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A Quantitative Analysis of Korean Residential Clusters in Auckland

A methodological investigation

Seong-Yun Hong

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in Geography, The University of Auckland, 2011.
Abstract

The residential clustering of ethnic minorities is a common feature of the urban landscape. Although the causes and consequences of this phenomenon vary across individual ethnic groups and locations, nearly all ethnic minorities residing in major cities exhibit some degree of residential clustering, at least during the early stage of their settlement. This thesis investigated the residential clustering of Koreans in the Auckland urban areas using quantitative methods.

The research began by examining the geographic distribution of Koreans using the spatial segregation indices. The index of spatial dissimilarity showed that Koreans in Auckland are residentially clustered, and the optimisation clustering algorithm revealed that they are relatively concentrated around the North Shore and Howick–Dannemora areas. The index of spatial exposure, however, indicated that Koreans are not isolated from other ethnic groups in an absolute sense. They were well-mixed with other ethnic groups residentially, particularly with Europeans and Chinese, and it seemed that they have formed an ethnoburb-like concentration in Auckland.

The demographic and socio-economic characteristics of Koreans supported this perspective. Correspondence analysis of census and survey data suggested that their residential clusters have formed as a result of individual preferences and socio-cultural needs and not because of structural disadvantages or discrimination. In this regard, the Korean community in Auckland can be seen as an empirical example of the contemporary suburban ethnic community model, although it is smaller and less socio-economically polarised than its counterparts in North America.

Interestingly, however, the economic structure of the Korean community in Auckland
was somewhat different from the contemporary ethnic economy observed in North American cities. Statistical analysis of the Korean business directory data demonstrated that most Korean businesses in Auckland rely on co-ethnic clients and are geographically concentrated in their residential clusters. The economic structure of the Korean community appeared to be dependent on the state of their home country's economy, and thus, their businesses were more like economic satellites than independent economic entities in the transnational market, as observed in the North American suburban ethnic settlements. This characteristic may be an important feature that distinguishes the suburban ethnic settlements of Koreans in Auckland from their counterparts in North American cities. The Korean residential clusters in Auckland are an example of how suburban ethnic settlements can vary in terms of geographic, demographic, and socio-economic profiles, and it highlights how important it is to carefully investigate individual ethnic settlements to understand their true nature.
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Chapter 1  Introduction

The residential clustering of immigrants and other ethnic minorities is a common phenomenon in metropolitan areas. Chinatowns are present in most major cities throughout the world, and other ethnic neighbourhoods such as Little Italy, Little India, and Little Tokyo have become a familiar part of the urban landscape. As a result, the reasons for the emergence of such ethnic residential areas, as well as their roles and significance in multi-ethnic societies, have been a long-standing interest of geographers and sociologists since the early twentieth century.

Until the 1980s, most of the literature on ethnic residential settlements focused on the residential segregation of African Americans and early European settlers in North American cities (see, for example, Lieberson, 1963; Massey, 1985; Taeuber & Taeuber, 1964). At that time, immigrants were generally perceived as less educated, less skilled, and economically disadvantaged, and they could not afford to reside in prosperous suburban areas, which were dominated by the majority population group. New immigrants, therefore, tended to settle initially in inner-city areas, where housing costs were relatively inexpensive and most low-income jobs were lo-
cated. However, once they achieved a higher income level and social status, they were likely to move to more desirable residential areas (see Section 2.1 for more details). Through this process, only those who were poor and less educated tended to remain in the inner-city ethnic enclaves, and in this context, residential clustering is not only a separation of residential areas but also of socio-economic status (Burgess, 1925; Lieberson, 1963).

The recent economic growth of Asian countries and ever-increasing transnationalism, however, has substantially altered the characteristics of immigrants and, therefore, ethnic enclaves. Many contemporary immigrants have moved in search of better lifestyles and educational opportunities, not because of poverty or political instability, and they are generally more affluent than previous settlers. Furthermore, ethnic communities no longer consist exclusively of permanent immigrants. Rather, there are now a considerable number of entrepreneurs, investors, and international students who typically reside there for only a fixed period of time. These changes have inevitably blurred the negative relationship between residential clustering and socio-economic and cultural integration. Residential clusters are currently emerging in affluent suburban areas, and living in an ethnic enclave does not necessarily indicate poor economic conditions. The characteristics and roles of ethnic residential clusters have diversified significantly, and it has become crucial to understand individual ethnic communities within the context of their demographic and socio-economic profiles (Johnston et al., 2008; Logan et al., 2002).

In this regard, this research attempts to investigate the residential clusters of Koreans—one of the fastest growing ethnic minorities in New Zealand—in the Auckland metropolitan area. As will be described in more detail in the following sections, this study begins by examining the geographic distribution of Koreans between 1996 and 2006, highlighting areas where they were relatively concentrated. The Korean residential clusters are then examined in terms of their demographic and socio-economic characteristics and compared with other relevant ethnic settlements. The results of these analyses are expected to shed light on the residential clusters'
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roles and significance and their development over time.

1.1 Research Background

Like many other Western countries, New Zealand has experienced very rapid growth of its Asian population over the last two decades. Once dominated by the early British settlers and indigenous Māori population, the country has transformed into a more multi-ethnic and multicultural society through a large inflow of immigrants from Asian and Pacific Island countries. In the mid-1980s, a point system for immigration selection that emphasises individual characteristics, skills, and economic conditions rather than country of origin was introduced, and the Asian population increased almost sevenfold, from 48,949 (or 1.6% of the national population) to 354,549 (or 8.8%) between 1986 and 2006 (Bedford et al., 2000a; Ongley & Pearson, 1995).

Koreans represent the third-largest Asian ethnic group in New Zealand (after Chinese and Indians), comprising approximately 8.7% of the total Asian population (or 30,792 out of 354,549 people). Until the mid-1980s, the number of Koreans was little more than 100, but it has grown rapidly since the late 1980s (Yoon, 1998). The 1991 census showed that there were around 1,000 Korean people nationwide. This figure increased to 12,753 people over the next five years and reached over 30,000 by the 2006 census. This growth rate makes Koreans the fastest growing population in the country over the last four census periods.

Fig. 1-1 shows the number of Koreans approved for residence in each financial year (i.e., 1 July to 31 June of the following year), providing a more detailed, year-by-year pattern of immigration from South Korea. It suggests that there were two main waves of immigration: the first between 1992 and 1995 and the second between 2001 and 2005. The sharp decrease in the intake of Korean people during the late 1990s is due to the stricter requirements for English
INTRODUCTION

Fig. 1.1. Number of Koreans approved for residence between 1992/1993 and 2006/2007


proficiency as well as the Asian economic crisis of 1997 (Chang et al., 2006). By comparing the two waves, it appears that most of those who entered prior to 1996 moved in family groups primarily for lifestyle reasons, whereas a relatively large fraction of the recent arrivals are individuals and ‘astronaut families’ motivated by the educational environment\(^1\) (see Section 5.2 for more details).

During the second wave of Korean immigration to New Zealand, the number of international students attending primary or secondary schools also markedly increased. These students have become an important component that distinguishes the contemporary Korean community from other ethnic groups. In 1996, there were 1,604 foreign-fee-paying students from South Korea, which was approximately 7.8% of the entire Korean population at that time (Ministry of Education, 2001). This number, however, jumped to 4,503 in 2006, and their share

---

\(^1\) Astronaut families are an increasingly common family arrangement among Asian immigrant households. In this arrangement, the head of the household, typically the father, works in the country of origin to support the family members remaining in the host country (Aye & Guerin, 2001; Ho & Bedford, 2006).
in the community grew to 14.6% (Ministry of Education, 2009). Considering that the proportion of international students of Chinese ethnicity (which includes people from mainland China, Hong Kong, and Taiwan) is only 1.1% (or 1,681 out of 147,570 people), comprising such a large proportion of international students can be considered a unique characteristic that differentiates the Korean population from other ethnic populations in the country.

Another important feature of the Korean population is that a majority of Koreans had similar socio-economic backgrounds in their home country. That is, most of them had been professionals and white-collar workers with high educational qualifications and were economically middle-class at the time of their move (Yoon & Yim, 1997). Despite the high unemployment rate and low income level in New Zealand, their relatively high homeownership rate in relatively affluent areas and the high education level seem to reflect this aspect of the community.

In terms of geographic distribution, Koreans in New Zealand are overwhelmingly concentrated in a few metropolitan areas, such as Auckland, Wellington, and Christchurch. According to the 2006 census, these three cities account for over 80% of the total population of Koreans in the country, with almost 70% in the Auckland region alone. Although such a high concentration of the population in large cities is a general phenomenon for ethnic minorities, their main residential areas appear to be separated from those of other population groups. The scatter plots in Fig. 1-2, for example, present the number of Koreans in census tracts against Europeans (left panel) and Chinese (right panel). The rather random patterns in both plots together with the small correlation values ($\rho = 0.360$ and 0.425, respectively) seem to suggest that their main residential clusters might be located in different places.

In the Auckland region, which is the study area of the present research, the most popular area for Koreans since the early 1990s has been North Shore City\(^2\) (Fig. 1-3). While the city ac-

\(^2\)The former territorial authority North Shore City, which covered the entire North Shore ward and part of the Albany ward, has amalgamated into the newly-established Auckland Council. Although the city was
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commodates about 15% of the total regional population, it is home to more than 40% of the regional Korean population. This concentration of Koreans in the northern district has been observed since the earliest period of their immigration and has remained the largest residential cluster of Koreans.

In addition to this dominant northern cluster of Koreans, there are some smaller but still significant clusters in other parts of the region. Fig. 1-3 illustrates a notable concentration around the central area and its nearby suburbs in Auckland City, where a number of prestigious private schools are located. In Manukau City, a considerable number of Koreans are agglomerated in newly built suburbs. Furthermore, the northern part of Waitakere City seems to embrace another small cluster in the vicinity of North Shore City. This geographic distribution is perhaps

Fig. 1-2. Scatter plots of the Korean population in the Auckland region against the European (left, $\rho = 0.360$) and other Asian population (right, $\rho = 0.425$)

Source: New Zealand Census of Population and Dwellings for 2006

officially abolished in November 2010, this thesis uses the old administrative name across the thesis because most census data (i.e., the primary data source) were available only in the old geographic units (i.e., North Shore City, Manukau City, etc.). The following webpage has more information on the restructure, its effects on the census data, and some basic statistics on the new Auckland geography: http://www.stats.govt.nz/aucklandcouncil
related to Koreans’ emphasis on their children’s education and financial affordability, as discussed above; however, little is known about the exact location factors.

Compared to their Asian counterparts, Koreans in New Zealand have drawn less attention from scholars and the media in the last few decades. As a result, their settlement patterns have not been explored in detail. Although there is a substantial amount of literature concerning ethnic neighbourhoods elsewhere, the explanations based on other population groups in other regions may not be applicable to Korean immigrants in Auckland due to their (possibly distinc-
operative) demographic characteristics outlined above. This necessitates an in-depth investigation of the demographic and socio-economic profiles of Koreans in Auckland, in order to reveal the nature of their residential clustering.

1.2 Research Questions and Objectives

Given that little is known about the context of Korean settlement patterns in New Zealand, this research aims to identify the causes, patterns, and implications of their residential concentrations by addressing the following questions:

- How are Koreans distributed in the study area, and where are they concentrated? How has this pattern changed over the last two decades with the rapid increase in the ethnic population?

- What are the demographic and socio-economic characteristics of those Koreans living in the main residential clusters? How do they differ from the characteristics of Koreans residing outside of the ethnic neighbourhoods? What is the main cause of their residential concentration?

- Are there any significant differences between the Korean residential clusters in terms of geographic, demographic, and socio-economic aspects? If so, what are the underlying reasons for these differences?

- Do the inferences drawn from the above questions generally conform to the existing ethnic settlement models? If not, how are they different, and what is the significance and implications of the Korean ethnic clusters in Auckland?

The first, and perhaps foremost, question is whether the Korean population forms residential clusters in the study area, as the remaining research presumes that there exist significant concentrations of Koreans across the region. Although a quick view of the census data in the previous section provides reasonable evidence of clustering (particularly in the northern suburbs),
formal testing must be conducted to identify the geographic boundaries of the cluster(s) and to examine their spatiotemporal changes. However, as will be discussed in Section 2.4, contemporary ethnic clusters, especially those located in suburban areas, have somewhat vague boundaries with a relatively dispersed population, and it is often difficult to visually recognise the extent of the geographic areas or to utilise existing measures of clustering, which are designed to detect a very high degree of separation. In this regard, it has been necessary to develop a new approach that takes into account the nature of the contemporary ethnic residential clusters to address this question effectively.

Having identified the locations and extent of the Korean residential clusters, the next objective is to examine the demographic and socio-economic characteristics of the people within these ethnic neighbourhoods. This part of the research aims to reveal the representative attributes of individuals living near their co-ethnic members through statistical analyses of the census and survey data presented in Section 3.1, and to compare them with the profiles of Koreans who are geographically assimilated (i.e., those living outside of the residential clusters). The results are expected to provide insight into the important determinants of their residential concentration, which could differ for each of the clusters.

The ultimate goal of this study is to justify these statistical findings about the Korean ethnic communities and their economic structure and to explain how these communities are related to the existing theories developed in the North American context. This will shed considerable light on the significance and implications of the Korean ethnic clusters in Auckland and hint at the possible trajectories of their future development.
1.3 Scope and Limitations

This study investigates the residential clustering of Koreans in Auckland at a macro level, focusing on the general characteristics of Koreans who are residentially clustered. Examination and analysis of individual experiences is beyond the scope of this work, though such micro-level studies might form a basis for future research. It is also beyond the scope of this thesis to construct a predictive statistical model for the residential clustering of Koreans in Auckland. Although this study attempts to identify the determinants of the Korean residential clustering, it is to show how different (or similar) the Korean clusters in Auckland are from the existing ethnic settlement models, not to develop a model for forecasting.

In order to achieve the main research objectives within the scope of this study, an exploratory statistical technique called correspondence analysis is used as a main tool for investigation, and the census data as a primary source of information. The choice of data and analysis techniques will be discussed in more detail and justified in Chapter 3.

1.4 Study Area

The current study focuses on New Zealand’s largest metropolitan area, the Auckland region. The Auckland region is one of sixteen administrative regions of New Zealand and is home to nearly one-third of the total national population. It is the most populous region of the country as well as the most diverse in terms of ethnicity and culture, where Asian and Pacific people comprise approximately 31.6% of the local population. The Korean population is also largely concentrated in this part of the country: more than two-thirds of them (or 21,399 out of 30,792 people) resided in this region as of 2006.
Compared to other major cities such as Christchurch and Wellington, where a relatively small number of Koreans are located (4,569 and 777, respectively), the large population size in Auckland makes Korean residential clusters more visible and facilitates the collection of a reasonable amount of customised survey data. Further, Auckland is believed to be the most representative region in the country for studying the residential patterns of Koreans because it attracts the entire spectrum of the immigrants to the country, from entrepreneurs to international students and from permanent immigrants to short-term residents.

It should be noted, however, that the study area in the present thesis does not include the entire Auckland area. Before the disestablishment of the old territorial authorities in November 2010, the Auckland region consisted of four cities, Auckland, North Shore, Waitakere, and Manukau, and three rural districts, Rodney, Papakura, and Franklin. The study area of this research is limited to the metropolis, which is composed of the entire (former) North Shore and Auckland cities (excluding the Hauraki Gulf islands) and the urban parts of the Waitakere and Manukau cities (Fig. 1-4). Because the primary objective of this study is to identify the extent and determinants of the Korean residential clusters in Auckland, the inclusion of the rural districts unnecessarily increases the size of the study area and requires much more effort to process the data, while its impacts on the conclusions would be minimal due to the small population size in those areas. Therefore, the rural districts were not included in the analyses, and throughout the thesis, the study area will be referred to as the Auckland metropolitan areas or the Auckland urban areas.

Table 1-1 compares the population and area of the study area to the entire Auckland re-

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3 In April 2009, the New Zealand Government made a decision to combine the seven local authorities into one unitary Auckland Council. The new Council is composed of thirteen wards, each of which is subdivided into a number of local boards and subdivisions (see Local Government Commission, 2010, p. 16 for the full list of the wards, local boards, and subdivisions). The study area based on the district boundaries is approximately equivalent to the area consisting of the following wards: Albany (excl. Hibiscus Coast Subdivision), North Shore, Waitakere (excl. Waitakere Ranges Local Board), Albert–Eden–Roskill, Waitakere and Gulf (excl. Waiheke Local Board and Great Barrier Local Board), Ōrākei, Maungakiekie–Tamaki, Manukau, Howick, and Manurea–Papakura (excl. Papakura Local Board).
According to the 2006 census, the Auckland metropolitan areas had the population of 1,110,978 (or 27.6% of the total national population) and covered the area of approximately 717.5 km². In 2006, Europeans comprised the largest share of the regional population (50.5%, or 560,787), followed by Asians (20.3%, or 225,459) and Pacific peoples (15.3%, or 169,731), while the Māori population was relatively underrepresented in the study area (9.9%, or 110,940). Koreans consisted of only 1.8% of the population in the Auckland urban areas, but since it was almost two third of the total Korean population in the country (65.4%, or 20,145 out of 30,792), the study population could be considered representative of the overall group.

Table 1-1 — Population and area of New Zealand, Auckland, and the Auckland urban areas (study area)

<table>
<thead>
<tr>
<th></th>
<th>New Zealand</th>
<th>Auckland</th>
<th>Auckland urban areas</th>
</tr>
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<tbody>
<tr>
<td><strong>Area in km²</strong></td>
<td>268,021</td>
<td>6,059</td>
<td>717.5</td>
</tr>
<tr>
<td><strong>Population</strong></td>
<td>4,027,947</td>
<td>1,303,068</td>
<td>1,110,978</td>
</tr>
<tr>
<td>European (%)</td>
<td>2,609,592 (64.8%)</td>
<td>698,622 (53.6%)</td>
<td>560,787 (50.5%)</td>
</tr>
<tr>
<td>Māori (%)</td>
<td>565,329 (14.0%)</td>
<td>137,133 (10.5%)</td>
<td>110,940 (9.9%)</td>
</tr>
<tr>
<td>Pacific peoples (%)</td>
<td>265,974 (6.6%)</td>
<td>177,936 (13.7%)</td>
<td>169,731 (15.3%)</td>
</tr>
<tr>
<td>Asian (%)</td>
<td>354,549 (8.8%)</td>
<td>234,219 (18.0%)</td>
<td>225,459 (20.3%)</td>
</tr>
<tr>
<td>Korean (%)</td>
<td>30,792 (0.7%)</td>
<td>21,399 (1.6%)</td>
<td>20,145 (1.8%)</td>
</tr>
</tbody>
</table>

Source: New Zealand Census of Population and Dwellings for 2006

Note: The respondents were allowed to choose more than one ethnic group.
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Fig. 1-4. Map of the Auckland region
1.5 Thesis Structure

The thesis consists of seven chapters, as shown in Fig. 1-5. Chapter 1 begins with background information on the general characteristics of Koreans in New Zealand, followed by a brief illustration of the research motivations. It then states the specific research questions to be addressed in the thesis and justifies the choice of the study area (i.e., the Auckland metropolitan areas).

Chapter 2 is dedicated to the literature review. It discusses the key theoretical models of ethnic residential settlement and introduces relevant studies in the New Zealand context. Three major conceptual models that explain the causes and effects of ethnic residential clustering are reviewed here (i.e., the spatial assimilation model, the place stratification model, and the ethnic community model), and ethnic economy theories are discussed in relation to these models. In the following section, previously published studies on the settlement patterns of ethnic minorities in New Zealand are examined with particular attention to their relevance to the conceptual models. The last section of the chapter concerns measures of residential segregation and clustering that may be useful in investigating the geographic distribution of the Korean population in Auckland.

Chapter 3 describes the main data sets and analysis methods used in this study. This chapter first describes the data collection process and discusses the scope and limitations of the data. This is followed by a detailed explanation of an optimisation clustering method, which is utilised to identify the locations and extent of the Korean ethnic neighbourhoods in Auckland, and a brief overview of other statistical methods employed in the research.

The subsequent three chapters constitute the main body of the thesis, providing the results of the data analyses. Chapter 4 begins with calculations of the degree of segregation and exposure of Koreans in Auckland and compares the figures with those of other groups. In the
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next section, the (statistically) most likely extent of the Korean residential clusters is identified using the optimisation clustering method and some general characteristics of the clusters are examined using correspondence analysis. Chapter 5 presents the demographic characteristics of the Korean people living in the ethnic neighbourhoods and reveals their main location factors. Chapter 6 concerns the economic structure in the Korean residential clusters. It explores Koreans’ business patterns and how they use their class and ethnic resources, based on data derived from the Korean Business Directory.

Chapter 7 summarises the major findings and explains the significance of the Korean residential clusters in relation to the theoretical models. This chapter also states the main contribution of this research to the current literature and concludes with a suggestion of issues to be explored in future studies.
# Thesis Structure

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<td>Defines and justifies the study area</td>
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<td>Introduces relevant studies in the New Zealand context</td>
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<td>Reviews the existing segregation and clustering measures</td>
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*Fig. 1-5. Thesis structure*
Chapter 2  Literature Review

This chapter presents a review of the literature related to the current research in four sections. The first two sections set out the theoretical framework in which the findings of this study can be discussed and interpreted. The third section introduces a number of relevant studies focused on New Zealand. The last section describes several key methods of examining the residential distribution of ethnic minorities and evaluates their relative strengths and limitations.

More specifically, Section 2.1 explores important conceptual models for understanding ethnic settlement including the spatial assimilation model, the place stratification model, and the ethnic community (or ethnoburb) model, with particular attention given to the social and historical context that led to their emergence and to their interrelationships. Section 2.2 shifts the focus to the economic structure of ethnic enclaves by considering literature that has documented and analysed the entrepreneurial activities of immigrants and ethnic minorities.

Section 2.3 introduces relevant empirical studies focused on New Zealand and demon-
strates how the theoretical models from the previous sections can be applied to these cases. Although relatively little research has been conducted on ethnic minorities in New Zealand, in part because the country was bi-ethnic and bicultural until very recently, the large inflow of Asian immigrants since the 1980s has resulted in increasing interest in this area. While most studies noted in this section focus on broad ethnic groups such as Asians and the Pacific peoples or emphasise a few sizable subgroups such as the Chinese and Indians, there are also several case studies on Korean immigrants.

Section 2.4 reviews a variety of existing techniques that can measure residential segregation of ethnic groups, or that can identify the location of possible clusters. Some of the methods presented in this section are not specifically designed to indicate the presence or location of the clusters, but they can be useful to some extent. There are, however, certain limitations to these methods when they are used on an ethnoburb-like concentration of small population groups, and it raises the need for an alternative method that is developed in the following chapter.

2.1 Ethnic Settlement Patterns

Based on the past experiences of European immigrants, it has long been believed that immigrants tend to be concentrated in less desirable areas during the initial stage of the settlement process (Burgess, 1925; Duncan & Lieberson, 1959; Massey, 1985). The assumption underlying this idea is that new migrants are usually young and less educated with limited economic resources, and that these socio-economic circumstances force them to settle in poor inner-city enclaves (Alba & Logan, 1991; Alba et al., 2000; Massey, 1985). From this point of view, ethnic residential concentration is generally considered a negative phenomenon, and an enclave is a place to escape from. Therefore, as people acquire better economic standing and experience cultural and linguistic assimilation into mainstream society, they usually move towards suburban
areas in search of more residential amenities (Alba, et al., 2000).

This perspective is often referred to as a theory of spatial assimilation (Massey, 1985), with suburbanisation believed to imply that the immigrants have left their ethnic residential enclaves and entered areas where the majority group dominates (Fong & Shibuya, 2000). In this theory, such spatial assimilation is socially significant because “residential segregation is not only important as an indicator of assimilation in its own right, but also has implications for other dimensions of socio-cultural integration that are highly related to propinquity” (Massey, 1981, p. 67). That is, the degree of residential segregation is a direct outcome of socio-economic status as well as linguistic and cultural assimilation, and therefore represents the overall level of social integration of an ethnic group.

This theory is derived from the work of the Chicago School in the 1920s, and is well known as human ecology studies (Massey, 1985). Based on his observations regarding Chicago, Burgess (1925) suggested a descriptive model of urban land use that divides cities into several concentric circles from the central business district to the outer residential suburbs (Fig. 2-1). He suggested that cities expand through the ecological processes of succession and invasion so that residents in each inner zone move towards the next outer zone in search of better living amenities as they improve their economic status and social position. This approach presumes that the residential distance from the central business district is positively correlated with individual socio-economic indicators, typically income. Because most immigrants were low-class labourers at the time this theory was developed, their residential communities tended to be concentrated in the central “Loop” of cities, which may be the so-called “deteriorating area” (Burgess, 1925, p. 75). Whereas this area becomes a port of entry for newcomers, previous residents move to the outer zone where better housing is located. Inevitably, this facilitates the residential separation of ethnic minorities from mainstream society and hence increases the degree of segregation. As time passes, however, economically successful and culturally integrated
immigrants, perhaps the second or third generation, eventually move towards the encircling outer zone where the majority of the skilled, mainstream labourers reside and assimilate into their community.

The early and mid-twentieth century witnessed the validity of this theory as a large influx of immigrants moved from undeveloped countries to the industrialised world. Duncan and Lieberson (1959) investigated the degree of residential segregation experienced by foreign-born and second-generation European migrants in Chicago using the 1930 and 1950 census data. They calculated two simple index measures, namely the index of dissimilarity and that of centralisation, and then observed their correlations with a number of assimilation and economic indicators (see Section 2.4 for more details about the index measures). The results generally indicated that (1) "new" immigrants tended to be more segregated than "old" immigrants, (2)
the degree of segregation declined with the amount of time following an ethnic group’s arrival, and (3) segregation was inversely related to most assimilation and economic variables that they take into account. Although they clearly recognised that there are considerable variations between individual ethnic groups, and although they reported some contradictory findings such as positive correlations between segregation and homeownership⁴, their overall analysis supports the ecological perspective well.

Lieberson (1963) extended this analysis to ten major cities in the United States, including Boston, Buffalo, Chicago, Cincinnati, Cleveland, Columbus, Philadelphia, Pittsburgh, Saint Louis, and Syracuse using the censuses of 1910, 1920, 1930, and 1950. Lieberson compared the segregation indices for several European immigrant groups over the four census periods and confirmed their geographic dispersion over time and across generations. The degree of socio-economic assimilation was measured using census variables such as length of residence, English proficiency, educational qualifications, housing costs, and occupation, and the observed patterns were similar to his earlier findings.

In this context, Massey (1985) argued that spatial assimilation is a direct function of acculturation and socio-economic mobility and that the separation of residential areas based on ethnic groups implies that these groups are socially, economically, and culturally distinguishable in society. Historical and contemporary ethnic residential patterns in many immigrant-receiving countries at the time agree with these propositions, and variation between individual ethnic groups is shown to have occurred due to structural conditions such as the history and scale of immigration and public attitudes toward particular groups (Massey, 1985). Despite some methodological limitations that will be discussed in a later section and conflicting residential patterns found among African Americans and Puerto Ricans, the spatial assimilation model

⁴Duncan and Lieberson employ the homeownership rates in 1940 as an indicator of prosperity and compare them with the segregation figures for 1930. The contradictory results may be due to the differences in the years the data come from, or they could have arisen because the homeownership rates do not adequately reflect the group’s economic condition.
LITERATURE REVIEW

has become one of the most influential models in the literature (Alba & Logan, 1991; Allen & Turner, 1996; Logan, et al., 2002).

The residential patterns of African Americans in the U.S. have always been recognised as an exception to the pattern of ecological representation. Considering the group's level of social and cultural assimilation into mainstream society and relatively high average income as compared to that of old European immigrants, the level of residential segregation that African Americans experience is extreme. Most African Americans are concentrated in areas demographically dominated by African Americans, and these areas are geographically separated from the ‘white’ residential suburbs (Clemence, 1967). Many researchers have confirmed that there is little relationship between economic affluence and residential assimilation for this group (Lieberson, 1963). Taeuber and Taeuber (1964), for example, revealed that although an increase in socio-economic status decentralised African American residential areas from 1920 to 1950, the degree of residential segregation remained high during that time. Their investigation indicated that even native-born African Americans in Chicago who were fully integrated into American society at the time were more segregated than newly arriving European immigrants.

This distinctive pattern has been conventionally considered to be a combined result of African Americans’ preference for living in ethnically concentrated areas, their economic status (which is improving but is still insufficient for them to enter most suburban areas), and the reluctance of the dominant society to allow residential integration by this group. However, the 1965 census data from the Cleveland metropolitan area showed that the economic factor is not a crucial determinant of segregation because “simple observation reveals that poor whites are segregated from poor Negroes, and wealthy Negroes are segregated from wealthy whites” (Taeuber, 1968, p. 12). Taeuber (1968) concluded that the residential separation of black people in the southern U.S., where the vast majority were farmers at that time, was caused by their low income level. However, he suggested that the high level of segregation in the metropolitan
areas of the northern regions was more likely to result from the desire to live in co-ethnic neighbourhoods and from racial discrimination.

Farley and his colleagues (1978) attempted to quantitatively measure the significance of these two factors – the preference to live in an ethnically concentrated area and the resistance of the dominant population to residential integration. They conducted interviews with a total of 734 whites and 400 blacks in Detroit in the spring and summer of 1976, and asked them about what degree of residential integration they would allow using a set of diagrams representing neighbourhoods with differing racial composition. Fig. 2-2 presents the diagrams used for the white respondents. Rather surprisingly, almost all black people indicated that they were willing to move to areas where white families comprised the majority, whereas less than one-fifth of them indicated an exclusively black neighbourhood as their first or second choice of residence. In contrast, the white respondents clearly indicated a reluctance to be integrated into racially mixed settings: about half of them answered that they would feel uncomfortable with three or so black families living in the neighbourhood (i.e., W-3 or W-4 in Fig. 2-2), and would move out of this neighbourhood in favour of other areas.

The residential areas of Puerto Ricans in New York are often located close to those of African Americans, and Puerto Ricans have exhibited a similar high degree of segregation from the majority population since the 1980s (Jackson, 1981; Massey & Bitterman, 1985). Although the persistent concentration of the Puerto Rican community may in part result from their low income level, the social prejudice against them due to their race is thought to be important in creating the pattern (Massey & Bitterman, 1985), making this group another example against the direct relationship between socio-economic achievement and residential assimilation.

Massey and Bitterman (1985) argued, however, that whereas these exceptions appear to conflict with the ecological model, they do in fact conform to the basic principles of human ecology. The difference between African Americans and other immigrant groups is that the former
group has experienced a long history of discrimination and poverty that has encouraged prejudice against them and placed obstacles in the way of their residential integration. As previously mentioned, the socio-economic resources required to achieve residential assimilation are influenced by the history and size of an individual ethnic group, and for black people in the U.S., the threshold income level may be substantially higher than it is for the other groups (Lieberson, 1980; Massey & Bitterman, 1985). Once they achieve the required income level, they should also be able to move out of racially segregated communities and into the white-dominated suburban areas, following the path suggested by the ecological model (Massey & Bitterman, 1985).

This explanation notwithstanding, the persistent or even increasing level of segregation experienced by fully acculturated, native-born, middle-income African Americans in some suburban areas has remained of interest for sociologists. From the traditional ecological perspective, entry into the ‘outer cities’ implies a rather affluent, racially mixed neighbourhood (Burgess, 1925), but the emergence of ethnic enclaves in suburbs represents a counterexample. Alba and Logan (1991) observed that the concentration of ethnic people in particular areas has

**Fig. 2-2. Neighbourhood diagrams for white respondents**
(Reproduced from Farley et al., 1978)
caused the *stratification* of the suburbs in terms of demographic and socio-economic indicators and argued that this stratification is a more persistent phenomenon than suggested by human ecologists due to the institution of racial discrimination towards certain minority groups.

The significant feature of this place stratification theory is that it considers social attitudes towards certain minorities as an important determinant of the degree of residential segregation and patterns. Both the spatial assimilation theory and the stratification theory presume that as an individual achieves better educational qualifications and a higher income level than his neighbours in the current residential area, he will attempt to move to another zone where people have a similar socio-economic status. These theories are distinct, however, in the sense that the latter has to do with the effects of racial discrimination and social structure as a direct and primary factor influencing residential patterns, whereas the former considers it as secondary, as reflected in the socio-economic indicators used (Alba & Logan, 1991).

Obviously, these two theoretical perspectives complement each other rather than contradict one another. Spatial assimilation theory may be useful in explaining the settlement patterns of the early European immigrants, who were able to easily translate their socio-economic resources into residential integration (i.e., the social structure was not a factor for them), whereas the place stratification theory provides a more plausible conceptual framework for understanding the experience of African Americans and black Puerto Ricans in New York in this regard (Alba & Logan, 1991; Alba, et al., 2000; Fong & Wilkes, 1999).

However, a considerable number of recent studies have found that these models are less relevant to the settlement patterns of more recent immigrants, particularly those from Asian countries (Alba et al., 1999; Alba & Nee, 1997; Rumbaut, 1997). Global economic growth over the last two decades and the increasing mobility of people have paved the way for an influx of highly skilled workers, entrepreneurs, investors, and international students into western countries. These newcomers are similar to earlier immigrants in that they also tend to initially settle
in areas where the presence of their co-ethnic predecessors is relatively concentrated (Allen & Turner, 1996; Peach, 1996). However, unlike those of the old settlers, the new residential clusters are often located in rather desirable suburbs where the middle-class, majority group dominates the population, and because these Asian minorities do not usually suffer from discrimination in the housing market (Alba & Logan, 1993), residential turnover occurs slowly if at all. That is to say, the residential concentration of contemporary immigrants in affluent suburbs is more likely to be voluntary, and it is neither associated with their social and cultural integration nor imposed by the majority society (Balakrishnan et al., 2005; Logan, et al., 2002).

The *ethnic community* theory emerges in this context, emphasising the role of residential preferences in the formation of ethnic settlement patterns. Although Lieberson (1963, pp. 4-5) recognised the propensity of immigrants to live close to their co-ethnic members, he argued that the effects of such cultural factors on their residential distribution are quite limited due to poor economic conditions upon arrival. Clark (1992, 2009), however, showed that the residential preferences of ethnic groups have become a crucial determinant that creates and maintains the concentration of the minority population in suburbia, and Logan and his colleagues (2002) also pointed out that:

"The Chicago School ecologists noticed an element of preference as well as necessity in the creation of immigrant colonies. ... Because the immigrants they studied appeared to have little choice in where to live – preference was of secondary importance in their theory of spatial assimilation. What makes it potentially more significant today is the presence of immigrant groups with high levels of human and financial capital, such as Asian Indians ..." (p. 301).

