Residential Assimilation of Immigrants: A Cohort Approach

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Abstract

This paper measures the process of residential assimilation for three cohorts of immigrants from each of five countries of birth entering Auckland, New Zealand between 1991 and 2006. It tracks, and compares, the changes in spatial segregation, isolation, and autocorrelation for these cohorts over time, using index measures adjusted for random location variation. We find evidence of residential assimilation, whereby immigrants become less spatially concentrated in the years following arrival. Overall concentration has nevertheless been increasing over time, with successive cohorts entering with higher levels of initial concentration. By examining the spatial location patterns of arrival cohorts, we show that entering cohorts are attracted to the current rather than initial locations occupied by the previous cohort of their compatriots. Despite differences across cohorts and over time, there is nevertheless a high degree of stability in the 'residential footprint' of different immigrant groups within Auckland.

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Keywords

immigration, segregation, residential location, ethnic diversity

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1. Introduction

The spatial distribution of new migrants differs from that of the host population. New immigrants settle predominantly in metropolitan regions and are often concentrated in specific parts of cities. In many cases, entering migrants live disproportionately in the same areas as earlier cohorts of migrants with similar backgrounds, sometimes to the extent that the areas where they live are referred to as ethnic enclaves (Edin et al., 2003).

Location choices may reflect the attraction of social networks among immigrant groups, or may reflect shared preferences for local amenities or types of housing. Like all residents, new immigrants must make tradeoffs between the desirability and costs of neighbourhoods. Immigrants may also face discrimination in housing markets, constraining their choices (Butcher, Spoonley, & Trlin, 2006). Income, education, ethnicity, family characteristics, occupation, regional characteristics, housing affordability and accessibility of transport are all factors that influence immigrants' location choices (Dawkins, 2009). For immigrants, the terms of these tradeoffs are likely to change over time as they settle in the receiving country. Their income and employment outcomes generally improve with duration of residence, expanding the range of locations in which they can feasibly live. Immigrants may also broaden their networks within the wider host population, raising the attractiveness of neighbourhoods other than those in which they initially settle.

The focus of the current paper is on documenting patterns of residential assimilation by examining the spatial distribution of immigrants when they first arrive in the host city, and the change in this distribution as they spend longer in the host country. The process of spatial dispersion has been linked to social mobility and, for migrants, to acculturation (Massey & Denton, 1985). It is thus tempting to interpret dispersion as a positive outcome, and spatial concentration as a symptom of poor socio-economic outcomes. Concentration is, however, neither a necessary nor a sufficient condition for social exclusion or poor settlement outcomes. Nor is spatial assimilation synonymous with successful settlement.

The process of immigrants 'finding their feet' may manifest itself spatially in a variety of ways. Successful settlement may involve a process of spatial assimilation, though it is not *a priori* clear which immigrant attributes and circumstances are associated with successful settlement. Immigrants have an incentive to move closer to groups with whom they maintain valuable social interactions. The impact of a residential location on the commute to work and the presence of (dis) amenities play important roles as well (e.g., Maré et al., 2012). For these reasons, the spatial distribution of new immigrants may become more similar to that of the host population, to that of earlier immigrants from the same country, or to that of other residents who have similar characteristics such as education, or income. Immigrants may remain in the areas in which they initially settle if those areas continue to be attractive for a variety of reasons.

It is an empirical question, which this study investigates, whether newly arriving immigrants remain in their entry neighbourhoods, follow in the footsteps of their settled compatriots, or increasingly mix with other residents. We investigate residential mobility using a range of summary measures of spatial concentration that capture patterns of segregation, isolation, and spatial autocorrelation. We also use an area-specific measure of spatial concentration to identify in which areas different immigrant groups are concentrated.

Our empirical analysis uses full-coverage census micro-data on immigrants within the Auckland Urban Area, for the years 1996, 2001 and 2006.[1] Auckland is New Zealand's largest and most ethnically diverse city. In 2006, immigrants accounted for 43% of Auckland's 25 to 64 year old population, up from 34% in 1996. We focus on five countries of origin: the United Kingdom, China, Korea, India and South Africa, which have been significant contributors to the growth in immigrants to Auckland between 1996 and 2006. This paper is the first to provide a detailed description of the nature and extent of immigrant residential sorting patterns from 1996 to 2006 in the Auckland Urban Area.

The next section of the paper outlines the context for the current study and discusses relevant insights and observations from the existing literature. We then review in section 3 the key measures that we use in our empirical analysis, and provide information on the data in section 4. Section 5 presents the findings of our study, and is followed by a summary with concluding comments.

2. Immigrant residential assimilation

The process of assimilation, also referred to as adaptation or integration, has been well-documented for immigrant groups in many countries, across a range of dimensions. For many immigrants socio-economic outcomes improve when they remain longer in the host country, through accumulation of skills, knowledge and networks that are valued in the host country (Chiswick, 1978). Many immigrant groups experience poor outcomes relative to comparable

[1] Micro-data from the 2013 Census that would have enabled us to extend the analysis reported in this paper to the 2006-2013 period were not yet available at the time of writing of this paper. An analysis of the impact of the Global Financial Crisis, and significant changes in New Zealand's international migration flows in recent years, would constitute a fruitful topic for a separate paper.

natives when they first arrive, but a convergence of outcomes to the host population may nonetheless be observed with increasing years of stay. Although the speed and extent of such convergence varies across domains, immigrant groups and host countries, the general pattern is widely observed. It has been well documented internationally and in New Zealand for a wide range of outcomes, including employment and earnings (LaLonde & Topel, 1992; Poot, 1993; Stillman & Maré, 2009; Winkelmann & Winkelmann, 1998), occupation (Chiswick, Lee, & Miller, 2005; Poot & Stillman, 2010), and language (Carliner, 2000; Chiswick & Miller, 2001).

