ACCOUNTING FOR SOCIAL DIFFERENCE WHEN MEASURING CULTURAL DIVERSITY

David C Maré*
Motu Economic and Public Policy Research Trust, PO Box 24390, Wellington 6142, New Zealand. Email: dave.mare@motu.org.nz

Jacques Poot
Te Ngira: Institute for Population Research, Private Bag 3105, Hamilton 3240, New Zealand. Email: jacques.poot@waikato.ac.nz

*Corresponding Author

ABSTRACT: We introduce a measure of cultural diversity of a population that is composed of groups classified by country of birth and/or ethnicity. Our measure takes 'social difference' between these groups into account. We measure social difference by exploratory factor analysis of subjective identity, attitude and value responses in Aotearoa New Zealand's 2016 General Social Survey. We examine the level of, and change in, our social difference-based measure of cultural diversity in 31 urban areas between 1976 and 2018, using census data. We compare these patterns with those derived from a standard fractionalisation measure of diversity. We find that the two diversity measures are highly correlated across the urban areas. Diversity increased everywhere between 1976 and 2018. However, the social difference-based measure increased much faster than the standard measure in all but one of the urban areas. This suggests that growth in the fractionalisation measure of diversity is likely to have underestimated the trend in experienced social difference.

KEYWORDS: Cultural diversity; social difference; fractionalisation; New Zealand; urban areas.

ACKNOWLEDGEMENTS: Funding for this project was provided by the 2014-2020 CaDDANZ (Capturing the Diversity Dividend of Aotearoa New Zealand) research programme, with co-funding from Te Pūnaha Matatini Centre of Research Excellence.

DISCLAIMER: Access to the data used in this study was provided by Stats New Zealand under conditions designed to give effect to the security and confidentiality provisions of the Statistics Act 1975. The results presented in this study are the work of the authors, not Stats New Zealand or individual data suppliers. Data access was granted under microdata access agreement MAA2003-18.

1. INTRODUCTION

In this article, we focus on changes over time and on spatial differences in the socio-demographic diversity of the population of Aotearoa New Zealand (NZ). With a relatively large proportion of the population being foreign born, particularly in the metropolitan areas, and with a relatively large number of *tangata whenua* – the NZ Māori indigenous population – the population of Aotearoa NZ is highly diverse by international standards (Stone *et al.*, 2021).

There are many ways to quantify the socio-demographic diversity of the population of a country or area (Nijkamp and Poot, 2015). One of the simplest, and most easily interpretable, of these measures is fractionalisation: the probability that two randomly selected individuals belong to two different groups. Table 1 shows that Auckland is NZ's most diverse city, whether the fractionalisation measure is based on ethnic diversity, country of birth diversity, language diversity, or diversity of religion. The Table 1 also shows the generally lower population diversity in the South Island. The least diverse city in terms of country of birth diversity and language diversity is Invercargill; with diversity of religion lowest in Dunedin and ethnic diversity lowest in Nelson.

However, fractionalisation does not convey how diversity is experienced. For example, if an area is home to people from various countries of birth that are culturally very similar, fractionalisation may signal more diversity than is actually experienced. We, therefore, investigate the implications for diversity measurement when considering that a city or any other area may not only house a variety of distinct groups but also groups that significantly differ from one another in terms of their behaviours, attitudes, or values. We broadly refer to these differences as 'social differences'. Our motivation is to identify a measure of socio-demographic diversity that captures not only the likelihood but also – at least potentially – the nature and intensity of interactions between people of different groups within NZ cities. This will support analysis of the contribution that such diversity might make to a range of social and economic outcomes. Diversity measures based solely on local population proportions for categories defined by ethnicity, country of birth, language or religion may be misleading because being in a different category may be only a weak indicator of the likelihood, intensity and nature of the interactions. We, therefore, derive a measure that better captures the degree of diversity that is encountered in inter-group interactions, based on indicators of social difference.

Table 1. Fractionalisation in Main Urban Areas Across Selected Domains.
Source: the Authors.