The voluntary clustering of ethnic minorities in affluent suburbs is now a common occurrence in immigrant-receiving countries, and a great deal of work has been done over the last decade to describe and explain this phenomenon (Alba & Logan, 1991, 1993; Fong, 1994; Ip & Friesen, 2001; Laux & Thieme, 2006; Li, 1998a, 1998b; Logan, et al., 2002; Smith & Logan, 2006; Wood,
Perhaps one of the most well-known examples of suburban ethnic communities is the San Gabriel Valley in California, located a few miles east of the city of Los Angeles. Once dominated by the European population, the large influx of immigrants from China, Taiwan and Hong Kong that occurred since the 1980s has transformed the area into a multi-ethnic suburb where Asians comprise the majority (Fong, 1994). Unlike the patterns that create traditional urban enclaves of disadvantaged immigrants, this transformation is seen as a reflection of the group's residential preferences: according to Fong (1994), the San Gabriel Valley has gradually gained a reputation as the "Chinese Beverly Hills" since a group of Chinese entrepreneurs began to invest in residential and business properties in the area during the early 1970s, and it has consequently become a favoured destination of new Chinese immigrants looking for "a friendly, relatively inexpensive, and less congested alternative to the nearby Los Angeles Chinatown" (p. 174).

Li (1998a) argued that the ethnic community, or ethnoburb, as in the San Gabriel Valley can be distinguished from traditional urban enclaves not only in terms of the main causes of the concentration but also in terms of its economic structure, demographic composition, and geographic patterns. In ethnoburbs, new migrants own a diverse range of businesses including professional service organisations and large-scale retail stores that attract potential co-ethnic workers and customers, reinforcing the expansion of the residential concentration in the area. As a result, the ethnoburbs boast residents with heterogeneous socio-economic backgrounds, housing individuals from migrant entrepreneurs to ethnic workers and from old settlers to recent arrivals. Furthermore, unlike urban enclaves, which are usually confined to a few blocks of cities with clear boundaries, these ethnoburbs are located in wider geographic areas, encompassing several suburbs with a lower population density (Li, 1998a, 2005).

As illustrated through many empirical examples (Ho & Bedford, 2006; Smith & Logan, 2006; Wood, 2006), ethnic communities are now a common form of ethnic settlements that are
not limited to the Los Angeles context. Increasing transnationalism and globalisation in recent years has encouraged an influx of more affluent immigrants such as investors and other professionals, and this has accelerated the emergence of ethnoburb-like suburban settlements around the world. The role of residential preferences has become crucial to consider in interpreting the phenomena of ethnic concentration (Clark, 1992, 2009), and therefore, the theory of voluntary concentration emerges as a useful and valid conceptual framework, particularly for understanding the patterns of contemporary immigrants.

As has been previously discussed, each of these theoretical models emphasises a different element as the main determinant of ethnic settlement patterns. The spatial assimilation theory stresses socio-economic conditions, whereas the place stratification theory argues that the discrimination toward and disadvantages experienced by certain ethnic groups cause the separation of residential areas. In the ethnic community theory, the residential preferences of immigrants are the foremost factor affecting their geographic concentration. In addition to these three factors, some researchers note that the immigration law and policy of the receiving countries are a secondary but significant factor because they control the number of new immigrants and influence demographic characteristics including education levels, occupational skill and financial status (Yoon, 1998).

These determinants are not mutually exclusive, and in fact are closely interrelated as depicted in Fig. 2-3. However, because the significance of each element differs between ethnic groups, it is important to understand which factors play the most influential role for a group of interest. In general, the spatial assimilation theory is considered to be more relevant to the old settlers, whereas the ethnic community theory should be more applicable to affluent contemporary immigrants. Nevertheless, considering that there are still many marginalised ethnic minorities and refugees, the spatial assimilation theory may be an appropriate framework in some cases (see, Johnston et al., 2006, for Hispanics in the U.S.). Ethnic residential neighbourhoods
are now diversified, embracing various ethnic groups with different reasons for migration and different socio-economic backgrounds. Hence, the residential concentration of a particular ethnic group should be evaluated based on the identity of the group and the reason for the concentration (Logan, et al., 2002).

2.2 Ethnic Businesses

Asian immigrants have been shown to display a relatively high rate of self-employment compared to other ethnic minorities. In New Zealand, the 2001 census showed that the Asian ethnic group had the highest rate of self-employment without employees (13.30%), and that almost one-third of Koreans (30.02%) were involved in a small business at the time of the census (Table 2-1). The state of affairs was very different for the other ethnic minorities, with self-
Although the reasons for the high levels of entrepreneurship among Asian immigrants are not a main concern of this study, a brief review will be beneficial to the interpretation of the economic structure of Korean residential clusters and its implications. There are several conceptual frameworks that emphasise different elements as the main causes of Asians’ overrepresentation in small business. This section will present these frameworks in the form of three broad theories: the disadvantage theory, the resources theory, and the interaction theory. As with the theories of ethnic settlement patterns discussed in the previous section, the most relevant framework for Koreans in New Zealand must be chosen based on their particular characteristics so that it can be utilised as a concrete basis for further discussion.

The disadvantage theory posits that immigrant entrepreneurship is a product of labour market disadvantages for ethnic minorities (Auster & Aldrich, 1984; Ladbury, 1984; Light, 1979; Min & Bozorgmehr, 2003). Factors such as linguistic barriers impede immigrants’ access to well-paying mainstream jobs, and non-transferable educational qualifications and work experience from the home country further limit options in the employment market. Prejudice and

### Table 2.1 — Self-employment rates of selected ethnic groups in New Zealand

<table>
<thead>
<tr>
<th>Ethnic Group</th>
<th>Self-employed without employees</th>
<th>Total employed</th>
<th>Self-employment rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>European</td>
<td>191,385</td>
<td>1,449,060</td>
<td>13.21</td>
</tr>
<tr>
<td>Māori</td>
<td>11,565</td>
<td>185,820</td>
<td>6.22</td>
</tr>
<tr>
<td>Pacific peoples</td>
<td>3,150</td>
<td>77,352</td>
<td>4.07</td>
</tr>
<tr>
<td>Asian</td>
<td>11,895</td>
<td>89,466</td>
<td>13.30</td>
</tr>
<tr>
<td>Korean</td>
<td>1,515</td>
<td>5,046</td>
<td>30.02</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>213,177</strong></td>
<td><strong>1,867,179</strong></td>
<td><strong>11.42</strong></td>
</tr>
</tbody>
</table>

*Source: New Zealand Census of Population and Dwellings for 2001
Note: The respondents were allowed to choose more than one ethnic group.*

employment rates of only 6.22% and 4.07% for the Māori and Pacific peoples, respectively.
discrimination based on race or ethnicity also contribute the high rate of unemployment among new arrivals, thus leading them to start their own businesses to survive. This perspective views high rates of self-employment as a forced phenomenon shaped by external factors. Bonacich and Modell (1980) illustrate the nature of immigrant entrepreneurship using the experience of Japanese immigrants in the U.S. prior to 1965:

“... Japanese concentration in small business has been accounted for by the racism emanating from the surrounding society. They became proprietors, it is argued, because racial discrimination prevented them from finding opportunities for advancement in the general economy. Independent small business was an alternative route to success that did not depend on white goodwill” (p. 61).

This perspective provides a convincing explanation for the overrepresentation of ethnic minorities in small business compared to the non-minority individuals (Fairlie & Meyer, 1996; Light, 1979; Min & Bozorgmehr, 2003), and is understood as particularly relevant to Asian immigrants with a low level of proficiency in the majority language and non-transferable educational credentials. A survey of Korean entrepreneurs in Atlanta conducted in 1981 (Min, 1984) indicates that a considerable proportion of them entered into small businesses because there were no white-collar jobs available at the time (27.7%) or because of discrimination and disadvantages in the employment market (22.6%). Raijman and Tienda (2000) also found that for Koreans, the “mismatch between their skills and the jobs available in the labour market was an important reason for becoming business owners” (p. 701). As will be discussed in greater detail in the next section, the situation seems to be similar for contemporary Korean immigrants in New Zealand. Lee (2008) interviewed twenty Korean business owners in Auckland, all of whom indicated that the language barrier is the most influential reason for self-employment.

However, considering that such discrimination and disadvantages are common to some extent for most ethnic minorities, the disadvantage theory alone does not fully account for the observed variations between individual ethnic groups (Light, 1979). African Americans, for in-
stance, have been frequently discriminated against and structurally excluded from many aspects of society (Lieberson, 1980), but their self-employment rate tends to be notably lower than those of other immigrant populations. In 1982, the rate of business ownership for African Americans in the U.S. was only half of that for Hispanics and one-fourth of that for Asian Americans (Bogan & Darity, 2008). In New Zealand, the Asian ethnic group as a whole has a higher self-employment rate than the other population groups, but there are large variations within the overall Asian group (Table 2-2): whereas almost one-third of Koreans in New Zealand (31.9%) had income from self-employment or from a business, the corresponding figures for Filipinos and Sri Lankans were only 7.2% and 9.4%, respectively. This implies that although social discrimination is an important factor that pushes ethnic minorities to start their own businesses as alternatives to low-income jobs, there are other determinants of the differences in the rate of self-employment between different ethnic groups.

The resources theory attempts to explain these intergroup variations by focusing on the cultural and socio-economic resources that certain ethnic groups possess (Light, 1972; Light & Rosenstein, 1995). The basic idea of this theory is that the cultural predisposition towards hard work and entrepreneurship is not the same across all ethnic groups, and that this predisposition influences the proportion of people who start their own businesses and the manner in which they run them (Light, 1979; Light, 1972). Such ethnic resources include certain cultural traditions based on trust and cooperation between members of co-ethnic communities, and Light (1972) argues that these are the main factors that have caused the overrepresentation of Chinese and Japanese immigrants in small businesses in U.S. cities. For example, early Chinese entrepreneurs were able to amass business capital to open their shops or businesses relatively easily using so-called rotating savings and credit associations (Light, 1979; Light, 1972; Light &

5 Note that the figures in Table 2-1 and Table 2-2 are not only different in the years of the data, but also they are derived from different questions in the census. While the latter may be a more direct indicator of the self-employment rates, that information for 2006 is not publicly available, nor is the statistics for individual ethnic groups.
Gold, 2000), cooperative financial institutions that were informally organised and operated based on co-ethnic trust. Geertz (1962) briefly describes the principle below:

"A lump sum fund composed of fixed contributions from each member of the association is distributed, at fixed intervals and as a whole, to each member of the association in turn. Thus, if there are ten members of the association, if the association meets weekly, and if the weekly contribution from each member is one dollar, then each week over a ten-week period a different member will receive ten dollars (i.e., counting his own contribution)" (p. 243).

This type of institution has been traditionally popular in many countries in Asia, Latin America, and Africa as a method of acquiring a large amount of money for weddings, funerals, or travel (see Anderson, 1966 for chit funds in India; Campbell & Ahn, 1962 for kye in South Korea; Dekle & Hamada, 2000 for mujin in Japan), and some migrants benefit from this tradition in starting businesses (Light, 1972; Light & Gold, 2000). In contrast, researchers including Light (1972) have argued that African Americans do not have such a tradition and that this has contributed to their under-representation in the body of self-employed individuals.
Ethnic resources of this kind are common features of an ethnic group that encourage entrepreneurial activities (Light & Rosenstein, 1995). Ethnic solidarity, rotating savings and credit associations, and skills and knowledge that provide ethnic-specific goods and services are typical examples of such group resources. These resources are shared among all members of the group, and therefore, “an emphasis on ethnic resources leads one to interpret immigrant entrepreneurship as collectivistic” (Min & Bozorgmehr, 2003, p. 31). As mentioned in the previous section, however, the demographic and socio-economic characteristics of contemporary immigrants have become diverse, and there are often substantial status gaps within a group.

Class resources are another component of the resources theory that enables it to address intra-group variation. Class resources constitute the socio-economic and cultural endowment of individual immigrants as achieved within the class structure of the society in question, and they include private wealth, educational qualifications, prior business experiences, and social position in the home country (Hurh, 1998; Light, 1972; Light & Gold, 2000; Light & Rosenstein, 1995). Unlike ethnic resources, these are individual resources that may vary within an ethnic group depending on the type and purpose of immigration, among many other factors.

These ethnic and class resources are largely interrelated and blended with one another in real ethnic economies, but it remains unclear which of these resources are more central to the emergence of small businesses in ethnic communities. In general, the traditional studies conducted prior to the 1990s tend to view ethnic resources as main determinants of the existence of ethnic businesses (Light, 1972; Werbner, 1984; Wong, 1977). In contrast, a number of recent survey studies have reported that contemporary immigrants are more reliant on class resources. Yoon (1991) states, based on interviews with 199 Korean shopkeepers in Chicago, that ethnic resources are only marginally important for middle-class Korean entrepreneurs, and that those with sufficient class resources are unlikely to utilise ethnic resources in establishing their businesses. The greater significance of class resources for contemporary middle-class immigrants
was supported by similar findings for Taiwanese business owners in Los Angeles (Tseng, 1995) and for Japanese immigrant entrepreneurs in New York (Hosler, 1998; Min & Bozorgmehr, 2003).

In this vein, Min and Bozorgmehr (2003) point out that the relative importance of ethnic and class resources is dependent on the nature of the business and the structure of the ethnic economies. That is, a considerable number of small businesses and family-oriented shops are still largely reliant on ethnic resources, whereas more sizable businesses that compete in the mainstream market tend to be operated by those with strong class resources. The recent emphasis on class resources is therefore a result of the increase in the number of affluent immigrant entrepreneurs and investors with sufficient capital and entrepreneurial skills to establish their own businesses.

Although the resources theory provides a useful conceptual framework for explaining the overrepresentation of Asian immigrants in small business, it is often criticised for neglecting the demand side of the economy (Aldrich et al., 1985; Waldinger, 1984). Waldinger (1984) argued that ethnic and class resources are a necessary but not sufficient condition for beginning entrepreneurial activities, as they can only be utilised when sufficient opportunities are given to ethnic minorities. He therefore emphasised the interaction between the characteristics of ethnic groups (including their cultural and material resources) and the opportunity structures in the host society as the main force shaping ethnic economies (Waldinger, 1984). That is to say, even if an individual has enough financial capital and sufficient prior business experience to enter a particular business area, that person's ability to start a business and their success in doing so will be significantly affected by market conditions and whether they facilitate business ownership (Waldinger, 1984).

The presence of well-developed ethnic communities or enclaves, for instance, can provide greater opportunities for immigrants because the spatial concentration of the population
leads to the formation of a protected market that favours products and services offered by co-ethnic individuals (Aldrich, et al., 1985). In the early stages of immigration, the only businesses in ethnic communities are usually those offering cultural services and amenities that cannot be provided by non-ethnic individuals or would be very difficult for them to provide. However, as residential succession occurs and the size of the enclave increases, the majority population tends to move out of the area to maintain the minimum social distance, consequently also relocating shops and stores that were previously located within the enclave. Theoretically, this opens up further opportunities for new migrant entrepreneurs who possess sufficient wealth and experience and encourages (or allows) them to diversify their business areas. The ethnoburb phenomenon discussed in the previous section is perhaps a good example of this scenario.

On the other hand, a number of empirical studies have shown that some minority groups seek such opportunities outside of their ethnic markets. This is particularly the case when a group has a significantly high rate of self-employment compared to the co-ethnic population because in this case, being confined to the ethnic community implies severe competition within a small niche. In the U.S., for example, a large number of successful businesses operated by Koreans, Chinese, or Japanese are located in residential areas populated by African Americans or Hispanics and targets them (Waldinger, 1989). These businesses are often in areas where majority corporations and white business owners are reluctant to settle their businesses due to relatively high crime rates and lower income levels, or at least the appearance of those qualities. The absence of the majority population in some areas provides the opportunity for businesses run by minorities, and Bonacich (1973) argued that these opportunities are apt to be seized by non-permanent immigrants (or sojourners, as he termed them) who intend to return to their home country because their ethnic resources are usually suitable for such middleman industries.

Government policies for immigrants are also an important component of the opportunity structure because they affect the business opportunities of ethnic minorities both directly and
indirectly. In some countries, governments explicitly restrict immigrants' access to ownership positions in particular business and industrial areas, mainly to protect the domestic population, while encouraging newcomers to work in other areas, especially those with a shortage of skilled labourers. In New Zealand, immigration policies give significant preference to those who possess specific skills in shortage areas, work in those fields, or are willing to establish a business in these areas.

In summary, as with the determinants of ethnic settlement patterns, the factors that influence the self-employment rates of ethnic groups are intimately intertwined (Fig. 2-4). Entrepreneurship and occupational concentration as presented in a particular ethnic community is a product of these factors, and thus, it is important to interpret the structure and implications of an ethnic economy in relation to these factors. The relative significance of the four determinants in Fig. 2-4 for Koreans in Auckland will be discussed in Chapter 6.

2.3 New Zealand Cases

Until very recently, New Zealand was a bi-ethnic and bicultural country, consisting of early British settlers and indigenous Māori people. Before the introduction in 1987 of a point system for immigration selection that considers the capital, skills, and educational backgrounds of applicants and is blind to their ethnicity or nationality, the immigration door was opened almost exclusively to those with European backgrounds and a limited number of Pacific people (Bedford, et al., 2000a; Kim & Yoon, 2003; Lidgard, 1996; Lidgard et al., 1998; Ongley & Pearson, 1995). At that time, the number of immigrants from non-traditional source countries, such as China and Korea, was insignificant, and there were virtually no apparent ethnic residential clusters.

The extensive inflow of Asian immigrants and the increase of the Pacific population dur-
The 1990s have made their residential concentration more visible to scholars and the media, and the settlement patterns of ethnic minorities have begun to draw attention. In 2000, the New Zealand Herald quoted a study by the Auckland University of Technology:

“Cantonese and Northern Chinese have been drawn to Howick, Koreans have added their cultural presence to Torbay and Sunnynook while Hindi and Gujarati-speaking Indians have concentrated in New Windsor and Lynfield. ... other Polynesian groups have been influencing the character of different parts of the region: Tongans in Penrose and Sandringham, Samoans in Mangere, Otahuhu and other parts of southern Auckland” (New Zealand Herald, 2000).

Poulsen, Johnston, and Forrest (2000) formally examined the ethnic composition of major cities in New Zealand to test the presence of enclave-like ethnic residential concentrations. They analysed the population share of fifteen ethnic minorities (i.e., Māori, six Pacific Islander groups, and eight Asian groups) at the census tract level and found that none of the individual groups that they examined were spatially segregated in 1996. There was, however, some evidence of
clustering for Pacific peoples as a whole, as they formed a large proportion of the local population in South Auckland. By contrast, Asians were relatively dispersed even when considered as a whole, and this pattern persisted over the next two census years, 2001 and 2006 (Johnston, et al., 2008).

While overseas-based researchers have attempted to measure the degree of segregation and to find ethnic enclaves using quantitative approaches, New Zealand-based researchers have focused on explaining the characteristics of empirically identified ethnic settlements. In the case of Chinese in Auckland, several authors have noted that they were concentrated in affluent suburban areas, such as Howick and Pakuranga (Ip, 2003; Yoon, 2003 for Taiwanese, in particular). Ip (2003) argued that this is a result of “the preference of the urban Chinese for brand-new, low-maintenance and brick-and-tile homes” (p. 349) and that some reputable state schools within the areas may have attracted recent Chinese immigrants, who prioritise their children’s education. Although the Chinese community in the Auckland region is not yet as visible as their North American counterparts and there is a difference in scale, the recent changes in demographic and socio-economic profiles indicate that they share more attributes with ethnoburbs than with ethnic enclaves (Ho & Bedford, 2006).

In a similar vein, the central Auckland suburb of Sandringham could be considered another example of the contemporary ethnoburb phenomenon. According to Friesen, Murphy, and Kearns (2005), the recent growth of Asian immigrants, particularly those from India, has significantly diversified the ethnic fabric of Sandringham, and there are now many ethnic retailers as well as middle-class Indian immigrants. While relatively low housing prices and rents in this area have perhaps contributed to attracting newcomers, the increase in ethnic retailers and religious facilities in Sandringham has played a more important role in maintaining the Indian ethnic community. In this regard, Sandringham (at least for Indians) is not a place to escape, like the stereotyped urban enclaves. Rather, it is a place that caters to cultural needs such as Indian
food and clothing in a new country (Friesen, et al., 2005).

In contrast to the Chinese and Indian communities, the residential pattern of Pacific peoples is generally interpreted as an involuntary separation caused by their economic conditions. The Pacific people in New Zealand are relatively young and less affluent compared to the other immigrant groups. Most Pacific peoples are concentrated in suburbs where low-cost state housing is provided, and their degree of segregation is higher than it is for other ethnic groups (Johnston, et al., 2008). Hence, although cultural ties may influence their choice of a residential location to some extent, the geographic distribution of Pacific peoples is not generally thought of as voluntary, indicating that ethnoburb-like clusters have not yet emerged for Pacific peoples in New Zealand (Bedford et al., 2000b).

Compared to these major immigrant groups, Koreans have received little attention from researchers due to their fast-growing but still small population size as well as the perception that they are ‘similar’ to Chinese. There seem to be no studies specifically focusing on the settlement patterns of Korean immigrants, though a brief mention has been made in several papers (e.g., Anderson, 2008; Kim & Yoon, 2003; Yoon, 2003; Yoon & Yim, 1997).

Koreans’ reasons for migration and their socio-economic well-being in New Zealand have been more popular topics, probably because these are less dependent on the scale of the population. Lidgard (1996; Lidgard, et al., 1998), for example, examined the educational and economic background of Korean immigrants (along with others from Taiwan and Hong Kong) and their socio-economic status in New Zealand based on an open-ended interview with 42 participants (31 in 1998). Yoon and Yim (1997) analysed the business pattern of Koreans in Auckland and its spatiotemporal changes between 1992 and 1996. They found that most Korean businesses at that time were restaurants, travel agencies, and souvenir shops targeting Koreans, and these were mostly concentrated in North Shore City and the CBD area. According to their research, almost all businesses were owner-operated, catered to the social and cultural needs of a co-
Lee (2008) interviewed 20 Korean business owners in Auckland and investigated their reasons for self-employment and methods of establishing their businesses. Although the findings based on these interview data could be biased due to the small sample size and the non-random sampling process, they provide useful information on how ethnic and class resources have been utilised among Korean entrepreneurs. Lee’s findings were consistent with Yoon and Yim’s (1997) study, which found, in that Korean businesses are an alternative to unemployment and depend considerably on ethnic resources.

Yoon (1998) discussed the cultural identity of Korean immigrants in New Zealand. He argued that cultural identity is formed by the interaction of four factors: the attitudes of the host society, immigration law and policy, the cultural heritage and economic prosperity of the home country, and length of residence in the new country. Because the immigration history of Koreans to New Zealand was short, they were neither integrated nor assimilated socially or culturally to the majority society. Yoon noted, “Their identities, how they view themselves: Koreans, New Zealanders, or Korean New Zealanders, are yet to be formed” (p. 75). However, he pointed out based on his observations that first-generation Korean immigrants tend to maintain strong emotional ties to their home country.

Case studies of Koreans living in cities other than Auckland are important for comparison, but they are few in number due to the small population size. For example, Christchurch, the second most popular destination for Korean immigrants, had only about 4,569 Koreans in 2006, which is less than a quarter of the Korean population residing in Auckland. One of the few available studies was conducted by Chang, Morris, and Vokes (2006). They recruited participants using ethnic newspaper advertisements and interviewed 36 Korean immigrants regarding their reasons for migration and their experiences in Christchurch. Like Koreans in Auckland, most
respondents indicated that they came for their children’s education and for better, less stressful lifestyles, and a considerable number of them were self-employed as an alternative to unemployment or underemployment in the new country.

Despite this recent focus on the demographic and socio-economic aspects of Koreans, their settlement patterns have not been investigated in detail, probably because their population scale is not yet as big as that of Chinese and Indians. Nonetheless, they form residential clusters that are quite distinctive from other Asian ethnic groups in the Auckland urban areas (Yoon, 2003, pp. 98-101). This will be addressed in Chapter 4 using statistical methods outlined in the next section.

2.4 Relevant Statistical Tests

2.4.1 Global statistics

Sociologists and other social scientists have attempted to develop a numerical method for summarising the current status of ethnic settlement patterns since around 1950. While the index of dissimilarity, which was originally proposed by Duncan and Duncan (1955), has dominated the literature for over a half a century, there are many others, such as the Gini coefficient and the index of spatial proximity, as well as more recent local approaches, including the local Moran’s $I$ index. As Jahn (1950) pointed out a long time ago, these different measures may address different aspects of residential segregation, and therefore, which one is correct or best should be determined based on the nature of a given research problem.

In this regard, Massey and Denton (1988) argued that there are five interrelated but conceptually distinguishable dimensions of residential segregation, namely, evenness, exposure, concentration, centralisation, and clustering, and various segregation measures can also be clas-
sified accordingly. They surveyed a variety of segregation indices available at the time and analysed their interrelationships using the factor analysis. The results supported that the segregation indices can be effectively grouped into five different subsets based on their correlations, and the five hypothetical aspects of segregation are legitimate to a certain extent. This section primarily focuses on evenness and clustering because these two dimensions are particularly relevant to the present research problem.

The index of dissimilarity has been considered to be one of the best methods to assess the evenness of a population distribution across geographic areas (Massey & Denton, 1988). It indicates the degree of spatial evenness based on the proportions of two mutually exclusive population groups across a set of spatial units (e.g., census tracts). The formula can be written as:

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

where \(X\) and \(Y\) denote the total population counts of two population groups in the region, which is divided into \(k\) subareas, while \(x_i\) and \(y_i\) are the local populations in the \(i\)th census tract. The output value ranges from 0 to 1, indicating the proportion of a group population that should be moved from overrepresented areas to underrepresented ones to achieve uniform distribution of the population proportions (i.e., \(\frac{y_i}{X} = \frac{1}{k}\) for all \(i\)).

As Duncan and Duncan (1955) clearly noted, this index measure is closely related to more classical methods such as the Lorenz curve and the Gini index, both of which were developed in the early twentieth century. As with the index of dissimilarity, the Gini index provides

---

6 The list of segregation indices reviewed in their article is as follows: (1) Unevenness: index of dissimilarity, Gini index, entropy index, and Atkinson index with \(b=0.10, 0.50, \) and \(0.90\); (2) Exposure: interaction index, isolation index, and correlation ratio; (3) Concentration: Duncan’s delta index, absolute concentration index, and relative concentration index; (4) Centralisation: proportion in the central city, absolute centralisation index, and relative centralisation index; and (5) Clustering: absolute clustering index, special proximity index, relative clustering index, distance decay interaction index, and distance decay isolation index. This section covers only a few selected measures among them.
information about inequality, and the Lorenz curve visually represents the unevenness of population distribution. To see that they are interlinked, Fig. 2-5 shows the Lorenz curve of the Asian population in Auckland City (solid), and a hypothetical diagonal represents the completely even distribution of the population proportions (dotted). In the graph, the maximum distance between the Lorenz curve and the diagonal line indicates the index of dissimilarity, and the Gini index can be similarly retrieved from the area between the two lines (see Dorfman, 1979; Duncan & Duncan, 1955 for further explanation). According to Massey and Denton (1988), such comparability of the dissimilarity index, and its straightforward calculation and interpretation, have made it one of the most popular methods in the relevant literature since the 1950s.

One limitation of this simple indicator may be that it does not take spatial arrangement of the spatial units into account. White (1983) elucidated the issue using a checkerboard whose squares represent census tracts (parcels):

"Once the composition of each parcel (square) is given, any spatial rearrangement of them will still result in the same calculation for D. ... A city in which all the non-white parcels were concentrated into one single ghetto would have the same level of calculated segregation as a city with dispersed pockets of minority residents" (pp. 1010-1011).

This is often called the checkerboard problem (White, 1983), and is considered a critical shortcoming for studies that aim to capture the spatial dimensions of segregation, such as clustering (Massey & Denton, 1988).

In this context, an alternative measure called the index of spatial proximity has been proposed to focus more on the spatial aspects of segregation (White, 1983). This approach first estimates the average distance between all individual spatial units regardless of the (racial) group and then compares that with the sum of the within-group proximities weighted by their respective population size:
In equations (2.2) and (2.3), $X$, $Y$, $x$, and $y_i$ are defined as in (2.1). Unlike the index of dissimilarity, this formula can be easily extended to three or more groups by adding them to the numerator in the same manner as the groups $X$ and $Y$. The distance function should be chosen based on a priori to represent the relationship between social interaction and physical distance, but White (1983) demonstrated that, in general, $f(d_{ij}) = e^{(-d_{ij})}$ performs well. The resulting value
would be equal to one if the population groups were equally distributed and increase as the members of each group are clustered. When the population groups are rather randomly scattered, the outcome tends to be smaller than one. Massey and Denton (1988) recommended the use of this method to capture the clustering of ethnic minorities since it has "... at least appeared in the research literature" and is "easier to calculate and to interpret" (p. 309).

The Moran's index of spatial autocorrelation, perhaps better known as Moran's $I$, is similar to the spatial proximity measure in that it also evaluates the degree of clustering, but its calculation is based only on a single group of interest (Moran, 1950):

$$I = \frac{n}{\sum_{i=1}^{k}\sum_{j=1}^{k} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^{k}\sum_{j=1}^{k} w_{ij}}$$

(2.4)

where $w_{ij}$ is an element at $(i, j)$ in a symmetric neighbourhood matrix, $w$, which describes the spatial relationship between the spatial units. This statistic was not included in Massey and Denton's review (1988) and had been used little, if any, in the racial segregation literature until very recently (see, for example, Frank, 2003). However, it may provide a more reliable indication of clustering than the $SP$ index when the population of interest is small in size, as it is not affected by the spatial arrangements of other big population groups. Moreover, unlike most other traditional measures of segregation, the statistical significance of Moran's $I$ can be tested because the expected value and standard deviation are known under the hypothesis of no clustering (Moran, 1950).

In practice, when the minority group constitutes more than a certain proportion of the total population, the index of spatial proximity and Moran’s $I$ are usually correlated with the dissimilarity index. As shown in the top three plots in Fig. 2-6, these measures are positively associated when the minority population comprises over 10% of the total population. This probably means that, as Reardon and O'Sullivan (2004) argued, the evenness and clustering dimensions of
segregation can be considered as one single aspect, because a high degree of unevenness almost always implies a high degree of clustering in such cases.

When the minority population is small in size, however, uneven distribution is likely to be caused by random chance, and the checkerboard-like pattern can exist at the same time. For areas where the minority population consists of 10% or less of the total population, there is no clear trend in the correlation plots (the bottom three plots in Fig. 2-6), indicating that the evenness and clustering indices contain significantly different information. A careful choice of methods is therefore particularly required to address a given research question when dealing with a

Fig. 2-6. Pairwise scatter plots showing the correlations among the index of dissimilarity, the index of spatial proximity (SP), and Moran’s I when the minority population comprises over (top) and less than (bottom) 10% of the total population

Morrill (1991) has attempted to combine the structural and spatial measures by incorporating the average proportional difference of a minority group between pairs of adjacent areas into the equation (2.1):

\[
D(\text{adj}) = D - \frac{\sum_{i=1}^{k} \sum_{j=1}^{k}|z_i - z_j|c_{ij}}{\sum_{i=1}^{k} \sum_{j=1}^{k} c_{ij}}
\]

where \(z_i\) and \(z_j\) are the proportions of the minority population in the \(i\)th and \(j\)th area unit, and \(c_{ij}\) denotes an element at \((i, j)\) in a symmetric binary contiguity matrix \(c\). Theoretically, the modified index value will be similar to the original index of dissimilarity if the area units with a high proportion of the minority population are clustered in certain parts of the region. By contrast, if the high proportion areas are scattered across the study region like a checkerboard, the resulting index value may be substantially lower than the original one (Morrill, 1991).

Wong (1993) has supplemented this adjusted index of dissimilarity by taking more geometric characteristics, such as the lengths of the shared boundaries and the shapes and sizes of the area units, into account. He argued that the use of a binary neighbourhood matrix to represent the spatial structure of the data may oversimplify the actual phenomenon because “the binary matrix fails to capture the variation of interaction intensity across boundaries due to the variation of the ease of crossing boundary indicated by the boundary length” (Wong, 1993, p. 562). He proposed replacing the binary neighbourhood matrix in (2.5) with a distance-weighted matrix, \(w\), which contains the normalised lengths of the common boundaries:

\[
D(w) = D - \frac{\sum_{i=1}^{k} \sum_{j=1}^{k}|z_i - z_j|w_{ij}}{\sum_{i=1}^{k} \sum_{j=1}^{k} w_{ij}}
\]

and
where $d_{ij}$ is the length of the shared boundary between two spatial units $i$ and $j$.

Wong (1993) further argued that since geometric shapes of the spatial units could also affect individuals’ accessibility to neighbouring areas, the sizes and lengths of the units should be considered to reflect this factor. He claimed that such spatial information can be summarised by the ratio of the perimeter to the area, and therefore, the modified index can be formulated as below:

\[
D(s) = D - \frac{1}{\sum_i \sum_j w_{ij} \sum_i \sum_j \left( |z_i - z_j| w_{ij} \frac{P_i/A_i + P_j/A_j}{2 \text{MAX}(P/A)} \right)}
\]  

(2.7)

where $P_i$ and $A_i$ are the perimeter and area of the spatial unit $i$, and $\text{MAX}(P/A)$ is the maximum possible ratio in the entire region. In general, the boundaries of the study area do not account for the calculation of this statistic as no interactions with the outside are presumed.

These adjusted measures are an efficient way of providing comprehensive information about segregation, but some caution is required when the population size is small. Because the spatial components in equations (2.5), (2.6), and (2.7) do not only depend on the relationship between census tracts (as intended) but also on the proportions of the minority population, $z_i$, small variations in $z_i$ can eliminate them to a large extent.

To illustrate, the three indices have been calculated for two ethnic groups, namely Pacific people and Middle Eastern, Latin American and African (MELAA) people, in Porirua city using the 1991 census data and compared with the traditional index of dissimilarity, the spatial proximity index, and Moran’s $I$. Fig. 2-7 presents the geographic population distribution for each ethnic group, its Lorenz curve, and a box plot of the $(z_i - z_j)$ values. The index of dissimilarity
derived from the Lorenz curves indicates that both of them are somewhat unevenly distributed (0.578 for Pacific people and 0.436 for MELAA), while Pacific people tend to be more concentrated in certain parts of the city ($SP = 1.34, I = 0.46$ for Pacific people, and $SP = 1.00, I = -0.11$ for MELAA). That being said, it would be reasonable to expect that the former three methods significantly lessen the level of segregation for MELAA, as they are more scattered across the region, and that the segregation values for Pacific people should be much less affected. The re-
sults, however, show that the level of segregation for MELAA has largely remained the same (i.e., $D(adj) = 0.434$, $D(m) = 0.433$, and $D(s) = 0.435$), whereas it has been lowered by up to 20% for Pacific people (i.e., $D(adj) = 0.454$, $D(m) = 0.479$, and $D(s) = 0.523$). This contradiction is perhaps due to the small $(zi - zj)$ values for MELAA as given in Fig. 2-7, which practically neglected the spatial components.