For the analysis of residential assimilation, it is less clear that a corresponding metric exists for judging whether the observed changes in residential patterns is desirable from the public policy perspective. For instance, convergence of immigrant residential patterns to those of natives in terms of home ownership (Borjas, 2002) or suburbanisation (Dawkins, 2009) can be less unequivocally classified as improvements, compared with improvements in employment or earnings. Furthermore, causal links between residential assimilation and immigrant integration may operate in either direction (Bolt, Özüekren, & Phillips, 2010), with improvements in socioeconomic outcomes being either a cause of residential assimilation, or a consequence of it. There is an extensive literature on positive and negative spillovers that may accompany residential segregation. These may affect immigrant outcomes such as education, employment, and language acquisition (Borjas, 1995; Chiswick & Miller, 2005; Cutler, Glaeser, & Vigdor, 2008; Edin, Fredriksson, & Olof, 2003; Beckhusen, Florax, de Graaff, Poot & Waldorf, 2013). De Graaff and Nijkamp (2010) show that immigrants may face poorer outcomes if neighbourhood diversity is too high, but also if it is too low. Using U.S. census data, Zhang and Zheng (2015) provide evidence that segregation is an urban disamenity in that both black and white migrants exhibit a willingness to pay to live in less segregated cities. The current paper does not examine the impacts of immigrant residential assimilation but focuses instead on analysing the assimilation patterns.

Empirically, the generally observed pattern is that immigrants do experience residential assimilation. Their spatial distribution becomes more similar to that of non-immigrants as they remain longer in the host country. Improvements in incomes and employment are accompanied by a wider range of location choices, subject to the constraints of income and housing affordability (Friesen, 2015; Grbic, Ishizawa, & Crothers, 2010). Location choices may also reflect and strengthen the development of broader social networks and interactions within the host community (Peach, 1996). Distinct spatial patterns of immigrant location choices may reflect their own preferences for proximity to their own ethnic and cultural networks, or those of other groups for living in non-immigrant areas (Schelling, 1969). Discrimination in housing markets may play a role, though Friesen (2015) notes that, at least for Asian immigrants in Auckland, there is a “significant element of choice”.

Studies of immigrant residential patterns in New Zealand have focused on Auckland, and have shown that different ethnic and immigrant groups have distinct location patterns (Grbic et al., 2010; Johnston, Poulsen, & Forrest, 2008; Johnston et al., 2011; Maré et al., 2012). Two studies focus particularly on the location patterns of recent migrants. Maré et al (2007) analyse the distribution of recent and earlier immigrants across 58 labour market areas (LMA) within New Zealand, and find that recent migrants are drawn to LMAs where previous immigrants from their region of birth are already located. The re-location decisions of earlier migrants also reflect an attraction to their compatriots. Local labour market conditions appear to become a more important consideration for earlier than for recent migrants, consistent with economic assimilation. Maré and Coleman (2011) analyse the location choices of recent migrants at a much finer intra-urban geographic scale. They look at residential location across meshblocks within Auckland, and find that recent migrants locate disproportionately in meshblocks where there is a high presence of people from their country of birth. This pattern cannot be explained by differences in amenities, socio-economic sorting, or land rents.

3. Methods

There are numerous ways to measure residential sorting patterns. Global indices give an overall indication of the degree of segregation of a particular group, while local measures give an indication of segregation for each individual area under analysis, allowing for mapping and identification of local “hot spots” of clustering or absence (Anselin, 1995). Cutler et al. (2008a, 2008b) use the indexes of dissimilarity and isolation to compare members of an immigrant group to the remainder of the population. By following new immigrant arrival groups, they show that the newest groups tend to have the highest levels of segregation. Musterd (2005) applies a segregation index to European cities and conclude tentatively that immigrant segregation is higher in US cities than in European cities. Peach (1996) applies a dissimilarity index to detailed ethnic groups in Britain and also finds lower levels of segregation than in the US.

A range of summary measures have been used to capture residential location patterns, offering complementary insights. There continues to be debate about the relative merits of alternative indices (Gorard, 2011; Johnston & Jones, 2010; Nijkamp and Poot, 2015). We use three group-level summary measures to capture the differing spatial distributions of immigrant groups by country of birth. These capture three different aspects of residential concentration – segregation, isolation, and spatial autocorrelation (Massey & Denton, 1988). We also use a measure of geographic concentration calculated for each area to identify in which areas each immigrant group is concentrated. In all equations that follow we will use a common notation. Let P_{ga} refer to the population of group g (=1,2,...,G) in area a (=1, 2, ... A). A subscript dot refers to the sum over that particular subscript.

3.1. Global measures of spatial association

3.1.1. Segregation

The first summary measure captures the extent to which a group's location pattern differs from that of non-group members. We use the conventional index of segregation that summarises the dissimilarity. The segregation index for group g across area units a is:

$$S_g = \frac{1}{2}\sum_{a=1}^{A}\left|\frac{P_{ga}}{P_{g.}} - \frac{(P_{.a}-P_{ga})}{(P_{..}-P_{g.})}\right| \quad (1)$$

This index is a measure of displacement – the proportion of people in a group that would have to relocate in order to make their distribution identical to that of other residents (Duncan & Duncan, 1955). The index takes the value of 1 when the group lives separately from other residents, and 0 when their distribution is proportional to the total population (Maré et al., 2012). Segregation indices based on ethnic and immigrant groups in Auckland have been calculated previously by Johnston et al. (2009) and Maré et al. (2012), though not for immigrant arrival cohorts.