Main Urban Area	Ethnicity	Country of birth	Religion	Field of study	Language	GSS-based country/ ethnicity
Auckland	**0.796**	**0.740**	**0.849**	0.813	**0.635**	**0.853**
Rotorua	0.739	0.468	0.834	0.797	0.495	0.782
Gisborne	0.702	0.359	0.834	0.789	0.425	0.739
Wellington	0.662	0.566	0.805	**0.828**	0.496	0.733
Whangarei	0.640	0.438	0.833	0.788	0.391	0.712
Hamilton	0.631	0.492	0.826	0.806	0.425	0.697
Napier-Hastings	0.564	0.406	0.831	0.790	0.355	0.642
Palmerston North	0.576	0.448	0.818	0.799	0.391	0.638
Tauranga	0.508	0.448	0.816	0.788	0.317	0.623
Kapiti	0.437	0.483	0.796	0.796	0.286	0.604
Whanganui	0.531	0.349	0.827	0.782	0.328	0.602
Christchurch ^	0.495	0.482	0.796	0.802	0.367	0.591
New Plymouth	0.464	0.403	0.812	0.794	0.295	0.558
Dunedin ^	0.448	0.424	*0.767*	0.801	0.334	0.538
Nelson ^	*0.393*	0.431	0.770	0.792	0.275	0.533
Blenheim ^	0.418	0.377	0.812	*0.779*	0.275	0.517
Invercargill ^	0.412	*0.288*	0.797	0.780	*0.245*	*0.473*

Notes: Fractionalisation has been calculated with 2013 Census data. The largest number in each column is in bold type and the smallest number is in italic type. The urban areas are ordered by the final column. ^ indicates a Main Urban Area located in the South Island of New Zealand. The country of birth/ethnicity groups that were used in this final column are based on the 2016 General Social Survey and are listed in Table 2.

Hence, we present a new social difference-based measure of diversity for NZ cities. Using data from all successive population censuses between 1976 and 2018, we disaggregate the population in each of 31 urban areas in terms of country of birth and, for those born in Aotearoa NZ, in terms of ethnicity. To quantify social difference, we use data from the 2016 General Social Survey (GSS) on associational membership, acceptance of diversity, cultural identity, cultural participation, language, political participation, social connectedness, social identity and trust. This enables us to calculate a group-size-weighted average social difference in each of the urban areas that we use to examine the level and growth of socio-demographic diversity across NZ urban areas. For comparison, we also calculate country of birth / ethnicity fractionalisation in each census year and urban area.

Our study contributes to a well-established literature that measures socio-demographic diversity at the country or subnational level. The most common and most easily implemented measures are those based on population proportions belonging to groups defined by classifications that are readily available from statistical sources. NZ diversity studies have generally focused on Auckland and have restricted attention to composition by ethnicity (Grbic *et al.*, 2010; Johnston *et al.*, 2011), by birthplace (Maré *et al.*, 2016), or both (Maré and Poot, 2019a). Mondal *et al.* (2021) document Auckland's residential diversity by a wider range of attributes (age, income, occupation, and education), while Maré *et al.* (2019b) consider, besides diversity defined for birthplace and ethnicity, also religious affiliation.

Ethnicity and birthplace are the most commonly used categories for cultural diversity measurement in the international literature, given the wide availability of population statistics on these two characteristics. Classification-based diversity measures have also been constructed internationally on the basis of other population attributes such as language (Desmet *et al.*, 2012; Eberle *et al.*, 2020) or religion (Hudson and Taylor, 1972; Reynal-Querol, 2002).

The use of birthplace fractionalisation, which measures of the probability that two randomly selected persons were born in different countries, was popularised in cross-country studies by Mauro (1995) and was subsequently adopted by Ottaviano and Peri (2006) in their influential study of cultural diversity and economic performance in the United States (US) cities. Ottaviano and Peri acknowledge that cultural diversity has many dimensions other than national origin, including ethnicity, language, identity, and religion. However, they argue that, for their study of US cities, migration flows of foreign-born people represent the primary driver of diversity change.

NZ shares a similarity with the US in terms of substantial birthplace diversity, with 27 per cent of the NZ population being foreign-born, and 15 per cent in the US. However, the presence of a large indigenous population, accounting for 16 per cent of the population identifying with Māori ethnicity in the 2018 census, and the, at least partial, transmission of cultural identity to subsequent generations (Mondal *et al.*, 2020) imply that a measure of cultural diversity in Aotearoa NZ should account for both country of birth and self-identification of ethnicity. However, as noted above, the primary focus of this article is to take the extent of intergroup differences into account – such as the linguistic distance between languages that are being spoken by members of two groups that interact with each other.