This point may become clearer if the adjusted indices are applied to a more extensive data set from sixteen New Zealand cities. Fig. 2-8 demonstrates that when the population size is small (so there are virtually no variations in the proportion differences of neighbouring units), the spatial components contain very little extra information. However, as the population size increases, the additional spatial terms do make a difference, and the results can be interpreted as intended.

When the minority population is small in size, there is another important issue related to the use of these indices. That is, since this measurement works on the data in which the population counts are agglomerated into arbitrarily defined geographic areas, such as census tracts, electorates, and school zones, the resulting degree of segregation depends not only on the actual distribution of the population but also on the choice of geographic units (Openshaw, 1984). The impact of this so-called modifiable areal unit problem (MAUP) is particularly large when the population of interest constitutes only a small fraction of the total population compared to the number of geographic units, as local proportions are likely to be unstable in that case. Table 2-3 shows how the index of dissimilarity can change by small shifts in the unit boundaries for different population sizes, $p$, when the number of geographic units, $n$, is held constant (i.e., aggregation problem). The variation would be much greater if the geographic units were agglomerated into smaller numbers (i.e., scale problem).

---

7 The population size and the mean and standard deviation of $(z_i - z_j)$ are, of course, conceptually very different, but in practice these are often positively correlated. For that reason, although the plots in Fig. 2-7 are based on the mean of $(z_i - z_j)$, the suggestions made in this paragraph used the population size as an indicator.
Of course, this issue can be completely eliminated if the exact point locations of the data are available, or if at least the spatial units can be customised to fit research objectives (Reardon & O’Sullivan, 2004; Wong, 1997). In practice, however, the data are usually available in aggregated forms only due to confidentiality issues, and therefore, it is important to estimate the effects of the MAUP before interpreting the indices (Wong, 1997; Wong et al., 1999). One way to assess the MAUP bias may be to combine the smallest geographic units into different combinations of larger areas and to observe the variations in the results (Tobler, 1989; Van Beurden & Douven, 1999; Wong, 1999). If the data are susceptible to the MAUP, then other alternative approaches that could possibly reduce its effects to some extent should be sought.

Table 2.3 — Variations in the index of dissimilarity for different population sizes, $p$

<table>
<thead>
<tr>
<th>$p$</th>
<th>min</th>
<th>$\mu$</th>
<th>max</th>
<th>$\sigma$</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>0.4590</td>
<td>0.6889</td>
<td>0.8241</td>
<td>0.0538</td>
</tr>
<tr>
<td>25</td>
<td>0.2941</td>
<td>0.4322</td>
<td>0.5723</td>
<td>0.0419</td>
</tr>
<tr>
<td>100</td>
<td>0.1439</td>
<td>0.2112</td>
<td>0.2887</td>
<td>0.0226</td>
</tr>
<tr>
<td>1000</td>
<td>0.0488</td>
<td>0.0693</td>
<td>0.0924</td>
<td>0.0075</td>
</tr>
</tbody>
</table>

Note: The simulation algorithm is provided in Appendix A.

Fig. 2.8. Scatter plots showing the correlations between the spatial components (D(adj), D(w), and D(s)) and $\mu(z_i - z_j)$.
The spatial dissimilarity index ($\tilde{D}$) proposed by Reardon and O'Sullivan (2004) avoids the MAUP issue as it is theoretically independent of spatial units. This multi-group segregation measure is defined as:

$$\tilde{D} = \sum_{m=1}^{k} \int_{\Omega} \frac{\tau_p}{2\pi T} |\tilde{\rho}_{pm} - \pi_m| dp$$

(2.8)

where $k$ is the number of racial groups, $T$ the total population in the study region, and $\pi_m$ is the proportion of the group $m$ in the total population ($m = 1, 2 \ldots k$). $\tau_p$ is the total population density at point $p$, $\tilde{\rho}_{pm}$ the population density of $m$ in the local environment of point $p$, and $I$ is:

$$I = \sum_{m=1}^{k} (\pi_m)(1 - \pi_m)$$

Unlike the traditional dissimilarity index and its spatial associates outlined above, this does not require the use of aggregate spatial units such as census tracts, and is theoretically free from the MAUP problem. Although, in practice, almost all data available are already in aggregate form, so the use of a MAUP-free approach does not necessarily eliminate all possible errors, it can reduce the risk substantially by utilising an appropriate interpolation map.

Despite this methodological advantage, however, it has not been widely used in the literature probably due to its difficult calculation. Compared to the traditional segregation indices, the spatial index is very computer intensive, and constructing an appropriate interpolation map requires significant computing skills and knowledge in statistics. While many spatial measures are implemented as standalone programs or extensions to help researchers (Apparicio et al., 2008; Wong, 2003), none of the software packages ‘publicly’ available support the spatial dissimilarity index, limiting its wide use. Nonetheless, Kramer and his colleagues argued in their recent paper that such surfaced-based approaches can be more accurate and provide better insights (Kramer
et al., 2010), and the present research will employ this index as a measure of the overall clustering, together with the spatial exposure index.

The spatial exposure index ($\tilde{P}^*$) was also proposed by Reardon and O’Sullivan (2004) and the degree of exposure of group $m$ to group $n$ is defined as:

$$m\tilde{P}^*_n = \int_{p \in R} \frac{\tau_{pm}}{T_m} \tilde{n}_{pn} dp,$$

where $\tilde{n}_{pn}$ is defined as in (2.9), and $\tau_{pm}$ and $T_m$ refer to the population and density of $m$, respectively. Although this research is mainly about residential clustering of Koreans, the exposure index will also be used in Section 4.1, as useful contextual information to explain the clustering.

In a similar vein to the spatial dissimilarity index, O’Sullivan and Wong (2007) have proposed the use of the kernel method for summarising the geographic distribution of a population. Kernel density estimation is a common technique to estimate the density function of a variable, or variables, using a discrete set of observations (e.g., centroids). The bivariate kernel estimator is defined as:

$$\hat{f}(x) = \frac{1}{nh^d} \sum_{i=1}^{n} K\left\{ \frac{1}{h} (x - X_i) \right\}$$

where $X_1, ... X_n$ are the coordinates of the data points whose underlying structure is to be found, $K(x)$ is the kernel function, and $h$ is the size of kernel. Once an appropriate kernel function and bandwidth are chosen, a lattice grid is projected on to the data surface, and then $\hat{f}(x)$ is computed for each cell. Intuitively, the choice of $h$ is critical to the degree of the smoothness of the data and thus is recommended to examine several $h$ values to find the most reasonable choice. While there are a variety of available kernel functions, including the Uniform and Gaussian functions, the Quartic (biweight) function is often adopted for the bivariate kernel estimator and is
implemented in most standard statistical packages, including R.

O’Sullivan and Wong (2007) suggested applying this kernel method to the population data normalised by its total population so that the density function for each group has the total volume of one. Segregation of one racial group from another can then be measured by:

\[ S = 1 - \frac{V_I}{V_U} \]  

(2.10)

where \( V_I \) denotes the volume of the intersection between the two distributions, and \( V_U \) is the union of them (see O’Sullivan & Wong, 2007, pp. 154-156; Wong, 1999, pp. 639-643 for more details). Since the volumes of the intersection and union can be approximated as:

\[ V_I = \sum_i \min(p_{xi}, p_{yi}) \]  

(2.11)

and

\[ V_U = \sum_i \max(p_{xi}, p_{yi}) \]  

(2.12)

substituting (2.11) and (2.12) into (2.10) leads to:

\[ S = 1 - \frac{\sum_i \min(p_{xi}, p_{yi})}{\sum_i \max(p_{xi}, p_{yi})} \]

\[ = \frac{\sum_i \max(p_{xi}, p_{yi}) - \sum_i \min(p_{xi}, p_{yi})}{\sum_i \max(p_{xi}, p_{yi})} \]

\[ = 1 - \frac{\sum_i |p_{xi} - p_{yi}|}{\sum_i \max(p_{xi}, p_{yi})} \]  

(2.13)

where \( p_{xi} \) and \( p_{yi} \) are defined as in (2.3). Note that (2.13) resembles the index of dissimilarity (2.1), except that it is not divided by two. As the grid size is getting smaller, the \( S \) index converg-
es into the index of dissimilarity, which is adjusted by a spatial component $2/V_0$ and hence, becomes reasonably comparable to the most popular measure of segregation.

The $S$ index has an advantage over the other indices outlined above in that it does not only provide the overall level of clustering and evenness in the study region but is also capable of visualising the local variations of segregation. The kernel density maps allow exploration of areas where the population of interest is concentrated and thus justifies the given index value to some extent. Where further confirmatory tests are desired, there is a group of statistical tests that are particularly designed to test the significance of segregation at the local level, which will be discussed in the following section.

2.4.2 Local statistics

As has been shown so far, various index measures compute the degree of residential segregation in different ways to put emphasis on different aspects of the social phenomenon. In a broad perspective, however, these methods are the same in that they are intended to summarise the overall distribution of a given population as a single numeric value. This kind of methods is often referred to as global statistics, or general tests, and is useful to characterise the general trend of the entire study region. Nonetheless, relying on these global statistics could potentially distort the situation because they are usually vulnerable to the outliers and large variations in the data, especially when the population size is small.

Local statistics, also known as focused tests, overcome this limitation by assessing the degree of spatial autocorrelation (i.e., segregation in this context) at each individual spatial unit and identify hotspots that may require extra attention. Even when no evidence of overall clustering is found in the whole region, local statistics can discover pockets of areas where the minority population is significantly clustered. Examples of the local statistics include Openshaw's
Geographic Analysis Machine (GAM), Kulldorff’s scan statistic, the local Moran’s $I$, and the local $G_i$ statistics; each of these will be briefly outlined below. Though strictly speaking, the former two should be classified as scan statistics and distinguished from focused tests, they are reviewed in this section as they can also detect the locations of possible clusters and test their significance.

Openshaw’s GAM attempts to investigate all possible sets of observations that are spatially close to one another (Openshaw et al., 1987). As with the kernel density estimation, the testing procedure begins with superimposing a regular grid lattice with the grid size, $g$, and then at each grid node counts the number of data points within a distance $r$. If we can assume that the data follow a certain probability distribution, the statistical significance of a group being tested can be obtained by comparing the observed value with the expected under the hypothesis of no clustering. Once all grid nodes have been visited and examined, areas with a considerable concentration of the subject that is unlikely to occur by random chance can be highlighted with one or more overlapping circles, depending on the grid size, $g$, and the search radius, $r$.

Obviously, the careful choice of $g$ and $r$ is crucial to the accuracy and reliability of the result. Although there are no rules of thumb to determine them, it is generally recommended to make the grid size sufficiently smaller than the search radius so that the test sets can be overlapped to a large extent (Openshaw, et al., 1987). In practice, several different $g$ and $r$ are applied to the test to ensure that all possible combinations are considered, while the minimum search radius is often chosen based on the average nearest-neighbour distance in the data; thus, each test of significance can include a meaningful number of observations.

The use of an appropriate test statistic for a given data set is also essential to gain reasonable outcomes from GAM, but it is usually, if not always, problematic to determine the test statistic because the true underlying distribution is unknown (Openshaw, et al., 1987). Because this method is mainly utilised in the field of epidemiology to find areas with a high incidence
rate of a certain disease, the Poisson probability density function is often conventionally accept-
ed as an adequate estimation; but, in case overdispersion of the data being examined is sus-
ppected, which is typical when the data are highly autocorrelated (i.e., spatial heterogeneities), the
negative binominal may be more appropriate.

Although GAM is a useful exploratory tool to generate hypotheses regarding where the
clusters may be located, the significance tests are not considered reliable because the results are
likely to contain an unacceptable level of type I error (i.e., false detection). Since GAM carries a
large number of statistical testing on the overlapping and dependent data sets, the Bonferroni
correction, which divides the local threshold of the $p$-value by the number of tests to maintain
the overall level of segregation, tends to be too conservative (Kulldorff & Nagarwalla, 1995). In
this regard, Haining (2003) pointed out that: “its testing procedure and approach to visualization
tend to pick out in the study region clusters in small, densely packed spatial units with large
populations” (p. 253).

To overcome this shortcoming, Kulldorff and Nagarwalla (1995) have proposed the use
of the likelihood ratio test to choose the most significant cluster among all possible subsets. Simi-
lar to GAM, it draws a regular or irregular grid lattice that goes through all observed data points,
which could be centroids of the given spatial units if the data are in aggregate form. Instead of
using an arbitrarily-defined radius of a circle, however, Kulldorff’s scan statistic begins with a
search radius of zero, which only includes the chosen data point itself and gradually increases
the size until it covers a certain fraction, $p$, of the total population. Once all possible sets are con-
structed, it calculates the likelihood function at each subset, $z$:

$$L(z, p, q) = p^{c_z}(1 - p)^{n_z - c_z}q^{c - c_z}(1 - q)^{(N - n_z) - (c - c_z)}$$  \hspace{1cm} (2.14)

where
Among all \((p, q)\) that meet the conditions \(p, q \in [0,1]\) and \(p + q = 1\), the one that maximises (2.14) is chosen, and then the likelihood-ratio test statistic can be derived as usual with the null hypothesis, \(H_0: p = q\), and the alternative, \(H_1: p > q\). The significance of the computed value can be evaluated through a large number of iterations in the Monte-Carlo simulation.

In the field of epidemiology, Kulldorff’s scan statistic is the most widely used method to detect the most likely cluster of a certain disease, and there is a considerable amount of literature that advocates its application in a wide range of disciplines and circumstances. Such a scan statistic has, however, rarely, if ever, appeared in the segregation literature, while other similar forms of focused tests, such as the local Moran’s \(I\) and Getis-Ord’s local \(G/G^*\) statistics, have become relatively popular since the late 2000s.

Anselin (1995) has shown that the Moran’s index of spatial autocorrelation, \(I\), which is discussed above, can be decomposed into local values, \(I_i\):

\[
I_i = \frac{(x_i - \bar{x})}{s^2} \sum_{j=1}^{n} w_{ij} (x_j - \bar{x})
\]

(2.15)

where \(s\) denotes the sample standard deviation of \(x\). Each local indicator of spatial autocorrelation (LISA), \(I_s\), describes the extent to which adjacent areas of a given census tract, \(i\), are similar to, or different from, \(x_s\) and the sum of all LISA is proportional to the global index of spatial autocorrelation (Anselin, 1995). When the weight matrix \(w\) is row-standardised and \(n\) is large, the
expected value for $I_i$ is approximately zero, and thus, as with its global counterpart, a high value of $I_i$ can suggest statistically significant clustering of similar values at the location $i$.

The local $G_i/G_i^*$ statistics are an alternative way of estimating spatial clustering at the local level. At each data point, whether weighted or not, the test statistic calculates an index indicating if high or low values are clustered within a predefined distance, $d$:

$$G_i(d) = \frac{\sum_j w_{ij} z_l}{\sum_j z_i}, \text{ and } i \neq j$$

and

$$G_i^*(d) = \frac{\sum_j w_{ij} z_i}{\sum_j z_i}$$

where $w_{ij}$ is a symmetric matrix of spatial proximity between the points. The difference between $G_i$ and $G_i^*$ is that the former excludes the data in the current location in the calculation, while $G_i^*$ includes it, so it is perhaps more appropriate to detect clusters (Haining, 2003).

For both statistics, a large positive index value indicates possible clustering of high values around the point, $i$, and a large negative value implies clustering of low values. The expected value for $G_i(d)$ and $G_i^*(d)$ is approximately zero under the hypothesis of normality (or randomness), and the normality assumption is preserved when the distance $d$ is large enough. However, if global autocorrelation is present, this could affect the mean and standard deviations of these local indicators, and therefore, any inference on the significance of a particular cluster should be made with caution (Anselin, 1995).

When the local Moran's $I_i$ and $G_i/G_i^*$ are applied to the whole study region to be used as scan statistics, they usually involve a fewer number of tests than GAM, so the Bonferroni correction may be feasible (Haining, 2003). With the use of the Bonferroni correction, the resulting
map would be less conservative than that from Kulldorff’s scan statistics in finding multiple numbers of clusters, whereas it would be more effective than GAM in terms of a smaller type I error.

Nevertheless, despite the methodological improvements made over the last two decades and the immense computing power, these local measures of spatial clustering have been little used in the residential segregation literature until very recently; yet, they are now receiving an increasing amount of attention from researchers. Brown and Chung (2006), for example, have utilised the local Moran’s I to explore the ethnic clustering of a population in Franklin county in Ohio. Poulsen, Johnston, and Forrest (2009) have also employed the local statistics to examine the residential patterns of London in 2001. While the traditional general tests of segregation only answer the question of whether a minority population group is evenly distributed across the study region or clustered in certain parts, the focused tests can address to some extent the question of where possible clusters may be located.

It may be noteworthy, however, that most of the local statistics have been originally developed for the epidemiological studies where clustering is often very rare. That probably means that these methods could be somewhat conservative for finding ethnic communities, which have become a common component of the urban landscape in many metropolitan cities. As mentioned in Section 2.1, one of the characteristics of contemporary ethnic communities is that they are often located across several suburbs with relatively low population densities, so they could be overlooked by such conservative approaches. Considering this, it would be necessary to modify (loosen) the definition of clusters to better fit the context of ethnic segregation and to customise the testing procedure to reflect it. In this regard, Section 3.2 of the present thesis proposes an alternative measure that supplements this aspect, and, in Chapter 4, it will be applied to the Korean population data to delineate their ethnic communities.
Chapter 3 Data and Methods

The choice of data and analysis techniques is a crucial component that affects the validity and reliability of any research findings. Therefore, it is important to understand the scope and limitations of the data and to select appropriate methods that are suitable for both the data and the research questions. This research primarily utilised the New Zealand census data for the last three census periods and employed a detailed household survey data set and the Korean Business Directory of Auckland as secondary sources. Section 3.1 describes these data sets with particular attention to the manner in which they were collected and processed.

Section 3.2 presents an optimisation clustering algorithm that can detect the main residential areas of a small population group using geographically aggregated information. While the essence of the approach is derived from the general hill-climbing method, the exact procedure differs in two ways: the method of measuring the distance between areas and its clustering criterion. The advantages and potential limitations of these properties are also discussed in this section.
Section 3.3 discusses other statistical methods employed to discover underlying patterns in large volumes of data and to evaluate the significance of the findings. As this research conducted comparisons of multiple demographic and socio-economic variables between the ethnic clusters, correspondence analyses were used in some cases to simplify the data dimensions and to identify important relationships. Furthermore, in cases where the data being analysed involved any form of sampling, likelihood-ratio chi-squared tests were conducted to determine their statistical significance. Because more detailed definitions of these methods can be found elsewhere (see, for example, Agresti, 2007; Greenacre, 2007), this section focuses on the relevance of these methods, any drawbacks for the data being used and possible implications for the conclusions.

3.1 Data

3.1.1 Census

Statistics New Zealand conducts a census every five years to collect information about various characteristics of the total population (Statistics New Zealand, 2006). The information gathered in a census covers all individuals who live in the country at a specific time, and there are generally no alternative sources for these kinds of data. The census has, therefore, been considered the most important resource for ethnic minority studies. Most of the literature discussed in the previous chapter employed the census as the primary data source, with the exception of a few studies, such as Ho, Bedford, and Goodwin (1997) and Yoon and Yim (1997).

The current study is largely based on census data from the last three census years, 1996, 2001, and 2006, when the Korean population in Auckland rapidly increased via migration. The data for earlier years were not employed in this analysis because there were only approximate-
ly 500 Koreans in the region prior to 1996. Analyses and comparisons based on such a small number contain large variability, and the results are often unreliable. In light of this, the study years were chosen to ensure that the population size is large enough to yield statistically robust conclusions.

Table 3-1 presents a list of census variables used in the research to identify determinants for the residential clustering of Koreans and to examine the demographic and socio-economic structure within the ethnic community. Due to concerns regarding confidentiality\textsuperscript{8}, all of the data are provided as categorical, mostly in a univariate table for each geographic unit. Even variables with continuous distributions, such as age and income, are supplied categorically, as shown in the table. Although these data tables may not be suitable for capturing the complex interrelationships between the variables as no further cross-tabulation is possible, they can provide useful insights into the demographic and socio-economic characteristics of Koreans living in the study region.

Random rounding is another confidentiality assurance technique designed to protect individuals’ privacy in the published census data. This technique was applied to all of the census figures in this research. It rounds all census counts to one of the two nearest multiples of three (e.g., 99 or 102 for an original count of 100), except zero counts and counts that are already multiples of three, and can cause some discrepancies between the total and the sum of individual items. However, because the impact of random rounding on the overall reliability and accuracy tends to be small in general, especially when the research focuses on the general trend of the data rather than the precise slope and strength of association between the variables (Statistics

\textsuperscript{8} Statistics New Zealand, which is a government department that conducts the national census every five years and publishes the results, releases information on a certain geographic unit only when the number of subject populations in that unit is at least twice the number of categories in the census variable of interest. Since most census area units contained only a few Koreans (especially in 1996 and 2001), the data used here are the most detailed available to the public. More information on the confidentiality rules can be found at: \url{http://www.stats.govt.nz/Census/about-2006-census/methodology-papers/2006-census-confidentiality-rules.aspx}
Table 3-1 — Census variables, data types, response categories, and non-response rates

<table>
<thead>
<tr>
<th>Variable</th>
<th>Data type</th>
<th>Response categories</th>
<th>Non-response rate&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>2001</td>
</tr>
<tr>
<td>Usual residence</td>
<td>Nominal</td>
<td>CAU name of the dwelling where the respondents usually reside</td>
<td>0.7%&lt;sup&gt;+&lt;/sup&gt;</td>
</tr>
<tr>
<td>Age</td>
<td>Ordinal</td>
<td>0-19 / 20-29 / 30-39 / 40-49 / 50-59 / 60+</td>
<td>3.7%&lt;sup&gt;+&lt;/sup&gt;</td>
</tr>
<tr>
<td>Sex</td>
<td>Ordinal</td>
<td>Female / Male</td>
<td>4.1%&lt;sup&gt;+&lt;/sup&gt;</td>
</tr>
<tr>
<td>Language spoken</td>
<td>Nominal</td>
<td>English only / Korean only / English and Korean / Other</td>
<td>4.6%</td>
</tr>
<tr>
<td>Qualification</td>
<td>Nominal</td>
<td>No Qualification / Secondary School Qualification / Vocational Qualification / Bachelor Degree / Higher Degree / Not Elsewhere Included</td>
<td>6.5%</td>
</tr>
<tr>
<td>Tenure of household</td>
<td>Nominal</td>
<td>Dwelling owned or partly owned by usual residents / Dwelling not owned by usual residents</td>
<td>3.7%</td>
</tr>
<tr>
<td>Years since arrival in New Zealand</td>
<td>Ordinal</td>
<td>0-4 / 5-9 / 10-19 / 20+</td>
<td>5.2%</td>
</tr>
<tr>
<td>Total household income</td>
<td>Ordinal</td>
<td>$0 or less / $1 - $20,000 / $20,001 - $40,000 / $40,001 - $50,000 / $50,001 - $60,000 / $60,001 - $80,000 / $80,001 - $100,000 / $100,001 +</td>
<td>18.5%</td>
</tr>
<tr>
<td>Sources of income</td>
<td>Nominal</td>
<td>Wages, Salary Paid by Employer / Self-employment or Business / Interest, Dividends, Rent, Other Investments / Student Allowance / All Other Government Benefits, Government Income Support Payments, or War Pensions / Other Sources of Income, Including Support Payments from People living in Other Households / No Source of Income</td>
<td>3.7%</td>
</tr>
<tr>
<td>Work and labour force status</td>
<td>Nominal</td>
<td>Paid Employee / Self-employed and without employees / Employer / Unemployed</td>
<td>7.9%</td>
</tr>
</tbody>
</table>


<sup>a</sup> Non-response rates are based on the total population, and the 1996 data are unavailable.

<sup>+</sup> Figure refers to the imputation rate as a response was imputed if the question was not answered.

New Zealand, 2002a; Williamson, 2007), the effects of this post adjustment are neglected in this thesis.

A high rate of non-response in the census can also affect the validity of the outcomes, in-
introducing bias by excluding certain groups of individuals. Table 3-1 shows that the non-response rates were small for most census variables used in this study, except for the household income data, for which the non-response rate in 2006 was 16.2%. However, the rate for Asians was considerably lower (8.9%) than the overall rate, so it is assumed that all census figures are representative of the actual distribution.

One issue regarding the comparability of these data involves changes in the wording and format of the census questions. In the case of the variable ‘tenure of household’, for example:

“The way in which tenure of household is derived has changed. … Dwellings in a family trust were treated as not owned in 2001. … Comparisons of 2006 Census data on home ownership with previous census data could be made by aggregating the three ‘dwelling owned or partly owned by usual residents …’ categories together with the three ‘dwelling held in a family trust by usual residents …’ categories for the 2006 data. However, this will still not provide an exact time series comparison, because of the different treatment of dwellings held in a family trust in the 2001 Census” (Statistics New Zealand, 2010b).

This research, therefore, combined the ‘dwelling held in a family trust’ category with the ‘dwelling owned or partly owned’ category to enable comparisons of homeownership rates over time.

There were also some significant changes in the wording of the question that asks about ethnicity. While the question in the 2001 census was almost the same as that asked in 2006, it had a different format in the 1996 census. In all three years, respondents could provide more than one response to the question, but the wording of the 1996 question was much more explicit. As a result, there were an increased number of single responses in the 2001 and 2006 census compared to 1996, and a consequent reduction in multiple responses (Statistics New Zealand, 2002b). These changes have affected the comparability of the data, particularly for the European population group. However, its impact on the analysis of this research is considered to be marginal, as the Asian population has been less affected by the question changes (Statistics New Zealand, 2002b).
Zealand, 2002b), and there was a very small number of Koreans in 1996.

The present research employed census area units (CAUs) as the main geographic units. The CAUs are the second smallest unit (after meshblocks) and typically contain 3,000 - 5,000 people in urban areas. The boundaries of the CAUs change from year to year to reflect the population changes in the areas. This thesis used the 2006 version of the CAUs for all data years and analyses based on geographic locations. In 2006, the Auckland region consisted of 397 CAUs, 320 of which were from the four cities and 77 from the three rural districts. The study region, which includes only the urban parts of the cities, consisted of 297 CAUs in 2006. Throughout this thesis, the term 'census tract' is used interchangeably with 'CAU'.

3.1.2 Survey

Because the census data do not contain immigrant-specific questions such as reasons for immigration, a household survey was developed to supplement census materials. The focus of the survey was on capturing additional demographic information and residential preferences that may have been missed in the census.

The survey questionnaires were sent to 830 householders with the surname 'Kim' who were listed in the 2007 issue of the Auckland White pages telephone directory. Kim is a common, but unique surname that is used only by Koreans; more than 20% of Koreans have the surname Kim, and it has a uniform Romanisation with very few exceptions (Shin & Yu, 1984). Although other East Asians who use Chinese characters in their native language also have the surname Kim (金), most of them adopt different spellings, such as Jin or Chin. This surname-based sampling has been widely used since the mid-1980s, and it has been regarded as an effective way to identify ethnic Koreans using a telephone directory (Min, 1992; Shin & Yu, 1984; Toshiaki, 1994).
DATA AND METHODS

Table 3-2 — Distribution of the Korean population, survey questionnaires and the responses

<table>
<thead>
<tr>
<th></th>
<th>North Shore</th>
<th>Auckland</th>
<th>Manukau</th>
<th>Waitakere</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Korean population</td>
<td>8,973</td>
<td>4,794</td>
<td>3,735</td>
<td>2,655</td>
<td>20,157</td>
</tr>
<tr>
<td>Questionnaires sent out</td>
<td>378</td>
<td>201</td>
<td>159</td>
<td>92</td>
<td>830</td>
</tr>
<tr>
<td>Undeliverable questionnaires</td>
<td>22</td>
<td>27</td>
<td>7</td>
<td>2</td>
<td>58</td>
</tr>
<tr>
<td>Responses (%)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>95 (26.7%)</td>
<td>42 (24.1%)</td>
<td>41 (27.0%)</td>
<td>24 (26.7%)</td>
<td>202 (26.2%)</td>
</tr>
</tbody>
</table>

Source: New Zealand Census of Population and Dwellings for 2006
<sup>a</sup> Response rates were calculated after excluding the undeliverable questionnaires.

Table 3-2 shows that the geographic distribution of the survey questionnaires and responses closely corresponded to that of the Korean population and that a reasonable response rate was achieved. The overall response rate was 26.2%. Of the 830 questionnaires, 58 unopened envelopes were returned due to insufficient addresses or changes in address, while 202 complete responses were received. Among the four urban districts in Auckland, Auckland City had the highest undeliverable rate of 13.4%, in part because a considerable number of the listed residents in this area lived in apartment-like dwellings and exact unit numbers were sometimes omitted in the directory. Excluding these undeliverable questionnaires, however, there was very little variation in response rates across the localities (ranging from 24.1% to 27.0%). The number of responses seems sufficient to draw reliable conclusions regarding the demographic characteristics and location factors of Korean immigrants in Auckland.

The survey questionnaire consisted of four sections (see Appendix A for the questions): (1) demographic characteristics, (2) main reasons for migration, (3) location factors, and (4) degree of satisfaction with current residential location and preferred areas to live.

The demographic characteristics of the respondents were measured by five variables, including householder’s age group, household size, years of residence in New Zealand, whether the household was an astronaut family, and their intention to live in New Zealand permanently.
The first three variables were collected to validate the survey data via comparison with the census data.

For the question regarding the main reasons for migration, the participants were asked to choose from a list of seven possible reasons: (1) a relaxed lifestyle in New Zealand, (2) the clean and green image of New Zealand, (3) economic opportunities, (4) political stability, (5) educational opportunities, (6) children's education, and (7) invitation from friends or families in New Zealand. They were allowed to choose more than one reason. If there were other reasons that were not listed, they were able to provide these in writing. Nineteen people indicated their own reasons, such as recuperation and missionary work. However, these were not used for analysis in this research because none of the reasons formed a significant fraction, and all of the 19 respondents gave at least one reason from the list.

The location factors were collected using a method similar to the reasons for migration. There were thirteen items in the questionnaire that might have influenced respondents' decisions about where to live, and the respondents were asked to choose up to five of them. The listed factors included proximity to (1) workplace or school if the respondent was a student, (2) shopping malls, (3) Korean supermarkets and other ethnic facilities, (4) religious amenities, (5) parks and recreational spaces, (6) families or friends, and (7) children’s school, as well as (8) investment value, (9) economic affordability, (10) road network, (11) access to public transport, (12) familiar environment, and (13) safety from crime. As with the reasons for migration, the participants were given an option to provide their own location factors, but these were not taken into account in the analysis.

In the last section of the questionnaire, the respondents were asked to evaluate their satisfaction with their current residential area on a five-point scale (1 for very unsatisfied and 5 for very satisfied) and to identify where they would like to live if they could move from their current area. The preferred suburbs were coded as CAUs. While most respondents gave the names
of suburbs for this question, there were five people who indicated North Shore City as their preferred residential place, with no specific suburb names provided. In this case, it was assumed that they meant the CAU with the largest number of Koreans in that city (i.e., Forrest Hill). This assumption was based on my personal experience as a member of the Korean community in the East Auckland area: I have seen that many Koreans who reside in Howick and Dannemora (i.e., the second largest Korean residential cluster in Auckland; see Section 4.2 for details) are unaware of the suburbs’ names in the northern district, and the term ‘North Shore City’ usually refers to the most established Korean settlement around Forrest Hill among them. Although the impact of this practice is deemed to be small because the proportion of people who did not specify the names of suburbs was only 2.5% (or 5 out of 202), the results derived from this question (i.e., Table 5-5 in Section 5.4) should be interpreted with care.

The survey results were analysed and interpreted using the correspondence analysis and likelihood-ratio chi-squared tests, and confidence intervals were calculated where required. The findings from the survey will be presented and discussed in Chapter 5.

3.1.3 Korean Business Directory of Auckland

To analyse the business patterns of Koreans in Auckland, this study utilised a business directory published by the Korean Society of Auckland in 2006. This North Shore-based association publishes the ‘Korean Guidebook in New Zealand’ every three years to provide a list of Korean-related firms, professionals, and organisations. This directory is perhaps the best available resource to investigate the geographic distribution of Korean businesses because it contains physical addresses for almost all listings. Though there are a number of other ethnic magazines that provide similar lists, they usually provide only phone numbers and thus are of little use for studying the spatial structure of ethnic businesses. For the same reason, the Korean Guidebook
published in 2009 was also inadequate as most business addresses were omitted in this latest edition.

The directory used in the present research contained a total of 1,225 firms, professionals, and organisations in the Auckland region, ranging from real estate agents to international trading companies. However, this included not only businesses owned or operated by Koreans but also government associations and public service centres that serve the Korean population. The Asian health service centre, for example, is operated by local District Health Boards (DHBs) but was listed in the directory because it provides health-related advice in the Korean language. Because such organisations would not be included in the analysis, they were removed from the data set.

Fig. 3-1 illustrates the clean-up process used to generate an accurate and comparable set. The procedure began by eliminating businesses not operated by Koreans (i.e., those that simply target the Korean population) based on the listed names. Because the listed names of Korean-owned businesses are usually written in Korean to appeal to potential co-ethnic customers, all names listed in the ethnic language were retained in the data set. If the name did not clearly indicate whether it was a Korean-owned business, the registered directors and shareholders were identified from the New Zealand Companies Office website. During this stage, 34 firms and organisations were excluded.

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9 The Companies Office, which is a government agency responsible for registering and maintaining company details, provides the names and addresses of the registered directors and shareholders for public viewing (URL: http://www.companies.govt.nz/).
DATA AND METHODS

The remainder were then classified according to the 2006 Australian and New Zealand Standard Industrial Classification (ANZSIC) to improve comparability with the census data. The ANZSIC, a joint development by the Australian Bureau of Statistics and Statistics New Zealand to facilitate the study of the industrial relationship between the two countries, is structured in four levels: Divisions, Subdivisions, Groups, and Classes (Australian Bureau of Statistics & Statistics New Zealand, 2006). The first three levels were applied to the data set. The finest level of classification, Classes, was not used because it was too detailed and would likely have led to ‘over-

**Fig. 3-1. Three stages for business directory processing**

- **Step 1**
  - **Data clean-up**
    - Identify and eliminate businesses, which are not owned and operated by Koreans, based on the business names

- **Step 2**
  - **Classification**
    - Classify the businesses according to the 2006 ANZSIC and then group them into three categories

- **Step 3**
  - **Geocoding**
    - Pinpoint the businesses to analyse spatial structure
    - Remove incomplete or duplicate listings

Korean business names: 가나다라마바사아자차카 ...

English names: ABCDEF ...

