been little significant segregation change even in the claimed postmodern cities such as Los Angeles (Dear and Flusty 1998) and Miami (Nijman 2000). All cities, however, show increasing concentration of Hispanics and Asians and moderately decreasing concentration of Caucasians and African Americans with different degrees between the racial/ethnic groups, generally following the historical trend.
A more critical issue to the Los Angeles school involves the claim of quasi-random occurrence of urbanization. However, regularity in spatial organization of a city still can be verified in contemporary postmodern cities. For example, Shearmur and Charron (2004) found that the urban form models provided by the Chicago school stand through the examination of income distribution in Montreal, 1996.

All in all, the Los Angeles school gives us lessons for further urban studies. First, urban researchers need to investigate a diverse set of cities to complement or avoid specificity or particularity of Chicago or Los Angeles. Second, urban research needs to be performed in multifaceted ways and within a diversity of geographic layers while continuously asking whether the change is continuity of existing pattern and change as fundamental shift to a new order (Brown 1999).

2.2. Conceptual Frameworks of Segregation Changes

Residential segregation along race/ethnicity persists to the present despite significant decrease due to the Civil Rights movement and anti-discrimination legislation such as Fair Housing Act. This section reviews three conceptual frameworks of segregation change as efforts to understand the persistence of segregation - spatial assimilation, place stratification, and resurgent ethnicity.

2.2.1. Spatial Assimilation

The spatial assimilation framework embodies the Chicago School’s version of segregation change. Segregation, as a spatial outcome of socio-economic factors, is attributed to low assimilation of a minority group to the major society (Massey 1985).
There are two types of assimilations (Gordon 1964) - ‘structural assimilation,’ indicated by socio-economic status such as income and educational attainment; ‘cultural assimilation,’ indicated by acculturation such as English language ability and length of stay in the US. The latter is valid for recent immigrant groups only. It sees an inverse relationship between assimilation and segregation and hypothesizes a minority group becomes residentially integrated with the majority group as it becomes wealthier, educated, acculturated, and fluent in English (Massey and Denton 1985).

Advocates of assimilation are linked to the melting pot idea of contemporary segregation change. They welcome recent minority decentralization as the spatial outcome of individual or group assimilation, attesting to increasing racial/ethnic integration. Furthermore, they argue that racial/ethnic segregation is giving way to income segregation (Farley and Frey 1994; Hwang and Murdock 1998).

Despite some evidence, it has been pointed out that the improvement of socio-economic status does not necessarily result in residential integration (Darden and Kamel 2000). For instance, Farley (1995) evaluated the role of income and housing cost on racial residential segregation, with a case study of St. Louis in 1990 using census data. He found that African Americans and Caucasians with similar economic status are as much segregated as the two racial groups overall. He concludes that one cannot simply rule out the role of race/ethnicity in shaping residential patterns. In addition, evidence for the spatial assimilation model is often mixed and varies over racial/ethnic groups. Some Asian and Hispanic immigrants tend to settle in relatively affluent suburbs, skipping the long-lasting immigrant enclave in inner-city areas (Allen and Turner 1996a, 1996b; Alba,
Logan, Stults, Marzan, and Zhang 1999). In their more recent study on New York and Los Angeles, Logan, Alba, and Zhang (2002) show that some new Asian and Hispanic immigrants reside in more affluent areas without acculturation. This implies that there could be other factors than low assimilation that result in racial/ethnic segregation. This is far different from expectation of the traditional *melting pot* idea that all immigrants would lost ethnic traits and identity and become completely converged into the mainstream society. A recent recognition from assimilation theorists is *segmented assimilation* (Portes 1995; Portes and Rumbaut 1985; Zhou 1997) which embraces the divergent paths of assimilation: (1) acculturating middle-class values of the racial/ethnic majority society, (2) falling towards an underclass, or (3) advancing socially while keeping strong ties with origin ethnicity (Wright and Ellis, 2000).

In sum, the spatial assimilation framework attributes segregation to a low degree of individual or group assimilation and envisions that a racial/ethnic minority group moves out from impoverished inner-city immigrant enclave to integrated neighborhoods as it becomes assimilated and acculturated. Hence, encountering a large flow of immigrants, racial/ethnic neighborhoods could persist over time while playing a role as a temporary shelter for new immigrants with low assimilation.

### 2.2.2 Place Stratification

The *place stratification* framework, provided by Logan and Molotch (1987), attributes the persistence of segregation to racial stereotyping and discriminatory practices such as *steering*, *blockbusting*, and *redlining* in the housing market.
Discriminatory practices based on racial/ethnic prejudice segment the housing market and sort racial/ethnic groups by place. As a result, disadvantaged groups are confined to low layer housing markets and their upward residential mobility is intervened, even after socio-economic improvement. Here, the focus shifts, from personal choice in the spatial assimilation framework, to structural constraints. Empirical studies were enhanced with the Home Mortgage Disclosure Act in 1975 and the following fair housing audits performed by various state and local organizations.  

In the review of seventy-one fair housing audits, Galster (1987, 1990a, 1990b, 1990c) found that racial/ethnic minorities experience discrimination in seeking homes for sale and rental housing in terms of price/financing, availability, qualifying requirement, and information. There also are differences between racial/ethnic groups. African American home seekers have a greater chance to face discrimination than do Hispanics regardless if it is a home for sale or rent. Real estate agents perform discriminatory practices because of homeowners’ antipathy to racial integration; anticipated homebuyers’ racial preference; and agents’ afraid of having negative reputation as minorities are introduced to all-majority neighborhoods. In short, racial/ethnic steering by real estate agents is a discriminatory practice in home seeking, inducing minorities to concentrate in certain parts of urban space.

*Blockbusting* is another real estate agent practice that deserves attention. It indicates threatening racial majority residents to sell their house, while emphasizing potential loss of its property value from racial mixing. In doing so, the real estate agents

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3 This Act requires depository institutions to release the data on the number and size of the mortgage loans they make to specific neighborhoods (Dingemans 1979).
obtain more commissions and profits by purchasing houses cheaper from racial/ethnic majority and selling them more expensively to minority movers. As a result, this profit-seeking practice instigates and accelerates racial turnover, particularly in racial mixed neighborhoods, eventually re-generating segregation.

The third discriminatory practice is redlining performed by the banking industry. This indicates refusal of a mortgage loan request, even to whom is qualified but living in an undesirable neighborhood. A mortgage loan is usually necessary when one purchases and/or improves a house. Its spatial distribution, however, is not uniform over urban space, at least historically. Dingemans (1979) found that minority-dominant areas receive a lower level of mortgage lending than for the metropolitan area as a whole in his study of Sacra Sacramento, California in 1976. He argues that it is largely due to lenders who lack confidence in the future of racial/ethnic minority neighborhoods. Although his research does not provide conclusive evidences of discriminatory practices in mortgage lending, the result implies that race/ethnicity, alongside social status and age of a neighborhood, is one of the factors to explain unevenness of mortgage lending, generating neighborhood change. A recent study on mortgage lending in New Jersey 1990 also reveals that minorities still have a higher home mortgage rejection rate than the majority has even after controlling a borrower characteristics, loan characteristics, neighborhoods, and bad credit. Also, there is difference among racial/ethnic groups. African Americans have higher rejection rates than Hispanics (Myers and Chan 1995).

Furthermore, it is pointed out that the level of discrimination varies across occupational specialization of neighborhoods, influencing segregation (Farley and Frey
1994; Wilkes and Iceland, 2004). Manufacturing employee neighborhoods absorb minority laborers historically and/or for their needs, having high minority representation: African Americans from the South during the first half of twentieth century and, more recently, low-skilled Asian and Hispanic immigrants. Many residents in university neighborhoods spend only a few years, so their sense of belonging to their neighborhoods is ephemeral. Hence, university neighborhoods are more open to minority neighbors. Government employee neighborhoods tend to be highly aware of the Fair Housing Act and more open to minority neighbors. Retirement neighborhoods tend to have relatively low minority representation. Few retired African Americans have obtained the required savings to move into retirement neighborhoods, so the elderly residents in those neighborhoods are largely Caucasians. In addition, the elderly Caucasian residents have been exposed to histories of racial strife and incline to desire a homogeneous neighborhood. In short, the place stratification argues racial/ethnic minority concentration/segregation occurs in manufacturing employee, university, and government employee neighborhoods but less likely in retirement neighborhoods.

Spatial patterns from discriminatory practices are well articulated in Gotham’s (2002) study on African American neighborhood change in southeast Kansas City, Missouri, 1950-70. He found that African American neighborhood expands in rapid, channeled, and directional manners. He also found that channeled and directional racial transition at the neighborhood level is attributed to discriminatory school boundary decision-making by school boards and its rapidity is due to blockbusting by real estate agencies. It shows that there are institutional and structural factors that prevent
racial/ethnic groups from translating their achieved socio-economic resources into residential upward mobility, confining them in a low layer of housing market.

In summary, *place stratification* accuses discriminatory profit-seeking practices in housing and banking industries for persistent segregation. Discriminatory practices such as racial *steering* and *redlining* segment housing markets by stereotyping neighborhoods, generating concentrations of disadvantaged racial/ethnic groups in certain parts of urban space. Even after their relocation, the racial/ethnic minorities remain segregated due to *blockbusting*. Their neighborhoods are vulnerable to deterioration since they have difficulty in having proper mortgage loans.

### 2.2.3. Resurgent Ethnicity

*Resurgent ethnicity* framework attributes segregation to racial/ethnic preference in residential choice, addressing the questions as to why segregation persists even after improvement of the socio-economic status of racial/ethnic minorities and amelioration of discriminatory practices. In-group attraction based on race/ethnicity, combined with out-group aversion, generates a particular preference in racial/ethnic composition of one’s neighborhood, entailing segregation. For instance, the Detroit Area Survey in 1976 reveals significant difference in the preference of racial composition of a neighborhood between Caucasians and African Americans (Massey and Denton 1993). About half of the Caucasian respondents answer not to move into neighborhoods with more than 20 percent African Americans, while African American respondents express strong preference for half-African American and half-Caucasian neighborhoods. More recently,
Krysan and Farley (2002) confirm that African American residential preference to the 50-50 neighborhoods still persists, even in mid-1990s. This difference in the residential preference between two groups undermines the stability of racial mixed neighborhoods.

Racial/ethnic preference in residential choice is also found in Asians and Hispanics in major immigrant gateways. Some Japanese and Mexicans in Los Angeles and New York tend to settle in relatively affluent suburbs, skipping the long-lasting immigrant enclave in inner-city areas (Allen and Turner 1996a, 1996b; Alba, Logan, Stults, Marzan, and Zhang 1999). An explicit statement of resurgent ethnicity is provided by Logan, Alba, and Zhang (2002) in their study of Asian and Hispanic immigrants who settle in more affluent suburbs of New York and Los Angeles, often without cultural assimilation such as English fluency. They argue that these racial/ethnic settlements could be better understood as ‘ethnic communities’ driven by preference rather than ‘immigrant enclaves’ driven by economic-cultural constraint. In general, the resurgent ethnicity framework hypothesizes racial/ethnic preference in residential choice generates segregation even though residential integration (assimilation) is socio-economically feasible and there has been an abatement of discriminatory practices in housing markets.

Having noted that traditional immigrant enclaves may not play a part as the first shelter for recent immigrants, resurgent ethnicity could appear and transform racial/ethnic geography in three ways. The first is a spillover effect. Mass immigration makes traditional enclaves insufficient to hold newcomers as shown in Mexican concentrations in Los Angeles, 1990 (Allen and Turner 1996a: 153). The second is chain migration. New immigrants who have ties with residentially assimilated relatives or
friends tend to settle nearby them. The third involves the high socio-economic status of some new immigrants. For example, Japanese nationals who work for Japanese corporations directly settle in more affluent co-ethnic suburbs in South California (Allen and Turner 1996a: 152). Other examples include Chinese and Koreans in Los Angeles County (Allen and Turner 1996b). Moreover, resurgent ethnicity, in the case of a large socio-economic difference among co-ethnic immigrants, could enlarge existing disadvantaged neighborhoods on one hand and generate spatially and socially separated affluent neighborhoods on the other hand. This spatial-social polarization is exemplified with two Armenian concentrations with distinct SES and acculturation (Allen and Turner 1996a: 152).

This resurgent ethnicity processes in terms of immigrants are easily applied to co-ethnic group members who resided in a traditional racial/ethnic neighborhood but move to another that is commensurate with their improved SES. All in all, geographical manifestation of resurgent ethnicity involves two socio-economically and spatially polarized racial/ethnic neighborhoods, both of which are subject to spill over through chain migration.

2.3. Research Tasks and Hypotheses

An extensive body of evaluative studies on the validity of the segregation frameworks have been employing cross-urban comparison metrics, examining a large number of MSAs (Farley and Frey 1994; Frey and Farley 1996; Logan, Stults, and Farley 2004; Massey 2000, Massey and Denton 1989, 1993; Wilkes and Iceland 2004) or
focusing on several largest MSAs and/or immigrant gateway cities (Alba, Logan, and Stults 2000; Clark and Blue 2004; Poulsen, Johnston, and Forrest 2002a, 2002b). It is also common to rely on city-suburb dichotomy in their approach to segregation change under the recent minority decentralization (Alba and Logan 1991, 1993; Alba, Logan, Stults, Marzan, and Zhang 1999; Logan and Alba 1993; Logan, Alba, and Leung 1996; Logan, Alba, McNulty, and Fisher 1996; Logan and Schneider 1984; Massey and Denton 1988a).

The findings from the cross-urban studies, however, are circumstantial at best, falling short in shedding light on underlying processes of segregation change in metropolitan areas. For instance, in their examination of White-Black segregation change during 1980s, Farley and Frey (1994) noted, “a high percentage of new housing is linked to declines in segregation” (p. 40) without providing underlying processes. Another example includes Logan, Alba, and Leung’s (1996) studies on minority residential patterns in eleven MSAs. They called an evidence for place stratification in that “white use segregation preserve their social position in the face of a threatening – that is, large – minority advance” (p. 875) based on their findings of positive relationship between minority population size and segregation. However, it does not necessarily imply that a particular MSA with a large number of minorities have higher white aversion against the minorities. Another example is Logan, Stults, and Farley (2004) analysis on segregation in all MSAs, 2000. They noted “[the] segregation of both Hispanics and Asians grew the most in centers of durable-goods manufacturing, suggesting that the economies of these places somehow promote the segregation of all groups (p. 19)” without providing
underlying mechanisms.

This researcher diagnoses the shortcomings as the result of neglecting of local variability of segregation within a MSA, partly due to less attention to local segregation measures. In response, this dissertation proposes, and utilizes, local measures to estimate segregation at the block group level, and evaluates the relative roles of the frameworks by means of investigating spatial patterning of race/ethnicity and neighborhood characteristics of racial/ethnic clustering/segregation. It is believed that unveiling intra-urban segregation allows us to make a thorough evaluation of the segregation frameworks and have better understanding of underlying processes in the current U.S. racial/ethnic geography. Analyses have the following hypotheses to test with a case study of Columbus Ohio MSA, 1990 and 2000.