The value of this index does tend to vary with the size of the subgroup and the area, even when location is random. To adjust for this, we calculate the value of the segregation index for a population equal in size to the group of interest that has been randomly allocated across areas, which the chance of allocation to a particular are being equal to the area's share of the total population within the same age range. In this way, we control for life-cycle changes in location patterns that may otherwise be confounded with immigrant residential assimilation. We focus on the 25-64 year old population when considering cross-sectional populations. Arrival cohorts are identified as 25-54 years of age at the time of arrival and are matched to a 5-year-older age bracket in the following census. The statistic that we report is $\widetilde{S_g} = S_g - S_g^*$ where S_g^* is the mean value of the index calculated for 500 random allocations. Appendix One reports the values of the indices obtained from random allocation.

3.1.2. Isolation

The isolation index is an alternative global measure to the segregation index. The isolation index captures the extent to which members of a population subgroup are disproportionately located in the same area units as other members of their group (Maré et al., 2010). The formula for the isolation index is:

$$Isolation\ Index_g = 100 * \frac{\left(\left[\sum_{a=1}^{A} \pi_{ga} \frac{P_{ga}}{P_{.a}}\right] - \frac{P_{g.}}{P_{..}}\right)}{\left(1 - \frac{P_{g.}}{P_{..}}\right)} \tag{2}$$

where $\pi_{ga} = P_{ga}/P_{g.}$ and $\sum_{a=1}^{A} \pi_{ga} = 1$ for all g. The term is square brackets is the weighted average own-group share experienced by members of the group. This takes on a maximum value of 1 when the group is completely isolated, and a minimum value of $P_{g.}/P_{..}$ when the group is distributed in proportion to the total population. The isolation index thus takes values between 0 and 100, with higher values indicating greater isolation.

As for the segregation index, we adjust the index by subtracting the mean value obtained from 500 randomly allocated populations equal in size to the group.

3.1.3. Spatial Autocorrelation

The segregation and isolation indices reflect concentration of groups across distinct areas but do not capture whether areas of high concentration are located close to each other. We therefore also present the Moran (1950) *I* index of spatial correlation, which captures the relationship between a group's concentration in an area and its concentration in a neighbourhood around that area. Neighbourhood characteristics are calculated as the weighted sums of characteristics in all areas, using spatial proximity weights w_{an}. The spatial proximity weights are row-standardized and weighted by population, so that $\sum_n w_{an} = 1$ for all a. The weight of an area j in the neighbourhood of area a is equal to $P_{.j}/\sum_{n=1}^{N_a} P_{.n}$ if the selected area is in the neighbourhood of a, and zero otherwise. N_a is the number of neighbourhoods surrounding a. Moran's I for group g is calculated as:

$$I_g = \sum_{a=1}^{A} \frac{\left(\frac{P_{ga}}{P_{.a}} - M_g\right)\left(\sum_{n=1}^{N_a} w_{an}\left(\frac{P_{gn}}{P_{.n}} - M_g\right)\right)}{\sum_{a=1}^{A}\left(\frac{P_{ga}}{P_{.a}} - M_g\right)^2} \tag{3}$$

where a refers to areas and n indexes the N_a other areas that are in the neighbourhood of a. M_g refers to the unweighted mean group share $\left(P_{ga}/P_{.a}\right)$, averaged over all areas. We report the values of the index adjusted by subtracting the mean value obtained from 500 randomly allocated populations equal in size to the group.

Moran's *I* can be easily visualised as the slope of a regression line of the weighted group share of each population in the surrounding neighbourhoods on the group share in the selected area itself (Anselin, 1995). Moran's *I* takes values between -1 and 1 and provides a global measure of how similar the population compositions of areas are to the composition of surrounding areas.[2] A negative value may be indicative of isolated enclaves in which areas with a high proportion of an immigrant group are surrounded by areas in which low proportions of the same immigrant group live. A value of Moran's *I* close to one is indicative of segregation into parts of the city that straddle many areas.

3.2. Area-level measure of spatial association

3.2.1. Getis and Ord G*

The three measures defined above provide an average indication of clustering for a group but cannot reveal *where* spatial concentrations occur. A range of distributions are consistent with any given global measure. To investigate spatial patterns of concentration, we calculate Getis & Ord's (1992) G^* local measure of concentration for individual local areas. As for Moran's *I* index, the G^* index relies on information about geographically-defined neighbourhoods, identifying areas of neighbourhood clustering that are significantly different from the average situation in the total study area (Johnston et al., 2009). Unlike the Moran calculation, neighbourhoods underlying the G^* index are defined to *include* the central area, rather than to be a neighbourhood *around* the central area. The formula of Getis and Ord's G^* statistic for the concentration of group g in area a is:

$$G_{ga}^* = \frac{\sum_{n=1}^{N_a} w_{an}^* \left(\frac{P_{gn}}{P_{.n}} - M_g\right)}{\sqrt{\left(\sum_{a=1}^{A} \frac{\left(\frac{P_{ga}}{P_{.a}}\right)^2}{A}\right) - M_g^2} \sqrt{\frac{\left(A \sum_{n=1}^{N_a} {w_{an}^*}^2 - 1\right)}{(A-1)}}} \quad (4)$$

Spatial proximity weights including the central area are denoted w_{an}^* and are row normalised based on shares of neighorhood population. The index values are normally distributed z scores under the null hypothesis of no spatial clustering. A value of G^* for an area that is greater than 1.96 indicates that there is less than a 2.5 percent chance that the high degree

[2] The question of whether the observed spatial pattern is different from a random allocation of population (i.e. Moran's *I* is statistically significant) is more complex. Two sets of standard errors can be calculated under the assumptions of standardisation and normality (Cliff & Ord, 1981; Pisatio, 2001). For the data used in this paper, both sets of standard errors give statistically significant Moran's *I* values in all cases.

of concentration that is observed around the area would be observed under random location decisions. *G** values for each country-of-birth group can be displayed on a map to show specific neighbourhoods where groups are over and under-represented.