NZ Company Office Database

<table>
<thead>
<tr>
<th>Individuals</th>
<th>Businesses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ANZSIC</td>
</tr>
</tbody>
</table>

The remainder were then classified according to the 2006 Australian and New Zealand Standard Industrial Classification (ANZSIC) to improve comparability with the census data. The ANZSIC, a joint development by the Australian Bureau of Statistics and Statistics New Zealand to facilitate the study of the industrial relationship between the two countries, is structured in four levels: Divisions, Subdivisions, Groups, and Classes (Australian Bureau of Statistics & Statistics New Zealand, 2006). The first three levels were applied to the data set. The finest level of classification, Classes, was not used because it was too detailed and would likely have led to ‘over-
classification’ (i.e., each class would only have had one or two businesses). As mentioned previously, because the raw data consisted of not only business places but also individual professionals employed by mainstream-owned companies, the data was divided into two groups accordingly. This differentiated, for example, between a Korean dentist working for a mainstream-owned clinic and a dental clinic owned and operated by Koreans, although both have the same ANZSIC class.

The last step of the data processing was the geocoding of the listed addresses to investigate the spatial distribution of the businesses. The Core Record System (CRS) data, developed by Land Information New Zealand to record and maintain cadastral information, were used to automatically pinpoint the business addresses. During this procedure, a number of businesses were identified as having incomplete or duplicate addresses, and some of them were selectively removed from the data if they could not be geocoded at street-level accuracy (i.e., incomplete data) or another business located at the same address had the same ANZSIC group code (i.e., duplicate data). The final data set included 1,053 individuals and businesses.

When interpreting this business data set, it may be important to remember that participation in this publication was completely voluntary. Because the listing was free of charge and the publication was well-advertised throughout the community, it is believed that a substantial proportion of Korean businesses were recorded in the directory. As Yoon and Yim (1997) pointed out, however, businesses that do not target the co-ethnic population may not be attracted to advertising in the ethnic-specific publication. Nonetheless, the effect of this non-sampling error was presumed to be non-significant because their overall English proficiency given in the census data was still very low to be serving a non-ethnic population. More importantly, the more than 1,000 listings in the directory seem to be reflective of the total number of businesses, in consideration of the Korean population in 2006.
Table 3.3 — Summary of the data sets by main use, data year, and relevant chapters

<table>
<thead>
<tr>
<th>Main use</th>
<th>Data year</th>
<th>Chapters</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Zealand Census</td>
<td>1996, 2001, 2006</td>
<td>Chapter 4, 5, 6</td>
</tr>
<tr>
<td></td>
<td>- Explore the geographic distribution at the CAU scale</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Examine the overall demographic and socio-economic characteristics of Korean ethnic clusters</td>
<td></td>
</tr>
<tr>
<td>Household survey</td>
<td>2008</td>
<td>Chapter 5</td>
</tr>
<tr>
<td></td>
<td>- Supplement the census data for demographic analysis</td>
<td></td>
</tr>
<tr>
<td>White pages®</td>
<td>2007</td>
<td>-</td>
</tr>
<tr>
<td>Business Directory</td>
<td>2006</td>
<td>Chapter 6</td>
</tr>
<tr>
<td></td>
<td>- Investigate the economic structure of Korean ethnic clusters</td>
<td></td>
</tr>
<tr>
<td>CRS Data</td>
<td>2008</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>- Geocoding the Korean businesses</td>
<td></td>
</tr>
</tbody>
</table>

3.1.4 Summary

Table 3.3 summarises the data sets adopted in this research according to their sources and the chapters that use them. This is to provide a sense of the data consistency and reliability of the interpretations discussed in the corresponding chapters. Although there are some discrepancies between the years of the data, it was assumed in this thesis that the effects of these discrepancies were marginal.

3.2 Optimisation Clustering Method\(^\text{10}\)

3.2.1 Background

As mentioned in Chapter 1, the Korean ethnic group in New Zealand has experienced an exponential increase in population over the last two decades. As a result, several ethnic residential concentrations have emerged, particularly around the country’s largest metropolitan area, Auckland. The primary objective of this study is to explain such residential clustering in com-

\(^{10}\) An earlier version of this section was presented at the GIScience 2010 conference, 16 September 2010.
parison with the existing ethnic settlement theories, which have been developed mainly in the North American context. Intuitively, the first step towards achieving this goal was to identify the areas where the Korean population is concentrated so that the main causes of the given distribution could be sought based on the profiles of the people living in these clusters.

Because the results of the subsequent statistical analyses are largely affected by the configurations of the clusters, it is essential to choose a reliable method that could properly divide the data set into a number of constituent groups in terms of geographic locations and population densities. In the past, researchers were able to visually identify the boundaries of ethnic enclaves because the minority population was often segregated in small areas with fairly clear borders. Contemporary ethnic residential neighbourhoods, however, tend to be located across several suburbs, and their exact boundaries are not as apparent as the traditional inner-city ghettos. The delineation of such ethnoburb-like clusters has become somewhat vague and arbitrary, and there is often no clear-cut point on the continuum of population density that draws a line between clusters and non-clusters. This necessitates the use of a more objective method to define Korean residential clusters in the study region.

Obviously, the presence or location of ethnic clusters was not the question. As shown in Chapter 1, a simple choropleth map of the population can provide clear evidence of clustering in certain parts of the Auckland urban areas. Difficulties arise in delineating their boundaries, as there seems to be no obvious thresholds that indicate the end of the clusters. The question to be addressed, therefore, is related to the extent of the clusters, particularly which areas would be included.

One possible approach is the application of the local statistics or scan statistics discussed in the previous chapter. At each census tract that appears to be part of a cluster, statistical tests can be carried out with varying search radii and the most likely one (i.e., with the lowest $p$-value) can be chosen. However, because these statistics are designed to detect an unusual con-
centrations of health or crime events under the hypothesis of randomness, the results could be less reliable when this assumption is not met. Considering that the Korean population in Auckland is exponentially distributed (as are most ethnic minority groups; see Section 4.1 for more details), the use of the local $G^*$ or Kulldorff’s scan statistic would be inadequate for the given objective. In addition, these methods typically require the specification of the shape and size of clusters before use, which is also an important limitation. Thus, it is more efficient and accurate to employ an alternative technique that is able to handle the data set without the need to assume specific parameters.

The following approach describes a variation of the optimisation partitioning method, which performs reasonably well when the number of clusters and their approximate locations are known (Everitt et al., 2001). Unlike the methods mentioned above, the results from this approach only depend on the starting configurations, such as the number of clusters and the initial search points. This approach does not require any other statistical parameters to be set prior to its application. Furthermore, the present algorithm could be more advantageous for locating non-spherical clusters than most scan statistics, which typically utilise a circular search window. As will be demonstrated, the clustering procedure is simple and straightforward, and it directly addresses the question, ‘where does this cluster end?’

### 3.2.2 Clustering procedures

Suppose that the study region is divided into $n$ census tracts, $\Omega = \{x_1, x_2, x_3 \ldots x_n\}$, and the aim is to identify a particular number of groups whose data values are distinctively larger than those of the remaining census tracts. Each group consists of geographically continuous census tracts, $A_i = \{x_{i1} \ldots x_{in}\}$, where $i = 1 \ldots g$, and they do not overlap with one another. For convenience, let $A_0$ denote a set of residuals that are not included in any $A_i$, so that $\Omega = A_0 \cup A_1 \cup \ldots \cup A_g$. The funda-
mental idea behind these clustering procedures is that the quality of a given clustering can be represented by numerical indices, and the best possible subsets can be found by optimising the index values. Among a variety of numerical clustering measures suggested by statisticians since the 1960s, this study employs one of the simple criteria, the within-group sum of absolute deviations, whose minimum value indicates the best solution:

$$w = \sum_{i=0}^{g} \sum_{j=1}^{n_i} a_{ij} |\bar{b}_i - b_{ij}|$$

where $n_i$ is the number of census tracts in $A_i$, $a_{ij}$ is the weight of the corresponding census tract, and $b_{ij}$ is the data value of interest. In this research, for instance, the size of the census tracts could be used as the weight and the Korean population density could be used as the data value. $\bar{b}_i$ refers to the weighted mean of the data values in $A_i$, which indicates the overall density of the cluster $i$.

Perhaps the most straightforward way to identify a set of $A_i$ that minimises $w$ is to investigate all possible combinations and choose the best one. When $n$ is small and the spatial structure is simple, this approach is feasible and even guarantees the identification of a global optimum (if there is one). Not surprisingly, however, it rapidly becomes impractical as $n$ increases, due to its computationally expensive nature, even with today’s computing power (Everitt, et al., 2001).

The hill-climbing algorithm is an alternative that overcomes the limitation of examining all possible combinations. The exact procedures vary depending on the problem, and the following steps outline the procedure that was implemented to detect the Korean residential clusters using the census population data.

1) Choose a census tract (either randomly or using a priori information) that is suspected to be a part of a cluster and calculate its total within-group absolute deviations, $w$. 

77
2) Combine the current set of a cluster with its neighbouring census tracts in all possible configurations and compare the \( w \) values.

3) Replace the set with the one that minimises \( w \) and repeat (b) and (c) until no further improvements can be made.

4) Repeat the procedures above for each cluster of interest.

Although there is a vast amount of literature devoted to the selection of an initial set (see, for example, Everitt, et al., 2001; Friedman & Rubin, 1967), such complicated mathematical calculations may not be required in the present context because, as has been mentioned, the approximate locations of the clusters are clearly given in the map. This clustering algorithm provided convincing results when applied to hypothetical data sets in the following section as well as when it was applied to the Korean population data in Chapter 4.

3.2.3 Examples

In this section, the optimisation clustering method is applied to three hypothetical data sets shown in Fig. 3-2. The results are then compared to those from the local \( G^* \) statistic to demonstrate the advantages and limitations of the proposed approach.

The first two data sets were generated from an exponential distribution with \( \lambda = 0.005 \), arranged in basic grids of 10-by-10 metres. As shown in Fig. 3-2 (a) and (b), one contains a spherical cluster, and the other contains a linear-shaped cluster. To illustrate how the performance of the present algorithm could be affected by the initial configurations, four different starting points were chosen for each data set: two inside the cluster and two outside. The first two clustering outcomes in Fig. 3-3 and Fig. 3-4 demonstrate that when the starting points were located well within the clusters of interest, the nearby cells with high data values were effectively grouped as intended and the \( w \) values were reasonably minimised. However, when the start-
ing points were placed outside of the clusters (Fig. 3-3 (c) – (d) and Fig. 3-4 (c) – (d)), the algorithm seemed to be trapped by small local variations of the data values and failed to recognise the obvious clusters. These results emphasise that the choice of where to begin is crucial for the reliability and accuracy of the method and that the use of a priori information can greatly enhance the performance of the algorithm.

Fig. 3-3 (e) and Fig. 3-4 (e) display the extent of the most likely clusters found using the local $G^*$ statistic, along with the centres of other statistically significant clusters (i.e., $z \geq 1.96$). In these examples, four different spatial weight matrices were constructed based on the distance between the centroids of the cells:

$$w_{ij} = \begin{cases} 
0 \text{ when } d_{ij} \geq a \\
1 \text{ when } d_{ij} < a 
\end{cases}$$

where the distance, $a = \{1, 2, 4, 8\}$, and the one that maximised the $z$-score of the most likely cluster was chosen for each data set. As shown in the figures, the results were generally analogous to those obtained using the optimisation clustering method, but they included some units with very low data values. The degree of such false detection was more severe in the second da-
In contrast to the first two data sets, the third example follows a Poisson distribution with $\lambda = 200$ and no apparent clusters. As with the previous examples, four different starting points were chosen for the optimisation clustering method. However, because there were no notable concentrations of the data values, the four points were randomly selected (Fig. 3-5 (a) – (d)). The results highlighted on the grids, together with the box plots, indicate that the algorithm performed poorly in this case – it only captured small, insignificant local variations in the data set. The local $G^*$ method, by contrast, successfully identified a few small clustering of the high values (Fig. 3-5 (e)).

These three examples demonstrate that for the question of the presence or (approximate) location of clusters, the use of the local $G^*$ statistic is a sensible choice and may have an advantage over the optimisation clustering method. However, if the main objective concerns the accurate shape or size of a certain cluster, the present algorithm may yield more reliable outcomes than the other approaches as long as the starting point is well chosen.
Fig. 3-3. Clustering results for the example (a)

Note: (a) – (d) using the optimisation clustering method, (e) using the local G statistic
Fig. 3-4. Clustering results for the example (b)

Note: (a) – (d) using the optimisation clustering method, (e) using the local G statistic
Fig. 3-5. Clustering results for the example (c)

Note: (a) – (d) using the optimisation clustering method, (e) using the local G statistic
3.2.4 **Summary**

In general, the optimisation clustering method is the same as the other local or scan statistics in that it attempts to identify a set of geographically close observations that have high (or low, depending on the context) values compared to the rest of the data. What distinguishes this algorithm from the others is that it does not require ‘close’ or ‘high’ to be defined prior to its application. This may be the main advantage of using this approach over the others. It is important to note, however, that the validity of the clustering results is radically affected by the initial configuration because an invalid classification from an earlier stage cannot be corrected later. Nevertheless, the examples in the previous section illustrate that this method generates convincing outcomes when the starting points are placed within the approximate boundaries of a possible cluster. Therefore, the use of the optimisation clustering method to identify Korean residential clusters is considered reasonable in this context.

3.3 **Other Statistical Methods**

Empirical studies of ethnic settlement patterns can be classified into two groups. The first group observes a phenomenon and attempts to establish or find a conceptual framework that can provide a general explanation of the pattern. The second group, on the other hand, interprets a phenomenon within an existing conceptual framework but focuses on revealing distinctive characteristics of the subject. When these studies are carried out quantitatively, exploratory analysis techniques, such as principle component analysis and factor analysis, may be sufficient for the former type of study, whereas inferential statistics, such as those described by Clark and Hosking (1986), can be more helpful for the latter.

As mentioned in Chapter 1, one of the main objectives of this study was to find a suitable
conceptual framework for explaining the settlement patterns of the under-studied but significant ethnic population of Koreans in Auckland. For this purpose, it was important to explore the various demographic and socio-economic characteristics of the Korean residential clusters without presuming a particular theoretical model. Because the main data in this study (i.e., the census) were multivariate and categorical, correspondence analysis was adequate to uncover any underlying systematic relationships in the data. In some cases where the data were based on samples, the likelihood-ratio chi-squared tests were needed to justify the outcomes.

In this section, these methods will be briefly described and their possible implications for the conclusions will be discussed. More detailed definitions and theories of the likelihood-ratio chi-squared tests and correspondence analysis can be found in Agresti (2007) and Greenacre (2007), respectively.

3.3.1 Correspondence analysis

Correspondence analysis (CA) is a dimension-reduction method for contingency tables. As with similar techniques, such as principle component analysis (PCA) and factor analysis, CA aims to graphically represent multivariate data in fewer dimensions so that underlying patterns can be revealed. As with PCA and factor analysis, CA is not a hypothesis-testing tool; rather, it is a hypothesis-generating tool that explores the data with no statistical assumptions.

Instead of describing the mathematical procedures of CA, this section attempts to demonstrate how CA can help the interpretation of a two-way contingency table using an example. The theory and calculation behind the method are explained elsewhere, such as Greenacre (2007, pp. 201-211) and Lebart, Morineau, and Warwick (1984).

Table 3-4 shows the population by ethnic group (i.e., European, Māori, and Asian) in six-
teen New Zealand regional councils. A brief look at the table indicates that Europeans dominate the ethnic composition in South Island and the Māori are mainly distributed in North Island, particularly in Northland and Gisborne. Although Asians consist of only a small fraction of the population in most regions, their proportion is significant in Auckland. Because there are only three columns, it is fairly trivial to visualise the table in a three-dimensional space, as in Fig. 3-6 (a). The pattern described above, however, is not readily apparent in this three-dimensional plot, and it is quite difficult to interpret. CA can reduce the number of dimensions while keeping

<table>
<thead>
<tr>
<th>North Island</th>
<th>European</th>
<th>Māori</th>
<th>Asian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northland</td>
<td>93,351</td>
<td>66.9</td>
<td>43,527</td>
</tr>
<tr>
<td>Auckland</td>
<td>698,622</td>
<td>65.3</td>
<td>137,133</td>
</tr>
<tr>
<td>Waikato</td>
<td>257,322</td>
<td>73.1</td>
<td>76,569</td>
</tr>
<tr>
<td>Bay of Plenty</td>
<td>165,012</td>
<td>68.6</td>
<td>67,662</td>
</tr>
<tr>
<td>Gisborne</td>
<td>22,677</td>
<td>52.5</td>
<td>19,761</td>
</tr>
<tr>
<td>Hawke’s Bay</td>
<td>97,725</td>
<td>72.5</td>
<td>33,558</td>
</tr>
<tr>
<td>Taranaki</td>
<td>77,163</td>
<td>81.1</td>
<td>15,798</td>
</tr>
<tr>
<td>Manawatu-Wanganui</td>
<td>157,341</td>
<td>75.7</td>
<td>42,285</td>
</tr>
<tr>
<td>Wellington</td>
<td>302,973</td>
<td>76.7</td>
<td>55,434</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>South Island</th>
<th>European</th>
<th>Māori</th>
<th>Asian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tasman</td>
<td>35,712</td>
<td>90.8</td>
<td>3,063</td>
</tr>
<tr>
<td>Nelson</td>
<td>33,504</td>
<td>87.7</td>
<td>3,615</td>
</tr>
<tr>
<td>Marlborough</td>
<td>32,022</td>
<td>86.7</td>
<td>4,275</td>
</tr>
<tr>
<td>West Coast</td>
<td>24,024</td>
<td>88.0</td>
<td>2,916</td>
</tr>
<tr>
<td>Canterbury</td>
<td>393,219</td>
<td>85.7</td>
<td>36,669</td>
</tr>
<tr>
<td>Otago</td>
<td>148,974</td>
<td>88.1</td>
<td>12,270</td>
</tr>
<tr>
<td>Southland</td>
<td>69,555</td>
<td>85.7</td>
<td>10,422</td>
</tr>
</tbody>
</table>

Source: New Zealand Census of Population and Dwellings for 2006
the relative distances between the points consistent, and, as shown in Fig. 3-6 (b), it summarises the important relationship between the columns and rows more clearly. This simple visualisation is a great advantage when dealing with a large data set such as the census and allows comparisons among different contingency tables as well.

CA reduces the data dimension by placing new axes that maximise the total variance. Calculating the position of the new axes involves complex mathematical procedures, such as the singular value decomposition, so this study utilised an R package called ca for analysis. In R, CA was performed on the example data as follows:

```r
> ca(example.tb) # the object 'example.tb' contains Table 3-4

Principal inertias (eigenvalues):

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>0.073482</td>
<td>0.054706</td>
</tr>
<tr>
<td>Percentage</td>
<td>57.32%</td>
<td>42.68%</td>
</tr>
</tbody>
</table>

Rows:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass</td>
<td>0.062499</td>
<td>0.062499</td>
<td>0.062499</td>
<td>0.062493</td>
<td>0.062505</td>
</tr>
</tbody>
</table>
```

**Fig. 3-6. 3D scatter plot (left) and 2D symmetric CA map (right) for the ethnic composition of sixteen New Zealand regional councils**

*Note: Abbreviations used in the plots are: EUP = European, NTH = Northland, AK = Auckland, BOP = Bay of Plenty, and GB = Gisborne.*
The result shows that the first principle axis explained about 57.3% of the total variation and the second axis accounted for the remaining 42.7%.

It may be worth mentioning that the coordinates of the row and column points in Fig. 3-6 (b) are different from those in the R output above. This is because the row and column positions, which are two different data, were scaled separately so that both could be displayed in the same space. This is called a symmetric CA map and is a popular way of visualising CA results in a plot (Greenacre, 2007). Although it does not change the relative intra-distance among row points and among column points, the symmetric CA map could alter the inter-distance between the row and column points. While the impact of this alternation on the validity of the interpretation is marginal, it is important to keep in mind that there could be some distortion in symmetric CA maps.
3.3.2 Likelihood-ratio chi-squared statistic

This study is based on the idea that the Korean population in Auckland is residentially clustered and that the nature of clustering can thus be examined quantitatively. It assumed that socio-demographic profiles of Koreans living in ethnic neighbourhoods were distinct from those who were not and that these differences could shed light on important characteristics of the clustering (e.g., whether it was voluntarily created or imposed by circumstances). To reveal the main determinants for the observed settlement patterns, a set of census and survey variables were examined and compared across the clusters.

As described in the previous section, CA is a useful tool for exploring and comparing contingency tables and was used as a primary method for analysis in this study. In general, patterns found from CA could be interpreted ‘as-is’ when the analysis was based on the census data; the results did not require testing statistical significance. Because census figures refer to the total population, there were theoretically no sampling errors and any differences in the table are statistically significant regardless of degree. For example, if the average income of the Koreans living in one cluster was about $50 higher than those in another cluster, it is true that the former group was richer on average than the latter, although this may have no practical importance at all.

When comparisons are made with samples, however, small differences between groups (i.e., clusters) may not be real; they may be the result of sampling variations in the current data set. Therefore, if a different set of samples was taken, the results could be completely different. In the above example, if the incomes were based on a sample of Korean households instead of the census, the $50 difference would not be enough to claim that one group has a higher average income than another group. A test of statistical significance would have to be conducted to evaluate the stability of the result.
In this research, the survey data (which are mainly referenced in Chapter 5) were based on a sample of 202 respondents, so any patterns derived from this source were possibly due to sampling errors. A significance test was carried out for CA with the survey data to ensure the reliability of the analysis and to prevent misinterpretation. The test assumed that all cluster groups had the same distributions for survey variables and examined whether the data contradicted the hypothesis. While there are many different ways to test, the one that was employed in this study was the likelihood-ratio chi-squared statistic, which is defined as:

\[ G^2 = 2 \sum_{i=1}^{r} \sum_{j=1}^{k} x_{ij} \log \left( \frac{x_{ij}}{y_{ij}} \right) \]  

(3.1)

where \( x_{ij} \) is the observed value in the cell \((i, j)\) and \( y_{ij} \) is the expected value according to the null hypothesis of equal distributions. \( G^2 \) is 0 when all observed values are identical to the expected values (i.e., \( x_{ij} = y_{ij} \) for all \( i, j \)) and provides no evidence against the null hypothesis. \( G^2 \) increases with the difference between \( x_{ij} \) and \( y_{ij} \), and a large \( G^2 \) value can lead to the rejection of the null hypothesis (i.e., at least one of the cluster groups has a different distribution of a survey variable than the others).

This significance test was applied to the reasons for migration and residential preferences of the Korean survey participants (i.e., Table 5-2 and Table 5-3), and helped to identify key factors responsible for their residential clustering. Any statistically significant differences were worth investigating further, as they could uncover important relationships in the data.

It should be noted, however, that statistical significance is different from practical significance, and a statistically non-significant difference does not necessarily mean that it is negligible (it is likely, though, because there is a high chance that such differences do not even exist). Because practical significance is more important than statistical significance, interesting patterns found in the survey data were interpreted regardless of their statistical significance (i.e., \( p-\)
values) if they could be justified in other ways, such as by prior knowledge. In this research, therefore, the likelihood-ratio chi-squared statistic was only used as an indication of the stability of the survey results, not as a way to determine the main factors for clustering.
Chapter 4  Geographic Distribution

This chapter is concerned with the geographic distribution of Koreans in the Auckland urban areas. Particular attention is given to the spatiotemporal changes in the population distributions and the similarities and differences between these changes and the conceptual models that were presented in Chapter 2.

Section 4.1 examines the settlement patterns of the Korean population using global measures. The degrees of segregation and clustering are evaluated using the spatial dissimilarity index ($\tilde{D}$) and the spatial exposure index ($\tilde{P}^*$), and the results are compared with those of other ethnic groups in New Zealand. Section 4.2 attempts to identify areas where Koreans are relatively concentrated. The optimisation clustering method that was proposed in the previous chapter is employed to locate groups of census tracts that form possible clusters. Then, the geographic growth of these clusters over the last three census years is described.

Section 4.3 investigates general socio-demographic characteristics of the areas where the
Korean clusters are located. To examine potential location factors that attracted Korean immigrants, this section analyses the ethnic composition and socio-economic levels of the census tracts that were classified as clusters. Section 4.4 summarises the findings from the statistical analysis and then briefly discusses their limitations.

4.1 Degree of Segregation and Exposure

The residential concentration of ethnic minorities is a common feature of the urban landscape. Although the causes and consequences of this phenomenon vary across individual ethnic groups and locations, nearly all ethnic minorities in major cities exhibit some degree of residential clustering, at least during the early stage of their settlement. These ethnic residential clusters can be broadly classified into two distinct types: enclaves of socio-economically disadvantaged people and voluntarily created ethnic communities of rather affluent immigrants (e.g., ethnoburbs). As has been discussed in Chapter 2, the former are often confined to small areas with a high population density of ethnic groups and are geographically isolated from the majority population. In contrast, the latter tend to be located across several suburbs dominated by middle class families. Therefore, enclaves are likely to exhibit a high level of dissimilarity and a low level of exposure to the majority population, while ethnoburb-like clusters would display a relatively lower degree of dissimilarity and a high degree of exposure to the majority population. The current section examines the geographic distribution of Koreans in Auckland, using two global measures: the spatial dissimilarity index ($\bar{D}$) and the spatial exposure index ($\bar{P}'$).

Before computing these indices, a visual inspection of the population distribution was conducted to provide initial insights into their segregation level. Fig. 4-1 shows density histograms of the Korean population at the CAU level in the last three census years (1996, 2001, and 2006), and the histograms clearly indicate that Koreans were exponentially distributed. In other
words, most Koreans were concentrated in a few census tracts, and the other CAUs contained only a small fraction of the ethnic population. In 1996, approximately 44.9% of Koreans were found in the top 30 (i.e., 10%) census tracts, and this fraction increased to 46.2% in 2001 and 49.8% in 2006. These proportions are much higher than those of both the European population (19.4%, 19.4%, and 20.1% over the last three census years) and other Asians (29.4%, 28.2%, and 28.7%), implying that Koreans are more likely to be segregated than other ethnic groups in Auckland\textsuperscript{11}.

In a similar vein, geographic correlations between ethnic group populations could indicate the relative degree of exposure among the groups. If two ethnic groups are highly exposed

\begin{tikzpicture}
  \begin{axis}[
    title={Exponentially distributed Korean population in the Auckland region},
    xlabel={Density},
    ylabel={0.000, 0.010, 0.020},
    xmin=0, xmax=250,
    ymin=0, ymax=0.025,
    xtick={0, 100, 250},
    ytick={0.000, 0.010, 0.020},
    yticklabels={0.000, 0.010, 0.020},
    legend style={at={(0.5,0.5)},anchor=west},
    legend entries={$\lambda=1/3$, $\lambda=1/4$, $\lambda=1/5$},
  ]
  \addplot[thick,dashed,mark=none] table [x index=0, y index=1] {data1.csv};
  \addplot[thick,solid,mark=none] table [x index=0, y index=2] {data2.csv};
  \addplot[thick,dashdotted,mark=none] table [x index=0, y index=3] {data3.csv};
  \legend{$\lambda=1/3$,$\lambda=1/4$,$\lambda=1/5$}
\end{axis}
\end{tikzpicture}

\textbf{Fig. 4.1. Exponentially distributed Korean population in the Auckland region}

\textit{Note:} The dotted lines represent the distribution of an exponential random variables with parameter $\lambda=1/x$, where $x$ is the average number of Koreans in a census tract for the corresponding census year.


\textsuperscript{11}Although the statistics for Korean may not be directly comparable to those of aggregate ethnic groups, such as Europeans, Asians, and Pacific peoples, the comparisons here could provide some idea on the relative level of clustering for Korean residents in Auckland. The population data for individual ethnic groups (e.g., Tongan, Samoan, Chinese, etc.) were not publicly available at the time of the research at the census tract level, and the Korean population data used in this study were obtained by a special request to Statistics New Zealand through the University of Auckland library. A comparison of Korean with other similar groups disaggregated from the 'Asian' group would require similar data sets to be obtained, and it was judged beyond the scope of the present thesis. Such comparisons might form a basis for future work.
to each other, the two groups may share main residential areas, and the correlation between them may be close to one. In contrast, if two ethnic groups are isolated from each other, then their correlation may be negative. In this regard, Table 4-1 seems to suggest that the Korean population in Auckland is somewhat exposed to Europeans and other Asians, while the negative correlations with Māori and Pacific peoples imply a rather high degree of residential separation between Koreans and these ethnic groups.

To confirm these initial observations, the spatial dissimilarity index ($\bar{D}$) and the spatial exposure index ($\bar{P}^*$) were calculated for Koreans and the other major ethnic groups in Auckland. Unlike their aspatial (traditional) counterparts, the calculation of spatial indices requires two additional components: (1) data on the exact location of the population, and (2) a spatial proximity function, which reflects spatial interaction between the groups (Reardon & O'Sullivan, 2004). However, because the exact location data were not publicly available in New Zealand for confidentiality reasons, this study adopted an approximate point data set, which was constructed based on census data. The data consisted of points placed every 100 m in the study area, and the population was allocated to the points under the assumption of constant density within each individual census tract. If a census tract contained 500 Koreans and there were 100 points placed within that tract, then each point was assigned five Koreans. For the spatial proximity function, a simple binary variable that assumes that only the points within 1 km had social interaction was used:

$$\phi(p, q) = \begin{cases} 
0 & \text{when } d(p, q) > 1000 \\
1 & \text{when } d(p, q) \leq 1000
\end{cases}$$

where $d(p, q)$ is the Euclidean distance between two points $p$ and $q$. These assumptions may not be realistic but are perhaps reasonable for exploratory purposes.

The spatial dissimilarity index values provided in Table 4-2 support the preliminary find-
The degree of residential segregation of Koreans has been considerably high since their number reached a significant level in 1996 ($\bar{D}= 0.407, 0.424, \text{and } 0.465$ over the last three census years); the only ethnic group that has exhibited a higher index value was Pacific peoples ($\bar{D}= 0.424, 0.448, \text{and } 0.462$ for the same period). This result clearly indicates that the Korean population is concentrated in certain parts of the city, forming a residential cluster (or clusters) in Auckland.

The level of segregation increased constantly throughout the three census periods, and in general, recent arrivals displayed a relatively higher degree of residential separation than those who arrived before 1996. Interestingly, the segregation values for Koreans rose with the length of residence in New Zealand: $\bar{D}$ for Koreans who arrived before 1996 was $0.407$ in 1996, but it increased to $0.436$ in 2001 and then $0.479$ in 2006. Similarly, $\bar{D}$ for those who came between 1996 and 2001 was $0.483$ in 2001 but jumped to $0.520$ in 2006. This temporal pattern suggests that the level of socio-cultural adjustment may not be a primary determinant of the residential clustering of Koreans, although a time span of 10 years is not sufficient to confirm this notion.

Table 4.3 shows that Koreans do not form enclave-like clusters that are completely iso-

<table>
<thead>
<tr>
<th></th>
<th>European</th>
<th>Māori</th>
<th>Pacific peoples</th>
<th>Asian (excl. Korean)</th>
<th>Korean</th>
<th>Other ethnicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>European</td>
<td>-</td>
<td>-0.089</td>
<td>-0.418</td>
<td>0.179</td>
<td>0.348</td>
<td>0.966</td>
</tr>
<tr>
<td>Māori</td>
<td>-0.089</td>
<td>-</td>
<td>0.720</td>
<td>0.054</td>
<td>-0.220</td>
<td>-0.151</td>
</tr>
<tr>
<td>Pacific peoples</td>
<td>-0.418</td>
<td>0.720</td>
<td>-</td>
<td>0.010</td>
<td>-0.304</td>
<td>-0.465</td>
</tr>
<tr>
<td>Asian (excl. Korean)</td>
<td>0.179</td>
<td>0.054</td>
<td>0.010</td>
<td>-</td>
<td>0.399</td>
<td>0.182</td>
</tr>
<tr>
<td>Korean</td>
<td>0.348</td>
<td>-0.220</td>
<td>-0.304</td>
<td>0.399</td>
<td>-</td>
<td>0.385</td>
</tr>
<tr>
<td>Other ethnicity$^a$</td>
<td>0.966</td>
<td>-0.151</td>
<td>-0.465</td>
<td>0.182</td>
<td>0.385</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: New Zealand Census of Population and Dwellings for 2006

$^a$ Other ethnicity refers to those who do not identify themselves as European, Māori, Pacific peoples, Asian, and MELAA. In 2006, the vast majority of ‘other ethnicity’ was New Zealander.
lated from other ethnic groups (the reasons for this will be discussed in the next chapter). The spatial exposure index values between Koreans and the other major ethnic groups support the interpretation based on the correlations (i.e., Table 4-1), namely, that they are well exposed to Europeans and the other Asian groups ($\bar{P}^* = 0.644$ and 0.426, respectively) but isolated from Māori and Pacific peoples ($\bar{P}^* = 0.198$ and 0.080, respectively). This trend is similar to the characteristics of typical ethnic communities, where middle-class ethnic minorities are residentially mixed with the majority population but typically live apart from less well-off groups.

Overall, the initial data suggest that the Korean population in Auckland is geographically concentrated in certain areas, and the residential clusters of Koreans are similar to ethnic com-

Table 4.2 — Spatial dissimilarity index values for ethnic groups in the Auckland urban areas

<table>
<thead>
<tr>
<th></th>
<th>1996</th>
<th>2001</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>European</td>
<td>0.265</td>
<td>0.273</td>
<td>0.279</td>
</tr>
<tr>
<td>Māori</td>
<td>0.274</td>
<td>0.298</td>
<td>0.281</td>
</tr>
<tr>
<td>Pacific peoples</td>
<td>0.424</td>
<td>0.448</td>
<td>0.462</td>
</tr>
<tr>
<td>Asian</td>
<td>0.212</td>
<td>0.222</td>
<td>0.277</td>
</tr>
<tr>
<td>Korean</td>
<td>0.407</td>
<td>0.424</td>
<td>0.465</td>
</tr>
<tr>
<td>Arrived before 1996</td>
<td>-</td>
<td>0.436</td>
<td>0.479</td>
</tr>
<tr>
<td>Arrived between 1996 &amp; 2001</td>
<td>-</td>
<td>0.483</td>
<td>0.520</td>
</tr>
<tr>
<td>Arrived after 2001</td>
<td>-</td>
<td>-</td>
<td>0.501</td>
</tr>
<tr>
<td>Other Korean*</td>
<td>-</td>
<td>0.279</td>
<td>0.307</td>
</tr>
<tr>
<td>Other Asian</td>
<td>0.226</td>
<td>0.232</td>
<td>0.280</td>
</tr>
<tr>
<td>Other ethnicity*</td>
<td>0.169</td>
<td>0.128</td>
<td>0.080</td>
</tr>
<tr>
<td>Total</td>
<td>0.279</td>
<td>0.287</td>
<td>0.279</td>
</tr>
</tbody>
</table>


* Other Korean refers to those who arrived prior to 1996 and those who were born in New Zealand. In 1996, their number was only 430 (or 4.3% of the total Korean population), but it grew to 1,340 in 2001, and 4,345 in 2006 (17.5% and 24.3%, respectively).