*Spatial assimilation* would stand if minority group residences were (a) gradually distributed throughout the MSA and (b) overlapped with majority residences so that new racial/ethnic clusters do not appear. It is also indicated if (c) the *traditional* racial/ethnic clusters, encountering a large inflow of new immigrants, could persist but only in less affluent inner-city areas with high residential mobility, serving as a temporary shelter to new immigrants with low structural and cultural assimilation.

The *place stratification* framework would be indicated if (new) minority group residences (a) were spatially limited and highly concentrated in less affluent areas; (b) were adjoining to 1990 minority clusters when developing anew; and (c) their 2000 patterns are correlated highly with 1990 patterns. On the other hand, there could be (d) spatially separate new clusters in areas of low discrimination as in manufacturing
employee, government employee, and university neighborhoods.

The resurgent ethnicity framework would hold if (new) minority group residences were bifurcated with (a) traditional clusters in disadvantaged inner-city areas, accommodating less structurally and culturally assimilated immigrants and native-borns and (b) new clusters in relatively affluent suburbs, serving as residences to entrepreneurs and professionals. (c) Both clusters are linked through extended transportation and communication networks.

2.4. Summary

This chapter reviewed two urban theories in terms of their perspective on spatial pattern and characteristics of racial/ethnic neighborhoods. The urban ecology of the Chicago school envisions racial/ethnic neighborhoods, as a temporary shelter for new immigrants with low assimilation, expand through invasion-succession process driven by aversion of racial/ethnic majority toward minorities and relocate through urban redevelopment and gentrification programs. The postmodern urbanism of the Los Angeles school emphasizes the role of social polarization, often affiliated by race/ethnicity, and expanded urban transportation and communication networks on racial/ethnic patterning. It is suggested that social polarization makes racial/ethnic minority neighborhoods more distinct from those of majority and the expanding networks facilitates racial/ethnic neighborhoods to be any part of a city.

Also, the chapter articulated three frameworks of segregation change: spatial assimilation, which attributes persistent segregation to low cultural and structural
assimilation; *place stratification*, which accuses persistent segregation of discriminatory practices in housing and banking; and *resurgent ethnicity*, which emphasizes role of racial preference in residential choice and in-group attraction. Noticing that the previous literatures pay less attention to intra-urban segregation change in evaluating the relative role of the three frameworks, the chapter presented research tasks and hypotheses derived from each segregation framework. The following chapter deals with methodological issues in accessing intra-urban segregation.
CHAPTER 3
METHODOLOGY REVIEW

The previous chapter reviewed two urban theories in terms of their perspectives on spatial patterns and characteristics of racial/ethnic neighborhoods and presented three conceptual frameworks on segregation change. It was pointed out that the existing literatures, predominantly relying on cross-urban metrics, provides circumstantial evidences only and fall short in shedding light on spatial processes of segregation changes within a city. This chapter presents a way of measuring intra-urban segregation. Noting two spatial dimensions of segregation in a local perspective, the chapter critically reviews global segregation measures – dissimilarity index and its modifications - through a controlled experiment. It is argued that more attention should be given to local segregation measures and proposed to use the Location Quotient (LQ) for concentration-evenness and Local Moran’s I (LM-I) for clustering-exposure. These allow us to access local variability of segregation within a city, hence the spatial patterning of race/ethnicity.

3.1. Spatial Dimensions of Segregation

In the course of reviewing the existing segregation measures and proposing a way of measuring local variability of segregation, the researcher adapts Massey’s five
dimensions of segregation (Massey and Denton 1988b, 1989; Massey, White, and Phua 1996, Wiles and Iceland 2004). One dimension is evenness, indicating the distribution of a specific racial/ethnic group over an entire urban area. The second dimension is exposure, referring to the isolation of a racial/ethnic group indicated by the degree to which it shares a neighborhood with others and/or neighborhood boundary. The third dimension is clustering, denoting that persons live close to others of the same race/ethnicity and form a large contiguous enclave. The fourth dimension is concentration, referring to the density of a group in a small area. The fifth dimension is centralization, referring to the proximity of a residential distribution of a group to the urban core. In general, then, the existence of any one of those dimensions indicates that a racial/ethnic group is spatially separated and therefore hindered from interacting with other groups.

The five dimensions, however, can be reduced to two in a local perspective. A racial/ethnic group may concentrate on a certain part of a city, generating uneven distribution. Its concentrations could locate close to each other and make a large cluster, lowering exposure to other groups. In this context, concentration is viewed as the other extreme of evenness. Clustering is also a pertinent geographic representation of low exposure. In fact, Massey (1989, 1996) found that there is high correlation between evenness and concentration measures and between exposure and clustering measures in his empirical study of 60 and later 318 metropolitan areas. And the remaining dimension, centralization, has a little concern in the contemporary polycentric and sprawled cities. Therefore, the researcher envisions there are essentially two spatial dimensions in
accessing local variability of segregation, hence intra-urban segregation: concentration-evenness and clustering-exposure. This suggests that the study of racial/ethnic patterning with a city should encompass both dimensions, and the degree to which these occur will be used as an evaluative metric of intra-urban segregation change. Keeping these two local dimensions of segregation in mind, the next section critically reviews the existing segregation measures.

3.2. Global Segregation Measures: Dissimilarity Index and its Modifications

A predominant segregation measure is the dissimilarity index proposed by Duncan and Duncan (1955). As a summary measure the index generates a single value for the study area ranging from zero to one. The value indicates what percent of a group should move from a current areal unit to another to achieve complete desegregation. Therefore, a higher value means higher segregation.

In the example of black and white segregation, the index is calculated as

$$D = \frac{1}{2} \sum_{i} \left| \frac{b_i}{B} - \frac{w_i}{W} \right|$$

where $b_i$ & $w_i$ are the black and white population in areal unit $i$ and $B$ and $W$ are the total black and white population in the study area (Duncan and Duncan 1955). The index states that if a group occupies so much proportion in individual areal units as it does in the entire study area, there is no segregation. Hence, the dissimilarity index portrays concentration-evenness (Massey and Denton 1988b) but does not indicate clustering-exposure.
Despite the advantage of simplicity and popularity, the dissimilarity index has a number of shortcomings. First, it is sensitive to population size in that the index value exaggerates the degree of segregation when the minority population is very small (Taeuber and Taeuber 1965: 210). This shortcoming could be significant when one compares two regions with different proportions of a minority. The second is the so-called ‘principle of transfers’ (White 1986). Exchange of target group members between their over-represented areas with respect to the proportion in the entire city does not reflect in the index value. Third, the dissimilarity index is vulnerable to aggregating effects (Wong 2003; Wong, Lasus, and Falk 1999; Kaplan and Holloway 1998). The index generates different values depending on the choice of spatial enumeration units. For instance, the value computed based on census tract differs from that based on block group data for the same city. Fourth, the dissimilarity index is also vulnerable to ‘zoning effects’ (Wong, Lasus, and Falk 1999). Changing boundary delineations over time, which is often necessary for the Census to keep the size of local population constant for the purpose of comparison, affect the index value. The third and fourth together are the well-known Modifiable Areal Unit Problem (Openshaw, 1984). All in all, these shortcomings make the dissimilarity index less reliable in comparing cities with different minority proportion and in taking account of segregation change when the areal unit boundaries change over time.

As an attempt to supply its lack of sensitivity to spatial pattern, geographers have
given attention to incorporating spatial components into the dissimilarity index. The dissimilarity index does not reflect different spatial distribution of racial/ethnic groups at all (Morrill, 1991; Wong, 1993). It is due to the fact that the dissimilarity index depends only on the demographic composition of each areal unit in the calculation. In order to remove the aspatiality of the dissimilarity index, Morrill (1991) modified it by incorporating a binary connectivity matrix that can reflect the probability of interaction based on geographical adjacency and propose ‘boundary modified segregation index \((D(\text{adj}))\)’. The modified index is computed as

\[
D(\text{adj}) = D - \frac{\sum_i \sum_j |c_{ij}(z_i - z_j)|}{\sum_i \sum_j c_{ij}}
\]

where \(D\) is the dissimilarity index; \(c_{ij}\) is the value of the cell in row \(i\) and column \(j\) of the connectivity matrix(binary 1/0); and \(z_i\) is the proportion of Black to White in areal unit \(i\).

Wong (1993) presents a further modification by replacing the binary connectivity matrix with one better reflecting the property of shared boundaries such as the length or shape of common boundary and shape of areal units.

In the light of the two local dimensions of segregation discussed in the previous section, the modification combines both dimensions. In the equation of \(D(\text{adj})\), the first

\[4\] Another effort to improve segregation measures is to generalize them to gauge multi-group segregation. Sakoda (1981) generalizes the dissimilarity index while keeping its significant meaning of the amount of movement toward evenness. James (1986) makes the interaction index applicable to a multi-group setting, showing the degree of exposure of a group toward others. Reardon and Firebaugh (2002) generalize the entropy-based diversity index that keeps most of desirable properties as a segregation measure even in its generalized version: organizational equivalence, size invariance, the principle of transfers and exchanges, and additive organizational and group decomposability.
term is the existing dissimilarity index that measures the degree of *evenness-concentration* obtained from demographic composition. The second term estimates potential interactions between racial/ethnic groups based on spatial structure, the degree of *clustering-exposure*.

Despite its conceptual advantages and some sensitivity to different spatial structure, the Boundary Modified Segregation Indices ($D(adj)$) have not been used in empirical studies. The researcher argues that it is partly because the index value has no systematic relationship with different spatial configuration as revealed in the following controlled experiment.

### 3.2.1. Controlled Experiment

Eight hypothetical spatial configurations were designed to confirm the aspatiality of the dissimilarity index and evaluate the spatial sensitivity of Morrill’s ‘boundary modified segregation index ($D(adj)$)’. A hexagon was adapted to represent each cell. This has two advantages: all neighboring cells can be conceived to be adjacent cells with a shared boundary, and the distance between them is identical.

Figure 1 (a) demonstrates a large centralized racial/ethnic cluster in the urban core. This situation could represent an immigrant enclave in Midwest and Northeast traditional industrial cities. The dissimilarity index yields the value of 1 since the ethnic composition of each cell is either 100 percent minority or 100 percent majority. Morrill’s spatial segregation index, however, has a value of 0.80 because spatial interaction between adjacent cells with different ethnic composition lowers the degree of
segregation.

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Explanation</th>
<th>$D$</th>
<th>$D(adj)$</th>
<th>Rank in $D(adj)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Large centralized ethnic racial/ethnic cluster in the urban core</td>
<td>1</td>
<td>0.80</td>
<td>2</td>
</tr>
<tr>
<td>(b)</td>
<td>Large de-centralized racial/ethnic cluster on the urban fringe</td>
<td>1</td>
<td>0.88</td>
<td>1</td>
</tr>
<tr>
<td>(c)</td>
<td>Uniform racial/ethnic enclaves with one in the core</td>
<td>1</td>
<td>0.53</td>
<td>5</td>
</tr>
<tr>
<td>(d)</td>
<td>Scattered, or random pattern, racial/ethnic enclaves in the core</td>
<td>1</td>
<td>0.72</td>
<td>4</td>
</tr>
<tr>
<td>(e)</td>
<td>Relatively large racial/ethnic cluster in the core and small clusters on the fringe</td>
<td>1</td>
<td>0.74</td>
<td>3</td>
</tr>
<tr>
<td>(f)</td>
<td>Contiguous expansion of racial/ethnic enclave to the middle ring</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(g)</td>
<td>Contiguous racial/ethnic enclave in the middle ring</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1. Segregation indices in hypothetical spatial configuration of two ethnic groups

Figure 1 (b) illustrates a large decentralized racial/ethnic cluster on the urban fringe. This could be the case when inner-city gentrification or geographic expansion of a metropolitan area takes place. Higher segregation is intuitively expected since the enclave is marginalized and isolated on the edge. The dissimilarity index, however, yields
an unchanged value of 1, attesting to its insensitivity to different spatial configuration (Morrill 1991; Wong 1993). Meanwhile, Morrill’s index generates a reasonable value of 0.88 in that the value is slightly higher than that in Figure 1 (a).

Figure 1 (c) demonstrates a uniform pattern of racial/ethnic enclaves. It is very likely to have lower segregation than the previous configurations since the majority areas surround all ethnic minority enclaves. Once again, dissimilarity index remains unchanged, but Morrill’s index shows sensitivity to the change, yielding the lowest value in this experiment at 0.53.

Figure 1 (d) shows scattered or randomly distributed racial/ethnic enclaves. Focusing on spatial distribution only, a lower level of segregation is expected that that of Figure 1 (c). Morrill’s index, however, gives us a much higher value of 0.72. This is because the ethnic minority enclaves on the edge have a smaller number of adjacent majority areas than those in the middle ring or in the core. It informs us that Morrill’s index is vulnerable to edge effects.

The spatial configuration in Figure 1 (e) could be a more realistic setting in the contemporary metropolitan area: one large cluster of enclaves in the core and some small clusters in the outer ring. Morrill’s index value of 0.74 seems to be reasonable since it is on the middle point between the intuitively high segregation (Figure 1 (b)) and low segregation (Figure 1 (c)). Researchers need to keep in mind, however, that spatial interaction of ethnic enclaves on the edge could be underestimated.

Figure 1 (f) demonstrates a situation where the racial/ethnic cluster shown in (a) expands contiguously and (g) demonstrates contiguous ethnic enclaves in the middle ring
as when an urban gentrification program relocates inner-city minorities. Noticeably, their number and areal size of black neighborhoods are larger than the previous configurations -- by 12 for (f) and by 6 for (g). Accordingly, higher segregation is expected in that blacks have less chance to contact with whites. However, the dissimilarity index yields constant value of 1 for both configurations. This indicates the dissimilarity index is not sensitive to a change of minority neighborhoods in size.

In summary, this controlled experiment demonstrates insensitivity of the dissimilarity index to different spatial distributions and areal size of racial/ethnic enclaves. By contrast, Morrill’s index is affected by different spatial configuration: a higher value for the marginalized configuration of Figure 1 (b); a lower value for the uniform and random configurations in Figure (c) and (d); a reasonable value for the configuration in Figure (e). The spatial index, however, does not generates systematic values, as shown in Figure (d), partly due to its vulnerability to edge effects, preventing researchers from linking an index value to a particular spatial configuration.

Further, as shown in the controlled experiment, the dissimilarity index and its spatial modifications are essentially global and thus are limited in revealing intra-urban residential patterning of race/ethnicity. Accordingly, the empirical studies relying on the global measures fall short in revealing underlying spatial processes of segregation changes. Hence, their findings tend to be circumstantial. A recent example is Logan, Stults, and Farley’s (2004) analysis on segregation in all MSAs, 2000. They noted “[the] segregation of both Hispanics and Asians grew the most in centers of durable-goods manufacturing, suggesting that the economies of these places somehow promote the
segregation of all groups (p. 19),” without indicating the underlying mechanisms. In this context, the researcher argues that more attention should be given to local measures which allow to access local variability of segregation within a city, hence the spatial processes of segregation.5

3.3. Local Segregation Measures: Location Quotient and Local Moran’s I

One approach to deriving local segregation measures is decomposition of a global statistic. Examples include Reardon and Firebaugh’s (2002) entropy-based diversity index and Wong’s (2003) framework for the spatial decomposition of global measures such as the dissimilarity index.6 However, this approach has three issues. First, decomposed segregation measures, tied to aspatial global indices, only demonstrate the relative contribution of an areal unit to the global indices and do not have an inherent meaning. Second, values from the measures are difficult to interpret. Thirdly, decomposed entropy-based diversity index and dissimilarity index deal with each areal unit independently and hence only portray the concentration-evenness dimension of segregation, not the clustering-exposure dimension.