4. Data

The New Zealand Census of Population and Dwellings is conducted every five years by Statistics New Zealand and collects socio-economic information on every person who was in New Zealand on census night. We use full-coverage data on the residential location of the usually resident population of Auckland from three Census years: 1996, 2001 and 2006. The 1991 census did not ask immigrants how many years they had been in New Zealand, and thus cannot be used for the current project. Corresponding data on the 2013 census was not yet available at the time of writing.[3]

We restrict attention to the usually resident population age 25-64 years of age, to abstract from the distinct location and mobility patterns of students and retirees. Immigrant groups are identified based on reported country of birth and immigrant arrival cohorts are defined based on the date that respondents say that they first arrived to live in New Zealand. For the purposes of tracking arrival cohorts across censuses, we focus on cohorts of immigrants who were 25-54 years of age at the time of the census and who reported first arriving in New Zealand less than five years prior to the census. Separate arrival cohorts are defined by country of birth. A 1996 arrival cohort from a given country thus first arrived between 1991 and 1996 and was aged 25-54 at the time of the 1996 census. This cohort is then identified in the 2001 census data as 30-59 year olds who first arrived between 1991 and 1996 (5-10 years earlier) and who were born in the given country, and in the 2006 census as 35-64 year olds who had been in New Zealand for 10-15 years.[4]

We focus on five immigrant groups, being those born in the United Kingdom, China (PRC), India, South Africa and the Republic of Korea. The UK has been historically the largest source country of immigrants in Auckland and still represents the largest proportion of the foreign born in that city. However, Auckland has seen a significant increase in new immigrants

[3] The 2011 census was delayed by two years due to a large earthquake which occurred in and around Christchurch on February 22 that year. The New Zealand census is administered by the Christchurch office of Statistics New Zealand.

[4] Our analysis could be potentially biased by internal and international re-migration of immigrants being spatially selective and by immigrants inducing selective migration of the New Zealand born. Maré and Stillman (2010) show that is unlikely to have been an issue in the present context.

from the other source countries over the 1996-2006 period. These five groups are also the focus of complementary qualitative studies conducted in recent years in the same *Integration of Immigrants Programme* (Lewin et al., 2011; Meares et al., 2009, 2011; Meares, Ho, Peace, & Spoonley, 2010a, 2010b; Watson et al., 2011).

Residential location information is available at a very fine ('meshblock') level. We classify locations based on slightly larger areas, defined by statistical 'area unit' boundaries. Area units are roughly equivalent to suburbs. There are 334 area units with the Auckland Urban Area, with an average population aged 25-64 of around 1,900 in 2006, and an average area of around 3.2 square kilometres. When defining neighbourhoods for use in the calculation of Moran's I and Getis and Ord G^* measures, we obtain geographic centroids for each area unit and identify neighbourhoods as the set of area units with centroids that are less than 3km away from that of the reference area unit. We omit a small number of area units that have no neighbours by this measure, accounting for around 2% of Auckland's population.

Census data contain additional information on person, household, and dwelling characteristics. We use information on individual employment status, and derive a measure of real household income. Household income is calculated as the sum of total income for all members of a person's household, with missing income imputed as the mean of reported incomes of other household members. Household income is equivalised, using the Luxembourg income study scale, which divides total household income by the square root of the number of household members, and deflated by the mean consumer price index for the relevant census year. Individuals are classified as having high household income if their household income indicator exceeds $55,000. Approximately 25% of Auckland residents aged 25-64 live in households with real incomes higher than this level. The proportion is higher in 2006 than in 1996 due to real income growth over the period.

5. Results

Immigrants are a large and growing fraction of Auckland's population, with particularly strong growth in Asian immigration in recent decades. Table 1 summarises the changing composition of Auckland's working age population (25 to 64 years of age) between 1996 and 2006. The New Zealand born share of the population declined from 65.8% in 1996 to 57.0% in 2006. There were particularly large increases in the population share of immigrants from the People's Republic of China, rising from 1.8% to 4.7%, and from India, rising from 0.9% to 3.2%. There were also increases in the population shares of South African and Korean immigrants, who in 2006 accounted for 2.1% and 1.7% of the population respectively. The single largest source country of immigrants in each year remained the United Kingdom, but with its share declining from 10.0% to 7.6% of Auckland's population. Despite this 1996-2006 decline of the UK born share, new immigrants from the UK contributed more to the population in 2006 (1.4%) than in 1996 (1.0%). The size of new arrival cohorts (of 25-54 year olds) grew faster than the population for all the listed origin countries, apart from Korean immigrants between 1996 and 2001, and a small decline in the relative size of South African immigrants between 2001 and 2006. China accounted for the largest share of new arrivals in 2006 (1.9% of population), up from 0.9% in 1996. The size of Indian arrival cohorts increased markedly, accounting for only 0.3% of the population in 1996, rising to 1.8% in 2006.

The immigrant groups differ not only by their birthplace but also by socio-economic characteristics. Table 2 summarises some key differences in incomes, employment rates, and qualifications. The first row summarises outcomes for the New Zealand-born population aged 25-64 in each year. In 1996, 31.3% of New Zealand-born residents in Auckland were in high-income households (defined by the 75th percentile for the whole population). By 2006, this had risen to 42.7%, reflecting real income growth over the decade, as well as a growing proportion of lower income groups in the population. The employment rate of New Zealand-born residents also rose during the period, from 72.2% to 74.6%, as did the proportion of the population with a degree qualification (from 10.9% to 19.1%). Most immigrant groups also saw improvements in average outcomes over the period – the only exceptions being a 1996-2001 deterioration in the employment rate for Chinese immigrants, a substantial 1996-2001 lowering of the qualification mix among Korean immigrants, and a drop in the educational and qualification mix of South African immigrants over the same period. More significant than differences between country-of-birth groups are, however, the differences between the foreign born and the New Zealand born. With the exception of UK immigrants in 1996, all immigrant groups were more highly qualified than the New Zealand-born population – a reflection of New Zealand's skill-focused immigration policies. In 2006, over half of Indian immigrants (57%) held a degree qualification, by far the highest among the groups considered. Despite their relatively high qualification levels, Chinese, Korean, and Indian immigrants experienced relatively low incomes and employment rates in all three periods. Even among the most highly qualified group, Indian immigrants in 2006, the proportion with high household incomes was less than half that of the New Zealand-born, though they were more likely to be employed.