* Other ethnicity refers to those who do not identify themselves as European, Māori, Pacific peoples, Asian, and MELAA. In 2006, the vast majority of ‘other ethnicity’ was New Zealander.
munities in the sense that Koreans do not form a majority of the population. Their distribution was uneven, and it was evident that they are relatively clustered. However, unlike those in enclaves, they did not appear to be isolated in an absolute sense. The next steps in investigating the Korean clusters include locating the areas where Koreans are concentrated and examining the socio-demographic features of the clusters. In the following two sections, the locations and boundaries of the Korean clusters are examined using the optimisation clustering method, and several census variables are analysed to determine how similar or different these clusters are from ethnoburbs and enclaves.

### 4.2 Residential Settlement Patterns

Simple choropleth maps of the Korean population suggest that there are four residential clusters in Auckland (see Fig. 4-3, Fig. 4-4, and Fig. 4-5). A considerable proportion of Koreans are concentrated in North Shore City\textsuperscript{12}, and there are also several smaller clusters in the western, asi

\textsuperscript{12} As mentioned in Chapter 1, although the four urban territorial authorities in the Auckland region, such as North Shore City and Manukau City, amalgamated into the newly-established Auckland Council in November 2010, this thesis uses the old administrative names because most census data are still available

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**Table 4.3 — Spatial exposure index values between ethnic groups in the Auckland urban areas**

<table>
<thead>
<tr>
<th></th>
<th>European</th>
<th>Māori</th>
<th>Pacific peoples</th>
<th>Asian (excl. Korean)</th>
<th>Korean</th>
<th>Other ethnicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>European</td>
<td>-</td>
<td>0.270</td>
<td>0.143</td>
<td>0.344</td>
<td>0.127</td>
<td>0.498</td>
</tr>
<tr>
<td>Māori</td>
<td>0.479</td>
<td>-</td>
<td>0.323</td>
<td>0.321</td>
<td>0.069</td>
<td>0.461</td>
</tr>
<tr>
<td>Pacific peoples</td>
<td>0.371</td>
<td>0.470</td>
<td>-</td>
<td>0.323</td>
<td>0.040</td>
<td>0.425</td>
</tr>
<tr>
<td>Asian (excl. Korean)</td>
<td>0.532</td>
<td>0.280</td>
<td>0.194</td>
<td>-</td>
<td>0.130</td>
<td>0.476</td>
</tr>
<tr>
<td>Korean</td>
<td>0.644</td>
<td>0.198</td>
<td>0.080</td>
<td>0.426</td>
<td>-</td>
<td>0.510</td>
</tr>
<tr>
<td>Other ethnicity</td>
<td>0.587</td>
<td>0.305</td>
<td>0.193</td>
<td>0.362</td>
<td>0.119</td>
<td>-</td>
</tr>
</tbody>
</table>

*Source: New Zealand Census of Population and Dwellings for 2006*
central, and eastern parts of the region. However, as previously mentioned, the boundaries of their residential clusters seem to be somewhat vague and unclear because Koreans occupy large areas with relatively low population density rather than being highly agglomerated in a few census tracts. Therefore, this section first utilises the optimisation clustering algorithm to determine the extent of the clusters and then examines how they changed and expanded between 1996 and 2006.

It should be noted that, in this section, the clustering algorithm is applied to the density of the Korean population rather than the proportions. This is because the term ‘cluster’ here refers to areas where a large number of Koreans is located, forming a sizable ethnic community, not areas where they are relatively concentrated. That is to say, if there are two possible Korean clusters of the same size, and if one has the Korean population of 5,000, comprising 5% of the local population while another has 1,000 Koreans, comprising 10% of the local population, then the former, which has the higher Korean population density but lower proportion, is considered a more important cluster in the present thesis. Nevertheless, however, the clustering results in this section would be reasonably comparable to those based on the proportions because in the Auckland urban areas, census tracts where Koreans are densely populated tend to have a higher proportion of Koreans as well (i.e., positively correlated as shown in Fig. 4-2).

4.2.1 1996

The choropleth map of Korean population density in Fig. 4-3 demonstrates that Koreans were mainly clustered in North Shore City and East Auckland in 1996. Most high and medium density census tracts (i.e., black and dark grey areas) were concentrated in the northern part of the region and around Howick, a middle-class Anglo-dominated suburb of East Auckland. Although

only in the old geographic units.
the Korean population density in the medium density census tracts was as low as 46/km$^2$, those tracts were geographically concentrated, forming distinct residential clusters. In addition to these two evident agglomerations, a number of census tracts with a medium Korean population density were also found in the central and western parts of the region, which can be classified as small clusters. The ellipses on the map represent approximate boundaries of the possible clusters, and one to three census tracts within each cluster were chosen as starting points for the clustering method. These points either had the highest population density within the circles, or they were located approximately at the centre of the circles. The clustering algorithm was applied to all possible starting configurations (i.e., 12 different combinations from 3×2×2×1), and the one that minimised the overall within-group sum deviation was automatically chosen.

The box plot in Fig. 4-3 shows that the clustering method effectively identified the high and medium density census tracts. The population density of Koreans in the highlighted areas was, on average, 65/km$^2$, whereas it was only 6/km$^2$ in the remaining areas of Auckland. The Korean proportions in the highlighted and non-highlighted areas were 2.7% and 0.5%, respectively. Several tracts with medium population density (those with approximately 50/km$^2$) were

![Fig. 4-2. Scatter plots showing the correlations between the Korean population densities and proportions in the Auckland urban areas, 1996 – 2006](image)

labelled as non-clusters or *residuals* because they were scattered across the region and did not form a distinct concentration. Conversely, a few census tracts with a relatively low Korean population density were included in the clusters, particularly in East Auckland, because they were adjacent to very high-density areas.

The clustering method identified 47 census tracts as Korean clusters (Fig. 4-3). The North
Shore cluster consisted of 28 census tracts, with a Korean population that was approximately 38.5% of the regional Korean population (3,285 out of 8,541). The East Auckland cluster was composed of 16 tracts, containing 10.8% (or 921) of the Koreans in the Auckland urban areas. Compared to these two large clusters, the central and western concentrations appeared to be too small to be considered clusters. Although the population density in the two CBD tracts and 'West Harbour' was as high as that in the northern and eastern counterparts, these clusters were small in terms of geographical and population size. However, these clusters grew quite significantly over the next decade, as shown below.

4.2.2 2001

With the large inflow of immigrants from Asian countries during the late 1990s, the number of Koreans in the study region nearly doubled between 1996 and 2001. Most census tracts experienced an increase in the Korean population, and for some of them, the figures were more than four times higher than those of the previous census year (e.g., 42 to 207 in North Harbour East, 18 to 114 in Pinehill, and 54 to 240 in Auckland Central West). Despite this rapid increase, the arbitrarily-grouped population density map at the top of Fig. 4-4 suggests that the approximate locations and boundaries of the clusters remained the same for all but the North Shore cluster, which slightly extended to the west. As in 1996, there were no notable concentrations of Koreans in the central and western parts of Auckland, but the population density in the two CBD tracts significantly increased.

To more clearly observe the changes in the main residential areas of Koreans, the optimisation clustering algorithm was applied to the 2001 data. Four clusters were assumed to be present, and the starting points were chosen using the same method that was utilised for the 1996 data. Of the nine different initial configurations, the one that minimised the clustering criteria is
shown in the map at the bottom left of Fig. 4-4. The number of census tracts classified as (part of) clusters increased from 47 (comprising 53.1% of the Koreans in the region) in 1996 to 60 (comprising 61.4% of the total Koreans in the region) in 2001. As in Fig. 4-3, a box plot is provided to indicate the overall quality of the clustering results.

The algorithm found that the North Shore cluster remained the most dominant residen-
tial location for Koreans in 2001, comprising 42.9% of the total Korean population. In 1996, the western and southern part of the city, namely the suburbs of North Harbour and Birkdale, were not included in this northern cluster. However, they were included in 2001 due to their significant growth rate over this period. Consequently, in 2001, the North Shore cluster nearly covered the entire city and remained the largest residential neighbourhood of Koreans, where they accounted for about 4.1% of the local population (cf. Koreans comprised only about 1.3% of the total population in the Auckland urban areas).

In the meantime, the once spherically shaped eastern cluster changed into a more north-south oriented ellipse over the five-year period. As shown in Fig. 4-3, the East Auckland cluster occupied the north-western part of Manukau City in 1996. However, some of the western suburbs, such as Pakuranga and Farm Cove, which are generally considered as Chinese residential clusters (see Ho & Bedford, 2006, pp. 215-222), were excluded from the Korean cluster in 2001. It seemed that the Koreans who were previously in these suburbs moved towards the newly-built residential area of Dannemora and Botany Downs, altering the cluster into a north-south shape. Regardless of this change in shape, the eastern cluster in 2001 consisted of 18 census tracts and included approximately 11.1% of the total Korean population in Auckland, which is consistent with the 16 census tracts and 10.8% of the total population in the previous census year.

Perhaps the most significant growth of the Korean population between 1996 and 2001 occurred in the CBD areas. The increasing demand for English learning in South Korea and the 'Working Holiday Program' that commenced in 1999\(^\text{13}\) accelerated the inflow of young Korean students during the early 2000s. These students might be concentrated in the CBD, where cheap rental housing is available, most English language schools are located, and many Korean restaur-

\(^{13}\) The New Zealand Working Holiday Program allows young people aged 18 and 30 to travel in New Zealand and undertake employment during their stay for up to 12 months. New Zealand and South Korea signed the agreement in 1998, and the program commenced in 1999.
rants, which may offer employment opportunities to them, can be found. As a result, while the extent of the Central Auckland cluster remained in only two CBD census tracts, the Korean population density in this area increased from 69/km$^2$ to 288/km$^2$, and they comprised about 8.9% of the local population in 2001. Koreans became the third largest individual ethnic group in the CBD, after New Zealand Europeans (2,511, or 37.0%) and Chinese (1,098, or 16.2%).

Another small cluster around West Harbour also experienced a slight expansion in both geographic size and population density. However, unlike the CBD, the reasons for this growth were unclear. While it certainly became a more visible concentration compared to the previous census year, it is noteworthy that the population increase in this cluster was not as significant as in the CBD counterpart, and the number of Koreans remained very small compared to the other clusters (i.e., approximately one-eighth of the Korean population size in the North Shore cluster). This, together with the fact that North Harbour (which is part of the northern cluster) is only a 20-min drive away from West Harbour, seemed to suggest that this small concentration is more likely to be an extension of the larger Korean cluster in North Shore City than a new independent ethnic community.

The box plot of the Korean population densities indicates that several census tracts with population densities as high as that in the main clusters were classified as residuals (Fig. 4-4). This high degree of overlap between the clusters and the remaining areas of the region suggests that a considerable number of the census tracts with a medium to high Korean population density were geographically scattered across the region. Each of these potential clustering errors was individually examined to determine whether the residual formed a possible cluster by making it an initial seed for the clustering algorithm. However, none provided a significant result: they were not surrounded by other high-density areas; and their population density was not high enough to be a single census tract cluster. The overrepresentation of Koreans in those outliers may have occurred randomly rather than by deliberate concentration of Koreans because
such overrepresentation was lost in the next census year.

4.2.3 2006

The number of Koreans in the Auckland urban areas reached over 20,000 in 2006, which is likely sufficient for uncovering demographic and socio-economic differences between the residentially concentrated and scattered populations. In terms of geographic patterns, the choropleth map in Fig. 4-5 displays that the population growth over the last five years was largely concentrated in a few established Korean communities, and as a result, the Korean population density in those areas became more distinctive from that in the remaining areas of the region. This is consistent with the increase in the spatial dissimilarity index value between 2001 and 2006 that was mentioned in the previous section.

The optimisation clustering method revealed that the two major clusters of Koreans—the North Shore and East Auckland clusters—remained intact in 2006. Despite a slight decrease in geographic extent, North Shore City was still the most popular residential destination for Koreans. A few census tracts in the far north no longer formed this large ethnic neighbourhood, because the Korean population density in those areas only marginally increased or even decreased. However, nearly two-fifth (39.3%) of Koreans in Auckland still resided in this northern cluster, where they comprised about 5.6% of the local population.

In a similar vein, the East Auckland cluster also became a geographically more compact cluster: the number of census tracts decreased from 18 to 14, while their share in the Korean population in Auckland slightly rose from 11.1% to 11.9%. The cluster had a narrow and long shape, distributed across the traditional suburb of Howick in the northern Manukau City and the newly built town of Point View in the south. Point View had the largest number of Koreans in the 2006 census, perhaps because modern houses in this planned suburb attracted newcomer-
ers who sought apartment-like, easy-to-maintain homes.

Compared to the two dominant clusters in the north and east, the Korean cluster in Central Auckland underwent a dramatic geographic expansion. As shown in the map, the central cluster included not only the CBD census tracts as in 2001 but also the prestigious suburbs of Remuera and Epsom. It encompassed 13 census tracts and 10.7% of the total Korean popula-
tion in Auckland, and the average Korean population density (i.e., 187/km\(^2\)) was noticeably greater than that in the northern and eastern clusters (i.e., 111/km\(^2\) and 121/km\(^2\), respectively).\(^{14}\) However, considering the differences between the CBD areas and affluent suburbs in regards to socio-economic characteristics and housing conditions, there might be more internal variance within this cluster. This is discussed in detail throughout the rest of the thesis.

Fig. 4-5 demonstrates that the size of the West Auckland cluster was similar to that in the previous census year, but the cluster slightly moved to the south. In 2006, approximately 3.4% of the Koreans in Auckland resided near Henderson, where middle-aged and low-to-middle-income families dominate the demographic composition. Although the population size was smaller than that in the previously mentioned clusters, the Henderson area has a somewhat distinctive socio-demographic profile in comparison to the other parts of the region that have been popular among Koreans (i.e., North Shore City and East Auckland). Therefore, further examining the causes and patterns of the residential clustering in the Henderson area is warranted.

The box plot of the Korean population densities indicates that there was a clear distinc-
tion between the clusters and the rest of the region in terms of the Korean population density. The 'West Harbour' census tract, which was classified as part of the western cluster in the previous census years, was considered an outlier in 2006, because the overall growth of the Korean population in Henderson and nearby suburbs was more significant than that in this tract. Furthermore, as noted in Section 4.2.2, since West Harbour is physically quite close to North Shore City and has a socio-demographic profile that is more similar to that of North Shore City, it would be reasonable to exclude West Harbour from the West Auckland cluster.

\(^{14}\)This was largely due to the exceptionally high Korean population density in the two CBD census tracts. The rest of the Central Auckland cluster showed a similar level to the other clusters.
4.3 General Characteristics of Clusters

The previous two sections focused on describing the geographic distribution of Koreans in Auckland using global and local measures. The spatial dissimilarity and exposure indices demonstrated that the Korean population has been relatively clustered in terms of residential distribution since 1996 but not segregated in an absolute sense. In the 2006 census, Koreans were highly exposed to other ethnic groups (e.g., European and other Asian groups), and their proportion did not exceed 10% in most of the areas where they were clustered. Using the optimisation clustering method, I found that the Korean residential clusters are located across several suburbs with low population density, particularly around the northern and eastern parts of Auckland. Although this pattern appears to be analogous to the description of a typical ethnic community (i.e., voluntary ethnic residential clustering), it is crucial to understand the underlying reasons for this geographic snapshot before determining the relevant conceptual model.

Whether a certain ethnic settlement is an enclave of disadvantaged minorities or an ethnic community of middle-class immigrants depends on how individuals are distributed and where they are located. While empirical evidence presented in Chapter 2 showed that these two attributes generally correspond, for small ethnic groups like Koreans in Auckland, geographically dispersed clustering may not necessarily imply a voluntary concentration in affluent areas. The current section, therefore, investigates general demographic and socio-economic profiles of the areas where Koreans were clustered in 2006 and attempts to explain possible factors that influenced them to settle in those neighbourhoods. Note that this is different from Chapter 5 and 6 in that the current section focuses on the general features of the cluster areas, whereas the following chapters examine more specific characteristics of Koreans living in the co-ethnic concentration. Therefore, the results in the current section should be considered background information and may not represent the true state of affairs of the Korean residential clusters (though it is likely that the information accurately represents the clusters).
To examine the general characteristics of the areas where the Korean residential clusters were situated, five categorical variables were employed from the 2006 census: ethnic composition, household income, educational qualification, study participation, and age group. The ‘ethnic composition’ variable was chosen to show the degree to which Koreans were integrated with other ethnic groups (e.g., European, Māori, Pacific peoples, other Asians, and MELAA) at the census tract level. The household income and educational qualification variables represent the social and economic status of the local population and are used as measures of the socio-economic level of the geographic units. The number of full- and part-time students was included, because a large proportion of the Korean population in Auckland is international students (see Section 1.1), whose residential preferences may somewhat differ from those of family immigrants. The ‘age group’ variable was utilised as a supplementary variable, and it has the same response categories as in Table 3-1.

The census variables were provided in two-way tables (Table 4-4) and were analysed using the correspondence analysis (CA) described in Section 3.3.1. In the current section, the Central Auckland cluster is considered as two separate subgroups, CBD and non-CBD areas, because they have rather different characteristics (described below). Henceforth, the term ‘central cluster’ refers to the non-CBD area, and the study region is divided into six cluster zones (i.e., five clusters and the rest of the region), as shown in Fig. 4-6.

The top-left plot in Fig. 4-7 displays a two-dimensional CA map of the ethnic composition data. The horizontal axis accounts for approximately 75.2% of the total variation and the vertical axis explains approximately 18.9% of the variation. On this plot, most Korean residential clusters (i.e., N, E, C, and CBD) are further apart from the non-cluster area (i.e., R), indicating a large difference between these areas in terms of the ethnic composition. The clusters seem to be mainly located in suburbs where the European, Asian, and MELAA population groups are overrepresented and the Māori and Pacific peoples are underrepresented. This result supports
Table 4.4 — Selected census variables for the total population by cluster groups

<table>
<thead>
<tr>
<th>Ethnic composition (%)</th>
<th>North</th>
<th>East</th>
<th>Central</th>
<th>West</th>
<th>Residua-</th>
<th>CBD</th>
<th>Other</th>
<th>Overall</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>European</td>
<td>65.27</td>
<td>53.56</td>
<td>38.20</td>
<td>53.99</td>
<td>49.11</td>
<td>49.42</td>
<td>49.59</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>5.64</td>
<td>3.43</td>
<td>5.02</td>
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<td>Post school(^b)</td>
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<td>Study participation (%)</td>
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<td>Age group (%)</td>
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<td>30 – 39 years</td>
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<td>13.21</td>
<td>15.16</td>
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<td>50 – 59 years</td>
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<td>60 years or older</td>
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</table>

Source: New Zealand Census of Population and Dwellings for 2006

\(^a\) Includes overseas school qualifications.

\(^b\) Includes vocational qualifications and other post-school qualifications.
the findings from the spatial segregation measures. Interestingly, however, the West Auckland cluster ‘W’ is quite close to the non-cluster point due to the relatively large proportion of Māori people around Henderson, distinguishing the western cluster from the other Korean residential clusters. Another notable feature in the ethnic distribution is a large vertical distance between the North Shore cluster ‘N’ and CBD. The CBD area includes more Asian and MELAA populations compared to the northern district. The proportion of these groups is over 50% in the two highly dense census tracts, which is more than double that in the North Shore cluster area (Table 4-4). These differences in ethnic composition imply that there could be substantial variations among
Fig. 4.7. CA maps of the selected census variables

Abbreviations

Cluster name
- N  North Shore cluster
- E  East Auckland cluster
- C  Central cluster (excl. CBD tracts)
- CBD CBD cluster
- W  West Auckland cluster

Educational qualification
- NQ  No qualification
- SS  Secondary school qualification
- PS  Post school qualification
- BD  Bachelor degree
- HD  Higher degree
the clusters, as assumed in Chapter 1.

As with the ethnic composition data, the household income and education levels also exhibited distinctive characteristics among the cluster zones (top-right and middle-left plots, respectively, in Fig. 4-7). The people living in the central cluster zone were economically prosperous and well educated (i.e., highest income and education levels), while those in the western cluster zone had a considerably lower socio-economic profile. For example, over one-third of the local population in Remuera and Epsom, where Koreans were relatively concentrated in 2006, had a bachelor’s degree or higher and a total household income of over $100,000. However, for those around Henderson, only 14.2% had a bachelor’s degree or higher, and 19.4% had a total household income of over $100,000. The CBD area is also interesting in the sense that it had a large proportion of secondary school and university graduates (45.7 and 22.2%, respectively), but the income level was even lower than that in the western cluster zone. This is perhaps related to the fact that most residents in the CBD area are young students (shown below). The northern and eastern cluster zones had similar socio-economic profiles; they were dominated by middle-class, well-educated families compared to the other parts of the region (where Koreans were not clustered).

The study participation rate and age distribution (middle-right and bottom-left plots, respectively, in Fig. 4-7) clearly represent the concentration of young students in the CBD area. Approximately 40.1% of the CBD residents indicated that they were full-time students at the time of the 2006 census, and 51.9% were aged between 20 and 29. Considering that the second highest figures for these two response categories were only 22.4 and 21.9%, respectively (both of which were reported in the central cluster zone), the notable concentration of students is an important characteristic of this area. Another interesting pattern is found in the age distribution of the population; the large vertical distance between E, C and W, R on the bottom-left plot in Fig. 4-7 suggests that the eastern suburbs of Howick and Botany Downs, as well as the affluent cen-
nal suburbs of Remuera and Epsom, were mainly occupied by middle-aged individuals (i.e., those in their 40s and 50s). By contrast, younger, working-age people (i.e., 30-39) were relatively concentrated in Henderson and other ‘non-Korean cluster’ areas.

In short, the areas where the Koreans were concentrated seemed to be dominated by European and other Asian ethnic groups, and these areas were characterised as affluent and well-educated. However, the CBD and western clusters were somewhat distinguishable from the others; the CBD area was mainly comprised of young students whose income level was low (so perhaps was the Korean cluster in this location), and the majority of the western zone residents were economically less prosperous and less educated compared to the other areas of Auckland. The following subsections summarise the geographic profiles of each cluster zone based on these results and briefly discuss potential location factors that have influenced the residential clustering of Koreans.

4.3.1 North Shore cluster zone

North Shore City was New Zealand’s fourth largest city in terms of population until the restructuring of the local government into a unitary Auckland Council in the late 2010 and was generally recognised as composed of middle-class family suburbs. The North Shore area has traditionally been dominated by a European population. In the 1991 census, over 90% of the local population indicated that they belonged to the European ethnic group. This figure decreased to 67% in 2006 but remained the highest proportion of Europeans in the Auckland urban areas.

The optimisation clustering algorithm demonstrated that the largest Korean residential cluster is located over this northern district of Auckland. In 2006, North Shore City consisted of 53 census tracts, and 34 of them formed part of a Korean residential cluster. The general demographic and socio-economic characteristics of these census tracts suggest that those living in
this area are generally middle-income and well-educated families, rather than poor, working- 
class young immigrants with little educational background. This profile implies that the concen- 
tration of Koreans in this area is unlikely to be a result of their poor socio-economic condition, 
as assumed in the spatial assimilation model.

According to Yoon (2003), this concentration is largely caused by the high quality of 
houses and schools in North Shore City, which attracted many Korean immigrant families in the 
1990s. Most immigrant families from Korea who arrived during the early- and mid-1990s came 
with sufficient economic resources to settle in their new country, and they were able to deter- 
mine where to live depending on their own needs and demands. Yoon (2003) argued that Kor- 
eans chose to reside in this northern district because the area provided good living and education 
environment. Then, after the community was established during the mid-1990s, ethnic super- 
markets and other cultural amenities were likely to be served as additional pull factors for new- 
comers. If this explanation is correct, the North Shore cluster may be a typical ethnoburb-like 
clustering in the sense that it is voluntary and coexists with the majority ethnic groups (i.e., Eu- 
ropeans in this case). The causes of the residential clustering will be investigated in Chapter 5.

4.3.2 East Auckland cluster zone

The second largest residential area for Korean immigrants is located in the Howick – Dannemo-
ra area of Manukau City, the south eastern part of the great Auckland region. Although its geo-
graphical extent has slightly changed over the census years, suburbs such as Howick and Botany 
Downs have consistently been popular destinations for Koreans. In 2006, 14 census tracts 
formed the East Auckland cluster, and they accounted for approximately 11.9% of the total Ko-
rean population in Auckland.

As discussed above, the general population living in this area had similar demographic
and socio-economic profiles as those in North Shore City, but the East Auckland area attracted more Asian populations, including Chinese and Indian. Ho and Bedford (2006) explained that the concentration of Chinese in the affluent eastern suburbs is largely due to the modern houses and good educational environment. These same factors may have appealed to Korean family immigrants.

Howick, which is one of the affluent eastern suburbs, has a number of reputable state schools and is perceived as providing a safe educational and living environment. East Tamaki and Flat Bush, which were once rural farmlands, have been developed as new residential sites since the late 1990s, and many modern brick dwellings have been built in these areas. The temporal trend suggests that the eastern Korean cluster mainly expanded to where the new houses were supplied, with Howick remaining the central part of the community. This implies that, as with the North Shore cluster, the concentration of Koreans in East Auckland is also likely voluntary, driven by their preferences and needs.

4.3.3 Central Auckland cluster zone

As mentioned in the beginning of Section 4.3, the Central Auckland cluster zone consists of two distinctive neighbourhoods: the CBD, where two universities and a large number of English language schools are situated, and the affluent suburbs of Epsom and Remuera, where some of the country’s most prestigious private schools are located. According to the 2006 census, the CBD residents were mostly full-time students in their 20s, and the majority of those in Epsom and Remuera were affluent, well-educated families with school-aged children.

Compared to the northern and eastern counterparts discussed in the previous sections, the concentration of Koreans in Central Auckland is a relatively recent phenomenon. Their residential clustering around the inner-city apartment dwellings first became noticeable in 2001,
likely due to the growth of international students who came for English language education, as well as university students who attended one of the two universities in the CBD. In contrast, the emergence of clustering in the other central tracts likely reflects the increase of Korean families who prioritised their children's education, because housing prices in that part of the region tend to be rather expensive, while the region lacks access to ethnic shops that cater to their cultural needs (see Section 6.2 for details).

Both the CBD and central clusters seem to have been chosen by residents for their own merits (i.e., close proximity to the universities and language schools, as well as access to prestigious secondary schools and a good educational environment). However, it is important to note that the CBD cluster may not be completely voluntary: if the income level of the Korean population in this area is as low as the general population, and if they have no financial support (remittance) from the homeland or parents, their primary location factor may be affordable rental prices in the CBD and easy access to low-income jobs offered by small ethnic businesses. At this point, it is not clear which factor played a more important role in the growth of the Korean population in the inner city. Therefore, this phenomenon is addressed using customised survey data in Chapter 5.

4.3.4 West Auckland cluster zone

The optimisation clustering algorithm showed that a sizeable residential concentration of Koreans in Waitakere City, the western urban district of Auckland, first appeared around the wealthy beachside suburb of West Harbour in 2001. However, this residential concentration is not considered an independent ethnic residential cluster in this thesis due to its small population, its geographic proximity to North Shore City, and the socio-demographic profiles of the area (which are similar to the most dominant ethnic neighbourhood). This area is considered an ex-
tension of the northern cluster, and therefore, the concentration is not discussed further. A more significant clustering of Koreans appeared in 2006, around the Henderson area, located approximately 9 km south of West Harbour. This is more meaningful and interesting in the sense that the area had somewhat distinctive demographic and socio-economic features compared to the other Korean clusters.

According to the 2006 census, Henderson and nearby suburbs had relatively low household income and educational levels compared to the regional average. Fig. 4-8 exhibits the distribution of the median household income at the CAU level, and it indicates that the areas where the western cluster is located have somewhat lower income levels than the rest of Auckland. As with the eastern suburbs of East Tamaki and Flat Bush, Henderson has been (re)developed since the early 2000s, and the newly built houses there may have attracted the Korean population to some extent. Nonetheless, it is generally understood that the affordable property prices in this area are the most important location factor for low- or middle-income couples and young families, and this may be the case for Koreans as well.

The socio-economic differences between this western cluster and the others imply that the Korean community in Auckland has been diversified to some extent. Because most Koreans in New Zealand moved under the point-based immigration system, they tended to be demographically and socio-economically homogeneous (i.e., middle-class families with school-aged children), up until the late 1990s (Kim & Yoon, 2003). Auckland has, however, transformed into a more diverse (and dynamic) community with the inflow of international students and young-couple families who have less financial resources and are not constrained by the education environment for children when choosing their residential location. The emergence of this western cluster may have been an outcome of such diversification, and the cluster is expected to grow further if an increase in working-age Korean immigrants continues.
4.4 Summary

This chapter examined the geographic distribution of Koreans in Auckland. It began by measuring their degree of spatial segregation and exposure and then identified the extent of significant Korean residential concentration. The last section explained the socio-demographic characteristics of the areas where Koreans are clustered using the census data and correspondence analysis. The results provided insight into possible location factors for each cluster and whether residence is voluntary or imposed by socio-economic conditions.
However, because the Korean population comprises only about 5% of the local population in most clusters, the general demographic and socio-economic characteristics presented in this chapter may not accurately reflect the true nature of the Korean clusters. It is, for instance, likely that the actual income level of Koreans living in the prestigious suburb of Remuera is not as high as that of the other local families. Some of the Korean families may only temporarily reside in the area, purely for their children to attend the local schools with a national reputation. Because there are relatively little data available for small ethnic groups in New Zealand, most past studies did not examine the characteristics of individual groups, such as Koreans. The next two chapters will, therefore, fill this void in the literature by investigating the demographic and socio-economic profiles of Koreans in detail, using the customised census and survey data sets.
Chapter 5  Demographic Profiles

Demographic profiles are an important measure that indicates the characteristics of the group population. As mentioned in the earlier chapters, New Zealand has a relatively short history of immigration, particularly from Asian countries, and a large proportion of the ethnic minorities are recent arrivals. For example, in the 2006 census, 67.4% of Asian-born immigrants (169,407 of 251,130) and 73.4% of Korean immigrants (21,102 of 28,731) reported that they had arrived in the last 9 years. Considering that Auckland is the most popular port of entry for newcomers, this figure may be much higher in the study region than the national average. In general, contemporary immigrants have different demographic characteristics and reasons for migration compared to settlers who arrived prior to the 1970s. Many of them moved in family groups for educational- or lifestyle-related reasons rather than economic motives. Because these differences in demographic profiles largely affect the nature of ethnic segregation (whether it is voluntary or imposed), it is important to understand who forms the clusters of interest.
Therefore, this chapter aims to investigate the demographic characteristics of Koreans in Auckland and identify important factors that affected their residential choice. In light of the fact that most areas where Koreans are clustered are middle-class family suburbs (Section 4.3), they are likely less constrained by economic circumstances and more motivated by their own preferences and needs. However, this interpretation (based on the profiles of the general population) may not truly represent the Korean community, because their population share in ethnic composition is quite small in most census tracts (i.e., less than 5%). To more precisely understand the phenomenon of Korean residential clustering, the present section employs the customised census and survey data described in Section 3.1.

Section 5.1 explores the geographic distributions of age, sex, household income, and education levels of Koreans in the 2006 census. The purpose of the examination is to determine how similar or different these attributes are across the cluster zones and the reasons for the patterns. This section also investigates the degree of socio-cultural assimilation based on the main language of use (i.e., English, Korean, or both), years of residence in New Zealand, and the type of immigration (i.e., temporary migration or permanent).

Section 5.2 considers the main reasons behind the migration of Koreans, and Section 5.3 discusses the main location factors that attracted them to settle in their current residential area. Section 5.4 analyses their degree of satisfaction with the current neighbourhood and preferred suburbs. These three sections are based on survey results that do not have a large number of respondents for small clusters. Therefore, the interpretations here are rather descriptive, with few statistical analyses.
5.1 General Characteristics of Koreans

5.1.1 Age and sex distribution

The 2006 census found that approximately two-fifths of the Korean population in the study region was school-aged or younger, and another 30% was middle-aged. The same figures for the general population were 28.4% and 27.1%, respectively, suggesting that a relatively large proportion of Koreans in Auckland were families with children.

The survey results provide supporting evidence for this view: the median age group of the respondents (i.e., householders) was 40-49, and the mean household size was 3.7. Nearly three of every four respondents were in the middle-aged group of either 40-49 or 50-59 (82 and 74 householders, respectively), while only nine respondents belonged to the 29-year-old or younger group. The mean household size of 3.7 was also larger than the regional average of three in the 2006 census. One- or two-people households, which included approximately 49.2% of the total households in Auckland, were relatively rare among the survey participants; only 16.8% fell in this group. Instead, three- and four-people households comprised the majority of the Korean community (51 and 81, respectively) and five- or more people households accounted for another 19.7% (or 41). These results indicate that most Korean immigrants in Auckland might be arrived in family groups15.

Fig. 5-1 shows age-sex pyramids of the general and Korean populations in New Zealand. Aside from the overrepresentation of the middle-age groups (i.e., between 40 and 59-years-old) in the Korean population, it exhibits another interesting pattern, which is a rather higher number of females in their 30s and 40s than males. For the group aged between 40 and 49, the gender ratio was 1.4 females per male, and for those aged 30-39, the number was over 1.7 females.

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15 The margins of error for these survey estimates are ±5.2% for one- or two-people households, ±6.0% for three-people, ±6.8% for four-people, and ±5.6% for five- or more people households at a 95% confidence level.
Considering the age groups of the overrepresented Koreans and the size of the school-aged population, one possible cause for this unnatural phenomenon is the inflow of astronaut families. In astronaut families, the father typically works in the country of origin, while the other family members reside in the host (receiving) country for the children’s education (Ho & Bedford, 2006; Lidgard, 1996). If the gender ratios of Koreans reflect the number of astronaut families, which has not been officially estimated, these families accounted for up to a quarter of the total Korean households in the country in 2006 (1,407 out of 5,244 households).

This age and sex distribution of the Korean population was reasonably consistent across the cluster zones in 2006. The correspondence analysis (CA) of the data (Table 5-1) indicates that while the West Auckland cluster had a slightly large proportion of those aged between 30 and 39 and the CBD cluster was clearly dominated by people in their 20s (presumably students), all of the major clusters (i.e., N, C, and E) and non-cluster areas (i.e., R) had a similar age-sex structure. The points that represent these four groups are concentrated on the left side of Fig. 5-2, whose horizontal axis explains approximately 89.4% of the total variation.