5 The shift from global to local measures makes a difference in the way of referring to segregation. As in Kaplan and Holloway’s (1998: 9) example, it allow us to make a statement, “John lives in a very segregated neighborhood” rather, “Chicago is more segregated than Los Angeles’. Hence, a local segregation measure makes it possible to access segregation at the neighborhood level. Furthermore, identifying segregated neighborhoods is a base to understand spatial patterns of intra-urban segregation.

6 In the decomposition approach, segregation values along a geographic hierarchy are additive. For example, a decomposed- \( D \) for block groups should add up to their census tract \( D \), or if all block groups are considered, to the MSA \( D \). An empirical study utilizing the decomposed diversity index is Fischer, Stochmayer, Stiles, and Hout’s (2004) examination of U.S. metropolitan segregation change, 1960 through 2000.
These issues require a different approach to increasing spatial-sensitivity in the study of segregation. The researcher’s approach is to employ accessible measures that have distinct meaning; are more intuitive in terms of understanding; and gauge both dimensions of segregation. Hereby, the research propose to utilize both the Location Quotient (LQ), for concentration-evenness and the local Moran’s I (LM-I) for clustering-exposure (Brown and Chung 2005).

The Location Quotient (LQ), a familiar index to economic geographers and regional economists, has been used to show the degree of specialization of a spatial unit in a selected feature; in other words, the degree of concentration of the feature in the spatial unit, with reference to its presence over the entire area (Burt and Barber 1996). With an example of black, the value is calculated with the following formula (Miller, Gibson, Wright 1991: 65):

$$LQ_i = \frac{b_i}{t_i} \div \frac{B}{T}$$

where $b_i$ and $t_i$ are the black and total population in areal unit $i$; $B$ and $T$ are the black and total population in the entire study area. In its application to racial/ethnic segregation, the value of 1 indicates the representation of a racial/ethnic group in a local areal unit equals to that for the urban area overall; a value greater than 1 indicates more representation in a local areal unit than that for the urban area overall; a value less than 1 indicates less representation. In fact, the most used criteria to determine racial/ethnic minority concentrations, or neighborhoods, has been the proportion of the concerned group

---

7 A recent application of LQ to segregation includes Ellis, Wright, and Parks (2004) at the census tract level.
relative to the local population with a cutting point of 20 percent. This is based on survey result wherein about half of Caucasians answer not to move into a neighborhood with more than 20 percent African Americans when Caucasian respondents were asked their feeling about hypothetical neighborhoods with different proportions of Caucasian and African-American households (Massey and Denton 1993; Gotham 2002). There are two issues concerning this method. First, it does not consider cross-urban and temporal variability in the proportion of the concerned minority group to total urban population. Second, the survey is only concerned with African Americans so that its findings cannot be applied to other minority groups. LQ estimates local representation of each group with respect to its overall representation in a city, providing a more consistent approach for cross-urban, temporal, and cross-group comparisons. In taking advantage of this LQ property, the study uses LQ of 1.2 or greater to indicate over-representation of a racial/ethnic group and LQ of 0.85 or smaller to indicate under-representation (Brown Lobao and Verheyen 1996: 188).  

While the LQ deals with each spatial unit independently, local Moran’s I (LM-I) as a measure of local spatial autocorrelation treats each unit with reference to its

---

8 To best knowledge of the researcher, there is no ‘systematic’ way of deciding cutoff values for LQ. This research has two concerns. First, the LQ value of 1 indicates the representation of a selected feature in a local areal unit matches its overall representation in the study area. If LQ is greater than 1, it indicates over-representation of the feature in a local areal unit. If LQ is lesser than 1, it indicates its under-representation in a local areal unit. Second, LQ has non-symmetric distribution, ranging from 0 to infinity. Given the meaning of LQ value 1 and non-symmetric distribution, the researcher adapted LQ value of 1.2 and 0.85 for the cutoffs. These correspond to 20% more and 15% less than the overall representation of the concerned feature, respectively. Because of this arbitrariness, the researcher focuses on changes rather than the meaning of individual values when interpreting the findings from LQ in the empirical analyses.
neighboring units, shedding light on the degree of clustering (Anselin 1985). The value is computed as (Anselin 1995: 99)

\[
LMI_i = \frac{(b_i - b^*) \sum_j w_{ij} (b_j - b^*)}{\sum_i (b_i - b^*)^2 / n}
\]

where \(b_i\) is the percent black for areal unit \(i\); \(b^*\) is the mean percent black for the study area; \(n\) is the number of areal units; \(w_{ij}\) is spatial weights matrix between \(i\) and \(j\) (often binary 1/0).

To understand the use of LM-I in this dissertation, consider Figure 2 which presents a schematic diagram of Moran scatterplot map. The x-axis represents the deviation of \(b_i\) from the study area average, \((b_i - b^*)\), whereas the y-axis represents the aggregated deviations for neighboring areal units, \(\sum j w_{ij} (b_i - b^*)\). Each quadrant indicates the relationship between the “target” areal unit and its neighbors as being either high-high, (+, +), in the upper right quadrant; high-low, (+, -), in the lower right quadrant; low-low, (-, -), in the lower left quadrant; or low-high, (-, +), in the upper left quadrant. LM-I generates a positive value for high-high and low-low relationships, indicating positive local spatial autocorrelation, and a negative value for high-low and low-high relationships, indicating negative local spatial autocorrelation.

In using LM-I as an indicator of racial/ethnic clustering/segregation, the researcher has two concerns. First, LM-I needs to show high-value clustering in racial/ethnic representation for situations in which over-represented areal units occur adjacent to one another, as well as low-value clustering for situations in which under-represented areal units occur adjacent to one another. Since LM-I generates a positive
value for both high-value clustering (high-high relationship) and low-value clustering (low-low relationship), the research distinguishes them by appending a + sign for high-value clustering and – sign for low-value clustering. By doing so, the research indicates whether or not an areal unit is strongly or weakly related to the concerned racial/ethnic group. The research also assigns a 0 to high-low and low-high associations since spatial dissimilarity in racial/ethnic representation is not a focus in this study of co-ethnic clustering/segregation.

Figure 2. A Schematic Diagram of Moran Scatterplot Map

The second concern is gauging the significance of high-value and low-value clustering. The research converts LM-I values to z-scores and uses a z-score + 0.667 or
greater to indicate significant high-value clustering and – 0.667 or smaller to indicate significant low-value clustering. The research focuses on these two types of clusters, indicated by solid black dots in Figure 2. The cutoff of 0.667 corresponds to a two-thirds standard deviation. It is noteworthy that LM-I is statistically useful for exploratory spatial data analysis when its values are converted into z-scores or p-values (Tiefelsdorf 1998).  

3.4. Summary

This chapter critically reviewed global segregation measures – dissimilarity index ($D$) and its modification, Boundary Modified Segregation Index ($D(adj)$). Controlled experiment revealed that they have limitation in shedding light on intra-urban residential patterning of race/ethnicity. This suggests that more attention should be given to local segregation measures to access local variability of segregation within a city. In response, the chapter proposed a set of local segregation measures along two spatial dimensions of segregation to understand local variability of segregation across urban space, hence to spatial patterning of race/ethnicity. The Location Quotient (LQ) with the advantages of familiarity and simplicity can be used to measure concentration-evenness. Local Moran’s $I$ (LM-I) with advantage of statistical robustness is useful to measure clustering-exposure. Both measures are easily visualized on a map and profitably applied to identify

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9 A similar approach was employed in Brown, Lee, Lobao, and Chung (2005). In the midst of empirical analyses for the dissertation, the researcher recognized that the G-statistics (Getis and Ord 1992; Ord and Getis 1995) has advantages in showing racial/ethnic clustering. G-statistics yields a high positive value for high-value clusters and a low negative value for low-value clusters, thus not requiring THE effort of appending signs that is used in this research (Omer and Benenson 2002). This recognition, however, was at the last stage of empirical analyses, so G-statistic is not incorporated.
segregated racial/ethnic neighborhoods and, hence, spatial patterning of segregation. The next chapter presents a research design for an empirical case study while utilizing the local segregation measures.
CHAPTER 4
STUDY AREA, DATA, AND METHODOLOGY

The previous chapter discusses the shortcomings of the existing global segregation measures in shedding light on local variability of segregation within a city and highlights the importance of local segregation measures to understand intra-urban residential patterning. It also proposes to use the Location Quotient (LQ) and Local Moran’s I (LM-I) as local segregation measures. This chapter presents the data and methodology for an empirical study. The first section presents data sources and introduces the study area. The second section presents variable selection and my analytical approach to evaluate the relative role of each segregation framework through examining spatial patterns and characteristics of racial/ethnic neighborhoods.

4.1. Study Area and Data Sources

A case study of Columbus Ohio MSA in 1990 and 2000 is performed using the boundary-matched Census of Population and Housing Summary File Tape 3 released by the U.S. Bureau of the Census.10 Columbus Ohio MSA consists of seven counties, has

10 It is necessary to match up the number and boundary block groups in this temporal study. Each pair of block groups for different times should have an identical spatial boundary for direct comparison since segregation indices calculated from different
the City of Columbus at its geographic center and encompasses surrounding satellite
cities (Figure 3). The City of Columbus holds several independent municipalities and
neighborhoods. In terms of interstate highway system, the MSA is defined by I-70
running east (Pittsburgh) to west (Indianapolis), I-71 running southwest (Cincinnati) to
northeast (Cleveland), an inner beltway (I-670) encircling the CBD, and an outer beltway
(I-270) that encompasses most of Columbus City and reflects the growth of the city over
time. In short, Columbus Ohio MSA is a polycentric city with a single Central Business
District (CBD) located in the geographic center of the area and other trade and business
centers in the metropolitan fringe.

In temporal terms, the researcher selects 1990 as a base year to gauge the changes
to 2000. The study area’s outer beltway (I-270) around the City of Columbus had a
significant impact on decentralization2. Beltway construction was completed in 1976, but
it is not until late 1980s that feeders and infrastructure for residence were constructed.
Accordingly, 1990 is an appropriate base year for the study.

Demographically, Columbus Ohio MSA has population of about 1.6 million in
2000, being the 41st largest MSA. Table 1 presents its racial/ethnic composition. African
American and Asian proportions in the study area are similar to their national
representation in 2000. The MSA has Caucasian proportion of 81% where its national
average is 69% and Hispanic proportion of 1.8% where its national average is 12.5%.11

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11 The nationwide racial/ethnic composition in 2000 is 69.1% non-Hispanic White;
12.0% non-Hispanic African American; 3.7% non-Hispanic Asian; and 12.5 %
Hispanic.
Figure 3. Columbus Ohio MSA, Counties, Interstate Highways and Main Arteries, Incorporated Cities and selected local Neighborhoods
Concerning changes from 1990 through 2000, all racial/ethnic groups increase in absolute number, but there are significant changes in size relative to the metropolitan population. The percentage of majority Caucasians decreases from 85.6 to 80.8, whereas that of each racial/ethnic minority increases. Among the minorities, Hispanic population increases noticeably by 181% but still remains the smallest minority group. The next most growing group is Asian, which increases by 81%. Meanwhile, the African American proportion grows only slightly from 12% to 13%. People in the category of ‘others’ increase dramatically during the last decade. This reflects that the category includes population of ‘two or more races’, 29,185 in 2000. Because the Census 2000 allowed respondents to choose more than one race for the first time, and for temporal comparison with 1990, the 2000 population of ‘two or more races’ were classified as

<table>
<thead>
<tr>
<th></th>
<th>1990</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian</td>
<td>1,178,794</td>
<td>1,277,091</td>
</tr>
<tr>
<td></td>
<td>(85.58)</td>
<td>(80.77)</td>
</tr>
<tr>
<td>African American</td>
<td>163,763</td>
<td>205,633</td>
</tr>
<tr>
<td></td>
<td>(11.89)</td>
<td>(13.01)</td>
</tr>
<tr>
<td>Asian</td>
<td>20,449</td>
<td>37,093</td>
</tr>
<tr>
<td></td>
<td>(1.49)</td>
<td>(2.35)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>10,106</td>
<td>28,424</td>
</tr>
<tr>
<td></td>
<td>(0.73)</td>
<td>(1.80)</td>
</tr>
<tr>
<td>Others*</td>
<td>4,308</td>
<td>32,825</td>
</tr>
<tr>
<td></td>
<td>(0.31)</td>
<td>(2.07)</td>
</tr>
<tr>
<td>Total</td>
<td>1,377,420</td>
<td>1,581,066</td>
</tr>
<tr>
<td></td>
<td>(100.00)</td>
<td>(100.00)</td>
</tr>
</tbody>
</table>

Note: Number in parenthesis is percentage.
* includes Native Americans and population of two or more races
‘others’ and excluded from the analyses. All in all, Columbus Ohio MSA is a representative of mid-sized urban areas and experiences decreasing proportion of the majority Caucasians and increasing racial/ethnic diversity during the last decade, echoing the national trend.

The basic unit of analysis is the block group, the smallest spatial unit for which most socio-economic data is available in the census. This dissertation refers to a block group with the term neighborhood. Analyses excluded 12 institutionalized block groups with correctional facilities or university dormitories and 10 block groups with less than 200 population at any census years for data comparability, most of which are explicitly commercial districts.12

4.2. Variable Selection and Analytic Approach

This dissertation performs an empirical study on the Columbus Ohio MSA to evaluate the relative role of three segregation frameworks: spatial assimilation, place stratification, and resurgent ethnicity. To accomplish this, the study examines the spatial patterns (Chapter 5) and socio-economic characteristics (Chapter 6) of racial/ethnic block groups. This section presents variable selection and analytic approaches, evaluating each segregation framework.

4.2.1. Spatial Patterns

Intra-urban residential patterning is investigated for four census-defined

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12 The correctional facilities include Franklin Pre-Release Center, Corrections Medical Center, Harrisburg Orient Correctional Facilities, Pickaway Correctional Institute, London Correctional Institution, Madison Correctional Institution, Ohio Reformatory for Women, and Southeastern Correctional Institution and Camp Reams.
racial/ethnic groups: non-Hispanic Caucasians, non-Hispanic African Americans, non-
Hispanic Asians, and Hispanics. This classification corresponds to the Census categories
of ‘race’ and ‘Hispanic origin.’ Hispanics are first defined as an exclusive group, and
Caucasians, African Americans, and Asians are identified through the category ‘race.’