5.1. Residential assimilation of arrival cohorts

Overall, there is clear evidence of distinct spatial location patterns for different country-of-birth groups, including the New Zealand-born. All segregation, isolation, and spatial autocorrelation measures in Table 3 are statistically significant. New Zealand-born residents are the least segregated, yet even for them, the segregation index is around 0.1 to 0.2. Immigrants other than those from the UK show segregation index values generally in the 0.3 to 0.4 range, with UK immigrants intermediate at 0.2 to 0.3. There is little evidence of spatial isolation of birthplace groups in New Zealand. The native-born residents yield the largest value of the isolation index, though even they are not really isolated at all – with an index value of 3 to 5 within a range of 0-100. Immigrant groups that increased their population shares over the study period (i.e., all except UK immigrants) did see clustering increase, with pronounced increases in the isolation index between 1996 and 2006, although this was also true for NZ-born residents in the same age ranges. All groups show moderately high spatial autocorrelation – mostly in the range of 0.3 to 0.8, with South African and UK immigrants showing the highest spatial autocorrelation in 2006.

Changes over time in average outcomes for each country-of-birth group reflect the differing profiles of successive arrival cohorts, as well as processes of assimilation for each arrival cohort. The first row of Table 3 summarises the location patterns of 25-64 year old New Zealand-born residents in each census year. Over time, New Zealand-born residents are becoming more segregated from other residents, more isolated, and more likely to live in neighbourhoods close to other New Zealand-born residents. These patterns reflect both life-cycle and time effects. The following three rows present summary measures from three 25 to 54 year old age cohorts.

Both time and cohort effects contribute to the rise in segregation and isolation. Each age cohort enters with a higher initial level of segregation and isolation than the preceding age cohort did 5 years earlier. In addition, segregation and isolation rise as the cohorts become older, as shown for the 1996 and 2001 cohorts. In contrast, there has been an overall rise in spatial autocorrelation among the New Zealand born, even though successive cohorts enter with slightly lower initial levels of spatial autocorrelation than their predecessors, and despite the fact that spatial autocorrelation reduces over time for each of the separate age cohorts.

Similar to New Zealand-born residents, there are in most cases rises in segregation, isolation, and spatial autocorrelation for each of the immigrant groups between each pair of census years. There is, however a difference in the mix of cohort and time changes compared with the patterns for New Zealand-born residents. For immigrant groups, segregation, isolation and spatial autocorrelation tend to decline, or are relatively stable, for each arrival cohort over time, consistent with residential assimilation. The overall rises are dominated by the fact that each cohort tends to have higher index values than the previous cohort from the same country of birth five years earlier.

There are some exceptions to this general pattern. Immigrants from the 1996 UK arrival cohort experienced an increase in segregation and isolation between 2001 and 2006, 5 to 15 years after arrival, following an increase in spatial autocorrelation between 1996 and 2001. The 1996 arrival cohort thus dispersed in their first 5-10 years in Auckland, but remained relatively close to other concentrations of their arrival cohort. UK immigrants overall were also somewhat more isolated in 2001 than in 1996. In contrast to the general pattern, the 2001 Korean arrival cohort entered with lower segregation and isolation than the corresponding 1996 Korean arrival cohort, possibly reflecting compositional changes, as captured in Table 2 by the relatively low rate of degree qualifications for Korean immigrants in 2001. Similarly, the 2001 Korean arrival cohort displayed higher spatial autocorrelation in 2001 than the corresponding 2006 cohort in 2006.

The summary measures presented so far have provided insights into the nature of location choices for different country-of-birth groups, and the overall degree of residential assimilation. Further insights can be gained by examining directly how the spatial 'footprint' of different groups changes over time as earlier arrival cohorts become less concentrated, and subsequent arrivals concentrate, possibly in different areas from those where their earlier compatriots settled. To illustrate the evolution of the spatial patterns, Figure 1 maps Getis and Ord's G* index for Chinese arrival cohorts. Darker areas indicate area units where the over-representation of arriving cohorts is statistically significantly different from zero.

The first row of maps in Figure 1 tracks the 1996 Chinese arrival cohort over time. Chinese immigrants are over-represented in central Auckland on arrival. As time in New Zealand increased from 5-9 years and 10-14 years, this cohort group became more concentrated in the Eastern suburbs, including the Howick and Bucklands Beach areas. Subsequent arrival cohorts are less concentrated in central Auckland on arrival. The location patterns of the 2001 arrival cohort when first observed more closely resemble the 2001 patterns of the earlier (1996) arrival cohort than they do the initial (1996) patterns of the 1996 arrival cohort. Similarly, the 2006 arrival cohort settles disproportionately in areas where the earlier (2001) arrival cohort is located in 2006. We conclude that rather than following the footprints of their earlier compatriots by choosing previous ‘ports of entry’, new arrivals appear to congregate wherever the preceding cohort is living at the time of arrival.

The pattern of new arrivals joining the previous arrival cohort from their country of birth is also evident for other country-of-birth groups. The patterns are summarised in Table 4, which shows correlation coefficients between values of Getis and Ord’s G* index, across area units with the Auckland urban area. There are a total of twelve pairs of maps for which correlations coefficients can be calculated (horizontal, vertical, and diagonal: nine adjacent and three “jumps”). The first panel show the contemporaneous correlation in locations of different arrival cohorts, as observed in 2001 and 2006. The first two columns show the correlation between location choices of consecutive arrival cohorts, which range from 90% to 98%. For each country of birth, the correlations between consecutive arrival cohorts are stronger than the correlation between the 1996 arrival cohort and the 2006 arrival cohort. In 2001, the 2001 arrival cohort settled largely where the 1996 cohort was at that time, except for the UK born.