**Fig. 5-1. Age-sex distribution of the general population (left, in 100s) and the Korean population (right) in New Zealand**

*Source: New Zealand Census of Population and Dwellings for 2006*
Table 5.1 — Selected census and survey variables for the Korean population by cluster groups

<table>
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<th>Residuals</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CBD</td>
<td>Other</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Age group (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 – 19 years</td>
<td>38.69</td>
<td>45.67</td>
<td>20.99</td>
<td>45.53</td>
<td>42.24</td>
<td>38.58</td>
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<tr>
<td>20 – 29 years</td>
<td>12.77</td>
<td>8.17</td>
<td>52.21</td>
<td>16.14</td>
<td>8.19</td>
<td>14.61</td>
</tr>
<tr>
<td>30 – 39 years</td>
<td>12.32</td>
<td>10.02</td>
<td>12.15</td>
<td>8.07</td>
<td>18.97</td>
<td>14.04</td>
</tr>
<tr>
<td>40 – 49 years</td>
<td>23.34</td>
<td>26.86</td>
<td>9.12</td>
<td>21.90</td>
<td>20.26</td>
<td>20.29</td>
</tr>
<tr>
<td>50 – 59 years</td>
<td>9.06</td>
<td>6.81</td>
<td>4.42</td>
<td>6.05</td>
<td>6.90</td>
<td>8.54</td>
</tr>
<tr>
<td>60 years or older</td>
<td>3.83</td>
<td>2.48</td>
<td>1.10</td>
<td>2.31</td>
<td>3.45</td>
<td>3.94</td>
</tr>
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<td>Household income (%)</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Less than $20,000</td>
<td>36.70</td>
<td>34.21</td>
<td>60.83</td>
<td>44.44</td>
<td>38.89</td>
<td>40.97</td>
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<td>$20,000 - $30,000</td>
<td>17.49</td>
<td>14.91</td>
<td>12.50</td>
<td>19.44</td>
<td>22.22</td>
<td>15.97</td>
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<td>$30,001 - $50,000</td>
<td>31.28</td>
<td>33.33</td>
<td>15.83</td>
<td>19.44</td>
<td>30.56</td>
<td>23.61</td>
</tr>
<tr>
<td>$50,001 - $70,000</td>
<td>7.64</td>
<td>11.40</td>
<td>6.67</td>
<td>16.67</td>
<td>8.33</td>
<td>8.33</td>
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<tr>
<td>$70,001 - $100,000</td>
<td>5.42</td>
<td>3.51</td>
<td>1.67</td>
<td>0.00</td>
<td>0.00</td>
<td>4.86</td>
</tr>
<tr>
<td>Over $100,000</td>
<td>1.48</td>
<td>2.63</td>
<td>2.50</td>
<td>0.00</td>
<td>0.00</td>
<td>6.25</td>
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<tr>
<td>Education level (%)</td>
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<td>4.17</td>
<td>6.72</td>
<td>8.67</td>
<td>5.93</td>
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<tr>
<td>Secondary school</td>
<td>50.16</td>
<td>52.77</td>
<td>40.38</td>
<td>44.54</td>
<td>53.33</td>
<td>48.49</td>
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<td>Post school</td>
<td>21.07</td>
<td>19.50</td>
<td>34.29</td>
<td>24.37</td>
<td>18.00</td>
<td>22.01</td>
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<tr>
<td>Bachelor degree</td>
<td>17.91</td>
<td>15.30</td>
<td>17.63</td>
<td>20.59</td>
<td>16.67</td>
<td>19.36</td>
</tr>
<tr>
<td>Higher degree</td>
<td>4.06</td>
<td>3.25</td>
<td>3.53</td>
<td>3.78</td>
<td>3.33</td>
<td>4.22</td>
</tr>
<tr>
<td>Years of residence (%)</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>0-4 years</td>
<td>50.71</td>
<td>57.78</td>
<td>55.69</td>
<td>50.62</td>
<td>66.84</td>
<td>53.48</td>
</tr>
<tr>
<td>5-9 years</td>
<td>21.02</td>
<td>23.41</td>
<td>24.25</td>
<td>23.29</td>
<td>13.27</td>
<td>20.87</td>
</tr>
<tr>
<td>10-19 years</td>
<td>28.18</td>
<td>18.81</td>
<td>20.06</td>
<td>26.09</td>
<td>19.90</td>
<td>25.65</td>
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<tr>
<td>20 years or longer</td>
<td>0.08</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<td>Main language (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Korean only</td>
<td>31.26</td>
<td>33.38</td>
<td>21.30</td>
<td>21.39</td>
<td>31.94</td>
<td>28.49</td>
</tr>
<tr>
<td>English only</td>
<td>10.51</td>
<td>8.87</td>
<td>16.27</td>
<td>11.56</td>
<td>12.04</td>
<td>9.08</td>
</tr>
<tr>
<td>Korean &amp; English</td>
<td>58.23</td>
<td>57.76</td>
<td>62.43</td>
<td>67.05</td>
<td>56.02</td>
<td>62.44</td>
</tr>
<tr>
<td>Rental properties (%)</td>
<td>40.17</td>
<td>37.93</td>
<td>66.88</td>
<td>51.02</td>
<td>46.55</td>
<td>31.77</td>
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<tr>
<td>Permanent residents (%)</td>
<td>72.09</td>
<td>50.00</td>
<td>63.64</td>
<td>16.67</td>
<td>66.67</td>
<td>74.65</td>
</tr>
<tr>
<td>Astronaut families (%)</td>
<td>10.47</td>
<td>9.09</td>
<td>18.18</td>
<td>16.67</td>
<td>16.67</td>
<td>8.45</td>
</tr>
</tbody>
</table>


* Figures were derived from the survey data. All other variables were from the 2006 Census data. The number of respondents for each cluster group is as follows: 86 for N, 11 for C, 6 for CBD, 22 for E, 6 for W, and 71 for R.
Unlike the age and sex distribution, there were some differences between the Korean clusters in terms of the years of residence in New Zealand and the main language of use.

As with other Asian groups, most Korean immigrants in New Zealand were recent arrivals: the 2006 census demonstrates that almost two-third of Koreans in Auckland arrived in or after 1997, and over 70% of them (i.e., 53.3% of the Korean population at the time of the census) arrived in the 2000s16. This resulted in a rather high proportion of those who lived in New Zealand for less than 5 years across the entire Auckland region, not only in the ethnic clusters but also outside of these concentrations (Table 5-1). Nonetheless, this overrepresentation of ‘new’ migrants was particularly more visible in the West Auckland cluster, whereas ‘old’ settlers

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16 The survey confirmed that the majority of the respondents had arrived in the last decade. Additionally, it found that there were two main waves of immigration from Korea: the first wave occurred in the mid-1990s, and the second wave occurred during the early 2000s. While there was a rapid shrinkage between these two periods (perhaps due to the Asian economic crisis at that time), about 35.3% of the respondents arrived between 1993 and 1996 and another 45.3% arrived between 2000 and 2003. This temporal pattern is consistent with previous studies of Koreans in New Zealand (see, for example, Yoon, 2003).
DEMOGRAPHIC PROFILES

comprised a relatively large population share in the North Shore (see the left plot in Fig. 5-3). However, it may be worth noting that the years of residence are neither a good indicator of socio-cultural assimilation nor an important determinant of the clustering of Koreans. A time span of 10 years may not be sufficient for cultural adjustment to a new environment. Furthermore, as shown in the CA map, the average length of residence for the residentially dispersed Korean population (i.e., R) was quite similar to that of Koreans living in the North Shore and Central Auckland clusters (i.e., N and C): the three groups were closely located to each other.

Perhaps a better indicator of socio-cultural assimilation in this context is the main language of use. Overall, the languages spoken reflect the high proportion of new immigrants in the Korean community. The 2006 census shows that approximately 29.6% of the Korean population was unable to speak English (not assimilated), and only 10.3% of the respondents were fluent in English but not Korean (fully assimilated). The rest of the population indicated that they could speak both languages. However, this figure does not have any practical significance, because the level of proficiency for each language was not specified. It is likely that some of these bilingual

Fig. 5-3. CA map of the years of residence in New Zealand (left) and languages spoken (right) for Koreans
Source: New Zealand Census of Population and Dwellings for 2006
people were fluent in only one language (presumably Korean) and were learning the other. They may not have reached the level of linguistic assimilation, and in that case, it would be inappropriate to classify them as a bilingual group. Unfortunately, the proportion of the truly bilingual population and that of the ‘learners’ was not provided in the 2006 census\(^\text{17}\). Therefore, the ‘speak both’ response cannot be used as an indicator of linguistic assimilation.

The CA map on the right side of Fig. 5-3 illustrates that the Koreans living in the CBD cluster were likely fluent in English. Interestingly, despite the concentration of the ‘old’ migrants who lived in New Zealand for more than 10 years, the North Shore cluster and the non-cluster areas displayed the least level of linguistic assimilation. The pattern presented in this CA map is somewhat similar to that of the age groups (i.e., Fig. 5-2), suggesting that the degree of linguistic assimilation among Koreans is more related to the age groups than the years of residence. This interpretation is plausible in the sense that the vast majority of Koreans in New Zealand are first generation immigrants (nearly 90% of them were born overseas in the 2006 census), who tend to retain their mother language regardless of the period of residence in the new country (Gordon, 1961). The high proportion of the ‘English only’ Korean population in the CBD is likely because there are many young students who migrated with their parents in their early years and are mainly educated in New Zealand in English. In this respect, the ‘languages spoken’ should not be seen as a factor that caused residential clustering in the CBD. Rather, it is perhaps a consequence of the concentration of young Koreans in this area.

\(^{17}\) A survey conducted by the North Shore-based Korean society of Auckland suggested that about 78% of the respondents used Korean as their main language in their daily life and 19% used both Korean and English. Because the survey took place at an annual Korean cultural festival in which the participants were mostly first-generation immigrants living in North Shore City, the ‘Korean only’ speakers could be overrepresented. However, the high discrepancy between the two data sources may be affected not only by the sampling error but also by the difference in question wording. While the census simply asked about languages the respondents could speak, the survey was concerned with the languages they actively used in their daily life. These figures therefore imply that a very large proportion of those in the ‘both languages’ group in the 2006 census may use only Korean as their main language.
5.1.3 Income and educational level

As shown in the previous section, most Korean residents in Auckland are first generation immigrants. The distribution of their income and educational level, therefore, conforms to the typical pattern of Asian immigrants (i.e., they are well educated but generally have a lower income level than the native population). Fig. 5-4 shows that the Korean population was more likely to have educational qualifications, particularly a bachelor’s degree, than the general population. Despite this high level of education, however, the income level of the Korean households was significantly below the regional average. Indeed, approximately 40% of them indicated that their household income was ‘under $20,000’, whereas only 12% of the general population reported this income level.

This pattern consistently appeared throughout the cluster groups and, therefore, does not seem to be a primary factor of residential clustering (or assimilation) in Auckland. The non-clustered Koreans were slightly more likely to have a high income (i.e., over $70,000) than those...
living in the suburban ethnic clusters, but the difference in actual numbers was quite marginal and can be neglected. However, the CA map at the right side of Fig. 5-5 suggests that the income level may have affected where they are clustered (to a certain extent). For example, the Koreans in the CBD were much more likely to fall in the lowest income group (i.e., under $20,000) than those in North Shore City, and the West Auckland cluster mainly consisted of economically less well-off Koreans compared to the East Auckland cluster. Given that rent and housing prices in the CBD and West Auckland are relatively affordable, this distribution seems quite plausible, and it implies that the influx of the Korean immigrants with less economic resources may have contributed to the recent growth of these ethnic clusters. This point will be addressed again in Section 5.3 (using the customised survey data) and further discussed.
5.1.4 Type of immigration and tenure of household

One important feature of contemporary immigrants that distinguishes them from early settlers may be their strong transnational ties with their country of origin. In the past, immigration often meant permanent settlement in a new environment, and at that time, it was difficult for the immigrants to maintain social and cultural connections with their home country. The recent economic growth in Asian countries and advances in transportation and communication technologies, however, have led to the emergence (or increase, at least) of more transnational immigrants who move to achieve particular goals (e.g., children’s education). Because these immigrants typically intend to return to their homeland after achieving their goals (or after some period of time) they can be referred to as temporary immigrants.

In the survey, approximately 31.7% of Korean householders indicated that they would return to Korea at some point, with a 95% confidence interval of ±6.3%. The 2006 census also showed that approximately 34.4% of those who had arrived between 1997 and 2001 left the country by the time of the next census. Not surprisingly, there were more temporary immigrants among astronaut families than among the other family types: 57.1% of the astronaut families from Korea reported that they would return to Korea at some point, while the non-astronaut families indicated a much lower rate of 27.9%. For reference, the survey found that 10.4% of Korean households in the Auckland urban areas were astronaut families in 2008 (95% CI = ±4.1%). This figure is lower than the estimate derived from the age-sex pyramids in Section 5.1.1, but it is nonetheless a considerable fraction of the ethnic population.

Fig. 5-6 displays how the Korean astronaut families and permanent immigrants were distributed across the cluster groups. To complement the survey data of small clusters that do not have a sufficient sample size to produce reliable results (e.g., the CBD and West Auckland clusters), the tenure of household in the 2006 census was adopted as supplemental information. In general, whether one resides in a rental property or in his/her own house primarily depends on
income level. For immigrants, however, it can also be an indicator of their commitment to remain in their new country for a long period of time. As expected, the CA map in Fig. 5-6 shows that the proportion of the astronaut families and rental occupiers were negatively related to that of the permanent immigrants. The point ‘P’, representing the permanent immigrants, is located at the left side of the plot with a negative x value; and the points ‘A’ and ‘R’, which indicate the astronaut families and rental occupiers (respectively), appear at the right side of the plot with a positive x value. The geographic distribution of these three points suggests that the inflow of the astronaut families and temporary immigrants influenced the clustering of Koreans, particularly in the CBD area, while the increase of the permanent immigrants contributed to their residential assimilation.
5.1.5 Summary

The demographic profiles of the Koreans examined in this section showed that the vast majority of this ethnic community consists of first generation immigrant families. Almost all of them arrived in the last two decades, and they generally exhibited a low degree of socio-cultural assimilation. These characteristics were quite consistent across the Korean population groups living in different localities, and therefore, they did not seem to be a primary factor for residential clustering. Although the CBD demonstrated some differences in terms of age structure and proficiency in English, this was more likely to be a product of concentration in that particular area, not the cause of clustering.

The income and education levels of Koreans did not seem to be important determinants for their residential clustering either. Perhaps, as a result of the low degree of linguistic assimilation, many Korean households in Auckland fell in the lowest income category (i.e., under $20,000) in the 2006 census, despite their relatively high educational background. This feature was generally common for both the clustered and non-clustered Koreans, though the correspondence analysis provided some visual evidence that the low-income level of some Koreans may have stimulated the recent concentration in the CBD and around the western suburb of Henderson to a certain extent.

An interesting characteristic of the Korean population in Auckland was a relatively large proportion of temporary immigrants who intended to return to their home country at some point. If a 'temporary immigrant' is defined as someone who resided in New Zealand for at least 12 months but no more than 9 years, then approximately 34.4% of Koreans in Auckland belonged to this group in the 2006 census. The same figure was only 10.3% and 23.8% among Pacific peoples and other Asians, respectively. The temporary immigrants, as well as the astro-

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18 Because this statistic is not directly available from the census data, the figures here were estimated by the ratio of the overseas-born population that arrived between 1997 and 2001 in the 2001 census to those that remained in 2006.
naut families, were somewhat overrepresented in the CBD and central clusters, implying that the inflow of such transnational Koreans particularly contributed to their population growth in these emerging clusters.

It should be noted, however, that these findings are preliminary and not conclusive. Although the correspondence analysis effectively identified some significant differences between the Koreans who reside in different parts of Auckland, it did not confirm any causal relationships between the socio-demographic characteristics and residential clustering in particular areas. Therefore, the possible location factors suggested in the present section are further justified and supplemented in Section 5.3 using the customised survey data.

5.2 Reasons for Migration

The survey results on the main reasons for migration generally correspond with previous empirical observations (see, for example, Anderson, 2008; Kim & Yoon, 2003; Lidgard, 1996; Yoon, 2003; Yoon & Yim, 1997). As shown in Fig. 5-7, the most common reason pertained to a relaxed lifestyle in New Zealand (130 out of 202, or 64.4%), followed by children’s education (120, or 59.4%), and the country's clean and green image (67, or 33.2%). The margins of error for these estimates are ±6.6%, ±6.8%, and ±6.5%, respectively, at a 95% confidence level. Almost 90% of the survey respondents (or 178) reported that they came for one or more of these three reasons, though some of them also indicated political stability or economic opportunities as additional pull factors (9 and 10, respectively).

Looking more closely at the three major reasons, there appears to be interesting temporal trends. Fig. 5-8 reveals that the proportion of those who were attracted by either a relaxed lifestyle or clean and green image gradually decreased over the years between 1992 and 2005,
whereas children’s education became a more important factor for recent immigrants. This figure is plausible, because the ‘accelerated globalisation’ of Korea during the time of the Asian economic crisis in the late 1990s has led to a strong emphasis on English learning in Korea. Since then, it has become a typical phenomenon for Korean parents to move to English-speaking countries with their children for educational purposes (Park, 2009). The two lifestyle-related reasons, on the other hand, seem to have reached their peak during the time when the Korean economy was rapidly growing (i.e., when Koreans were economically well-off), but their share has begun to decline when the recession occurred in 1997.

The increase of those who came for their children’s education may, at least partially, account for the high rate of temporary immigrants in the Korean population in Auckland. Because such education-driven migration is a type of investment for parents, it typically involves a specific objective and timeframe, and once the goal is achieved, they are likely to return to their home country. The survey results support this point. While approximately 37.5% of those who

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**Fig. 5-7. Main reasons of migration for Korean residents in the Auckland urban areas**

*Source: Korean Household Survey for 2008*

*Note: Respondents were allowed to indicate more than one reason (n = 202).*
came solely for their children’s education indicated that their residence in New Zealand is temporary, only 27.6% of the other respondents provided this answer.

To examine whether a particular locality was favoured by people with a particular purpose, Table 5-2 presents the main reasons for migration by the six cluster zones (i.e., five Korean residential clusters and the rest of Auckland). In the North Shore cluster, where over 40% of the respondents were concentrated, the reasons for migration were similarly distributed across the overall population: a relaxed pace of lifestyle was the most dominant factor, followed by children’s education, and the country’s clean and green image. Interestingly, the same pattern was observed for those who lived outside of the ethnic clusters, indicating that the clustering itself may not be a result of certain motives.

However, as with the type of immigration (permanent or temporary) and income level, the reasons for migration seem to have influenced, to a certain extent, where the Koreans are
clustered. For example, a relatively large proportion of the respondents from the CBD and West Auckland clusters stated economic opportunities as their main reason for migration, and another one-third of those in the CBD reported that they came for their own education. In other words, the recent Korean population growth in these areas is in part due to the inflow of less well-off immigrants and international students. This perspective is consistent with the findings from the previous section. In contrast, in the East Auckland cluster, there were a fairly high proportion of those who had contacts in New Zealand before migrating, suggesting that the chain migration of Koreans has somewhat contributed to the expansion of this eastern ethnic neighbourhood.

### 5.3 Location Factors

A residential placement decision is complex, involving the consideration of both preferences
and constraints, and the characteristics of an ethnic residential cluster are determined by which factor plays a dominant role (Logan, et al., 2002). The previous two sections have suggested possible location factors for Koreans who are clustered in different localities, but the results are rather circumstantial and, therefore, inconclusive. To justify and supplement these findings, the survey directly asked the respondents to specify up to five location factors that led them to settle in their current residential area.

Overall, close proximity to children’s schools and safe neighbourhoods were the two highest ranked factors among the participants (106 and 97, respectively), and this reflects their two main reasons for migration: a relaxed, better quality of life and children’s education. Close proximity to workplaces was also an important consideration for approximately 39.6% of the participants (or 80), and another 38.6% (or 78) prioritised easy access to co-ethnic shops and other cultural amenities. Approximately one-third of the participants (or 69) reported that they searched for affordable areas, but they tended to consider other factors, such as easy access to public transport, along with affordability.

Unlike the socio-demographic characteristics and reasons for migration, the geographic distribution of these location factors varied significantly between the clustered and non-clustered Korean populations. The most notable difference was the importance of proximity to children’s school. While over half of the respondents living in the ethnic neighbourhoods chose to settle there because of proximity to their children’s school, those who were residentially dispersed seemed to be less limited by that concern. As shown in Table 5-3, the residential preferences of the non-clustered population were more diversified, and they tended to prioritise access to workplaces more than access to co-ethnic shops or family members. In Section 5.1, we previously observed that the residential assimilation of Koreans in Auckland is not an outcome of socio-cultural integration, and the findings here (re)confirm that it is more likely a voluntary choice that is driven by individual preferences and needs.
The variations in Table 5.3 also accounts for clustering in different locations. The North Shore and central clusters, for example, were particularly preferred by the Korean households that stressed the importance of living in a safe neighbourhood. Approximately 61.6% and 72.7% of the respondents in these two areas reported that they were attracted by low crime rates, whereas in the other parts of Auckland, the rate was between 16.7% and 39.4%. Considering that the perception of being safe is largely influenced by the ethnic composition and socio-economic status of the neighbourhood, the general demographic profiles of these northern and central suburbs discussed in the previous chapter seem to have attracted some Korean immi-
grants to these areas\textsuperscript{19}. What distinguishes the North Shore cluster from the central counterpart is that the former is an established ethnic community, which provides easy access to Korean supermarkets and other cultural amenities, while the latter is an emerging concentration of more education-driven, temporary immigrants. As a result, the presence of Korean shops was one of the major location factors in the North Shore cluster (53.5%), along with the perception of safety and proximity to children’s school, but those who resided in the central cluster did not consider the presence of Korean shops important.

Aside from the importance of the ‘safety’ concern, those in the East Auckland cluster indicated location factors that were similar to those of the North Shore counterpart. Although smaller in scale, it is also an established Korean community that has continuously grown over the last three census years, and there are a number of good schools for children. Therefore, as with the North Shore cluster, proximity to children’s school and co-ethnic shops were the two most influential attractions in this ethnic settlement (54.5% for both). Nevertheless, there were some distinctive features as well, such as the importance of investment values and public transport. The survey showed that the Koreans in this area were more likely to prioritise the prospect of property prices over easy access to public transportation, implying that the increase in the people who viewed a house purchase as an investment particularly contributed to the Korean population growth in East Auckland. This perspective is upheld by the fact that, once located around Howick and Pakuranga, the East Auckland cluster has expanded over the last decade into the newly-built residential suburbs of East Tamaki and Dannemora (see Section 4.2), which had good investment value at the time of the development.

The location factors for the West Auckland cluster were consistent with the findings from the previous sections that the concentration around Henderson was mainly stimulated by eco-

\textsuperscript{19} North Shore City recorded the lowest crime rate per capita among the four urban districts in the Auckland region in 2006 (see Figure 38 in Auckland Regional Public Health Service, 2006). Because the North Shore ‘cluster’ covers nearly the entire city, this figure represents the status of the ethnic community.
nomic reasons. While over 80% of the respondents in this part of Auckland indicated economic affordability as a primary reason to settle in their current area, it was only around 30% in the other parts of the region. Although there were more affordable areas, especially around South Auckland, the western suburbs were preferred due to their reasonable access to Korean shops and good schools in the nearby North Shore City. In a similar vein, the main location factors for the CBD cluster also reflected the geographic and demographic characteristics. As shown in Section 5.1, the Koreans in the inner-city were mostly young and less well-off students, and their concentration was due to the employment and education opportunities available to them.

In sum, the survey results presented in this section demonstrate that the residential clustering of Koreans in Auckland is generally a voluntary phenomenon that is driven by individual preferences and needs. In other words, whether one resides in an ethnic concentration or not is more closely related to why they came to New Zealand and what they prioritise than to socio-economic status. However, some small, emerging ethnic clusters in the CBD and West Auckland mainly consisted of international students and young families with limited economic resources. The less well-off clusters are not enclaves in the strict sense, because there are more disadvantaged and marginalised suburbs elsewhere in Auckland. Therefore, the findings here signify that the Korean clusters in Auckland have been diversified to some extent to embrace people with more diverse backgrounds and values.

5.4 Degree of Satisfaction

The previous three sections focused on who formed the Korean residential clusters and the reasons for clustering in particular areas. The current section examines the degree of satisfaction that the Korean households felt about their residential location at the time of the survey to gain insight into how the ethnic clusters may change or develop in the future. In the survey, the re-
respondents were asked about the level of satisfaction with their current neighbourhood and desirable suburbs to live in if different from their current one.

Overall, more than 70% of the respondents reported that they were either somewhat satisfied (53.5%, or 108 out of 202) or very satisfied (21.8%, or 44) with where they resided, while approximately 19.8% (or 40) reported that they were neutral or unsure. There were only a few respondents who were unsatisfied with the current neighbourhood (4.9%, or 10)\textsuperscript{20}.

This degree of satisfaction, however, varied significantly depending on the respondents’ cluster group (Table 5-4). The North Shore cluster residents were most likely to be satisfied with their residential location (82.6%), followed by those who lived outside of the ethnic clusters (74.7%), and in the East Auckland cluster (68.2%). In the previous section, we observed that the resident location choices of these three groups were less constrained by economic concerns and more dependent on what they prioritised compared to those in the CBD and West Auckland clusters. In this respect, it is not surprising that these three groups exhibited a high level of satisfaction and a high level of desire to remain in their current neighbourhood (Table 5-5).

Among the other smaller and more recent clusters, the respondents in West and Central Auckland were fairly satisfied with their residential location (66.7% and 63.6%, respectively), but in the CBD, only one-third of them expressed satisfaction. Although these figures could be somewhat unreliable due to the small sample size, it is interesting that these small groups were more likely to report being “dissatisfied” (CBD and Central Auckland) and less likely to be “very satisfied” (CBD and West Auckland) than the three large groups above. As discussed in the pre-

\textsuperscript{20}It may be worth noting that this degree of satisfaction was somewhat lower than that of the general immigrants in New Zealand. The Department of Labour has conducted the ‘Longitudinal Immigration Survey New Zealand’ (LisNZ) since 2005. The results, based on 7,137 participants, showed that about 87% of immigrants in New Zealand were either satisfied or very satisfied with the overall quality of their housing situation’ (Department of Labour, 2009). Note that, however, the question asked in the LisNZ was slightly different from the one in the Korean household survey.
previous section, the ethnic cluster around Henderson is like an alternative destination for Korean immigrants who search for a good educational environment and easy access to co-ethnic shops but have rather limited economic resources to enter the North Shore ethnic community. In a similar vein, the CBD and central clusters emerged largely due to the increasing number of temporary immigrants with a specific goal (i.e., astronaut families and international students who prioritise the educational environment), but the areas are known to lack ethnic amenities that could fulfil their cultural needs. Given these characteristics of the small clusters, the levels of

| Table 5-4 — Degree of satisfaction with the current residential location by cluster groups |
|-----------------------------------------------|---------------|---------------|---------------|---------------|---------------|
|                                              | North         | East          | Central       | West          | Residuals     | Total |
|                                              |               |               | CBD           | Other         |               |       |
| Very satisfied (%)                          | 22.09         | 9.09          | 0.00          | 36.36         | 0.00          | 26.76 |
| Satisfied (%)                               | 60.47         | 59.09         | 33.33         | 27.27         | 66.67         | 47.89 |
| Neutral or unsure (%)                       | 12.79         | 27.27         | 33.33         | 18.18         | 33.33         | 23.94 |
| Dissatisfied (%)                            | 4.65          | 4.55          | 33.33         | 18.18         | 0.00          | 1.41  |
| Total respondents                           | 86            | 22            | 6             | 11            | 6             | 71    |

Source: Korean Household Survey for 2008

| Table 5-5 — Preferred residential areas for Koreans living in different cluster groups |
|-----------------------------------------------|---------------|---------------|---------------|---------------|---------------|
|                                              | North         | East          | Central       | West          | Residuals     | Total |
|                                              |               |               | CBD           | Other         |               |       |
| North Shore cluster (%)                     | 74.42         | 27.27         | 0.00          | 18.18         | 33.33         | 22.54 |
| Eastern cluster (%)                         | 2.33          | 45.45         | 33.33         | 9.09          | 0.00          | 11.27 |
| CBD cluster (%)                             | 1.16          | 0.00          | 16.67         | 9.09          | 0.00          | 0.00  |
| Central cluster (%)                         | 2.33          | 4.55          | 0.00          | 36.36         | 0.00          | 4.23  |
| Western cluster (%)                         | 0.00          | 0.00          | 0.00          | 33.33         | 0.00          | 2     |
| Outside of the clusters (%)                 | 19.77         | 22.73         | 50.00         | 27.27         | 33.33         | 61.97 |
| Total respondents                           | 86            | 22            | 6             | 11            | 6             | 71    |

Source: Korean Household Survey for 2008

vious section, the ethnic cluster around Henderson is like an alternative destination for Korean immigrants who search for a good educational environment and easy access to co-ethnic shops but have rather limited economic resources to enter the North Shore ethnic community. In a similar vein, the CBD and central clusters emerged largely due to the increasing number of temporary immigrants with a specific goal (i.e., astronaut families and international students who prioritise the educational environment), but the areas are known to lack ethnic amenities that could fulfil their cultural needs. Given these characteristics of the small clusters, the levels of
satisfaction presented in the survey results are understandable and can be justified.

Table 5-5 provides further supporting evidence for the degree of satisfaction. The large majority of the respondents in the small ethnic settlements indicated that they would like to move out of their current location and into a better-established ethnic neighbourhood (33.3% in the CBD and West Auckland and 27.3% in Central Auckland) or into other areas outside of the ethnic concentration, such as the prestigious seaside suburb of Mission Bay (50.0%, 33.3%, and 27.3%, respectively). Considering that those in the major clusters were more likely to remain in their current location (74.4% in North Shore City and 45.5% in East Auckland), this result corroborates the observed difference among the clusters in terms of the degree of satisfaction.

The difference in satisfaction levels between the established ethnic neighbourhoods and newly emerged concentrations offers some prospects to the Korean residential clusters in Auckland. For example, an inflow of Korean immigrants with sufficient financial resources and/or an improvement in socio-economic status of Korean residents in Auckland may lead to the growth of the North Shore cluster, because it is the most ‘preferred’ residential destination. In contrast, a further diversification in the demographic composition and the reasons for migration may largely influence the small clusters around the CBD and West Auckland or cause the emergence of another small but visible concentration in other parts of Auckland. There are, of course, additional external factors that affect an ethnic group’s residential clustering, such as the immigration policy or the attitudes of the majority society (e.g., white flight). However, the survey results imply that if such external factors remain constant, the residential clustering of Koreans is likely to persist for some time, but where they are clustered will change with changes in their demographic and socio-economic characteristics.
5.5 Summary

This chapter demonstrated that the Korean population in Auckland is generally homogeneous in terms of their demographic profiles and main reasons for migration. The large majority of the Korean households in Auckland appeared to be families with middle-aged parents and school-aged children, and over 90% of the survey respondents indicated that they came for either a relaxed lifestyle in New Zealand or their children’s education.

The rapid economic transformation and globalisation that occurred in South Korea during the late 1990s, however, have altered and diversified the characteristics of Korean immigrants to some extent. For example, the increased importance of English education has provoked the inflow of international students and astronaut families who come to achieve a specific objective within a particular timeframe. Furthermore, the economic crisis and employment instability in their home country have stimulated the recent growth of young, working-age immigrants in the Korean community in Auckland. The evidence found in the survey suggested that the emergence of the small ethnic clusters around the CBD and West Auckland is a result of this changing demographic composition, and therefore, the residential clustering of Koreans in different parts of Auckland can represent the degree of internal stratification within the ethnic community.

The findings in this chapter revealed that this geographic polarisation occurred voluntarily (at least not imposed by structural disadvantages or discrimination in the society), and in this regard, the Auckland urban areas might be considered as a typical ethnoburb-like community for Koreans, where they choose their residential location based on individual circumstances and priorities.
Chapter 6  Economic Structure

In the last two chapters, we observed that the Korean population in Auckland is clustered in middle-class suburbs. These residential clusters have been formed by individual preferences and socio-cultural needs rather than by structural disadvantages or discrimination. In this regard, the Korean clusters in Auckland can be seen as an empirical example of the contemporary suburban ethnic community model, although it seems to be smaller and less socio-economically polarised than its counterparts in North America.

As noted in Section 2.1, suburban ethnic clusters are distinguishable from the traditional enclaves not only in terms of geographic distribution but also in terms of their class-polarised internal structure. Li (1997) argued that an *ethnoburb*, a term she used to describe the residential clustering of ethnic minorities in suburbs, is where both affluent ethnic entrepreneurs who own businesses and economically less well-off immigrants who provide labour are concentrated together in different parts of the same locality. This socio-economic stratification in the ethnic
community, especially the influx of rich investors and experienced entrepreneurs, makes an ethnoburb an independent, fully functional economic entity that is not confined to a small ethnic market. However, compared to the Chinese community in the San Gabriel Valley of Los Angeles that Li observed, the Korean population in Auckland appears to be fairly homogeneous in terms of its demographic and socio-economic composition. Furthermore, most of this population has migrated in search of a relaxed lifestyle or their children's education rather than for economic opportunities. Given these differences, the economic structure of the Korean community in Auckland could be substantially different from the suburban ethnic settlement model.

This chapter explores various economic aspects of the Korean community in Auckland and compares it to the contemporary ethnic economy, which operates in a transnational market using its own class and ethnic resources. Section 6.1 analyses the economic activities of Korean immigrants, with particular attention given to explaining their high self-employment rate. Section 6.2 examines the type and size of the enterprises run by Koreans and discusses their status as an ethnic economy. In Section 6.3, the geographic distribution of Korean businesses is briefly described and explained in relation to the findings in the previous section.

It may be worth noting that the term ‘Korean business’ in this chapter is defined broadly, to include all businesses, which are operated by Koreans and take advantage of the ethnic resources. Although the term ‘ethnic business’ in the literature often refers (implicitly) only to small enterprises that are run by ethnic minorities, located in ethnic enclaves, and targeting the co-ethnic members, this chapter uses a broad concept of the term for two reasons. First, as will be discussed in more detail in Section 6.2, a considerable fraction of the Korean businesses in Auckland is health product retailers, and these retailers differ from the typical ethnic businesses in that they are not limited to ‘local’ ethnic clients and not necessarily located in their residential clusters. However, they should still be classified as Korean businesses because they largely rely on co-ethnic customers in Korea and actively utilise the ethnic resources (i.e., knowledge about
and experience with the Korean market). Second, there are also some businesses, especially restaurants and cafés, which do not rely on the co-ethnic customers but still a kind of ethnic business. Sushi restaurants (take-outs) operated by Korean immigrants can be a case in point. Sushi restaurants usually target the general population, and therefore it is not unusual that they are located outside of the ethnic residential clusters. However, as with the health product retailers, they are still ethnic businesses because the owners take advantage of their cultural resources to establish and operate their restaurants. The definition of the term ‘Korean business’ used in this chapter can include both cases, so it would be more appropriate to examine the entrepreneurial activities in the Korean community in Auckland than the narrow definition.