Comparison of race/ethnicity between 1990 and 2000 requires particular attention
since there were changes by the Census in collecting race/ethnic data in 2000. First, the
order of the race/ethnic questions was reversed in 2000. Unlike 1990, respondents were
first asked about their ethnic identity (whether or not he/she is Hispanic) and then about
their race in 2000. This change does not impact this study since it reflects a study that
suggests the order of questions has no significant impact on the number who claims to be
Hispanic (Johnston, Poulsen, and Forrest 2003). Second, 2000 respondents were allowed
to choose more than one race for the first time. Third, the race categories that respondents
can choose were changed. The category of ‘Asian and Pacific Islander’ in 1990 was split
into two separate categories in 2000 -- ‘Asian’, and ‘Native Hawaiian and Other Pacific
Islander’. Also, three separate categories of ‘American Indian’, ‘Eskimo’ and ‘Aleut’
were merged into one category of ‘American Indian and Alaska Native.’ In order to
facilitate comparisons across the years, this researcher combined ‘Asian’ and ‘Native
Hawaiian and Other Pacific Islanders’ in 2000. People who identify themselves as multi-
racial were excluded in the analysis since their number is very small.

Residential patterning of each racial/ethnic group is examined through
cartographic analyses. The results are presented in Chapter 5. The local segregation
measures proposed in Chapter 3 are used to identify segregated racial/ethnic block
groups: Local Moran’s I (LM-I) to measure the degree of *clustering-exposure* and Location Quotient (LQ) to gauge the degree of *concentration-evenness*. Racial/ethnic block groups must have +0.667 or greater for z-scored LM-I (also, sign-appended as indicated in Chapter 3) or 1.2 or greater for the LQ, denoted as racial/ethnic *cluster* and *concentration*, respectively. Furthermore, to understand residential patterning of a group outside its clusters and concentrations, the study investigates *growing* and *new* racial/ethnic block group for each group. *Growing* settlement indicates a block group that had more than a 50 percent increase in the number of group members, yet not large enough to be a concentration and *new* settlement indicates a block group with no group members in 1990 but more than 10 -- approximately, 5 households -- in 2000 (Table 2).

<table>
<thead>
<tr>
<th>Terminology</th>
<th>Definition</th>
<th>Segregation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Racial/Ethnic Cluster</td>
<td>A block group with greater than 0.667 for LM-I</td>
<td>Highest</td>
</tr>
<tr>
<td>Racial/Ethnic Concentration</td>
<td>A block group with greater than 1.2 for LQ</td>
<td>High</td>
</tr>
<tr>
<td>Growing Racial/Ethnic Settlement</td>
<td>A block group that has more than a 50 percent increase in the number of group members 1990 through 2000, yet less than 1.2 for LQ</td>
<td>Low</td>
</tr>
<tr>
<td>New Racial/Ethnic Settlement</td>
<td>A block group with no group members in 1990 but more than 10 (approximately, 5 households) in 2000</td>
<td>Lowest</td>
</tr>
</tbody>
</table>

Table 2. Classification of Racial/Ethnic Neighborhoods

This classification of racial/ethnic neighborhood reflects different degree of segregation. The degree of segregation declines in the order of racial/ethnic *cluster*,

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13 The U.S. Census indicates the mean household size is 2.08 in 1990 and 2.03 in 2000.
concentration, growing, and new settlement. Cartographic analyses of these four types of racial/ethnic block groups for each group and further cross-racial/ethnic group and temporal comparisons enable us to access intra-urban residential patterning of race/ethnicity and the spatial pattern changes of segregation, leading to evaluating the relative role of each segregation framework.

Hypothetical residential patterning of race/ethnicity, derived from each segregation framework is as follows. Under the spatial assimilation framework, we expect (a) minority group residences to be gradually and sparsely distributed throughout the MSA and (b) intermixed with majority residences so that new racial/ethnic clusters and concentrations do not appear. Also, (c) traditional racial/ethnic clusters and concentrations, encountering a large inflow of new immigrants, could persist but only in less affluent inner-city areas.

Under the place stratification framework, we expect minority group residences to be (a) spatial limited and highly concentrated and clustered in their patterning with little overlapping with majority residences; (b) adjoining 1990 minority clusters and concentrations when developing anew. Also, (c) 2000 patterns are correlated highly with 1990 patterns.

Under the resurgent ethnicity framework, we expect (new) minority group residences to be bifurcated with (a) traditional clusters and concentrations in disadvantaged inner-city areas and (b) new clusters and concentrations in affluent decentralized places. Also, (c) both clusters and concentrations are linked through extended communication and transportation networks.
4.2.2. Neighborhood Characteristics

Having examined spatial patterns, analyses then turns to socio-economic characteristics of racial/ethnic clustering/segregation. To gauge racial/ethnic clustering/segregation at the neighborhood level, this study adapts $z$-scores of Local Moran’s $I$ (LM-I) that is a more conservative and robust local segregation measure. To characterize neighborhoods, the study employs a set of socio-economic variables that are classified into four categories: structural/cultural blending, housing stock features, occupational specialization, and neighborhood stability (Table 3). These categories are derived from the hypotheses of one or more segregation frameworks for the purpose of evaluating the relative role of each framework. First, this section presents variables selection for each category and relationships between each category and clustering/segregation, predicted by one or more segregation frameworks. Second, statistical methodology for analyses is presented.

4.2.2.1. Variables and their Predicted Relationship with Clustering/Segregation

Socio-economic characteristics of neighborhoods are defined in four categories: structural/cultural blending, housing stock features, occupational specialization, and neighborhood stability. Table 3 shows variables for each category and discusses their relationship with racial/ethnic clustering/segregation, expected by each segregation framework.

**Structural/Cultural Blending.** The category of blending, a proxy of assimilation
is further divided into structural and cultural. Following Gordon (1964) and Alba, Logan, and Stults (2000), the empirical study adapts Median Household Income (INCOME), Percent of People with High School Diploma and/or Some Post High School (EDUATT), Percent of Professional Job Employment (PROFES), Percent of Service Job Employment (SERVICE), and Percent of Self-Employed Population to estimate structural blending. Low values of SERVICE and High values of the rest of the variables indicate high structural blending. On the other hand, the study employs Percent of Foreign-Born People (FOREIGN) and Percent of Households that do not Use English at Home (NONENG) for cultural blending. Higher values of the variables indicate lower cultural blending.

Concerning relationship between structural/cultural blending and clustering/segregation, spatial assimilation framework predicts a strong inverse relation since it defines racial/ethnic neighborhood as a shelter for immigrants with low cultural/structural assimilation. Meanwhile, place stratification envisions that the discriminatory practices prevent minorities from translating their acquired socio-economic resources to residential mobility. This implies minority group members with increased structural/cultural blending still remain in their racial/ethnic clusters. Hence, place stratification predicts a direct relationship between clustering/segregation and cultural/structural blending.

Resurgent ethnicity proposes that racial/ethnic neighborhoods are bifurcated into (1) traditional racial/ethnic clusters that accommodate less structurally and culturally assimilated immigrants and native-borns and (2) new clusters in affluent suburbs that serve as residences to entrepreneurs and professionals. Hence, resurgent ethnicity predicts that racial/ethnic clustering/segregation are not necessarily associated with low
<table>
<thead>
<tr>
<th>Categories</th>
<th>Variable</th>
<th>Definition</th>
<th>Assimil</th>
<th>Stratif</th>
<th>ResEth</th>
</tr>
</thead>
<tbody>
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<td>Structural Blending</td>
<td>Income</td>
<td>Median household income</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Education Attainment</td>
<td>Percent people with high school diploma and/or some post high school</td>
<td></td>
<td></td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Professional Job</td>
<td>Percent of the employed civilian population aged 16 and older who had management, professional occupations</td>
<td></td>
<td></td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Service Job</td>
<td>Percent of the employed civilian population aged 16 and older who had service occupations</td>
<td>+</td>
<td>−</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Self-employment</td>
<td>Percent of the civilian population aged 16 and older who were self employed</td>
<td>−</td>
<td>+</td>
<td>NA</td>
</tr>
<tr>
<td>Cultural Blending</td>
<td>Nativity</td>
<td>Percent of foreign-born people</td>
<td>+</td>
<td>−</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Language</td>
<td>Percent of households that do not use English at home</td>
<td>+</td>
<td>−</td>
<td>+</td>
</tr>
<tr>
<td>Housing Stock Features</td>
<td>Housing Value</td>
<td>Median Value for Specified Owner-Occupied Housing Units</td>
<td>−</td>
<td>−</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Housing Age</td>
<td>Median Year Structure Built</td>
<td>−</td>
<td>−</td>
<td>NA</td>
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<tr>
<td></td>
<td>New Housing</td>
<td>Percent of housing built in last 10 years</td>
<td>−</td>
<td>−</td>
<td>NA</td>
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<tr>
<td>Occupational Specialization</td>
<td>Manufacturing</td>
<td>Percent of the employed civilian population aged 16 and older who worked in the manufacturing industry</td>
<td>NA</td>
<td>+</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Government</td>
<td>Percent of the employed civilian population aged 16 and older who worked in the public administration</td>
<td>NA</td>
<td>+</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>College Student</td>
<td>Percent of the population aged 3 and older who were enrolled in college, graduate school, or professional school</td>
<td>NA</td>
<td>+</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Retirement</td>
<td>Percent of the total population aged 65 and over</td>
<td>NA</td>
<td>−</td>
<td>NA</td>
</tr>
<tr>
<td>Neighborhood Stability</td>
<td>Homeownership</td>
<td>Percent owner-occupied housing units</td>
<td>−</td>
<td>+</td>
<td>−</td>
</tr>
<tr>
<td></td>
<td>Residential stability</td>
<td>Percent residents lived at the same place 5 years ago</td>
<td>−</td>
<td>+</td>
<td>−</td>
</tr>
<tr>
<td></td>
<td>Single Family Housing</td>
<td>Percent of single family dwellings</td>
<td>−</td>
<td>+</td>
<td>−</td>
</tr>
</tbody>
</table>

Table 3. Neighborhood Characteristic Variables and their Predicted Effects on Clustering/Segregation by Frameworks
structural blending but to some degree with low cultural blending when encountering a large inflow of foreign immigrants.

**Housing Stock Features.** The category of housing stock features is further divided into housing market strata and age of housing/neighborhood. To gauge housing market strata, the study employs Median Value for Specified Owner-Occupied Housing Units (HOUVAL). Its higher value indicates higher strata of housing market. The variables to determine the age of housing/neighborhood include Median Built Year (MEDBLT) and Percent of Housing Units Built in the Last Ten Years (NEWHOU). Lower value of Median Built Year and higher Percent of Housing Units Built in the Last Ten Years indicates younger age of housing/neighborhood (Farley and Frey 1994; Wilkes and Iceland 2004).

Concerning relationship between housing stock features and racial/ethnic clustering/segregation, both spatial assimilation and place stratification predict racial/ethnic clustering/segregation occurs in old neighborhoods with low housing values for different reason. Spatial assimilation envisions minority residence in such neighborhoods is granted result from their low socio-economic resources whereas place stratification views it is due to discriminatory practices that prevent minority group from translating acquired resources to residential mobility. Meanwhile, resurgent ethnicity predicts there is less effect of the housing features on overall minority clustering/segregation because of the bifurcation of racial/ethnic neighborhoods.

**Occupational Specialization.** As proxies of occupational specialization of a neighborhood, the researcher employs Percent of Manufacturing Job Employment
Place stratification proposes that the level of discrimination varies across occupational specialization of neighborhoods, influencing segregation (Farley and Frey 1994; Wilkes and Iceland, 2004). Manufacturing employee neighborhoods absorb minority laborers historically and/or for their needs, having high minority clustering/segregation: African Americans from the South during the first half of twentieth century and low-skilled Asian and Hispanic immigrants more recently. Government employee neighborhoods tend to be highly aware of the Fair Housing Act and open to minority neighbors. Many residents in university neighborhoods spend only a few years, so their sense of belonging to their neighborhoods is ephemeral. Hence, university neighborhoods are more open to minority neighbors. Retirement neighborhoods tend to have relatively low minority representation. Few retired African Americans have obtained the required savings to move into retirement neighborhoods, so the elderly residents in those neighborhoods are largely Caucasians. Also, the elderly Caucasian residents have been exposed to histories of racial strife and incline to desire a homogeneous neighborhood. All in all, the place stratification predicts minority clustering/segregation occurs in manufacturing employee, government employee, and university neighborhoods but less likely in retirement neighborhoods. Spatial assimilation and place stratification provide no specific prediction on the relation
between racial/ethnic clustering/segregation and occupational specialization of a neighborhood.

**Neighborhood Stability.** The variables to estimate neighborhood stability, following Rohe and Stewart (1996), are Percent of Owner-Occupied Housing Units (OWNOCC), Percent of Residents Lived at the Same Place 5 years Ago (RESSTAB), and Percent of Single Family Dwellings (SINGFAM). High values of these variables indicate high neighborhood stability.

Concerning relationship between neighborhood stability and racial/ethnic clustering/segregation, *spatial assimilation* predicts that racial/ethnic neighborhoods are characterized by low neighborhood stability since racial/ethnic minority residents move out of such areas as soon as they obtain sufficient resources. Also, *resurgent ethnicity* predicts low stability of racial/ethnic neighborhoods since it views racial/ethnic minorities are (re)distributed into bifurcated racial/ethnic neighborhoods, commensurate with their socio-economic resources. On the other hand, *place stratification* anticipates racial/ethnic neighborhoods have high stability since minority residential mobility is impeded by discriminatory practices.

In summary, *spatial assimilation* predicts that racial/ethnic clustering/segregation occurs in old neighborhoods with low cultural/structural blending; low housing values; and low neighborhood stability. *Place stratification* predicts that racial/ethnic clustering/segregation is directly associated with cultural/structural blending and characterized by low-valued and old housing and high neighborhood stability. In particular, racial/ethnic minority clustering varies across occupational specialization of a
neighborhood. Higher clustering/segregation occurs in manufacturing employee, government employee, and university neighborhoods whereas lower clustering occurs in retirement neighborhoods. *Resurgent ethnicity* predicts that racial/ethnic clustering/segregation is not necessarily associated with structural blending but so is with cultural assimilation when encountering a large inflow of foreign immigrants. It also predicts that racial/ethnic clustering/segregation is characterized by low neighborhood stability due to (re)distribution of group members into bifurcated racial/ethnic neighborhoods, commensurate with their socio-economic resources.

### 4.2.2.2. Methodology for Analyses

Empirical study starts with analyses of zero-order correlation between racial/ethnic clustering/segregation -- judged by LM-I -- and the set of socio-economic variables to characterize neighborhoods. Then, to obtain parsimony and avoid collinearity, the study performs stepwise regression analyses for each racial/ethnic group. The dependent variable is the $z$-score of LM-I and independent variables are the set of socio-economic variables that reflects neighborhood characteristics, discussed in the preceding section. These correlation and regression analyses are performed for each racial/ethnic group and show how neighborhood characteristics covariate with racial/ethnic clustering/segregation. The study also performs residual analyses and identifies *outcrop* neighborhoods in which racial/ethnic clustering/segregation is not sufficiently explained by the regression model. The criteria used to determine *outcrop* neighborhoods are greater than 0.667 for $z$-score residual from the regression model; less
than 1.2 for LQ; and greater than 30 population for the concerned group so that an outcrop neighborhood is not large enough to be a racial/ethnic concentration or cluster, but accommodates a significant number of group members. The study performs further investigation on their spatial and socio-economic features. All results are presented in Chapter 6.