The dispersion of arrival cohorts in the years following arrival, as documented in Table 3, is evident in the second panel of Table 4. This panel shows correlation over time in the location choices of the 1996 and 2001 arrival cohorts. For new entrants from UK, China and India in 1996, the correlation of their location patterns in 1996 with those in 2001 is 74% to 83%. This is lower than their subsequent stability between 2001 and 2006 (93% to 97%). In contrast, there was stability in the location patterns of 1996 entrants from South Africa and Korea, with a high correlation in their location choices even over a ten year period (96% and 89% respectively).

The final panel of Table 4 quantifies the relative stability of ports of entry across different arrival cohorts, and of residential distribution observed 5 to 10 years after arrival. For UK and South African entrants, there is persistence in where they initially locate. There is a correlation of more than 90% between the entry points of the 1996 and 2006 arrival cohorts from these countries. For immigrants from other countries, there is greater change in where they first settle, with changes for Chinese-born entrants, the correlation is only 70% between the arrival cohorts in 1996 and 2006. Although arrival cohorts change their residential footprint with duration of residence, they do so in a way that echoes the changes experienced by the previous cohort of their compatriots.

6. Summary and Concluding Comments

This study provides new evidence on the extent of residential assimilation of immigrants in the years following arrival. It documents the location patterns of cohorts of immigrants arriving in Auckland, New Zealand, between 1991 and 2006. It traces the experiences of immigrants from five source countries – the United Kingdom, China, India, South Africa and the Republic of Korea. As noted early on in the paper, the study of residential assimilation provides insights into the settlement experiences of immigrants but does not by itself provide a measure of successful settlement. Whether residential concentration or dispersion is desirable depends on the nature of immigrants' networks and the strength of spillovers within and between country-of-birth groups. A more detailed account of these networks and spillovers is contained in related work on these immigrant groups in Auckland that takes a qualitative approach (Lewin et al., 2011; Meares et al., 2009, 2011; Meares, Ho, Peace, & Spoonley, 2010a, 2010b; Watson et al., 2011).

There is clear evidence of residential assimilation for most immigrant groups. For each arrival cohort, geographic concentration declines, or remains stable, the longer they spend in the host country. Because the study uses age-based synthetic cohorts, the reduction in geographic concentration will reflect a combination of immigrants relocating within Auckland, and immigrants disproportionately leaving areas within Auckland where they were initially concentrated. The only notable exception to this general pattern is the increased concentration of the 1996 UK arrival cohort, which become more geographically concentrated between 2001 and 2006.

Despite the dispersion of each arrival cohort, overall geographic concentration, as measured by indices of segregation, isolation, and spatial autocorrelation increased for each country-of-birth group, including the New Zealand-born, between 1996 and 2006. This change reflects the fact that successive arrival cohorts from each country of birth, or corresponding age cohorts of New Zealand-born residents, were more concentrated than the cohort that preceded them five years earlier. When finding their feet in Auckland, new entrants were more strongly attracted to the current locations of their earlier-arrived compatriots than to the particular areas where those compatriots arrived themselves first.

We have identified clear patterns of residential assimilation of arrival cohorts, and differences across cohorts and across countries of birth. There is nevertheless a high degree of persistence and stability in the location patterns of country-of-birth groups within Auckland, as is evident not only from the persistence of isolation, segregation and autocorrelation measures in Table 3 but also by the high correlations in Table 4 – for different arrival cohorts at a point in time, for particular arrival cohorts over time, and between the initial arrival points of successive cohorts. This persistent concentration of immigrant groups within Auckland is nevertheless the outcome of a dynamic process of ongoing adjustment.

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Table 1. Percentage of Auckland urban area population aged 25-64 by country-of-birth groups

	1996	2001	2006
New Zealand Born (25-64)	65.82%	62.43%	57.01%
All United Kingdom immigrants	10.03%	8.51%	7.60%
1996 Arrival Cohort UK	0.96%	0.60%	0.45%
2001 Arrival Cohort UK		0.98%	0.63%
2006 Arrival Cohort UK			1.39%
All China immigrants	1.76%	2.87%	4.69%
1996 Arrival Cohort China	0.92%	0.65%	0.59%
2001 Arrival Cohort China		1.17%	0.95%
2006 Arrival Cohort China			1.92%
All India immigrants	0.91%	1.52%	3.15%
1996 Arrival Cohort India	0.29%	0.18%	0.14%
2001 Arrival Cohort India		0.67%	0.52%
2006 Arrival Cohort India			1.77%
All South Africa immigrants	0.58%	1.46%	2.13%
1996 Arrival Cohort SA	0.29%	0.22%	0.16%
2001 Arrival Cohort SA		0.89%	0.66%
2006 Arrival Cohort SA			0.86%
All Korea immigrants	0.85%	1.12%	1.65%
1996 Arrival Cohort Korea	0.75%	0.50%	0.38%
2001 Arrival Cohort Korea		0.46%	0.30%
2006 Arrival Cohort Korea			0.70%
Auckland population 25-64 years of age	511,476	565,764	635,973