### 6.1 Sources of Income and Occupational Distribution

In general, first-generation immigrants, especially those with language barriers, experience difficulties finding a proper job in their new country (Ladbury, 1984; Light, 1979). They are unlikely to be able to resume the careers they held in their homeland because of non-transferable educational qualifications and work experience as well as a lack of communication skills. As a result, they are often forced to find an alternate way to make a living, and there are generally three main employment options for new immigrants.

The first option is to find any job that is available to them. Because such jobs are usually low-skilled, low-paying labour positions that are not taken by the native population, this option tends to be chosen by young immigrants with few economic resources. The second option, perhaps often chosen by wealthier, middle-class immigrants, is to remain unemployed and rely on other sources of income, such as investments or savings in the country of origin. Temporary immigrants motivated by their children’s education are likely to belong to this group because most of them are financially well established and can support themselves during their short-
term residence. The last option is to be self-employed (Light & Gold, 2000). As discussed in Section 2.2, the structural difficulties and disadvantages in the employment market encourage some immigrants to start their own businesses as an alternative. Such entrepreneurship is particularly popular among the Asian ethnic groups with sufficient ethnic and class resources.

This section explores the economic activities of Korean immigrants through their main sources of income and occupational distribution and attempts to show how they cope with the new economic environment. The data were derived from the 2006 census and are presented in two-way contingency tables (Table 6-1 and Table 6-2). It is worth noting that although most response categories in these tables are the same as those in the census data, the ‘benefit’ in Table 6-1 is a combined group of the following responses:

- Regular payments from ACC or a private work accident insurer
- New Zealand superannuation or veterans pension
- Other superannuation, pensions or annuities
- Unemployment benefit
- Sickness benefit
- Domestic purposes benefit
- Invalids benefit
- Other government benefits, government income support payments, war pensions, or paid parental leave

These responses were combined because each category had a very small number of Koreans and there were no interesting patterns among them.

Perhaps the most noticeable feature in the main sources of income for Koreans is their relatively small proportion of wage- or salary-earners (Table 6-1). Whereas the wage- or salary-earners formed the majority for most ethnic groups in the 2006 census, only about 24.8% of Koreans indicated that they had income from employment. This figure is distinctly lower than that of the mainstream European population (62.0%) and of other ethnic minorities, such as
By contrast, a considerably large proportion of Koreans received income from their own businesses. As shown in Table 6-1, about 20.4% of Koreans in Auckland were self-employed and earned income from business activities. This number is almost double that for Indians (11.4%) and Chinese (12.3%) and is over five times higher than that of Pacific peoples (3.6%).

These two results imply that a substantial number of Koreans may have turned to entrepreneurship after failing to find proper employment in the general labour market. Although the data table itself does not suggest or confirm any causal associations between the income categories, it should be noted that most Korean businesses in Auckland are small retail shops and restaurants, which generally involve long working hours and a high failure rate (see Section 6.2 for
more details about the types of Korean businesses). Given the demographic profiles and main reasons for migration of Korean immigrants, it is quite unlikely that they have voluntarily entered into such risky investments. Rather, it is more plausible that the disadvantages and barriers to employment encouraged (or forced) them to start their own businesses for livelihood.

The results from a study conducted by Lee (2008) support this cause-effect relationship. Lee interviewed 20 Korean business owners in Auckland through snowball sampling and found that 13 of them started their businesses because they could not find a proper job in the local employment market. In particular, one of his interviewees clearly noted:

"I came here in November, 1992 at the very early stage of Asian immigration. So there were few Korean residents in Auckland. I was a teacher of mathematics in a high school. I never thought that I could have a job as a teacher in New Zealand because I was not able to speak English fluently. I have once tried to apply for some jobs in retail shops, which were advertised in newspapers. After failures in my applications, I thought that it would be impossible for me to get an employment. Finally, I set up a travel agency, which specialises in inbound Korean tourists in May, 1993 because I anticipated that New Zealand would become a popular travel destination for Koreans as well in future" (Lee, 2008, p. 51).

Although one respondent established a business because he did not want to work for other people, most of the respondents became self-employed as an 'alternative' to unemployment or underemployment, as in this case.

The occupational distribution in Table 6-2 provides further circumstantial evidence for this point. Compared to the majority population group, Europeans, Koreans are markedly underrepresented in the medium- to high-skilled occupations, such as professionals and administrative workers, while being slightly overrepresented in the 'Labourers' category (although less than Māori and Pacific peoples). Considering the relatively high educational level of Korean immigrants we observed in Chapter 5, this result implies that Koreans may experience more diffi-
cultivates finding jobs that can satisfy their egos and needs, resulting in the high proportion of managers—presumably, self-employed owner-operators—in their occupational distribution.

Of course, the disadvantages and structural barriers in the general labour market may not be the only reasons for the high self-employment rate of Koreans. Most immigrant groups, especially those from non-English speaking backgrounds, encounter similar problems (see, Ho & Bedford, 2006, for Chinese in Auckland). However, not all of these groups exhibit such a high level of entrepreneurship; the self-employment rate of Koreans in the 2006 census was almost double that of other major Asian ethnic groups and was over five times higher than that of Pacif-
ic peoples\textsuperscript{21}. As discussed in Section 2.2, the self-employment rate of an ethnic group is determined by both push factors (e.g., disadvantages in the labour market because of the lack of communication skills or cultural differences) and pull factors (e.g., ethnic and class resources and business opportunities). In this regard, the economic conditions of Koreans may have contributed to their high self-employment as a pull factor.

Although many Korean households in New Zealand belonged to the low-income group in the 2006 census, the fact that they are residentially concentrated in middle-class suburbs suggests that they were financially secure at the time of their arrival in the new country. The economic resources they brought from the homeland would have helped them establish a small business as an alternative to low-paying, marginalised jobs, whereas other ethnic minorities with limited capital were more likely to be forced to accept underemployment.

Aside from the high self-employment rate, the main sources of income for Koreans present another interesting feature – a very large proportion of no-income earners (Table 6-1). In 2006, about 29.6% of Koreans in Auckland reported that they had no income from any sources during the twelve months prior to the census, which is almost six times higher than that of the European population (4.8%) and over 50% higher than the Chinese population (19.2%). As with the self-employment rate, this figure is partly a reflection of Koreans’ difficulties with employment, but it is also likely to be closely linked to the large proportion of temporary immigrants in the Korean community in Auckland. We observed in Chapter 5 that about 31.7% of Korean households intend to return to their home country after a few years in New Zealand. Such short-term residents, whose primary focus is to gain experience or educate their children in an Eng-

\textsuperscript{21}In this section, the proportion of those who earned income from business was used interchangeably with the self-employment rate. However, there could be substantial differences between these two figures because the former does not take into account unsuccessful entrepreneurs whose business does not generate profits. Nevertheless, given that the self-employment rate for detailed ethnic groups (e.g., Korean, Samoan, etc.) are not publicly available in the 2006 census, these may be reasonable estimates of the actual self-employment rates and their intergroup differences if we can assume that the business failure rates do not differ significantly between ethnic groups.
lish-speaking environment, usually bring enough financial resources to support themselves during their residence period. Therefore, they are generally uninterested in economic activities that place them in a disadvantaged position. In this regard, although the labour market disadvantages are the foremost reason for the high share of no-income earners (who presumably rely on savings or support from other family members), the demographic composition and characteristics of the Korean immigrants have significantly affected their decision to be self-employed or to remain unemployed as a way to cope with the new economic environment.

Fig. 6-1 displays the geographic distribution of the main income sources for Koreans, and it corroborates the relationship between the demographic characteristics and their labour participation pattern. The no-income earners are particularly agglomerated in the CBD, where international students and other temporary immigrants are clustered (Section 5.1.4), whereas those who have income from their own business (i.e., self-employed individuals) are overrepresented in the North Shore and East Auckland clusters. As shown in Section 5.1.3, Koreans in these areas are more likely to be financially established than those in the CBD and West Auckland. Thus, this CA map suggests that the amount of economic resources is positively correlated with the self-employment rate.

In sum, the sources of income and occupational distribution suggest that, as with most first-generation immigrants, Koreans experience difficulties in finding proper employment in their new country. Although the occurrence of underemployment did not seem to be particularly high compared to other ethnic minorities (Table 6-2), the Korean population’s unique demographic composition and the general economic status at the time of migration have raised the proportions of unemployment (i.e., no-income earners) and self-employment (i.e., those who received income from business) to a significant level. As a result, Koreans had 82 business owners for every 100 employees in 2006, suggesting that the economic structure of the Korean community in Auckland is mainly determined by its business activities. The next section, there-
fore, explores the types and sizes of Korean businesses in Auckland to gain an understanding of the status of their economic structure.

6.2 Nature and Structure of Korean Businesses

Ethnic businesses, which are owned and operated by ethnic minorities, have traditionally been small in size and highly concentrated in the retail sector, providing goods and services to co-ethnic customers. However, this general profile of ethnic businesses has begun to change in recent years because of the increasing inflow of investor immigrants provoked by globalisation and the large amount of capital they bring. Empirical evidence shows that contemporary ethnic businesses are now more diversified, ranging from trading companies to financial institutions, and their scale has also become larger than before. This transformation is particularly prevalent among affluent immigrant groups in North American metropolises where a large consumer
market exists. Therefore, suburban ethnic settlements, which are residential concentrations of middle- or upper-class ethnic minorities, often accompany the (re)structuring of ethnic businesses.

However, the presumed relationship between residential patterns and economic structure may not be always accurate, especially outside of the North American context. Different countries and cities have different opportunity structures for entrepreneurship; thus, the demographic and socio-economic background of immigrants, which determines the group’s ethnic and class resources, also varies depending on the destination country. New Zealand cities, for example, have a relatively small market size compared to U.S. metropolises, and the majority of Koreans in Auckland migrated for a relaxed lifestyle and their children’s education rather than for economic success. Although we observed in Chapter 5 that Koreans are mainly concentrated in middle-class suburban areas, their business patterns may be different from the patterns expected in such a contemporary suburban ethnic settlement. Therefore, this section examines the types and size of Korean businesses in Auckland and compares them with the diversified, large-scale ethnic economy in North American cities.

This section utilises data derived from the Korean Business Directory for 2006. As described in Section 3.1.3, the directory contains a total of 1,053 enterprises and self-employed professionals in Auckland. It is assumed to represent the true distribution of Korean businesses at that time. The listed businesses were classified using the Australia New Zealand Standard Industrial Classification (ANZSIC) code\textsuperscript{22}, and the result will be compared with the industrial distribution of businesses overall (i.e., those operated by the general population) in the region to help understand the economic structure of the Korean community.

\textsuperscript{22} The ANZSIC, which was jointly developed by Statistics New Zealand and the Australian Bureau of Statistics, was first released in 1993. It has been used to compile industrial statistics in both countries (Australian Bureau of Statistics & Statistics New Zealand, 2006). The ANZSIC code has four hierarchical levels: Divisions (at the broadest level), Subdivisions, Groups, and Classes (at the finest level). This section utilises the first three levels to classify the businesses listed in the Korean Business Directory for 2006.
Fig. 6-2 displays the industrial distribution at the broadest level (Division). The bar plot indicates that retail trade (labelled 'G' on the plot), accommodation and food services (H), education and training (P), and other services (S) were particularly popular among Korean entrepreneurs, and over 60% of Korean businesses were engaged in one of these four categories. On the other hand, capital-intensive sectors were clearly underrepresented: construction (E) and wholesale trade (F), for instance, comprised about 10.6% and 6.6% of the total businesses, but their shares of Korean businesses were only 2.6% and 1.7%. This suggests that the economic structure of the Korean community in Auckland is similar to the traditional enclave model, where ethnic firms are largely concentrated in the retail and hospitality sectors and target co-ethnic customers.

Table 6-3 presents the ten most popular types of Korean businesses at the Groups level (the second-finest level in the ANZSIC) and seems to support the above interpretation. The categories ranked in the table, which account for over half of all the firms and self-employed professionals in the directory (58.5%), are of the kind that have been historically preferred by ethnic minorities, as they are relatively accessible to inexperienced entrepreneurs. Although there may be some variations within the groups, cafés, groceries, and other retail stores are all typical ethnic businesses that can be set up without a large sum of financial resources and operated without professional business skills. Most restaurants run by Korean immigrants in Auckland mainly serve Korean food to co-ethnic customers or Japanese food to the general population, taking advantages of their cultural resources. Many Korean-owned groceries and retail stores also mainly deal Korean-made food products and consumer goods and rely on the special consumer demand of co-ethnics.

Real estate services, which are ranked fifth in Table 6-3, are another industry that is popular among ethnic minorities (see, for example, Min, 1993 for Koreans in Los Angeles; Teixeira, 1998 for the Portuguese in Toronto). As Yoon and Yim (1997) noted, although Korean real es-
tate brokers and sales agents in Auckland are usually employed by a large real estate firm, they are not different from other self-employed Korean entrepreneurs in the sense that their income is generally commission-based with no basic salary. As with Korean restaurants and groceries, real estate services are a typical ethnic business because they tend to rely on Korean community ties and ethnic networks in starting and operating their businesses. They mainly serve co-ethnic customers, and their business locations are often within the ethnic community (Teixeira, 1998). The fact that the number of the Korean real estate sale agents in Auckland rapidly increased during the mid-1990s when the immigration from South Korea was at its peak and then declined with the decrease of the Korean population in the late 1990s (Yoon & Yim, 1997) implies how dependent they are on the ethnic market.

Table 6-3 shows that a considerable proportion of Koreans in Auckland was also engaged in travel agency and tour arrangement services. According to Yoon and Bedford (1999), these
businesses have emerged as a response to the growing number of tourists from South Korea during the early- and mid-1990s: the number of short-term visitors from Korea was 1,923 in 1990, but it increased to 53,218 in 1994, and further to 110,262 in 1996. The tourism flows from their home country offered good business opportunities to the new Korean immigrants who are disadvantaged in the general labour market due to the English language proficiency and non-transferable job skills, and as a result, the tourism industry has become one of the major businesses of Koreans in Auckland. In the Korean Business Directory for 2006, most listings that belonged to this group were either tour service providers that mainly serve co-ethnic tourists from Korea, or travel agency that is specialised in air tickets to Korea for Korean residents in Auckland. In this respect, travel agency and tour arrangement services among Koreans can also be considered a typical ethnic business.

Although pharmaceutical retailing and education are generally not perceived as traditional niches for ethnic minorities, these are also 'old-style' ethnic businesses in that they rely
entirely on co-ethnic clients. Almost all businesses classified as pharmaceutical retailing sell health supplements to Korean customers, and education businesses are mainly small institutions teaching an English-language or Korean curriculum to international students. In this respect, the present industrial distribution given in Table 6-3 seems to suggest that the Korean ethnic economy in Auckland, which is characterised by business owners, has not experienced industrial diversification and expansion; rather, it remains in the traditional enclave-like economy that is limited to the small and isolated ethnic market.

To verify this perspective, about 20% of the Korean enterprises listed in the directory (212 businesses) were chosen by stratified random sampling, and their business types and sizes were surveyed in person or by telephone. The ANZSIC ‘Groups’ were used as strata in the sampling process, and samples were taken proportionally from each class (e.g., 23 from cafés and restaurants and 17 from pharmaceutical and other retailing). The sizes of businesses were classified by the number of employees to be comparable with the census (i.e., no employees, 1-5, 6-9, 10-19, 20-49, 50-99, and 100+), and the types were divided into three groups: (1) businesses specifically for Koreans, (2) general businesses that mainly cater to Koreans, and (3) general businesses that cater to the general (non-ethnic) population. Examples of the first group may be immigrant advisors who help newcomers from South Korea adjust and settle in New Zealand or supermarkets specialising in selling Korean products. The other two groups include all other general businesses, such as plumbing, hairdressing, and mechanics, but they are distinguished by their main clients.

The results of this informal survey confirm the information in the industrial distribution data. Of the 212 businesses sampled, 21.7% (or 44) were unavailable to be surveyed because of insufficient or incorrect contact details, or because the businesses did no longer exist at the time of the survey (8 and 36 businesses, respectively). Most of the surveyed businesses were small in size: 44 (or 26.2% of the surveyed businesses) reported that they had no employers at all, and
120 (or 71.4%) had 1-5 employers. There were four Korean enterprises that had more than five employers, but none of them had 20 or more employers. As expected, the majority of the businesses mainly served the co-ethnic customers: 87 (or 51.8%) were specifically for Koreans, and 54 (or 32.1%) mostly catered to Korean clients.

This pattern clearly runs counter to the contemporary ethnic economy observed in large ethnic settlements in North American cities. As mentioned above, based on the case of the Chinese ethnoburb in the San Gabriel Valley of Los Angeles, Li (1998a) argued that in an ethnoburb or the like, the industrial distribution of ethnic businesses is similar to that of the general population living outside of the ethnic cluster, and the economy is not necessarily confined to the ethnic market. Rather, it acts like a ‘global economic outpost’ that connects their homeland and the (immigration) receiving country, and large companies owned by Hong Kong and Taiwan entrepreneurs create employment for the co-ethnic population. However, this description does not fit the Korean businesses in Auckland, as the survey demonstrated that most of them are small and target Korean customers.

Nonetheless, it is noteworthy that globalisation and advances in Internet technologies (which have accelerated the growth of digital businesses) have influenced the economic structure of the Korean community in Auckland to a certain extent, making it different from the traditional enclave economy. The development of transportation and telecommunications has facilitated ethnic entrepreneurs’ access to the larger co-ethnic market in their home country. Moreover, it has resulted in the emergence of small businesses (and even e-businesses that do not have a physical store) that mainly deal with Koreans living in Korea. Such transnational but small export outlets comprise a substantial fraction of the Korean businesses in Auckland, and they differ from the typical ethnic businesses in that they are not limited to ‘local’ ethnic clients.

One case in point is health product retailers. The health supplements market has expanded significantly over the past two decades, especially in Asian countries, and there is a consider-
able demand in Korea for New Zealand-made natural products because of New Zealand’s clean and green image. As a result, it has become common for Korean retailers in New Zealand to export directly to Korean customers via website or telephone. Such international sales now generate a significant portion, if not most, of their profit. Of 42 health product retailers listed in the Korean Business Directory for 2006, 38 could be found in late 2009, and 94.7% (or 36) of them had a website in the Korean language or utilised an Internet phone (with a local Korean phone number) to attract customers in Korea. One business owner who has a shop in East Auckland reported that about half of the sales are made online by those living in Korea, whereas co-ethnic tourists visiting relatives or friends in the neighbourhood make up another 10% of sales. Although local Korean residents account for around 40% of the transactions, these purchases are usually gifts for families and friends in the homeland rather than for themselves.

International student recruitment agencies may be another example of transnational ethnic businesses. New Zealand’s clean and green image and reputation for providing a safe and affordable educational environment has resulted in a rapid increase of Korean international students, and education-related industries have grown rapidly in the Korean community in Auckland. In 1992, there were no international student recruitment agencies owned by Korean immigrants in Auckland, but the number grew to 19 by 1995 (Yoon & Yim, 1997) and reached 35 in 2006. Like the health product retailers, most of these businesses use a website and Internet phone to appeal to the potential clients in their home country, and they rely much more on the demand from Korea than on the local ethnic population.

The emergence and growth of these small transnational retail stores and services indicate that the Korean ethnic economy in Auckland has been changed by the globalisation process, but clearly not to the extent of complete economic restructuring. As discussed previously, the vast majority of Korean enterprises are small and limited to the ethnic market. Although some of them function as export outlets for products and services, they do not seem to actively con-
nect their home country with the country of residence, as observed in the North American examples. The economic structure of the Korean community has become dependent on their homeland’s economic condition while remaining isolated from the mainstream economy in Auckland. In this respect, it would be more appropriate to interpret this community as an economic satellite, which should be distinguished from the independent economic entity at large, developed ethnic settlements and the closed enclave economy within the ethnic concentration.

6.3 Geographic Distribution of Korean Businesses

The geographic distribution of Korean businesses reflects their concentration in the ethnic market. Fig. 6-3 shows that about 84.5% (or 889) of the 1,052 businesses listed in the directory were located within or very close to the Korean residential clusters. In particular, almost half of these (or 411) were agglomerated in the North Shore cluster, and approximately one out of every ten Korean businesses (or 107) was found in the East Auckland cluster. This spatial pattern is, however, somewhat different from that of the general businesses in Auckland. According to the 2006 business demographic statistics (Statistics New Zealand, 2010a), there was a total of 130,258 enterprises in the four urban districts of Auckland, and North Shore City and the East Auckland cluster accounted for only 19.8% (or 25,849) and 3.6% (or 4,682) of them, respectively. For the general population, the CBD and its vicinity seem to be more popular business areas, as about 49.6% (or 64,553) were concentrated in Auckland City in 2006. Although the CBD areas were also popular among Korean entrepreneurs, there were only a few Korean businesses in

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23 When the Asian economic crisis struck South Korea in the late 1990s, for instance, many travel agencies and language education providers targeting Korean customers were forced to close because of the rapid drop in demand, and other exporting businesses also suffered significantly. The number of Koreans who entered New Zealand was 127,356 in 1996 and 108,266 in 1997, but it rapidly decreased to 17,685 in 1998. Although this figure slightly increased to 43,234 in 1999, it was still less than half of the number prior to the economic crisis, and it took several years to recover the level of demand to maintain businesses.
the other major commercial areas in Auckland City, such as Parnell and Newmarket.

Considering that the large majority of Korean businesses are small retail shops and services for which geographic proximity to potential customers is essential, their geographic concentration in the co-ethnic neighbourhoods is deemed an understandable natural phenomenon. At the same time, however, we have observed that there are some differences across the Korean clusters in terms of their demographic profiles and income levels. This raises a question about their similarities and differences in terms of types of businesses. This section, therefore, investigates the industrial distribution of each locality and discusses their patterns and implications.
The correspondence analysis of the business types revealed that at the Subdivisions level, the North Shore, East Auckland, and West Auckland clusters have similar industrial distribution, but the CBD and Central Auckland clusters are quite different from them (Fig. 6-4). The size of the grey points in the CA map represents their relative proportion among Korean businesses. For instance, 'Other Store-Based Retailing' and 'Personal and Other Services' were the two most popular groups in 2006, and there were also a considerable number of 'Administrative Services' and 'Food Retailing'. The resulting two-dimensional space explains about 65.5% of the total variations. It indicates that administrative services and professional services, such as legal and accounting services, travel agencies, and tour arrangement services, were overrepresented in the CBD, whilst supermarkets, restaurants, and other small retail shops formed a more significant fraction in the suburban clusters. Further, the Central Auckland cluster was different from the others in that it had a smaller number of retailers but more real estate agents.

Looking more closely, the North Shore cluster, where over 40% of Korean immigrants reside, showed moderately diverse business activities. As illustrated in Chapter 4, North Shore City has been a popular residential destination for Koreans since the early 1990s, and the rapid influx of new immigrants over the past decades has accelerated the expansion of Korean businesses. Yoon and Yim (1997) found only four Korean shops and services in this area in 1992, but this number grew to 155 in 1996 and reached over 400 in 2006. This significant presence has contributed to the diversification of the industrial distribution of Korean businesses. There are currently 52 different ANZSIC groups operated by Koreans, ranging from 'Allied Health Services' to 'Specialised Food Retailing', to meet the social and cultural needs of the local co-ethnic population. Despite this diversification, however, the Korean ethnic market is obviously saturated (or nearly saturated) with the current number of ethnic businesses (i.e., one business per every nineteen Koreans), and there appears to be little room for growth in this area.

The strong competition and crowded market has encouraged immigrant entrepreneurs
to venture outside of their dominant residential cluster, and Korean businesses around the West Auckland cluster have begun to proliferate. The growth of the Korean population in West Auckland between 1996 and 2006 (i.e., 1,131 to 2,655) has generated a small but stable local demand for ethnic goods and services, and the geographical proximity to the North Shore neighbourhood has made it a more attractive place to set up ethnic businesses. As a result, the number of Korean businesses in this western district jumped from 24 in 1996 to 140 in 2006. Of these businesses, 85 were agglomerated around Henderson, the western residential cluster of Koreans, and another 33 were located between the two ethnic communities. In terms of industrial distribution, the West Auckland cluster appears to be less diversified than its northern counterpart, and a relatively large proportion of Korean entrepreneurs were retailers or restaurant owners (58.1% of those in the West Auckland cluster compared to 39.2% in the northern neighbourhood).

The industrial distribution in the East Auckland cluster was largely analogous to that in
North Shore City. The number of Korean enterprises in this area was 107 in 2006 (one business per every twenty-two Koreans), which is comparable to that in West Auckland, but almost all kinds of businesses that exist in the North Shore cluster could also be found in the eastern suburbs. This is perhaps because the East Auckland cluster, which is located around the suburbs of Howick and Dannemora, is geographically distant from the well-established ethnic economy in the northern part of Auckland, and thus it has developed its own ethnic economy to cater to the local Korean population. Ethnic supermarkets, restaurants, hairdressing services, and real estate agencies were among the most popular businesses types in this area, and various retail stores, health services, and education providers also met the demands of middle-class immigrants.

Compared to the other suburban residential clusters, real estate agencies were relatively overrepresented in Central Auckland, whereas ethnic supermarkets and other cultural amenities were clearly underrepresented. As we observed in Chapter 5, this area has been preferred by astronaut families and other temporary immigrants driven by their children’s education, and their constant demand for rental housing may have caused the overrepresentation of Korean real estate agents. On the other hand, it appears that other ethnic facilities for the local Korean population have not been established in this expensive part of Auckland because the emergence of this central cluster is a recent phenomenon and because their population size is still small.

The industrial distribution of the Korean businesses in the CBD was distinctive among the other suburban clusters. Professional services, such as immigration advisors and travel agencies, were particularly concentrated in the CBD, whereas there were only a few Korean supermarkets or retail shops selling ethnic products. The overrepresentation of immigrant advisors and travel agencies in the CBD and the underrepresentation of those in the suburban residential clusters are not because they deal with the non-ethnic population, but because their main clients are tourists and newly arrived immigrants who do not usually have sufficient local
knowledge to access suburban Auckland.

In sum, the geographic distribution of Korean businesses confirmed that the vast majority of them are concentrated in their residential clusters, reflecting their reliance on co-ethnic customers. As expected, however, there were also some variations across the clusters in terms of their business types. The North Shore and East Auckland clusters, for instance, were economically well established and exhibited a relatively diverse range of Korean enterprises to meet the socio-cultural demands of middle-class Korean immigrants. On the other hand, the recent cluster in Central Auckland showed a lack of ethnic facilities, whilst the Korean businesses in another recent cluster in West Auckland was well developed because of its proximity to North Shore City. The Korean businesses in the CBD were different from those in the other clusters in that their main customers were tourists and short-term visitors from Korea rather than established immigrants living in suburban Auckland.

6.4 Summary

It is common for ethnic immigrants to experience difficulties in the general labour market because of social and cultural disadvantages (or differences). Entrepreneurship is an alternative route for them to achieve economic success in their new country, but establishing and operating a business requires significant resources and opportunities. The former includes financial resources, business experience, and human networks, whereas the presence of a protected ethnic market is an example of the latter. In the past, ethnic entrepreneurs often utilised the so-called ‘rotating credit association’ to acquire capital for businesses (see Section 2.2) and relied on family labour to reduce costs. Historical evidence shows that these businesses are likely to be small in scale and to specifically target co-ethnic customers, at least in the initial stage of establishment. Such ethnic businesses tend to be concentrated in the areas where the minority popula-
tion is residentially clustered; consequently, they are often isolated from the majority economy.

These profiles of ethnic businesses have begun to change in recent years with accelerating globalisation. The economic growth of Asian countries and the advances in transportation have stimulated an influx of more experienced entrepreneurs and investors with sufficient financial resources and have led to not only the proliferation of medium- and large-scale ethnic businesses but also the diversification of their industrial distribution. The increasing demand for various ethnic products and services from middle-class immigrants and other population groups has generated a new market, and the international capital flow has facilitated the expansion of ethnic businesses into trading and wholesaling, which were traditionally dominated by non-ethnic enterprises. In particular, the emergence of transnational businesses has transformed the nature of the contemporary ethnic economy from an isolated economy into an independent entity that provokes interaction between the countries of origin and residence.

This chapter demonstrated that this transformation of ethnic businesses has not occurred in the Korean community in Auckland. Although the economic structure of Korean enterprises has been affected by the globalisation process such that it exhibits strong transnational linkages with their home country, most of these enterprises target co-ethnic clients in the retail sector and are geographically concentrated in their residential clusters. The economic structure of the Korean community has become more dependent on their home country's economic condition than ever before, and it appears to be an economic satellite rather than an independent economic entity in the transnational market, as observed in the North American suburban ethnic settlements.

Although the short history of immigration and the small size of the ethnic population could be reasons for the differences, a more fundamental reason may be related to Korean businesses' demographic and economic profiles and reasons for doing business. The general perception in Korea is that New Zealand is a clean, beautiful, and peaceful country, but not an attractive
place for business (New Zealand Trade & Enterprise, 2008). Therefore, entrepreneur and investor immigrants with a significant amount of capital tend to be concentrated in the U.S. and Canada, and those in New Zealand are often relatively less interested and experienced in entrepreneurship. We observed in Section 5.2 that most Koreans immigrated for a relaxed lifestyle or for their children’s education rather than for economic success, and they became self-employed as an alternative, not as a first option. These characteristics may have made their businesses more conservative, encouraging them to operate small businesses in a protected ethnic niche where they have certain advantages over non-ethnic entrepreneurs. In light of the fact that these demographic profiles are unlikely to change in the short term, this traditional, enclave-like Korean ethnic economy is also likely to persist for some time and to become an important feature that distinguishes the suburban ethnic settlements of Koreans in Auckland from their counterparts in North American cities. This can be seen as an example of how the economic structure of suburban ethnic settlements can vary, and it emphasises the importance of careful investigation of individual ethnic settlements to understand their true nature.
Chapter 7  Conclusions

This chapter summarises the main findings of this thesis and their contributions to the current knowledge in the field. The chapter also presents recommendations for future research that can be undertaken to supplement and extend the results from the thesis.

7.1  Conclusions

The main objectives of this study were to investigate the geographic distribution of Koreans in Auckland using quantitative approaches and to explain the nature of their patterns of residential clustering in comparison with the existing ethnic settlement theories. This thesis began with measuring the degree of segregation of Koreans in Auckland, and it then examined their demographic and socio-economic profiles to reveal the causes and implications of Korean residential clusters in the study region. A summary of the main research findings from the work carried out
In Chapter 4, the indices of spatial dissimilarity ($\tilde{D}$) and exposure ($\tilde{P}'$) illustrated that Koreans in Auckland are residentially clustered in some areas, but they are not isolated from other groups in an absolute sense. The degrees of clustering for Koreans were the second highest after Pacific peoples in 1996 and 2001 and the highest in 2006. At the same time, however, they did not exceed 20% of the total local population in any census tracts, and they were residentially well-mixed with other ethnic groups, particularly with Europeans and Chinese. They did not appear to be segregated in the sense of being separated from the rest of the society; rather, it seemed that they have formed an ethnoburb-like concentration in Auckland. Voluntarily created ethnic clusters tend to be located across large suburban areas with relatively low population density (until the ethnic population reaches a significant level); the index values seemed to fit with that description.

A local approach used in Section 4.1 also supported these global measures of segregation. The optimisation clustering method revealed that the Korean population in Auckland has been relatively concentrated in North Shore City, where middle-class European families dominate, and around East Auckland suburbs, where other Asian immigrants are overrepresented. In addition, the method demonstrated that there are a couple of small but significant clusters that have emerged in the CBD and West Auckland, reflecting the increasing level of residential clustering among Koreans over the last three census periods.

On the basis of the identification of these clusters, Chapter 5 examined the demographic profiles of Koreans and their location factors using the census and survey data. Overall, the Korean community in Auckland consisted of well-educated, middle-class families who moved in search of their children’s educational environment or a relaxed pace of life. However, the rapid economic transformation and globalisation that occurred in South Korea during the late 1990s seemed to have altered and diversified these characteristics of Korean immigrants. The in-
creased importance of English education, for example, provoked an inflow of international students and astronaut families who came to achieve a specific objective within a particular timeframe. The economic crisis and employment instability also contributed to the recent growth of young, working-age immigrants in the Korean community in Auckland.

While the survey results that were presented in Chapter 5 suggested that the residential clustering of Koreans in Auckland is largely a voluntary phenomenon that is driven by individual preferences and needs, some small ethnic clusters emerging around the CBD and West Auckland mainly consisted of international students and young families with relatively limited economic resources. The emergence of these small ethnic clusters can therefore be seen as a result of the changing demographic composition of the Korean community, and the residential clustering of Koreans in different parts of Auckland provides evidence for internal stratification within the Korean population group. Considering the demographic and socio-economic profiles of the emerging clusters, however, this geographic polarisation is also likely a product of diversified individual circumstances and priorities rather than a 'ghettorisation' caused by structural disadvantages and discrimination in the society. In this regard, the residential pattern of Koreans in Auckland appeared to be analogous to a typical suburban ethnic settlement.

In Chapter 6, however, we observed that the economic structure of the Korean community in Auckland is somewhat different from the contemporary ethnic economy observed in the ethnic settlements in North American cities. Using the case of the Chinese ethnoburb in the San Gabriel Valley of Los Angeles, Li (1998a) argued that in an ethnoburb or the like, the industrial distribution of ethnic businesses is similar to that of the general population living outside of the ethnic cluster, and the economy is not necessarily confined to the ethnic market. In particular, the emergence of transnational businesses caused by the globalisation process has transformed the nature of the contemporary ethnic economy from an isolated economy into an independent entity that provokes interaction between the countries of origin and residence.
Nonetheless, the results from the analysis of the Korean business directory indicated that such transformation of ethnic businesses has not occurred in the Korean community in Auckland. Although the economic structure of Korean enterprises was affected by globalisation such that it exhibits strong transnational linkages with their home country, most of these enterprises target co-ethnic clients in the retail sector and are geographically concentrated in their residential clusters. The economic structure of the Korean community has become more dependent on the home country's economic condition than ever before, and thus, it appeared to be an economic satellite rather than an independent economic entity in the transnational market, as observed in the North American suburban ethnic settlements.

As mentioned at the end of Chapter 6, although its short history of immigration and the small size of the ethnic population could explain the economic structure of the Korean community to a certain extent, a more fundamental reason might be related to the demographic and socio-economic profiles of Korean immigrants in Auckland and their reasons for doing business. In light of the fact that these features are unlikely to change in the short term, this traditional, enclave-like Korean ethnic economy is also likely to persist for some time and to become an important feature that distinguishes the suburban ethnic settlements of Koreans in Auckland from their counterparts in North American cities.