4.3. Summary

Having discussed the importance of local segregation measures in understanding racial/ethnic residential patterning, this chapter provided a research design for an empirical study utilizing the local segregation measures. It started with introduction of data sources and the case study area, Columbus Ohio MSA. Also, the chapter presented variable selection derived from the three segregation frameworks and analytic approaches to test the hypotheses of the frameworks, corresponding to two research tasks: spatial patterns and characteristics of racial/ethnic neighborhoods. The empirical study will perform cartographic analyses of racial/ethnic clusters (judged by LM-I), concentrations (LQ), and new and growing settlements to test the hypotheses of the three segregation frameworks (Chapter 5). Furthermore, the study will perform z-order correlation, stepwise regression and residual analyses to characterize racial/ethnic neighborhoods and further to evaluate relative roles of the three segregation frameworks (Chapter 6). The next two chapters present the results of the empirical analyses on the study area.
CHAPTER 5
SPATIAL PATTERNING OF RACE/ETHNICITY

The previous chapter discussed a research design to understand racial/ethnic residential patterning with a city and evaluate the relative roles of the three segregation frameworks: spatial assimilation, place stratification, and resurgent ethnicity. This chapter presents the results of cartographic analyses on the Columbus Ohio MSA, 1990 and 2000. First, the chapter examines overall segregation change in the MSA through the dissimilarity index and Global Moran’s I. Having noticed that these global measures fall short in understanding local variability of segregation within the MSA, the attention turns to spatial patterns of racial/ethnic clusters and concentrations judged by the two local segregation measures: Local Moran’s I and Locational Quotient. Also, the study estimate residential importance of these racial/ethnic clusters and concentrations in terms of how many proportion of group members live in such areas. The chapter also examines spatial patterns of new and growing settlements to understand racial/ethnic patterning outside these clusters and concentrations. Finally, the chapter summarizes the findings and evaluates the three segregation frameworks on spatial patterning of race/ethnicity.

5.1. Segregation Changes in a Global Perspective

As a preliminary analysis, overall segregation changes in the study area are
examined through Global Moran’s $I$ (GM-$I$) for each racial/ethnic group and the
dissimilarity indices for all pairs of racial/ethnic groups using the block group as a spatial
enumeration unit.\textsuperscript{14} Table 4 presents dissimilarity index values for six pairs of
racial/ethnic groups and global Moran’s $I$ values for four racial/ethnic groups in the study
area, 1990 and 2000. Judging by the dissimilarity index in 2000, the highest segregation
occurs between Caucasians and African Americans where the value of 0.66, which
indicates that 66 percent of either of the groups needs to move in order for every spatial
unit to hold the same proportions. Similarly high level of segregation is observed between
African Americans and Asians (0.65). Other racial/ethnic combinations show lesser
degree of segregation ranging from 0.40 to 0.51. Noticeably, African Americans are more
highly segregated than any other racial/ethnic group.

Concerning changes over the 1990-2000 decade, the dissimilarity index indicates
there has been decline in the level of segregation. The largest decrease is found for
Hispanics, compared to Caucasians (0.55 in 1990 to 0.40 in 2000); compared to African
Americans (0.70 to 0.51); and compared to Asians (0.64 to 0.45). The least decline
occurs in African American segregation compared to Caucasian (0.71 to 0.66). All in all,
the dissimilarity index, a global measure of \textit{concentration-evenness}, indicates that

\textsuperscript{14} The dissimilarity index indicates what percentage of people, usually minority people,
needs to move to achieve an even distribution, estimating \textit{concentration-evenness}. The
index also indicates the overall degree of intermixing between two concerned groups
with reference to overall representation of the groups (Duncan and Duncan 1955; Massey
and Denton 1988b). Global Moran’s $I$ provides a measure of the degree of
\textit{clustering-exposure} over the entire study area for each racial/ethnic group, taking into
account of spatial autocorrelation. A positive value approaching +1.0 indicates a very
high level of clustering and a negative value indicates dispersal (Cliff and Ord 1981;
Kaluzny, Vega, Cardoso, and Shelly 1998: 125). Global Moran’s $I$ relates to the Local
Moran’s $I$ in that GM-$I$ equals the average over all LM-$I$s.
African Americans have the least degree of intermixing in 2000; Asians have the second least intermixing; and Hispanic have the most intermixing. The last decade changes in dissimilarity index demonstrate persisting African American segregation, moderately decreasing Asian segregation; and dramatically decreasing Hispanic segregation toward the majority Caucasians.

<table>
<thead>
<tr>
<th></th>
<th>Caucasian</th>
<th>African American</th>
<th>Asian</th>
<th>Hispanic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian</td>
<td>0.791*</td>
<td>0.708</td>
<td>0.593</td>
<td>0.553</td>
</tr>
<tr>
<td>African American</td>
<td>0.805*</td>
<td>0.763</td>
<td>0.700</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td></td>
<td>0.204*</td>
<td></td>
<td>0.637</td>
</tr>
<tr>
<td>Hispanic</td>
<td></td>
<td></td>
<td>0.085*</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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<th>African American</th>
<th>Asian</th>
<th>Hispanic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian</td>
<td>0.812*</td>
<td>0.655</td>
<td>0.457</td>
<td>0.400</td>
</tr>
<tr>
<td>African American</td>
<td>0.841*</td>
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<td>0.509</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td></td>
<td>0.544*</td>
<td></td>
<td>0.447</td>
</tr>
<tr>
<td>Hispanic</td>
<td></td>
<td></td>
<td>0.249*</td>
<td></td>
</tr>
</tbody>
</table>

Non-Diagonal cells contain the Dissimilarity Index. Shaded Diagonal cells contain Global Moran’s I measures. * indicates significance at the 0.01 level.

Table 4. Segregation in Global Perspective

Global Moran’s I highlights another dimension of metropolitan segregation, that is, clustering-exposure. Higher clustering is found for African Americans (0.84) and
Caucasians (0.81) while moderate clustering is for Asians (0.54) and low clustering is for Hispanics (0.25). This indicates African American and Caucasian residences are spatially nearby those of the same race, forming a large cluster over urban space. The degrees of clustering for all racial/ethnic groups increase during the last decade, compared to those of 1990: from 0.79 to 0.81 for Caucasians; 0.81 to 0.84 for African Americans; 0.20 to 0.54 for Asians; and 0.01 to 0.25 for Hispanics.

The opposing change between two dimensions of segregation -- a decrease in dissimilarity indices but an increase in global Moran’s $I_s$ -- implies that racial/ethnic groups have had more intermixing with others, but that their concentrations are adjacent to one another, forming a large cluster. However, these findings from the global segregation measures are at best circumstantial. This requires examination of segregation at the neighborhood level. The question is where intermixing and clustering/segregation occur within the study area.

5.2. Segregation Changes in Local Perspective

Attention now turns to spatial patterning of racial/ethnic neighborhoods within the Columbus Ohio MSA. The researcher begins with cartographic analyses of racial/ethnic clusters and concentrations using the local segregation measures for all racial/ethnic groups. Then, residential importance of these racial/ethnic clusters and concentrations is estimated by measuring how many group members live in such areas. Finally, the section examines new and growing settlements for all minority groups to understand racial/ethnic residences outside the racial/ethnic clusters and concentrations.
5.2.1. Racial/Ethnic Clusters and Concentrations

This section utilizes local segregation measures, discussed in chapter 3, to understand the spatial patterning of segregated racial/ethnic neighborhoods: Local Moran’s $I$ (LM-I) for clusters and Locational Quotient (LQ) for concentrations. As noted in the chapter 3, LM-I deals with an areal unity with reference to its neighbors whereas LQ does so separately. The reference to neighbors makes LM-I more strict and conservative, which is clearly shown in the distribution of Asian neighborhoods (Figure 5). LM-I demonstrates Asian neighborhoods are highly confined to the northwestern sector of Franklin County while LQ shows they are distributed more widely and sparsely in the northern section along the outer beltway, i.e. I-270. Discussion about the distribution of racial/ethnic clusters and concentrations for each group proceeds with Figure 4 through 7 while being cross-referenced with Figure 3 in Chapter 4, which presents relevant Columbus Ohio MSA characteristics.

African American over-represented clusters are distinct from all others (Figure 4). Gauged by LM-I, African American over-represented block groups form a large single cluster to the east of the downtown Columbus but highly confined to within the outer loop beltway, I-270. The cluster includes so-called Columbus’ Model Cities area which War on Poverty programs in 1960s address (Andrew 1998). During the decade, African American clusters do not have changed significantly. However, they expand to the northeast through Linden, a former Italian blue-collar enclave, and to the east along I-70 and West Broad Street.
However, LQ maps present a different picture wherein African American concentrations occupy a larger residential space. African American concentrations stand out not only in the east section of Columbus, but also in the southwest portion of Columbus and the satellite cities of Delaware and Pastaskala.\(^{15}\) LQ maps also reveal that expansion of African American concentrations occur more widely: for instance, to the east along East Broad Street and I-70, moving beyond the outer belt into Reynoldsburg; to the south following High Street and I-71 into Grove City and nearby Groveport Village; and to the north, encompassing Minerva Park and reaching the Franklin County boundary. It also is noteworthy that the municipalities of Bexley and Whitehall are gradually enveloped by African-American neighborhoods, seeming to as an impediment to their expansion.

Through the lens of LM-I and LQ, then, African American clusters and concentrations persist in a sector of the city of Columbus and further expand contiguously along interstate highways to the northern and eastern fringe of Franklin County. This seems to correspond to a classic incidence of invasion-succession and downward housing-filtering processes (Gotham 2002; Kaplan and Holloway 1998). The study reveals the fact that upper- and middle-class incorporated cities could impede its contiguous expansion. In addition, it is interesting to note that the LM-I and LQ maps

\(^{15}\) The Delaware concentration served as a stopping point of the underground railway of the mid-1800s. The Pataskala concentration historically holds an African American community, named “Blanche Addition” or “Furrsville” that was initiated in 1929 by Reverend Levi Furr who moved from Columbus. However, the community now accommodates a number of Caucasian residents (Triplett 1999). The U.S. Census indicates Caucasian population increased from 288 (61% of local population) to 316 (76%) while African American population decreased from 184 (39%) to 82 (20%) during the 1990s.
Figure 4. African American Clusters and Concentrations in 1990 and 2000
Figure 5. Asian Clusters and Concentrations in 1990 and 2000
Figure 6. Hispanic Clusters and Concentrations in 1990 and 2000
Figure 7. Caucasian Clusters and Concentrations in 1990 and 2000
present very similar spatial patterns, albeit a much larger racial/ethnic fabric under LQ in general. This indicates the African American block groups are segregated in both dimensions: concentration-evenness and clustering-exposure.

The spatial patterns of Asian over-represented clusters and concentrations tell a different story from African Americans (Figure 5). LM-Is show that Asian clusters stretch from northern tip of the long-standing upper- and middle-class municipality of Upper Arlington to the northern boundary of Franklin County, largely occupying the northwestern section of the county. A separate cluster is found in the University District. Two important factors underpin this pattern. One is the Honda plant that was established in Marysville in 1982, gradually attracting related industrial establishments with strong Asian representation in organization and employee profile. This explains why Asian clusters include the affluent municipalities of Dublin and Worthington, close to the Franklin County Boundary. The second factor is the Ohio State University, which attracts a number of Asian students and families.

The LQ maps reveal Asian neighborhoods occupy much a larger proportion of metropolitan residential space than the LM-I does. Besides the northwestern section of Franklin County identified in the LM-I map, Hilliard, Westerville, New Albany, and Gahanna stand out as Asian concentrations. Particularly noticeable is change over the decade. Asian concentrations emerge along the northern arc of the outer beltway that links with clusters of the same race.

Concerning Hispanics (Figure 6), LM-Is illuminate that their over-represented clusters occupy a small proportion of urban residential space, having only three spatially
separate clusters: west of Hilltop, Minerva Park, and surrounding areas near Whitehall. All these clusters are in neighborhoods that are dominant blue-collar and middle class. Compared to 1990, these clusters newly emerged during the decade. LQ maps indicate Hispanic concentrations were sparsely distributed through the entire metropolitan area at the base year, but their concentrations emerged within the Franklin County during the last decade. This does not imply that Hispanic residents in the surrounding counties moved to the Franklin County. Rather, Hispanic population growth in Franklin County is significantly greater than overall growth in the MSA. In general, Hispanic concentrations are found more at the periphery than at the center of Columbus: west Columbus -- upper middle-class areas proximate to Dublin and Westerville; more blue-collar areas of Whitehall; and near the Columbus International Airport.

As shown in Figure 7, Caucasian clusters and concentration cover almost the entire metropolitan residential space except the inner-city area and eastern section of Franklin County within the outer beltway. LM-I maps show very interesting features of Caucasian neighborhoods. First is their decentralization. Virtually, all block groups outside the outer beltway are classified as Caucasian over-represented clusters. We also see clusters within Franklin County -- Upper Arlington, University district, Clintonville and Worthington. All of these are older but well-maintained upper- and middle-class residences. A second feature is their mirror image with African American clusters. Caucasian under-represented clusters areas are almost complete matches with African American over-represented clusters areas. LQ maps confirm these features. However, LQ maps demonstrate Caucasians as conspicuous only where they are indeed a homogeneous
group. This is because Caucasians account for 86% and 80% of the total population in 1990 and 2000, which requires that a block group reach 103% and 97%, respectively to be a significant Caucasian concentration (LQ value of 1.2). Hence, a relatively small number of African Americans, Asians, Hispanics, or some combination thereof will prevent a block group from being a significant Caucasian concentration in 2000.

Having discussed the residential patterning of each racial/ethnic groups, the discussion returns to the dissimilarity index in Table 4. We can see the advantage of local segregation measures in illuminating local incidences of racial/ethnic segregation and intermixing. The dissimilarity index indicates higher segregation of African American from Caucasian ($D=0.66$) and Asian ($D=0.65$). This corresponds to little overlapping of two pairs of racial clusters and concentrations shown in the LM-I and LQ maps (Figure 4, 5, and 6). The moderate overlapping between African Americans and Hispanics in northeastern and eastern Franklin County results in a dissimilarity index of 0.51 (Figure 4 and 6). A high degree of overlap is seen for Asians with Caucasians in Upper Arlington, University districts, Worthington, and Dublin, which is reflected in the lower dissimilarity index of 0.46 (Figure 5 and 7). Judged by the dissimilarity index, Hispanics are least segregated with other racial/ethnic groups. This is confirmed with a pictorial image of their small number of scattered clusters and concentrations.

5.2.2. Residential Importance of Racial/Ethnic Clusters and Concentrations

Attention now turns to residential importance of the racial/ethnic clusters and concentrations by estimating how many percent of racial/ethnic group members lives in
such areas (Table 5). Despite its compactness in the east sector of Franklin County, the
African American clusters and concentrations in 2000 accommodate a very large
proportion of the group members, 58% and 78%, respectively. Compared to 1990, the
proportions decline slightly, despite an increase in absolute number.