Table 2. Characteristics of country-of-birth groups

	% High Income (top income quartile of total Auckland population)			Employment rate (% of Working age population)			Degree-qualified (% of Working age population)		
	1996	2001	2006	1996	2001	2006	1996	2001	2006
NZ born (25-64)	31.3	36.2	42.7	72.2	73.8	74.6	10.9	14.0	19.1
All UK imm. (25-64)	34.4	42.6	51.2	78.7	81.4	83.9	6.1	17.8	27.3
All China immigrants	7.1	7.4	10.7	45.5	44.1	57.3	27.5	27.6	34.6
All India immigrants	14.1	16.9	20.7	60.4	67.0	78.4	34.6	42.7	56.6
All South Africa imm.	39.0	38.8	50.1	81.2	82.3	87.0	38.3	32.3	32.3
All Korea immigrants	5.9	8.2	8.5	39.0	49.0	55.0	34.8	20.9	27.2

Table 3. Global indices by country-of-birth groups

	Segregation Index (0,1)			Isolation Index (0,100)			Moran's *I* (0,1)		
	1996	2001	2006	1996	2001	2006	1996	2001	2006
NZ born (25-64)	0.11	0.14	0.17	3.01	4.34	5.18	0.53	0.58	0.59
Age cohort: 25-54 in 1996	0.07	0.10	0.10	1.83	3.26	3.99	0.39	0.31	0.07
Age cohort: 25-54 in 2001		0.10	0.13		2.72	4.04		0.38	0.29
Age cohort: 25-54 in 2006			0.12			3.19			0.37
UK imm (25-64)	0.17	0.18	0.21	2.43	2.34	2.84	0.69	0.73	0.74
1996 Arrival Cohort	0.18	0.16	0.19	0.43	0.24	0.34	0.45	0.61	0.55
2001 Arrival Cohort		0.22	0.20		0.54	0.35		0.64	0.59
2006 Arrival Cohort			0.27			1.14			0.70
China imm (25-64)	0.31	0.35	0.37	1.63	2.84	4.35	0.55	0.55	0.54
1996 Arrival Cohort	0.34	0.30	0.30	1.13	0.74	0.74	0.52	0.51	0.47
2001 Arrival Cohort		0.35	0.33		1.34	0.95		0.31	0.55
2006 Arrival Cohort			0.35			2.04			0.44
India imm (25-64)	0.25	0.32	0.35	0.73	1.94	3.85	0.50	0.51	0.54
1996 Arrival Cohort	0.32	0.24	0.21	0.63	0.34	0.25	0.44	0.45	0.37
2001 Arrival Cohort		0.38	0.33		1.64	1.05		0.46	0.51
2006 Arrival Cohort			0.37			2.64			0.48
South Africa imm (25-64)	0.24	0.31	0.33	0.53	1.64	2.45	0.59	0.81	0.82
1996 Arrival Cohort	0.29	0.28	0.26	0.43	0.34	0.25	0.53	0.63	0.56
2001 Arrival Cohort		0.32	0.33		1.24	0.95		0.77	0.76
2006 Arrival Cohort			0.33			1.34			0.74
Korea imm (25-64)	0.34	0.37	0.41	1.13	1.94	3.15	0.50	0.46	0.53
1996 Arrival Cohort	0.34	0.35	0.35	1.13	0.94	0.85	0.51	0.53	0.48
2001 Arrival Cohort		0.33	0.34		0.84	0.55		0.49	0.51
2006 Arrival Cohort			0.39			1.44			0.45

Note: Formulae for the indices are provided in the text. Each index value is reported as the difference between the raw measure and the value of the index that would arise if population were randomly allocated. The value under random allocation is obtained as the average of measures calculated for 500 simulated allocations of subpopulations equal in size to the subgroup and randomly allocated in proportion to the total population within the same age range. The random values are reported in Appendix One. All index values are significantly different from zero at the 95% confidence level.

Table 4. Correlation of geographic patterns across cohorts and years

(a) Colocation of arrival cohorts in different years

	Year 2006			Year 2001
	1996 & 2001 arrival cohorts	2001 & 2006 arrival cohorts	1996 & 2006 arrival cohorts	1996 & 2001 arrival cohorts
UK	95%	90%	82%	70%
China	95%	93%	80%	91%
India	94%	91%	86%	91%
South Africa	93%	98%	90%	95%
Korea	95%	95%	94%	90%

(b) Persistence of location patterns of arrival cohorts

	1996 arrival cohort			2001 arrival cohort
	1996 & 2001 years	2001 & 2006 years	1996 & 2006 years	2001 & 2006 years
UK	82%	97%	76%	79%
China	74%	93%	64%	89%
India	83%	94%	71%	89%
South Africa	97%	98%	96%	98%
Korea	96%	96%	89%	93%

(c) Correlation of residence location patterns by duration of residence

	After 0-4 years			After 5-9 years
	1996 & 2001 arrival cohorts	2001 & 2006 arrival cohorts	1996 & 2006 arrival cohorts	1996 & 2001 arrival cohort
UK	94%	93%	93%	95%
China	86%	90%	70%	96%
India	95%	91%	85%	96%
South Africa	96%	97%	90%	93%
Korea	87%	91%	84%	94%