The findings of this thesis might contribute to the current literature on the Korean immigrants and ethnic residential segregation in the following three points. First, these findings can enhance the understanding of the Korean residential clusters in Auckland. As compared with the other major immigrant groups, such as Chinese, Indians and Pacific peoples, the geographic distribution of Koreans in Auckland has been seldom studied, and the causes and patterns of their residential clustering has been remained largely unknown. This study attempted to fill in this gap in the literature by analysing various aspects of the Korean population in Auckland, with particular attention on the relationship between a number of selected demographic and
socio-economic indicators and their residential location. The results from the analysis of the census and other secondary data sets in the present thesis might be useful not only in their own right but also as a foundation for future research on the Korean population in Auckland.

Second, this thesis showed that the residential clusters of Koreans in Auckland cannot be fully explained within one existing theoretical framework, which is another contribution of the present study to the ethnic segregation literature. The Korean residential clusters in Auckland are an empirical example of how suburban ethnic settlements can vary in terms of geographic, demographic and socio-economic profiles. Ethnic residential neighbourhoods have become diversified, and as Logan (2002) clearly noted, “this is not a time, if ever there were a time, for a one-pattern-fits-all theory of residential location” (p. 321). The findings here have (re)confirmed that the residential concentration of a particular ethnic group should be individually evaluated based on the identity of the group and the reasons for concentration. In this regard, the Korean residential clusters in Auckland can be considered an important empirical case for contemporary segregation studies.

Third, and finally, this study has extended the methodological scope of previous works by using a heuristic clustering algorithm and correspondence analysis as a tool for identifying and examining ethnic residential clusters. I proposed an optimisation clustering method that uses a modified greedy algorithm to identify residential clusters of a small population group. The three synthetic examples in the thesis demonstrated that the proposed method has an advantage over other existing local approaches in identifying the extent of ethnoburb-like residential concentration; the clustering results for the Korean population data showed that it could yield a reliable outcome, even when applied to a small ethnic group that comprises less than 5% of the local population in the study region. In addition to the development of a new clustering method, this study illustrated the use of correspondence analysis for exploring the characteristics of Korean residential clusters. Although correspondence analysis has been little used in the segregation
CONCLUSIONS AND FUTURE STUDIES

studies, it is a useful exploratory technique that can summarise complex contingency tables in a two-dimensional graphical representation while preserving most of the important information contained in the data. This thesis showed that the interpretation of results from correspondence analysis is quite intuitive and straightforward, so this practical method can be easily adopted in other similar studies of ethnic settlement patterns.

7.2 Suggestions for Future Studies

There would be several directions in which this study can be supplemented and extended.

First, much of the work presented in this thesis is quantitative in nature. The data came from the census and a standardised questionnaire survey, and they were analysed using exploratory methods to address the research questions. One of the limitations in this approach is that it only considers the variables that were selected for investigation. While all attempts were made to ensure the completeness of the data sets, there might be other important determinants of ethnic residential clustering that were not included in the present study. Further research with qualitative approaches, such as in-depth interviews, can validate the choice of the variables and supplement the general findings here.

Second, this thesis employed descriptive statistics to uncover important determinants for the current geographic distribution of Koreans. It would be useful if the exact effects of these determinants can be estimated using confirmatory data analysis. Although it may require much more extensive data sets that allow cross-tabulation of the variables to draw reliable estimates, the findings could contribute to the development of a predictive statistical model, which can provide some idea of how the Korean residential clusters in Auckland will change in the future (e.g., whether the degree of residential segregation will increase when the number of astronaut
families increases, remains constant, or declines).

Third, the present study focused on only one ethnic group, Koreans, in Auckland. It would be valuable to examine how they interact with other ethnic groups, such as Chinese and Samoan. There could be significant socio-economic interactions between ethnic minorities, which were not taken into account in this thesis.
Appendix A: Survey Questionnaire

Participant Information Sheet

Project Title: Residential Clusters of Koreans in Auckland, New Zealand
Principal Researcher: Seong-Yun Hong
PhD candidate at the School of Geography, Geology, and Environmental Science

You are invited to participate in a research project that examines residential distribution of Koreans and its relationship with family arrangements. This project is designed for Korean households who have stayed or intend to stay in New Zealand for more than 12 months. If you are eligible, I would appreciate any assistance that you can offer us.

To participate, you will have to:

- Read carefully the Korean version of the participant information sheet
- Fill out the questionnaire at your leisure, and
- Send it back using the envelope provided until the 25th of July 2008.

If you are NOT eligible, please tick the "This survey is not applicable to me" option below, and return using the envelope provided. Please also provide your address information to avoid further reminders.

☐ This survey is not applicable to me

Address:

If you have any queries or wish to know more, please contact me by calling 021 252 7402 or emailing at yun.ho ng@auckland.ac.nz

My supervisor is: Associate Professor Hong-Kee Yoon
School of Geography, Geology and Environmental Science
The University of Auckland, Private Bag 92019, Auckland
Tel. 64 9 373 7599 ext 88466

The Director of School is: Professor Glenn McGregor
School of Geography, Geology and Environmental Science
The University of Auckland, Private Bag 92019, Auckland
Tel. 64 9 373 7599 ext 88284

If you have any concerns of an ethical nature you can contact the Chair of the University of Auckland Human Participants Ethics Committee at 373 7599 ext 89780.

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 14 May 2008 for 7 months from 1 June 2008 to 31 December 2008 Reference Number 2008/01/019

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본 페이지에는 설문조사의 내용과 목적에 관한 중요한 내용이 적혀 있습니다.

연구 주제: 오컬랜드 한인 주거지역의 공간적 분포와 가용
연구 자: 종성현 (오컬랜드대학교 대학원 지리학결과 박사과정)

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본 설문지의 작성에 소요된 시간은 약 10분 정도가 예상됩니다. 귀중한 시간 내에 주셔서 다시 한 번 감사드리며, 앞으로는 항상 좋은 일만 있고 건강하시기를 기원합니다.

감사합니다.

2008년 8월 종성현 출입

지도교수: Associate Professor Hong-Key Yoon (Ph: 373 7599 x 88466, Email: hk.yoon@auckland.ac.nz)
학 부 장: Professor Glenn McGregor (Ph: 373 7599 x 85284, Email: g.mcgregor@auckland.ac.nz)

본 설문 조사와 관련하여 윤리적인 문제점을 발견하였다면, 오컬랜드 대학교 윤리위원회 Human Participants Ethics Committee, 373 7599 ext 87830으로 연락해 주십시오.

APPROVED BY THE UNIVERSITY OF AUCKLAND HUMAN PARTICIPANTS ETHICS COMMITTEE ON 14 May 2008 for 7 months from 1 June 2008 to 31 December 2008 Reference Number 2008/D/016
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격식의 분량에 대한 응답은 체크 표기 [ ] 해 주시기 바랍니다.
주관식 문항에 대한 응답은 가능한 정자의 (정용)로 표기해 주시기 바랍니다.

1. 귀하의 연령대는 어떻게 되실까요?
   □ 20세 이하  □ 20~29세  □ 30~39세  □ 40~49세  
   □ 50~59세  □ 60세 이상

2. 뉴질랜드에 처음 오신 때는 언제입니까? (여행 등의 목적으로 단기 방문하였던 것은 제외)
   
3. 귀하 (세대주)께서 뉴질랜드로 오시게 된 동기는 무엇입니까? 해당하는 항목을 모두 선택해 주십시오.
   □ 경제적 기회  □ 보다 나은 삶의 질  □ 자녀 교육  
   □ 본인의 본부  □ 뉴질랜드에 대한 좋은 이미지  □ 경제적 안정  
   □ 연계 뉴질랜드에 근무하고 있는 친척, 친구 등 지인의 권유  □ 기타 (설명 기재:  )

4. 귀하께서는 자녀가 있으십니까?
   □ 예  □ 아니오

한국 자녀가 있으시다면, 귀하 (귀하)께서는 기자기 가족 (일시적 비동거 가족)에 해당하실까요?

★ 본 설문지 기자기 가족으로 불리는 일시적 비동거 가족은 부모 중 어느 한 분 (일반적으로 아버지)께서 한국 또는 뉴질랜드가 아닌 제 3국에서 생활에 종사하시며 가족을 부양하고, 다른 한 분께서는 뉴질랜드에 자녀와 함께 계시며 자녀들의 교육 등을 담당하는 가족의 형태입니다.

   □ 예  □ 아니오
5. 귀하께서는 한국으로의 귀국 또는 기타 재 8 국으로의 재이주를 생각하고 계실니까?
   □ 예 □ 아니요

   만약 그렇다면, 앞으로 얼마나 더 뉴질랜드에 거주하실 계획이실니까?
   □ 자녀들의 학업을 마칠때까지
   □ 본인의 간병을 마칠때까지
   □ 기타 (식점 기재: ____________ )
   작성예: 5 년, 35 년 정도, 3 년 이상 등

6. 현재 거주하시는 지역은 어디입니까?
   지역 SUBURB (대성예: Flat Bush, Howick, Tekapuna, Ardmore 등) 도시 CITY (대성예: Manukau 등)

   ____________

7. 다음의 항목 중, 귀하께서 현 거주지역을 선택하실 때 중요한 영향을 미친 항목 다섯 가지를 선택해 주십시오.
   □ 자녀들 학교와의 거리가 가까워서
   □ 본인(또는 배우자)의 직업/학교와의 거리가 가까워서
   □ 친척, 친구들이 많이 살아서
   □ 교육 서비스(한국 슈퍼마켓, 음식점, 비디오샵, 학원, 병원 등)이 많아서
   □ 다니는 교회, 상당, 점 등이 가까워서
   □ 대중 교통의 이용이 편리해서
   □ 자가 운전이 편리한 지역이어서
   □ 대형 소평센터, 극장 등이 가까워서
   □ 예배 또는 공원 등의 놀이터가 많아서
   □ 오래 살던 지역이라 익숙해서
   □ 상대적으로 범죄 등으로부터 안전한 지역이어서
   □ 가계 소득수준에 적당한 지역이어서 (렌트값, 임대료 등이 적당해서)
   □ 푸드칸(집값) 가격 상승에 대한 기대감에
   □ 기타 의견 (식점 기재: ____________ )

   2
9 현재 거주하시는 지역에 대한 만족도를 평가해 주실시오.

☐ 매우 불만족 ☐ 불만족 ☐ 보통 ☐ 만족 ☐ 매우 만족

9 반영 이사를 가신다면 어느 지역으로 이사를 가고 싶으시나?

지역 SUBURB (주소 예시: Takapuna, Rowick, Albany, Freemans Bay 등) 도시 CITY (주소 예시: Manukau 등)

10 키스타의 가정에 관하여 모두 및 본의 한국인이 함께 살고 계실니까? 여기서 한국인은 귀 질에 관계없이 본인을 한국인으로 생각하는 모든 분들을 의미합니다.

명

11 본 설문의 내용과 관련하여 기타 의견이 있으시면 가능하 영적의 프라이ден에 적어 주실시오 (장갑이 다른 필요하신 경우 평면의 하락을 이용해 주실시오).

설문에 참여해주셔서 감사합니다.

작성하신 설문지는 동봉되어 있는 안내서 별도에 넣어 7월 25일까지 가까운 우편물에 넣어주시오.
Appendix B: Computer Code for Segregation Measures

This appendix presents R code that was used in Chapter 2 to calculate various indices of residential segregation.

```r
# d.idx
#
# Index of Dissimilarity
#
# Description:
# 'd.idx' computes the traditional and spatial versions of the D index
#
# Usage:
# d.idx(x, nb = NULL, P = NULL, A = NULL, maxPA = NULL)
#
# Arguments:
# x: a matrix or data frame with two columns. If there are more than
two columns in the data, only the first two will be used.
# nb: optional. A symmetric neighbourhood matrix or a list object created
# by 'vect2neigh()'. If a list is given, it will be transformed into
# a matrix using d.neigh2nb().
# P: optional. A numeric vector containing the perimeters.
# A: optional. A numeric vector containing the area sizes.
# maxPA: optional. A single numeric value to be used as maxPA.

d.idx <- function(x, nb = NULL, P = NULL, A = NULL, maxPA = NULL) {
  if (ncol(x) > 2)
    warning("'x' has more than two columns")
  b <- x[,1]/sum(x[,1])
  w <- x[,2]/sum(x[,2])
  d <- sum(abs(b-w))/2                # Index of dissimilarity
  d.adj <- numeric()
  d.s <- numeric()
  if (!is.null(nb)) {
    # Calculates the spatial component!
    if (is(nb)[1] == "data.frame")
      # If 'nb' is a list object,
      nb <- d.neigh2nb(nb, nrow(x))
      # transform into a matrix
    if (is(nb)[1] != "matrix")
      stop("'nb' must be either a data frame from 'vect2neigh()' or a matrix")
    if (nrow(nb) != ncol(nb))
      stop("'nb' must be a symmetric matrix")
  }
```

bp <- as.numeric(apply(x, 1, function(x) x[1]/sum(x)))

for (i in 1:nrow(x)) {
  j <- which(nb[i,] > 0)
  d.adj <- append(d.adj, abs(bp[i]-bp[j]) * nb[i,j])
}

if (!is.null(P) && !is.null(A)) {  # If both 'P' and 'A' are given,
  PA <- P/A                         # calculates the D(s)!
  if (is.null(maxPA))               # If 'maxPA' is not specified, use the
    maxPA <- max(PA)                # local value.
  for (i in 1:nrow(x)) {
    j <- which(nb[i,] > 0)
    d.s <- append(d.s, PA[i]+PA[j])
  }
  d.s <- d.adj * ((d.s/2)/maxPA)
}

if (length(d.s) == 0) {
  if (length(d.adj) == 0)
    res <- d
  else if (length(d.adj) > 0)
    res <- list(D = d, M = d-sum(d.adj)/sum(nb))
  else if (length(d.s) > 0) {
    res <- list(D = d, M = d-sum(d.adj)/sum(nb), S = d-sum(d.s)/sum(nb))
  }
  res
}

# myls()
# myls <- function(x) {
#  p <- paste("^", letters, "|^", LETTERS, sep = "")
#  ix <- unlist(lapply(p, function(y) any(grepl(y, x)))))
#  p.use <- p[ix]
#  res <- lapply(p.use, function(y) grep(y, x, value = T))
#  names(res) <- letters[ix]
#  return(res)
#}

# d.neigh2nb()
# d.neigh2nb <- function(x, y) {
#  res <- matrix(0, nrow = y, ncol = y)
#  for (i in 1:nrow(x))
#    res[x[i,1], x[i,2]] = x[i,3]
#  invisible(res)
#}
# sp.idx()
#
# Description:
# 'sp.idx()' works only on the n * 2 data at the moment.
#
sp.idx <- function(x, coords) {
  px <- x[,1]/sum(x[,1])
  py <- x[,2]/sum(x[,2])
  p <- (x[,1]+x[,2])/sum(x)
  xx <- numeric()
  yy <- numeric()
  tt <- numeric()
  for (i in 1:nrow(x)) {
    for (j in 1:nrow(x)) {
      d <- exp(-dist(coords[c(i,j)]))
      xx <- append(xx, px[i]*px[j]*d)
      yy <- append(yy, py[i]*py[j]*d)
      tt <- append(tt, p[i]*p[j]*d)
    }
  }
  n <- sum(x[,1])*sum(xx) + sum(x[,2])*sum(yy)
  d <- sum(x)*sum(tt)
  n/d
}
Appendix C: Computer Code for the Optimisation Clustering Method

This appendix provides R code that iteratively searches adjacent areas of the current solution in order to determine the extent of a given cluster. An initial set of areas is combined with its neighbours that meet certain criteria, and keeps expanding until there are no more areas to add. More detailed coverage of the clustering procedure is given in Section 3.2.

```r
# get.adjacent.tracts()
# This function returns census tracts' IDs that are adjacent to 'x'.
get.adjacent.tracts <- function(x, nb) {
  out <- unique(unlist(nb[x]))
  out <- out[!(out %in% x)]
  return(out)
}

# is.wholenumber()
# This function tests whether the input value is an integer.
is.wholenumber <- function(x, tol = .Machine$double.eps^0.5) {
  if (is.numeric(x)) # If the input value is numeric, examine it!
    abs(x - round(x)) < tol
  else                # Otherwise, return 'FALSE'.
    0 > 1
}

# greedy()
# greedy <- function(x, y) {
this <- length(x)
if (any(y > x[this]))
  out <- which(y == max(y))[1]
else
  out <- -1
return(out)
```
# sa()
# ---------------------------------------------------
sa <- function(x, y, tol) {
  this <- length(x)
  if (any(y > x[this]))
    out <- which(y == max(y))[1]
  else if (any(y > x[this] * (1-tol))) {
    out <- which(y > x[this] * (1-tol))
    if (length(out) > 1)
      out <- sample(out, 1, prob = out/sum(out))
  } else
    out <- -1
  return(out)
}

# wgtvar()
# This function calculates the test statistic for opcl().
# ---------------------------------------------------
wgtvar <- function(x, wgt = NULL) {
  if (is.null(wgt))
    wgt <- rep(1, length(x))
  mu <- sum(x * wgt) / sum(wgt)   # Weighted mean
  dev <- sum(wgt * abs(mu - x))   # Weighted sum of absolute deviations
  c(mu, dev)
}

# get.score()
# -----------------------------------
get.score <- function(x, y, wgt) {
  p.df <- sapply(y, function(z) wgtvar(x[z], wgt[z]))
  q.df <- sapply(y, function(z) wgtvar(x[-z], wgt[-z]))
  mu <- p.df[1]
  return(list(score = score, mu = mu))
}

# sample.unique()
# -----------------------------------
sample.unique <- function(x, size, n) {
  cb <- numeric()
  for (i in 1:n) {
    flag <- FALSE
    # Repeatedly create a combination until getting a unique set!
    while(!flag) {
      tmp <- sort(sample(x, size))
      # If this is the first run, we know that 'tmp' is always unique:
      if (i == 1)
        flag <- TRUE
      # If this is the second run, there is only one set to compare:
      else if (i == 2 & !all(tmp %in% cb))

flag <- TRUE
    # If this is the third+ run, there is a matrix:
else if (i > 2 & !any(apply(cb, 2, function(z) all(tmp %in% z))))
    flag <- TRUE
    if (flag)
        cb <- cbind(cb, tmp)
}
return(cb)
}

# excl()
# --------------------------------------------------------
excl <- function(x, excl, action = "in") {
    out <- -1
    if (action == "in")
        out <- which(x == excl)[1]
    else if (action == "out")
        out <- excl[x]
    return(out)
}

# get.allcomb()
# --------------------------------------------------------
get.allcomb <- function(x) {
    n <- length(x)
    m <- 1
    out <- list()
    for (i in 1:n) {
        comb <- combn(n, i)
        for (j in 1:ncol(comb)) {
            out[[m]] <- x[comb[,j]]
            m <- m + 1
        }
    }
    return(out)
}

# get.comb()
# --------------------------------------------------------
get.comb <- function(x, comb, comb.max, verbose) {
    n <- length(x)
    numcomb <- sum(choose(n, 1:n))
    if (verbose)
        cat(numcomb, "possible combinations\n")
    # --------------------------------------------------------
    # Case 1. If 'comb' is FALSE or if the current cluster has too many
    # neighbouring census tracts, do NOT create census tracts' combinations!

if (!comb | n > 20) {
  if (n > 20 & verbose)
    cat("combinations are not created due to memory limit\n")
  out <- as.list(x)
}

# Case 2. If 'comb.max' is not specified, create all possible combinations
# of census tracts.
else if (is.null(comb.max))
  out <- get.allcomb(x)

# Case 3. If 'comb.max' is specified but if it is greater than or equal to
# the total number of combinations, then we still have to produce all possible
# combinations. Re-use the code in Case 2.
else if (!is.null(comb.max) & numcomb <= comb.max)
  out <- get.allcomb(x)

# Case 4. If 'comb.max' was specified and if it is smaller than the total
# number of combinations, do some sampling! This is the tricky part.
else if (!is.null(comb.max) & numcomb > comb.max) {
  out <- list()
  m <- 1
  selcomb <- sort(sample(numcomb, comb.max))
  End <- cumsum(choose(n, 1:n))
  Beg <- c(1, End + 1)[-(n+1)]

  for (i in 1:n) {
    # How many sets do we need at the current level of combinations?
    p <- sum(selcomb %in% (Beg[i]:End[i]))

    if (p > 0) {
      if (verbose)
        cat(p, " sets from 'combn(" n, ", ", i, ")'\n", sep = "")

      # Case 4.1. If over 30% of all combinations are needed from 'i'
      # combinations, create all possible sets and choose the required #.
      if (p > (choose(n, i) * 0.3)) {
        if (verbose)
          cat("create all possible combinations and choose", p, "sets\n")
        cb <- combn(x, i)
        cb <- cb[, sample(ncol(cb), p)]
        if (i == 1) {
          l <- length(cb)
          cb <- matrix(cb, ncol = l)
        } else if (p == 1) {
          cb <- matrix(cb, ncol = 1)
        }
      }
    }
  }
}
Case 4.2. If less than or equal to 30% of all combinations are needed from 'i' combinations, do NOT create all combinations. Instead, create the number of sets using while().

else {
  if (verbose)
    cat("create only", p, "combinations\n")
  cb <- sample.unique(x, i, p)
}

# Now we have a object called 'cb' from either Case 4.1 or 4.2. Each column of 'cb' should be appended to the list object 'out' that will be returned at the end of the current function.

if (length(ncol(cb)) == 0)
  l <- length(cb)
else
  l <- ncol(cb)
for (r in 1:l) {
  out[[m]] <- as.vector(cb[,r])
  m <- m + 1
}

# If p <= 0, then do nothing for this i.
if (verbose)
  cat(length(out), "combinations chosen\n")

return(out)

# opticl4()
# This function attempts to find a cluster using an optimisation clustering algorithm. The clustering process starts from a seed point 'init' & examines neighbouring census tracts. The exact strategy depends on user-specified parameters 'comb' and 'isSA'. Other parameters such as 'comb.max', 'tol' and 'tol.max' also have a minor effect on the clustering procedures.
# NOTE that this function is not intended to be used by end users. End users should use opc1(), which validates input parameters and produces a (more) meaningful output.

opticl4 <- function(x, nb, init, wgt, x.min, comb, comb.max, isSA, tol, tol.max, verbose) {
  if (verbose)
    cat("[SEED ID: ", init, "]\n\n", sep = "")

  # 'wgt' can be the size or total population of census tracts. If this is not provided, all values 'x' have the same influence, 1.
  if (is.null(wgt))
    wgt <- rep(1, length(x))

  # nomore controls the loop. The algorithm iterates until nomore = TRUE.
# iter represents # iterations. This increases as the loop moves.
# out a list object that contains census tract IDs of a cluster. This
# will be returned at the end of the function.
# score a vector of the test scores (absolute deviations).
# -----------------------------------------
nomore <- FALSE
iter <- 1
out <- list(init)
score <- (0 + wgtvar(x[-init], wgt[-init][2])^(-1)

# Repeat the clustering process until 'nomore' becomes TRUE.
while (!nomore) {
  # Get neighbouring census tracts of the current selection
  nb.this <- get.adjacent.tracts(out[[iter]], nb)
  # Get the number of the CAUs that are adjacent to the current selection
  n <- length(nb.this)
  
  # Case 1. If n = 0, change 'nomore' to TRUE and do nothing.
  if (n == 0) {
    nomore <- TRUE
    if (verbose) # If 'verbose' is TRUE
      cat("no more tracts to examine: iter =", iter, "\n")
  }
  
  # Case 2. If n > 0, create sets of census tracts to examine.
  else if (n > 0) {
    numcomb <- sum(choose(n, 1:n))
    if (verbose)
      cat(n, "neighbouring tracts: iter =", iter, "\n")
    
    allcomb <- get.comb(nb.this, comb, comb.max, verbose)
    if (verbose)
      cat(length(allcomb), "combinations received from get.comb()\n")
  }
  
  # Now the object 'allcomb' contains all or randomly chosen combinations of
  # census tracts to be examined. Now add the current selection to 'allcomb'!
  if (!nomore) {
    allcomb <- lapply(allcomb, function(z) append(out[[iter]], z))
    if (isSA) {
      if (iter <= tol.max) {
        for (i in 1:n)
          allcomb[[length(allcomb) + 1]] <- nb.this[i]
      }
    }
    # print(allcomb)
  }
  
  # Calculate the clustering scores of the combinations in 'allcomb'
if (!nomore) {
  tmp <- get.score(x, allcomb, wgt)
  x.this <- tmp$mu
  score.this <- (tmp$score)^(-1); rm(tmp)
  if (verbose)
    cat("all clustering scores calculated\n")

  # If the minimum population size was specified:
  if (!is.null(x.min)) {
    score.this[x.this < x.min] <- -1
    if (verbose)
      cat(sum(score.this == -1), "sets dropped as 'x' < ", x.min, "\n")
  }
}

# Case 1. Greedy algorithm
if (!nomore & !isSA)
  maxID <- greedy(score, score.this)

# Case 2. Simulated annealing
else if (!nomore & isSA) {
  tol.this <- tol - (log(iter) * tol)/log(tol.max)
  if (tol.this < 0)
    tol.this <- 0
  maxID <- sa(score, score.this, tol.this)
}

# Update the output variables
if (!nomore) {
  if (maxID != -1) {
    iter <- iter + 1
    out[[iter]] <- allcomb[[maxID]]
    score <- append(score, score.this[maxID])
    if (verbose)
      cat("cluster expanded successfully\n")
  } else {
    nomore <- TRUE
    if (verbose) {
      cat("no improvements made at the current iteration\n")
      cat("stop iteration\n")
    }
  }
}
rm(nb.this, n)
} # End of 'while()'

if (verbose)
  cat("cluster found!\n\n")
invisible(list(cl = out, score = score))
# opcl()
#
# This function is to identify clusters of population. This is an updated
# version of 'fun_opcl.R' that was used in my PhD thesis.
#
# Arguments:
# x         a numeric vector of population
# nb        neighbourhood list
# init      a numeric vector of starting points
# wgt       a numeric vector of the same length as 'x' containing weight of
#            each observation. If not provided, all observations will have the
#            same influence.
# x.min     minimum 'x' value to be considered as a cluster
# comb      if TRUE, all possible combinations of neighbouring census tracts
#            will be examined at each iteration.
# comb.max  if 'comb' is TRUE, and if this parameter is specified, only up
#            to 'comb.max' number of combinations will be randomly chosen and
#            examined at each iteration.
# overlap   is overlapping between clusters allowed?
# isSA      use a SA approach instead of the greedy algorithm?
# tol       proportional tolerance for SA
# tol.max   tolerance becomes 0 after 'tol.max' number of iterations
# verbose   if TRUE, very detailed information about clustering process will
#            be given on the screen. This is usually for debugging purpose.
# quite     if TRUE, no information about clustering process will be given.

opcl <- function(x, nb, init, wgt = NULL, x.min = NULL, comb = TRUE,
                  comb.max = NULL, overlap = FALSE, isSA = FALSE, tol = NULL, tol.max = NULL,
                  verbose = FALSE, quite = FALSE) {

  # Step 1. Validate input parameters

  if (!is.numeric(x))
    stop("'x' must be a numeric vector")
  x <- as.vector(x)

  if (!is(nb) == "nb")
    stop("'nb' must be a neighbourhood list")
  if (!is.numeric(init))
    stop("'init' must be a numeric vector")
  else if (all(!is.wholenumber(init)))
    stop("invalid 'init' values")
  init <- as.vector(init)

  if (!is.null(wgt)) {
    if (!is.numeric(wgt))
      stop("'wgt' must be a numeric vector")
    wgt <- as.vector(wgt)
  }

  if (!is.null(x.min)) {
    if (!is.numeric(x.min))
      stop("'x.min' must be a numeric vector")
  }

if (length(x.min) > 1)  
x.min <- x.min[1]  
if (max(x) < x.min)  
  stop("'x.min' is too big - all 'x' values are smaller than 'x.min'")
}

if (!is.logical(comb))  
  stop("'comb' must be TRUE or FALSE")

if (!is.null(comb.max)) {
  if (length(comb.max) > 1)  
    comb.max <- comb.max[1]  
  if (!is.numeric(comb.max))  
    stop("'comb.max' must be a numeric vector")  
  else if (!is.wholenumber(comb.max))  
    stop("'comb.max' must be an integer")  
  else if (comb.max <= 5)  
    stop("'comb.max' must be greater than 5")
}

if (!is.logical(overlap))  
  stop("'overlap' must be TRUE or FALSE")

if (!is.logical(isSA))  
  stop("'isSA' must be TRUE or FALSE")

if (isSA) {
  if (is.null(tol))  
    stop("'tol' must be provided when 'SA' is TRUE")  
  else if (!is.numeric(tol))  
    stop("'tol' must be a numeric vector")  
  else if (tol < 0 | tol > 1)  
    stop("'tol' must be between 0 and 1")  
  if (is.null(tol.max))  
    stop("'tol.max' must be provided when 'SA' is TRUE")  
  else if (!is.wholenumber(tol.max))  
    stop("'tol.max' must be an integer")  
  else if (tol.max <= 0)  
    stop("'tol.max' must be greater than 0")
} else {
  if (!is.null(tol.max) | !is.null(tol))  
    warning("'tol' and 'tol.max' are ignored when 'SA' is FALSE")
}

# Set up control variables that control overlapping clusters
# -------------------------------------------------------------
exclude <- numeric()  
fid <- 1:length(x)

# Set up output variables
# -------------------------------------------------------------
c1 <- list()  
score <- list()  
Time <- numeric()
for (i in 1:length(init)) {
    begTime <- Sys.time()
    if (i == 1 | overlap) {
        tmp <- opticl4(x, nb, init[i], wgt, x.min, comb, comb.max, isSA,
                         tol, tol.max, verbose)
        cl[[i]] <- tmp$cl[[length(tmp$cl)]]
    } else {  # overlap is not allowed!
        xE <- x[-exclude]
        wgtE <- wgt[-exclude]
        initE <- excl(init[i], fid[-exclude], "in")
        nbE <- nbmat(auck.nb, style = "B", zero.policy = T)[-exclude, -exclude]
        nbE <- apply(nbE, 1, function(z) which(z == 1))
        tmp <- opticl4(xE, nbE, initE, wgtE, x.min, comb, comb.max, isSA,
                        tol, tol.max, verbose)
        cl[[i]] <- tmp$cl[[length(tmp$cl)]]
    }
    exclude <- append(exclude, cl[[i]])
    score[[i]] <- tmp$score
    endTime <- Sys.time()
    Time <- append(Time, as.numeric(endTime - begTime))
    if (!overlap) {
        if (init[i+1] %in% exclude) {
            cat("next starting point is part of existing clusters\n")
            init[i+1] <- sample(fid[-exclude], 1)
            cat("resampling the starting point ...\n")
        }
    }
}

return(list(cl = cl, score = score, time = Time))

# Define a function that runs opcl() for randomly generated starting sets
opcl.auto <- function(x, nb, init = NULL, wgt = NULL, x.min = NULL, comb = TRUE,
                       comb.max = NULL, overlap = FALSE, isSA = FALSE, tol = NULL, tol.max = NULL,
                       verbose = FALSE, quite = FALSE, iter = NULL, num.cl = NULL, init.p = NULL) {
    if (!is.null(init))  # If 'init' is given, use them as starting points
        init <- as.matrix(expand.grid(init))
    else {  # If 'init' is not given, generate random seeds
        if (!is.null(init.p))
            init <- sample(1:length(x), iter * num.cl, replace = T, prob = init.p)
        else
            init <- matrix(sample(1:length(x), iter * num.cl, replace = T)
                            init <- matrix(init, nrow = iter, ncol = num.cl)
    }
    n <- nrow(init)
    cl <- list()
    score <- numeric()
Time <- numeric()

for (i in 1:n) {
  if (!quite)
    cat("Set ", i, ": ", sep = "")
  tmp <- opcl(x, nb, init[i,], wgt, x.min, comb, comb.max, overlap, isSA,
             tol, tol.max, verbose, quite)
  cl[[i]] <- unique(unlist(tmp$cl))
  score <- append(score, get.score(x, list(cl[[i]]), wgt)$score)
  Time <- append(Time, sum(tmp$time))

  if (!quite)
    cat("score = ", score[i], ", time = ", Time[i], " sec\n", sep = "")
}

best <- which(score == min(score))[1]
if (!quite) {
  cat("The best clustering score was", min(score), "at", best, ", \"")
  cat("Total time taken was", sum(Time), "\n\n")
}
return(list(cl = cl, score = score, time = Time))

# Define a function that runs opcl() for test purpose!
# ------------------------------------------------------------------------

opcl.test <- function(x, nb, wgt = NULL, x.min = NULL, comb = TRUE,
                       comb.max = NULL, overlap = FALSE, isSA = FALSE, tol = NULL, tol.max = NULL,
                       verbose = FALSE, quite = FALSE, iter = NULL, num.cl = NULL, init.p = NULL,
                       testRun = 100, testReport = TRUE, testName = "Test") {
  init <- NULL
  cl <- list()
  score <- numeric()
  Time <- numeric()

  for (i in 1:testRun) {
    if (!quite)
      cat("[RUN ", i, "]\n\n", sep = "")
    tmp <- opcl.auto(x, nb, init, wgt, x.min, comb, comb.max, overlap, isSA,
                     tol, tol.max, verbose, quite, iter, num.cl, init.p)
    l <- which(tmp$score == min(tmp$score))[1]
    cl[[i]] <- tmp$cl[[l]]
    score <- append(score, tmp$score[l])
    Time <- append(Time, sum(tmp$time))
  }

  out <- list(cl = cl, score = score, time = Time)

  if (testReport) {
    dir.create(testName)
    target <- HTMLInitFile(testName, Title = testName, CSSFile = "test.css",
                           useLaTeX = FALSE, useGrid = FALSE)
    HTML("<h1>Test Environment</h1>", target)
    HTML(paste("OS:\", paste(Sys.info()[1:3], collapse = " ")), target)
  
  return(out)
}
globals <- c(1,2,3,4)

# Best solution map
l <- which(score == min(score))[1]
png(filename = paste(testName, "/best.png", sep = ""))
par(mar = c(0.5, 0.5, 0.5, 0.5))
plot(auck.raw)
plot(auck.raw[cl[[l]],], col = "Royal Blue", add = T)
title(main = min(score))
dev.off()

# Choropleth map

# HTML(sessionInfo(), target)
HTML("<h1>Test Parameters</h1>", target)
HTML(match.call(), target)
HTML("<h1>Clustering Score Summary</h1>", target)
HTML(summary(score), target)
HTML("<h1>Computing Time Summary</h1>", target)
HTML(summary(Time), target)

# Best solution map
l <- which(score == min(score))[1]
png(filename = paste(testName, "/best.png", sep = ""))
par(mar = c(0.5, 0.5, 0.5, 0.5))
plot(auck.raw)
plot(auck.raw[cl[[l]],], col = "Royal Blue", add = T)
title(main = min(score))
dev.off()

# Choropleth map
Bibliography