<table>
<thead>
<tr>
<th></th>
<th>African American Clusters</th>
<th>Asian Clusters</th>
<th>Hispanic Clusters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of group members living in</td>
<td>103968</td>
<td>118137</td>
<td>9783</td>
</tr>
<tr>
<td>(63.5)</td>
<td>(57.8)</td>
<td>(47.8)</td>
<td>(43.8)</td>
</tr>
<tr>
<td>African American Concentrations</td>
<td>132539</td>
<td>159910</td>
<td>17506</td>
</tr>
<tr>
<td>(80.9)</td>
<td>(77.8)</td>
<td>(85.6)</td>
<td>(70.5)</td>
</tr>
</tbody>
</table>

Percentages are in parenthesis.

Table 5. Residential Importance of Racial/Ethnic Clusters and Concentrations in 1990 and 2000

Asian clusters and concentrations in 2000 also hold a very large proportion of
group members: 44% and 71%, respectively. Growth of Asian clusters and
concentrations during the last decade is impressive. The number of Asians living in
clusters increases by 66% while the number of the group living in concentrations
increases by about 50%. However, the proportion of Asians gradually declined from
47.8% to 43.8% for clusters and from 85.6% to 70.5% for concentrations.

Hispanic neighborhoods are less important as racial/ethnic habitats to group members. Hispanic neighborhoods experienced a drastic decrease in residential importance in that Hispanic concentrations in 2000 accommodate less than half of the group.

Combined with the findings of spatial pattern analyses, residential importance of racial/ethnic neighborhoods can be summarized as follows. African American residences concentrate and cluster in a relatively compact area of the eastern and northeastern sector of the Franklin County, accommodating a large proportion of the group and making a mirror image with Caucasian residences. However, the changes during the last decade indicate African American clusters and concentrations expand far beyond inner-city areas.

Asian residences are neither spatially limited nor highly concentrated but well spread out through the MSA to accommodate a large proportion of group members. This is most clearly indicated in their concentrations. Also, we see some intermixing with Caucasian residences in the northwestern sector of the Franklin County. Furthermore, new Asian concentrations emerged, largely linked with persistent Asian clusters through urban transportation networks.

Like Asians, Hispanic residences are neither spatially limited nor highly concentrated but well spread out through the MSA. Hispanic clusters and concentrations are sparsely distributed and occupy a much broader fabric of urban space, intermixing with other racial/ethnic groups including Caucasians, compared to other minority groups.
However, Hispanic concentrations and clusters account for small proportion of their residences.

5.2.3. New and Growing Settlements

Having seen that a larger proportion of minority group members live outside their racial/ethnic clusters and concentrations in 2000 than in 1990, attention turns to the question of where these residences are. An answer can be obtained by investigating new and growing settlements. A new settlement is indicated by a block group with no group members in 1990 but more than 10 (approximately, 5 households) in 2000. 16 A growing settlement is indicated by a block group that had more than a 50 percent increase in the number of group members, but was not yet large enough to be a racial/ethnic concentration with greater than 1.2 for LQ. Figure 8 exhibits these two types of racial/ethnic settlements for all minority groups.

African American growing settlements occurs outside the outer beltway I-270 in satellite cities such as Delaware, Newark, Marysville, and Circleville and even in distinctly exurban and/or recently developed areas such as between Pataskala and Newark, Groveport and south of Groveport, and Pickerington. This is a sharp contrast with their geographically confined clusters and concentrations in the east sector of Columbus city.

Asian new and growing settlements are more constrained but observed in

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16 The U.S. Census indicates that the mean household size is 2.08 in 1990 and 2.03 in 2000 (see http://www.cambridgema.gov/~CDD/data/demo/city/hhsize_2000.html for more data)
Figure 8. New and Growing Race/Ethnic Settlements, 1990-2000
suburban areas such as Powell and Westerville; in exurban areas such as Pickerington, Groveport; astride the Franklin County line well west of the outer beltway; and in the satellite cities of Marysville and Delaware. In short, Asian residences occupy much more extensive metropolitan residential space compared to their clusters and concentrations.

Hispanic *new* and *growing* settlements also show a decentralized and dispersed pattern. They occur in suburban areas such as Dublin, Gahanna, Worthington, and Westerville; near the satellite cities of London, Marysville, Delaware, and Circleville; and in the exurban areas of Canal Winchester, Pickerington, and the east of Grove City.

The lower right map in Figure 8, a composite map of the three maps mentioned above, shows spatial distribution of *new* and *growing* settlements for any of the three minority groups, indicating minority decentralization.

All in all, the spatial pattern of *new* and *growing* settlement indicates all minority groups are decentralized well beyond Franklin County to exurban and/or recently developed areas. This seems to be where significant intermixing between racial/ethnic groups and with majority Caucasian takes place. This implies that racial/ethnic minorities as well as Caucasian majority takes advantage of expanding urban residential space, generating racially heterogeneous neighborhoods.

5.3. Implication of Spatial Pattern Analyses for Segregation Frameworks

Through the lens of Local Moran’s $I$, the most conservative measure of clustering/segregation, African American and Asian residences, locationally distinct from one another, are spatially concentrated, forming a large cluster and accommodating about
half of the members of each group. Hispanic clusters are more scattered and less extensive. When these are combined with the findings from the Location Quotient, ‘dispersed and decentralized clustering’ is the best description of overall racial/ethnic patterning in Columbus MSA, 1990-2000. There is increasing spatial intermixing between racial/ethnic minority groups and with the majority Caucasian, but only in certain areas of the MSA. Further investigations on new and growing settlements indicate racial/ethnic minority residences are more extensive throughout the entire MSA, including distinctly exurban and/or recently developed areas. Also, a great deal of spatial intermixing between racial/ethnic groups or with Caucasians takes place in these settlements, but the number of the minorities living there remains yet small.

Keeping these in mind, this research now evaluates the relative roles of each segregation framework on intra-urban racial/ethnic patterning. Under the spatial assimilation framework, we expect (a) minority group residences to be gradually and sparsely distributed throughout the MSA and (b) intermixed with majority residences so that new racial/ethnic clusters and concentrations do not appear. Also, (c) traditional racial/ethnic concentrations and clusters, encountering a large inflow of new immigrants, could persist but only in less affluent inner-city areas. We observed (a) but not (b) and (c). African American and Asian clusters and concentrations expand contiguously, accommodating a large proportion of the group members. Also, we observed new concentrations and clusters along the outer loop beltway for all minority groups. Hence, the spatial assimilation is not supported.

Under the place stratification framework, we expect minority group residences to
be (a) spatial limited and highly concentrated and clustered in their patterning with little overlapping with majority residences; (b) adjoining 1990 minority clusters and concentrations when developing anew. Also, (c) 2000 patterns are correlated highly with 1990 patterns. We found (c) but not (a) and (b); hence, the *place stratification* is not supported. We observed the decreasing residential importance of racial/ethnic clusters and concentrations for all minority groups, despite their geographic expansion. Furthermore, the spatial patterns of *new* and *growing* settlements indicate spatial intermixing between racial/ethnic groups and/or with Caucasian occurs throughout the MSA for all minority groups. Apparently, high correlations were found in African American and Asian patterning between 1990 and 2000. However, this spatial inertia does not necessary indicates the presence of discriminatory housing practices. Therefore, overall findings do not advocate the *place stratification*.

Under the *resurgent ethnicity* framework, we expect (new) minority group residences to be bifurcated with (a) traditional clusters and concentrations in disadvantaged inner-city areas and (b) new clusters and concentrations in affluent decentralized places. Also, (c) both clusters and concentrations are linked through extended communication and transportation networks. We observed all (a), (b), and (c); hence, the *resurgent ethnicity* framework is supported. The distinct clustering and re-clustering of all minority groups are apparent through the lens of LM-I and LQ. Also, not conspicuous is overlapping between these minority neighborhoods and particularly with Caucasian neighborhoods. Moreover, minority residences are not confined to less affluent inner-city areas, as explicitly indicated in *new* and *growing* settlements. Hence, our
findings of ‘dispersed and decentralized clustering’ are consistent with the hypothesis of the resurgent ethnicity. This suggests racial/ethnic patterning is driven more likely by racial/ethnic preference in residential choice or in-group attraction with a desire to increase one’s amenities utilizing his social network.

5.4. Summary

This chapter applied the research design presented in the previous chapter to the Columbus Ohio MSA. In efforts to evaluate relative role of the three segregation frameworks through spatial patterning of race/ethnicity, the chapter examined spatial patterns and residential importance of racial/ethnic clusters and concentrations. Also, cartographic analyses of new and growing settlements for all minority groups were performed. The overall findings, summarized as ‘dispersed and decentralized clustering’ support the resurgent ethnicity framework, suggesting that racial/ethnic preference in residential choice, as well as so-called in-group attraction, operates in racial/ethnic geography in the study area. The following chapter performs another evaluation, in terms of characteristics of racial/ethnic clustering/segregation.
CHAPTER 6
NEIGHBORHOOD CHARACTERISTICS OF RACIAL/ETHNIC CLUSTERING/SEGREGATION

Having discussed the spatial patterning of race/ethnicity, attention in this chapter turns to neighborhood characteristics of racial/ethnic clustering/segregation. First, the examination begins with zero-order correlation analyses of the degree of racial/ethnic clustering against a set of socio-economic variables on neighborhood characteristics. To obtain parsimony and avoid collinearity, stepwise regression analyses for each group are performed. Both analyses address how neighborhood characteristics affect racial/ethnic clustering. Third, residual analyses are performed to understand characteristics of racial/ethnic clusters that are not sufficiently explained by the regression models. The chapter concludes with a discussion of the relative role of the three segregation frameworks: spatial assimilation, place stratification, and resurgent ethnicity.

6.1. Correlation Analyses
To characterize racial/ethnic clustering/segregation, this research employs a set of socio-economic variables, derived from the three segregation frameworks and classified into four categories: structural/cultural blending, housing stock features, occupational
specialization, and neighborhood stability (Chapter 4 and Table 3).

Table 6 presents the zero-order correlations between the level of clustering/segregation, measured by Local Moran’s $I$, and neighborhood characteristic variables. In 2000, high African American clustering occurs in neighborhoods with a high service sector employment ($r = 0.42$); low median household income (-0.40); and low median housing value (-0.41). To a lesser degree, African American clustering is inversely associated with educational attainment (-0.26), percent of professional employment (-0.26), percent of self-employment (-0.21), percent of manufacturing sector employment (-0.14), median built year for housing (-0.21), percent of new housing (-0.17), and homeownership (-0.21). Also, clustering is directly associated with percent of government employment (0.17). Similar associations are found also for 1990. In terms of the four categories of neighborhood characteristics, African American clustering/segregation are characterized with low structural blending, older and low-valued housing stock, government employment, and lower neighborhood stability.

Concerning Asian clustering, very strong association is found with high percent of foreign-born ($r = 0.65$) and percent of households that do not use English at home (0.57) in 2000. Correlation analysis also reveals that Asian clustering is directly associated with percent of college students (0.35) and, to a lesser degree, educational attainment (0.18) and professional employment (0.16). Asian clustering has inverse relationship with

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17 The analyses on neighborhood characteristics do not adapt Location Quotient (LQ), another local segregation measure employed in the spatial pattern analyses. For the purpose of cross-group comparison, it is necessary to standardize the segregation index values for each racial/ethnic group. In doing so, the mean of LQ is often over-estimated not to be a proper representative since it is vulnerable to observations extremely high value of LQ.
### AFRICAN AMERICAN

<table>
<thead>
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<th>Variable</th>
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<th>2000</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td></td>
<td>r</td>
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<td>-.14</td>
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<td>Foreign-Born</td>
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<tr>
<td>Non-English at home</td>
<td>.06*</td>
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</tr>
<tr>
<td>House Value (logged)</td>
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<td>Removed</td>
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<tr>
<td>Median Built Year</td>
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<td>Removed</td>
</tr>
<tr>
<td>New Housings</td>
<td>.08**</td>
<td>Removed</td>
</tr>
<tr>
<td>Manufacturing Employment</td>
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<td>-.21</td>
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<td>Own-Occupied</td>
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<tr>
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<td>.06</td>
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<td>Single Family Dwelling</td>
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<td>Intercept</td>
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<td>17.54</td>
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\(r^2=0.346; \text{F-statistic}=94.59\)

### ASIAN

<table>
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<tr>
<th>Variable</th>
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<td></td>
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<td>b</td>
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<td>House Value (logged)</td>
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<tr>
<td>Manufacturing Employment</td>
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<td>Removed</td>
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<tr>
<td>Residential Stability</td>
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<td>Removed</td>
</tr>
<tr>
<td>Single Family Dwelling</td>
<td>-.23**</td>
<td>Removed</td>
</tr>
<tr>
<td>Intercept</td>
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<td>-17.43</td>
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\(r^2=0.552; \text{F-statistic}=664.12\)

**significant at alpha=0.01; *significant at alpha=0.05**

Table 6. Correlation and Stepwise Regression Analyses of Racial/Ethnic Clustering/Segregation on Selected Variables
## HISPANIC

<table>
<thead>
<tr>
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<td>Professional Job</td>
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<td>-0.01</td>
</tr>
<tr>
<td>Self-employed</td>
<td>-0.18**</td>
<td>-0.01</td>
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<tr>
<td>Foreign-Born</td>
<td>0.41**</td>
<td>0.06</td>
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<td>Non-English at home</td>
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<td>0.03</td>
</tr>
<tr>
<td>House Value (logged)</td>
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<td>Median Built Year</td>
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<td>New Housings</td>
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<td>Manufacturing Employment</td>
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<td>Government Employment</td>
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<td>University Student</td>
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<td>Single Family Dwelling</td>
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<tr>
<td>Intercept</td>
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<td>6.34</td>
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$r^2=0.254; F$-statistic=52.32 $r^2=0.102; F$-statistic=24.45

## CAUCASIAN

<table>
<thead>
<tr>
<th>Variable</th>
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<th>2000 Multiple Regression</th>
</tr>
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<tbody>
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<td></td>
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<tr>
<td>Income (logged)</td>
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<td>Self-employed</td>
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<td>Foreign-Born</td>
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<td>Non-English at home</td>
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</tr>
<tr>
<td>House Value (logged)</td>
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</tr>
<tr>
<td>Median Built Year</td>
<td>0.22**</td>
<td>Removed</td>
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<tr>
<td>New Housings</td>
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<tr>
<td>Manufacturing Employment</td>
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<td>Government Employment</td>
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<td>-0.20</td>
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<td>University Student</td>
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<td>Residential Stability</td>
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<td>-0.05</td>
</tr>
<tr>
<td>Single Family Dwelling</td>
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<tr>
<td>Intercept</td>
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<td>-17.72</td>
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</table>

$r^2=0.347; F$-statistic=95.30 $r^2=0.331; F$-statistic=88.34

** significant at alpha=0.01; *significant at alpha=0.05

Table 6. Correlation and Stepwise Regression Analyses of Racial/Ethnic Clustering/Segregation on Selected Variables (continued)
percent of residents lived at the same places 5 years ago (-0.24), homeownership (-0.20),
manufacturing sector employment (-0.14), single family dwellings (-0.14), median
household income for housing (-0.12), and self-employment (-0.9). The comparison with
1990 indicates these associations generally persist during the last decade.