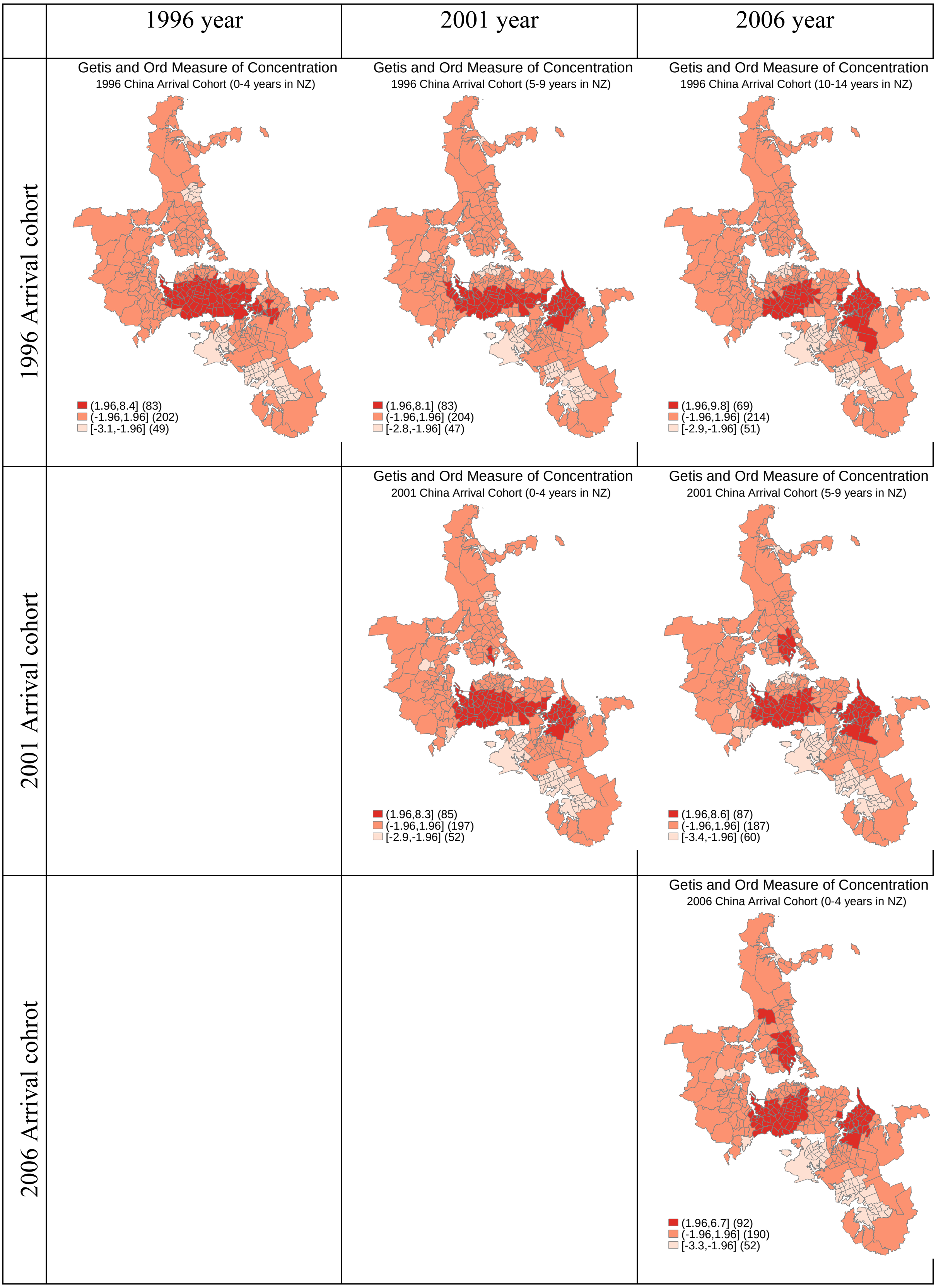
Note: Reported correlations are correlations across area units between values of Getis and Ord's G* statistics.

Appendix One. Random allocation benchmarks: Global indices by country-of-birth groups

	Segregation Index (0,1)			Isolation Index (0,100)			Moran's I (0,1)		
	1996	2001	2006	1996	2001	2006	1996	2001	2006
NZ born (25-64)	0.04	0.03	0.03	0.19	0.16	0.12	0.00	0.00	0.00
Age cohort: 25-54 in 1996	0.05	0.04	0.07	0.57	0.04	0.41	0.17	0.24	0.43
Age cohort: 25-54 in 2001		0.05	0.04		0.58	0.06		0.22	0.26
Age cohort: 25-54 in 2006			0.04			0.61			0.24
UK imm. (25-64)	0.03	0.04	0.03	0.07	0.06	0.06	0.00	0.00	0.00
1996 Arrival Cohort	0.10	0.12	0.14	0.07	0.06	0.06	0.00	0.00	0.03
2001 Arrival Cohort		0.10	0.11		0.06	0.05		0.01	0.01
2006 Arrival Cohort			0.08			0.06			0.02
China imm. (25-64)	0.08	0.06	0.04	0.07	0.06	0.05	0.00	0.00	0.00
1996 Arrival Cohort	0.10	0.12	0.13	0.07	0.06	0.06	0.00	0.00	0.04
2001 Arrival Cohort		0.09	0.09		0.06	0.05		0.01	0.01
2006 Arrival Cohort			0.07			0.06			0.02
India imm. (25-64)	0.10	0.08	0.05	0.07	0.06	0.05	0.00	0.00	0.00
1996 Arrival Cohort	0.18	0.22	0.24	0.07	0.06	0.05	0.00	0.00	0.00
2001 Arrival Cohort		0.12	0.13		0.06	0.05		0.01	0.00
2006 Arrival Cohort			0.07			0.06			0.02
South Africa imm. (25-64)	0.13	0.08	0.06	0.07	0.06	0.05	0.00	0.00	0.00
1996 Arrival Cohort	0.18	0.20	0.23	0.07	0.06	0.05	0.00	0.00	0.01
2001 Arrival Cohort		0.10	0.11		0.06	0.05		0.01	0.01
2006 Arrival Cohort			0.10			0.06			0.00
Korea imm. (25-64)	0.11	0.09	0.07	0.07	0.06	0.05	0.00	0.00	0.00
1996 Arrival Cohort	0.12	0.13	0.15	0.07	0.06	0.05	0.00	0.00	0.03
2001 Arrival Cohort		0.14	0.16		0.06	0.05		0.00	0.00
2006 Arrival Cohort			0.11			0.06			0.01

Note: The value under random allocation is obtained as the average of measures calculated for 500 simulated allocations of subpopulations equal in size to the subgroup and randomly allocated in proportion to the spatial distribution of the total population within the same age range.

Figure 1. China Arrival Cohort Local Clustering Maps



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