In terms of the four categories of neighborhood characteristics, Asian
clustering/segregation is characterized with low cultural blending but moderately high
structural blending and low neighborhood stability. Notably, Asian clustering shows
strong direct association with foreign-born people and university neighborhood. All in
all, Asian neighborhoods continue to absorb new foreign-born immigrants with low
cultural blending, implying operation of chain migration.

Turning to Hispanics, high clustering in 2000 occurs in the neighborhoods with
high percent of foreign-born \( r = 0.26 \) and non-English speaking households \( 0.21 \), but
to a lesser degree than Asians. Also, Hispanic clustering is inversely associated with
homeownership (-0.14) and residential stability (-0.13). The correlation model works
better in characterizing Hispanic clustering in 1990: direct association with percent
foreign-born (0.41), non-English speaking households (0.40), university students (0.35)
and education attainment (0.21); and inverse association with median household income
(-0.15), homeownership (-0.24), percent of residents lived at the same places 5 years ago
(-0.27), and single family dwelling (-0.27). This indicates that Hispanic neighborhoods
had common characteristics with Asians in 1990 but experienced changes during the last
decade. The recent Hispanic neighborhoods are less likely to be an impoverished
temporary shelter for new immigrants with low cultural and structural blending.
It is interesting to compare Caucasian neighborhood characteristics with those of minority groups. High Caucasian clustering is observed in neighborhoods with high median household income (0.42), high median housing value (0.42), and low service sector employment (-0.43). Also, Caucasian clustering is directly associated with educational attainment (0.24), professional employment (0.25), self-employment (0.24), manufacturing sector employment (0.17), homeownership (0.26), median built year for housing (0.20) and percent of new houses (0.18). It is inversely associated with government employment (-0.16). Similar associations are also found for 1990. It is noticeable that Caucasian clustering has very distinct characteristics from African American counterparts as they did so in the spatial patterns (Figure 4 and 7). Major distinguishing variables involve structural blending such as median household income and educational attainment and housing stock features such as median housing value and median built year. This indicates segregation between the two racial group masks residential separation along income and job occupation.

Racial/ethnic minority neighborhood characteristics and their changes based on zero-order correlation analyses are summarized as follows: in a sharp contrast to Caucasian, African American clustering/segregation occurs in neighborhoods with low structural blending and old/low-valued housing stock. Asian clustering, characterized by low cultural blending and neighborhood stability, play a role as shelter for new foreign-born immigrants. Hispanic neighborhoods had much in common with Asian counterparts in 1990. However, change in the last decade indicates Hispanic clustering becomes more varied, having less association with low cultural assimilation and university communities.
Concerning the three segregation frameworks, we see that low blending characterizes racial/ethnic clustering/segregation for all minority groups. Combined with the association of clustering with older/low-valued housing stock, this seems to support spatial assimilation. However, the moderate and decreasing association of Asian and Hispanic clustering with structural blending but the strong association with cultural blending is better explained by resurgent ethnicity. In terms of occupational specialization, Asian and Hispanic clustering/segregation occurs in university neighborhoods. One might argue that this is an evidence for place stratification. However, their representation in the university neighborhoods seems to be a result from the occupational particularity of the groups in the study area. Furthermore, low and decreasing neighborhood stability found for all minority groups implies high residential mobility. These facts are inconsistent with expectation of place stratification. The next section continues the investigation on the characteristics of racial/ethnic clustering/segregation through regression analyses.

6.2. Regression Analyses

To capture potential interaction between the variables and enhance the parsimony of the model, another effort to characterize racial/ethnic clustering/segregation is stepwise regression.\textsuperscript{18} The dependent variable is again the degree of racial/ethnic

\textsuperscript{18}Stepwise variable selection is essentially a combination of forward selection and backward elimination by checking multiple $r^2$ change caused by variable entry or removal. Two criteria are used to evaluate the significance of the $r^2$ change: one for entry and the other for elimination. The procedure begins with selection of two variables that result in significant increase in multiple $r^2$. If either of the variables meets
clustering, determined by the local segregation measure, Local-Moran’s $I$ and the independent variables are the set of socio-economic variables for neighborhood characteristics (Table 6).

Most important to African American clustering/segregation are the percent of employment in service jobs ($\beta = 0.24$), median household income (-0.20), and percent of university students (-0.20). To a lesser degree, lower housing value (-0.16) and greater government employment (0.17) also are associated with high African American clustering.

The African American regression for 1990 ($r^2 = 0.35$) is somewhat different from 2000 ($r^2 = 0.32$) in that median household income ($\beta = -0.53$) is a single dominant explanatory variable for African American clustering. While manufacturing and government employment (-0.30 and 0.22, respectively) maintain their importance, residential stability (0.19) and single family dwelling (0.26) also are incorporated into the 1990 model. In this temporal comparison, the decreasing importance of income for African American clustering undermines the hypothesis of spatial assimilation that racial/ethnic neighborhoods are a temporary shelter with low blending for future upward social and residential mobility. Also, the decreasing importance of residential stability undermines the hypothesis of place stratification that racial/ethnic neighborhoods remain highly stable.

Stepwise regression analyses provide identical models for Asian clustering in

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the criterion for elimination, it is removed (Norusis 2004: 532-533). In this paper, the procedure repeats until the sign of any partial regression coefficients reverses to be different from the previous correlation analyses.
1990 and 2000 with only two highly important variables, yielding significantly high \( r^2 \) of 0.55 for 1990 and 0.43 for 2000: percent of foreign-born and percent of university students. This reflects the Japanese Honda plant in Marysville and the Ohio State University both of which attract Asian workers, students, and their families. Furthermore, these variables, which are consistently important in 1990 and 2000, imply the continuous role of Asian neighborhoods as residences for co-ethnic foreign immigrants. In other words, Asian immigrants very likely settle down in existing Asian neighborhoods, implying the operation of chain migration. Unlike African American clustering, the variables for structural blending are not selected and have less explanatory power in explaining Asian clustering. This indicates that Asian neighborhoods cannot be defined as uniformly ‘immigrant enclave’ in the traditional meaning of the term, undermining spatial assimilation but supporting resurgent ethnicity. Noticeably, university neighborhoods explain a large proportion of variation of Asian clustering.

Concerning Hispanic clustering, the most important variables are percent of foreign-born (\( \beta =0.29 \)) and percent of people with high school diploma and/or some post high school education (-0.30) in 2000, but the regression model poorly predicts Hispanic clustering in 2000 with \( r^2 \) of 0.10. The 1990 model predicts better (\( r^2=0.25 \)) and reveals that Hispanic clustering co-varies with percent of foreign-born (0.20), percent of households that do not use English at home (0.16), percent of people with high school diploma and/or some post high school (0.16). Also, Hispanic clustering is inversely associated with percent of service sector employment (-0.10), percent of self-employment (-0.06), and median housing value (-0.28). This confirms that Hispanic neighborhoods
have changed dramatically as implied in their spatial pattern (Figure 6). One variable that remains for both 1990 and 2000 is percent of foreign-born, demonstrating the continuing role of Hispanic clusters as foreign-born immigrant shelters.

Turning to Caucasian clustering, the most important variables are median household income ($\beta=0.22$), manufacturing sector employment (0.23) and service sector employment (-0.22). This stands for 1990 as well. Notably, the important variables for Caucasian clustering are identical with those for African American clustering, but with opposite signs in both years. This is consistent with the previous spatial and correlation analyses, implying Caucasian and African American clustering are socio-economically distinguishable in neighborhood characteristic. We do, however, see a noticeable change over the last decade. There has been decreasing importance of median household income on Caucasian clustering (from 0.54 in 1990 to 0.22 in 2000), indicating that high income neighborhoods are no longer necessarily Caucasian neighborhoods and the economic status of a neighborhood becomes less significant in distinguishing Caucasian from minorities residential patterning. This implies that affluent and exclusively majority-dominant neighborhoods become less conspicuous in the metropolitan residential space. This also is consistent with the findings from the spatial analyses of new and growing minority settlements in that racial/ethnic intermixing occurs in more affluent municipalities and even recently developed areas in the urban fringe (Figure 8).

All in all, regression analyses show that most common across minority groups is ‘decreasing importance of structural blending’ on racial/ethnic clustering/segregation. And we could see the persistent roles of cultural blending in Asian and Hispanic
clustering. This finding is very consistent with the resurgent ethnicity. Meanwhile, housing stock feature variables including housing value and age of housing and neighborhood stability variables including homeownership, residential stability, and single family dwelling are less efficient in explaining the variability of racial/ethnic clustering.

6.3. Anomaly: Residual Analyses

Noticing some neighborhoods outside concentrations/clusters where racial/ethnic minority clustering cannot be sufficiently explained by the regression models, the researcher scrutinizes their spatial and socio-economic characteristics through residual analyses. Residual analyses investigate the anomaly of racial/ethnic clustering in terms of the regression model, shedding light on changes in racial/ethnic clustering. Outcrop neighborhoods denote block groups for which racial/ethnic clustering is underestimated by the regression model. The criteria by which outcrop neighborhoods are identified are (1) greater than 0.667 for $z$-scored residual of the regression model to gauge the significance; (2) less than 1.2 for LQ to exclude racial/ethnic concentrations/clusters; and (3) greater than 30 population for the concerned group and year. No neighborhoods at any year meet the criteria for Asian and Hispanic, but some do for African American. The section began with spatial pattern analysis of African American outcrop neighborhoods for each study year and proceeds to investigate demographic and socio-economic characteristics for these settlements.

Figure 9 presents spatial distribution of the African American outcrop
neighborhoods. In 1990, all of the *outcrop* neighborhoods are found near or outside of the outer loop beltway, i.e. I-270: Dublin (1 and 2), Powell (3), west Worthington (4), and east Whitehall (5). Ten years later, we can see another set of *outcrop* neighborhoods: Westerville to the north (6) and New Albany Village (7). In short, all African American *outcrop* neighborhoods are found at the fringe of Franklin County. It is worthy to notice that African American *outcrop* neighborhoods are spatially distinct from co-ethnic clusters and concentrations that is highly confined in eastern sector of Columbus City (Figure 4) and overlap with *new* and *growing* settlements (Figure 8).

To understand their neighborhood characteristics, this researcher classifies African American *outcrop* neighborhoods into three groups: (1) underestimated by both 1990 and 2000 model; (2) underestimated by 2000 model only; and (3) underestimated by 1990 model only.

Table 7 presents neighborhood characteristics of these three groups of African American *outcrop* neighborhoods. African American clustering underestimation by both 1990 and 2000 regression models occurs in block groups with a dramatic population increase, by more than 100% since 1990, and a higher percent of foreign-born compared with the metropolitan average of 4.2% ((1), (2), (3) in Table 7). Socio-economically, the neighborhoods also are characterized by high educational attainment (over 70% where the MSA average is 51%) and high professional employment (over 50% where the MSA average is 32%). Also, *outcrop* neighborhoods occur in new neighborhoods where homeownership is high (over 86% where the MSA average is 62%).
Figure 9. Outcrop Neighborhoods of African Americans in 1990 and 2000
<table>
<thead>
<tr>
<th></th>
<th>Underestimated by 1990 and 2000 model</th>
<th>Underestimated by 1990 model only</th>
<th>Underestimated by 2000 model only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Population</td>
<td>6966</td>
<td>14385</td>
<td>2487</td>
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<tr>
<td>% Caucasian</td>
<td>89.13</td>
<td>88.61</td>
<td>92.44</td>
</tr>
<tr>
<td>% A-A</td>
<td>2.18</td>
<td>1.47</td>
<td>7.36</td>
</tr>
<tr>
<td>% Asian</td>
<td>7.81</td>
<td>7.83</td>
<td>0.00</td>
</tr>
<tr>
<td>% Hispanic</td>
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<td>0.99</td>
<td>0.20</td>
</tr>
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<td>LQ for A-A</td>
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<td>0.11</td>
<td>0.62</td>
</tr>
<tr>
<td>% Foreign-borns</td>
<td>6.69</td>
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</tr>
<tr>
<td>Income (in thousands)</td>
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<td>77</td>
</tr>
<tr>
<td>Education Attn</td>
<td>82.90</td>
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<td>81.12</td>
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<td>Professional Job</td>
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<td>Housing Value (in thousand)</td>
<td>160</td>
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<td>222</td>
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<tr>
<td>Homeownership</td>
<td>73.96</td>
<td>74.88</td>
<td>95.90</td>
</tr>
<tr>
<td>% New Housing</td>
<td>6.60</td>
<td>60.63</td>
<td>14.58</td>
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</table>

Table 7. Characteristics of *Outcrop* African American Neighborhoods
Noticeably, these neighborhoods also have dramatic Asian and Hispanic population growth. In short, the rapidly growing affluent neighborhoods with high racial/ethnic heterogeneity have higher African American clustering in 1990 and 2000.

The residual analyses reveal two outcrop neighborhoods which African American clustering is significantly underestimated by 2000 model only: one in northwestern Westerville (6) and another in New Albany (7). These 2000-only outcrop neighborhoods have in common with 1990/2000 outcrop neighborhoods discussed just above: increasing minority and immigrant representation, high or increasing professional employment, increasing housing value with new housing construction.

The residual analyses also identify two outcrop neighborhoods which African American clustering is underestimated by 1990 model: one in the neighborhoods between Dublin and Worthington (4) and another between Whitehall and Reynoldsburg (5). It is interesting to compare these two 1990-only outcrop neighborhoods with the 1990/2000 and 2000-only outcrop neighborhoods. These two 1990-only outcrop neighborhoods have in common with high median household income, high education attainment, and high professional job employment. But, these neighborhoods differ from the 1990/2000 and 2000-only outcrop neighborhoods in having a stabilized population growth. Furthermore, The 1990-only outcrop neighborhoods are also different from each other. The Dublin-Worthington neighborhood (4) is adjacent to Caucasian clusters and characterized by low homeownership, high mobility, and relatively low housing values. Meanwhile, the Whitehall-Reynoldsburg neighborhood (5) is adjacent to African American clusters and has a high percent of senior citizens, high homeownership, and
low mobility.

This section examined anomaly of minority clustering/segregation in terms of the regression models presented in the previous section. Residual analyses identified several outcrop neighborhoods which African American clustering is sufficiently explained by the regression models. In their spatial patterns, the African American outcrop neighborhoods occur in outside outer loop beltway, being spatially distinct with co-ethnic concentrations and clusters (Figure 4) but overlaps with the new and growing settlements (Figure 8). In neighborhood characteristics, the African American outcrop neighborhoods are characterized by high socio-economic status and new housing stock. Noticeably, they experience dramatic population growth and increasing diversity in the racial/ethnic profile during the last decade.

Concerning racial/ethnic patterning and segregation, the anomaly shown in the outcrop neighborhoods indicates that racial/ethnic intermixing occurs in relatively affluent neighborhoods with new housing stocks and dramatic population growth. This seems to suggest there is association between new housing construction and burgeoning racial/ethnic heterogeneous neighborhoods shown in the new and growing settlements (Figure 8). The existing segregation frameworks have not explicitly indicated the role of new housing construction in segregation, requiring a new framework to capture the role of housing developers in racial/ethnic residential patterning.

6.4. Implication of Neighborhood Characteristics Analyses for Segregation

Frameworks

All findings from the neighborhood characteristic analyses can be summarized
with respect to the segregation frameworks. *Spatial assimilation*, attributing segregation to low assimilation, predicts that racial/ethnic clustering/segregation (a) has strong inverse relationship with low cultural and structural blending; (b) occurs in a low strata of the housing market with old and low-valued housing stock; and (c) has low neighborhood stability because of upward residential mobility of assimilated residents. We could not find sufficient support for *spatial assimilation* especially when we consider changes over the decade. We found an inverse association of structural blending with racial/ethnic clustering, but only for African Americans. Furthermore, the association is declining over the decade. The association of housing market strata with minority clustering for all groups is also declining, undermining the validity of *spatial assimilation* (Table 6).

Furthermore, we found African American *outcrop* neighborhoods in fast growing and relatively affluent neighborhoods (Table 7). Hence, *spatial assimilation* is not supported.

*Place stratification* emphasizes the role of discriminatory practices in segregation, which hinder minority groups from translating acquired socio-economic resources into residential mobility. The framework hypothesizes that racial/ethnic clustering/segregation is (a) directly associated with structural/cultural blending and is characterized (b) by low-valued and old housing and (c) high neighborhood stability. In particular, racial/ethnic minority clustering varies across occupational specialization of neighborhoods. (d) Higher minority clustering occurs in manufacturing employee, government employee, and university neighborhoods whereas lower clustering occurs in retirement neighborhoods. We could see (d) only but partly. African American clustering occurs in government neighborhoods whereas Asian and Hispanic clustering occurs in university
neighborhoods (Table 6). However, this does not necessarily mean low discrimination in these types of neighborhoods results in the minority over-representation, but reflects the occupational status of the groups. Hence, *place stratification* is not supported.

*Resurgent ethnicity* emphasizes the role of racial/ethnic preference in residential choice and in-group attraction in segregation. The framework predicts that (a) racial/ethnic clustering/segregation is not necessarily associated with structural blending but (b) so is with cultural blending particularly when encountering a large inflow of foreign immigrants. The *resurgent ethnicity* also predicts that (c) racial/ethnic neighborhoods are characterized by low neighborhood stability due to (re)distribution of group members into bifurcated racial/ethnic neighborhoods, commensurate with their socio-economic resources. We could see all three trends, (a), (b), and (c); hence, *resurgent ethnicity* is supported. Asian and Hispanic clustering is far less associated with structural blending but is with cultural blending. The decreasing association of neighborhood stability with their clustering supports the framework (Table 6). Also, African American *outcrop* neighborhoods, spatially and socio-economically distinct with co-ethnic concentrations/clusters, support the *resurgent ethnicity* framework (Figure 9 and Table 7).

### 6.5. Summary

Having evaluated the three segregation frameworks in terms of spatial patterning of racial/ethnicity, this chapter attempted to testify the hypotheses of each framework on characteristics of racial/ethnic clustering/segregation. In doing so, zero-order correlation
analyses between the level of racial/ethnic clustering and the set of socio-economic variables were performed for all racial/ethnic groups. For parsimony, a further inquiry was stepwise regression analyses of the clustering on the set of variables. Furthermore, residual analyses captured the anomaly of African American clustering with the further investigation of their spatial pattern and neighborhood characteristics. The overall findings support *resurgent ethnicity*. Racial/ethnic clustering/segregation is gradually less associated with low structural blending and low-valued and old housing stock, undermining the validity of *spatial assimilation*. Also, the decreasing association of residential stability with racial/ethnic clustering indicates racial/ethnic patterning in the study area is not a way that *place stratification* predicts. The best description for socio-economic characteristics and their changes is *resurgent ethnicity*. In terms of urban residential space, there are two distinct racial/ethnic neighborhoods: traditional racial/ethnic minority neighborhoods persist and even expand through chain migration when encountering a large inflow of co-ethnic immigrants, accommodating the group members with low structural and cultural blending. On the other hand, new racial/ethnic neighborhoods emerge in more affluent areas, taking advantage of abated discrimination and growth through the racial/ethnic network, attracting structurally blended group members. We could see racial/ethnic intermixing and segregation in the *outcrop* neighborhoods in relatively affluent neighborhoods with new housing construction. This suggests that the spatial extensiveness of *new* and *growing* settlements (Figure 8) could be a result of new housing construction and newly emerging neighborhoods. This requires a new framework to understand the potential role of housing developers on the
geography of race/ethnicity.
This study examined intra-urban segregation changes for racial/ethnic groups to evaluate relative role of three segregation frameworks: spatial assimilation, place stratification, resurgent ethnicity. Given the importance of segregation as a source of urban inequality, there have been at least three competing frameworks on segregation change. However, the previous efforts to evaluate the relative significance of each framework, dominantly relying on cross-urban metrics, fall short in shedding light on underlying processes of segregation changes within a city, hence presenting only circumstantial evidences for one or more frameworks.

In response, the study shifts attentions from segregation changes at the metropolitan level to those at the neighborhood level. Chapter 2 reviewed two urban theories in terms of their perspective on racial/ethnic neighborhoods: urban ecology of the Chicago school and post-modern urbanism of the Los Angles school. The chapter also articulated three segregation frameworks and their hypotheses on intra-urban segregation changes. The spatial assimilation framework attributes high segregation to low cultural and structural assimilation of individuals or groups (Gordon 1964; Massey 1985). The Place stratification framework emphasizes structural forces such as discriminatory
practices in housing and banking that impede racial/ethnic minorities from translating their acquired socio-economic resources to residential upward mobility (Logan and Molotch 1987; Yinger 1995, 1996, 1998). The Resurgent ethnicity framework focuses on role of co-ethnicity in residential choices that yields (re-)segregation even after residential integration is socio-economically feasible and housing discrimination has been abated (Logan, Alba, and Zhang 2002). In an evaluation of the relative role of each framework, the study had two research tasks: to describe the area’s racial/ethnic residential patterning and to analyze neighborhood characteristics of racial/ethnic clustering/segregation.

The study turned attentions to the issue of segregation measure in Chapter 3. A controlled experiment demonstrates that the global segregation measures such as the dissimilarity index and its spatial modification have limitation in showing residential patterning of race/ethnicity within a city. The study argues that more attention should be given to local segregation measures that allows us to access local variability of segregation within a city and propose to use a set of local segregation measures, corresponding to the two spatial dimensions of segregation: Locational Quotient (LQ) for concentration-evenness and Local Moran’s I (LM-I) for clustering-exposure.

Chapter 4 presented research designs for an empirical study of four racial/ethnic groups corresponding to two research tasks while utilizing the local segregation measures. Racial/ethnic groups were identified for Caucasians, African Americans, Asians, and Hispanics. After a brief description of the data source and the study area, the chapter presented an analytical approach to racial/ethnic residential patterning. The map
visualizations of racial/ethnic clusters (LM-I), concentrations (LQ), and new and growing settlements allow us to test the hypotheses derived from each segregation framework. Also, the chapter presented another research design for the second research task, neighborhood characteristics of racial/ethnic clustering/segregation utilizing zero-order correlation, regression, and residual analyses (outcrop neighborhoods). In order to characterize neighborhoods and evaluate the significance of each segregation framework, a set of socio-economic variables is derived from one or more frameworks. The variables are classified into four categories: structural/cultural blending, housing stock feature, occupational specialization, and neighborhood stability. The chapter also elaborated the relationship between racial/ethnic clustering/segregation and the four categories of neighborhood characteristics, predicted by each framework.

Chapter 5 and 6 presented the findings from the spatial pattern and neighborhood characteristics analyses on the study area, Columbus Ohio MSA. The findings are summarized with respect to three segregation frameworks. Spatial assimilation framework would be indicated if (a) minority group residences are gradually and sparsely distributed throughout the MSA and (b) intermixed with the majority residences so that new racial/ethnic clusters and concentrations do not appear. Also, (c) traditional racial/ethnic clusters and concentrations, encountering a large inflow of new immigrants, could persist but only in less affluent inner-city areas. We observed (a) but not (b) and (c). African American and Asian neighborhoods expand contiguously, accommodating a large proportion of the group members (Figure 4 and 5; Table 5). Also, we found new clusters and concentrations in relatively affluent suburbs for all minority groups (Figure
4, 5, and 6). Hence, *spatial assimilation* is not supported.

Concerning neighborhood characteristics, *spatial assimilation* predicts racial/ethnic clustering/segregation (a) has a strong inverse relationship with low cultural and structural blending; (b) occurs in a low strata of the housing market with old and low-valued housing stock; and (c) has low neighborhood stability because of upward residential mobility of blended residents. We could not find sufficient supporting evidence for *spatial assimilation* especially when we consider changes over the decade. We observed an inverse association of structural blending with racial/ethnic clustering, but only for African American. Moreover, the association is declining over the decade. Also, the decreasing association of housing market strata with minority clustering for all groups undermines the validity of *spatial assimilation* (Table 6). Furthermore, we found African American *outcrop* neighborhoods in fast growing and relatively affluent neighborhoods (Figure 9). Hence, *spatial assimilation* is not supported.

*Place stratification* emphasizes role of discriminatory practices in segregation, which hinder minority groups from translating acquired socio-economic resources into residential upward mobility. The framework hypothesizes that minority group residences (a) are spatially limited and highly concentrated in their patterning with little overlapping with majority residences (b) are adjoining to 1990 minority clusters and concentrations when developing anew, and (c) their 2000 patterns are correlated highly with 1990 patterns. We found (c) but not (a) and (b); hence, *place stratification* is not supported. We observed the decreasing residential importance of racial/ethnic clusters and concentrations for all minority groups despite their geographic expansion (Table 5).
Furthermore, the spatial pattern analyses of new and growing settlements indicate that spatial intermixing between groups and/or with Caucasian occurs throughout the MSA for all minority groups (Figure 8). High correlations were found in both African American and Asian patterning between 1990 and 2000 (Figure 4 and 5). However, this spatial inertia does not necessarily indicate the presence of discriminatory housing practices. Furthermore, African American and Asian new and growing neighborhoods, even though they accommodate small numbers of each group, were found in relatively affluent suburbs and even in exurban and newly developed areas. Therefore, place stratification falls short in explaining the dynamics of racial/ethnic patterning identified in this study.

Turning to neighborhood characteristics, place stratification predicts that racial/ethnic clustering/segregation is (a) directly associated with structural/cultural blending and (b) characterized by low-valued and old housing and high neighborhood stability. In particular, racial/ethnic minority clustering varies across occupational specialization of neighborhoods. (c) Higher clustering occurs in manufacturing employee, government employee, and university neighborhoods whereas lower clustering occurs in retirement neighborhoods. We could see (c) but only partly. African American clustering occurs in government neighborhoods whereas Asian and Hispanic clustering does in university neighborhoods (Table 6). However, this does not necessarily mean low discrimination in these types of neighborhoods entails in the minority over-representation, but reflects the occupational status of the groups. Hence, the place stratification is not supported.
*Resurgent ethnicity* framework emphasizes the role of racial/ethnic preference in residential choice and in-group attraction in segregation. The framework hypothesizes that (new) minority group residences were bifurcated, with (a) traditional clusters/concentrations in disadvantaged inner-city areas and (b) new clusters/concentrations in affluent suburbs. (c) Both clusters/concentrations are linked through extended transportation networks. We observed all three patterns (a), (b), and (c); hence, the *resurgent ethnicity* is supported. Clustering and re-clustering are apparent through the lens of LM-I and LQ for all minority groups (Figure 4, 5, and 6). Also, overlapping between these minority neighborhoods and particularly with Caucasian neighborhoods is not conspicuous (Figure 7). Moreover, minority residences are not confined to less affluent inner-city areas, as explicitly indicated in *new* and *growing* neighborhoods (Figure 8). Hence, our findings of ‘dispersed and decentralized clustering’ are consistent with the prediction of the *resurgent ethnicity*, suggesting racial/ethnic patterning more likely is driven by racial/ethnic preference in residential choice or in-group attraction with a desire to increase one’s amenities utilizing his social network.

In terms of neighborhood characteristics, *resurgent ethnicity* predicts that (a) racial/ethnic clustering/segregation is not necessarily associated with structural blending but (b) is associated with cultural blending when encountering a large inflow of foreign immigrants. *Resurgent ethnicity* also predicts that (c) racial/ethnic clustering are characterized by low neighborhood stability due to (re)distribution of group members into bifurcated racial/ethnic neighborhoods, commensurate with their socio-economic resources. We could see all three (a), (b), and (c); hence, *resurgent ethnicity* is supported.
Asian and Hispanic clustering is far less associated with structural blending but is associated with cultural blending. The decreasing association of neighborhood stability with their clustering is consistent with the framework (Table 6). Also, African American outcrop neighborhoods, spatially and socio-economically distinct with co-ethnic clusters/concentrations, support the resurgent ethnicity framework (Figure 9 and Table 7).

Taken as a whole, the study concludes that the resurgent ethnicity framework gives us better explanation on the geography of race/ethnicity and its changes in a contemporary metropolitan area. The best description of racial/ethnic patterning is ‘dispersed and decentralized clustering.’ Traditional immigrant enclaves persist in less affluent inner-city areas and even expand encountering a large inflow of new immigrants. On the other hand, new minority clusters/concentrations emerge in relatively affluent suburbs. This suggests that racial/ethnic minorities (re)distribute and concentrate into these two spatially and socio-economically distinct types of co-ethnic neighborhoods through racial/ethnic network, commensurate with their socio-economic resources.

This study is significant in advancing our understanding of racial/ethnic patterning and segregation change. There are, however, a number of limitations that need to be addressed more explicitly in future research.

First, given the validity of the resurgent ethnicity framework, future studies need to scrutinize minority groups by nation rather than by race/ethnicity used here in order to better understand the operation of ethnicity and in-group attraction in residential choice. Also, it is desirable to utilize individual data to understand what group members live in
racial/ethnic clusters/concentrations, which is not available to the public for the spatial enumeration unit employed in this study.

Second, future research might investigate roles of jurisdictional fragmentations -- such as school districts, tax districts, and local governments -- on segregation, which recently attract more attention in the place stratification framework. We could see the municipality of Bexley that impedes the expansion of minority neighborhoods and remains majority dominant. But, a more explicit research needs to be followed to understand the socio-economic-political mechanism.

Third, despite a great deal of evidence for resurgent ethnicity, none of the frameworks, including spatial assimilation and place stratification, sufficiently explains the geographical extensiveness of new and growing settlements (Figure 8) and the occurrence of the outcrop settlements in neighborhoods with new housing construction and drastic population growth (Figure 9 and Table 7). This suggests that we need a new framework to understand the roles of housing developers in future research. The new framework might turn our attention from the consumer side to the supplier side.

In conclusion, this dissertation examined intra-urban segregation change in terms of spatial patterns and neighborhood characteristics to evaluate relative roles of the three competing segregation frameworks. In doing so, this study goes beyond an African American versus Caucasian typology and inner-city versus suburb dichotomy that is often in the discussion of metropolitan segregation. Also, the study deals with all major racial/ethnic groups and a metropolitan area as a whole. Furthermore, this study goes beyond cross-urban comparison metrics in evaluating the segregation frameworks and
pulls our attention to the neighborhood level. The overall findings strongly support

*resurgent ethnicity* as the most relevant of the three frameworks.


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