There are three broad approaches to calculating the degree of inter-group difference. The first approach relies on measuring an observable characteristic that differs across groups, such as language or genetics. The second approach measures the frequency of actual or potential interactions between groups. The third approach focuses on group-level differences in attitudes, values, and beliefs, as captured in social surveys.

Taking the first approach, Fearon (2003) derives a measure of country-level ethnic diversity, using the similarity of languages to capture inter-ethnic differences. Ginsburgh and Weber (2020, s 3.2.1) document a variety of approaches to estimating the similarity between languages that can be used in this way, including measures based on historical patterns of language development, and measures based on similarity of words or sounds. Similarly, inter-group difference can be estimated on the basis of genetic variation. Genetic variation is captured as allele shares for an identified set of genes. From this, it is possible to derive measures of genetic difference within and between different populations (Li *et al.*, 2008), which capture the probability that two randomly chosen individuals are genetically different. Ashraf and Galor (2013) use this approach to develop measures of genetic diversity within countries, based on the genetic variation within and between resident ethnic groups. Spolaore and Wacziarg (2009) use the same underlying data to derive a measure of genetic distance between countries.

The second approach, i.e. the one that is actual or potential interaction-based, includes standard measures of inter-group 'exposure' (Massey and Denton, 1988; Nijkamp and Poot, 2015). These are commonly calculated under the assumption that the probability of interactions occurring is related to the population composition of residents in a local area. The standard fractionalisation measure of local diversity is then just the probability that two randomly chosen individuals residing in the same local area are from different groups. Reardon *et al.* (2008) have generalised this approach to allow for variation in the spatial extent of interactions.

More generally, interactions do not occur only in or around residential locations. 'Social interaction potential' approaches aim to capture interaction possibilities on the basis of people being in the same place at the same time (Hägerstrand, 1970). These approaches are quite demanding of data, and have been implemented by using space-time surveys (Park and Kwan, 2018), in transport modelling (Farber *et al.*, 2015), and more recently by using information on mobile phone locations (Östh *et al.*, 2018). Analysis of social media friendship networks and phone calls has been used to study exposure based on actual rather than potential interactions; applied, for instance, to interactions between racial groups (Barker, 2012) or different income groups (Galiana *et al.*, 2018).

Our analysis follows the third approach of measuring diversity in that we take group-level variation in responses to social survey questions into account to capture the degree of difference between populations. We restrict attention to potential interactions that could occur in local residential areas, and complement this with measures of differences in survey responses as a proxy for the nature of interactions. We posit that interactions between people with very different views represent a greater exposure to diversity than interactions within homogeneous groups. We do not examine the desirability of having more diverse interactions, or whether diversity generates positive or negative spillovers (see Nijkamp *et al.*, 2015, and Ozgen, 2021, for surveys on diversity impacts).

Our approach draws on Hofstede's (1991, 2011) pioneering approach to quantifying cross-cultural differences across organisations and nations. Hofstede *et al.* (2010) identify six dimensions along which cultures differ. We follow the general approach of identifying dimensions of difference, but do not replicate the specific dimensions that Hofstede identifies. Instead, we use dimensions that can be quantified by means of data from NZ's GSS. Our focus on the measurement of diversity draws on a literature which has used Hofstede's 'dimensional paradigm' as the basis for measuring cultural diversity. For example, Ashraf and Galor (2011) measure cultural diversity based on two dimensions of cultural variation that were previously identified by Ingelhart and Baker (2000) using factor analysis of World Values Survey (WVS) data (the dimensions are 'traditional versus secular rational' and 'survival versus self-expression'). Ashraf and Galor use cluster analysis to group respondents into what they refer to as cultural groups and to obtain a measure of how different groups are from each other. From this, they derive a difference-weighted within-country diversity index for each of 139 countries. Beugelsdijk *et al.* (2019) analyse similar data from the European Values Survey (EVS), but they measure diversity based on question-specific fractionalisation of responses rather than developing a metric of the degree of difference in responses.

While taking a similar approach to measuring social difference, we do not focus on the diversity of survey responses per se. Instead, we use inter-group average differences in response patterns to parameterise the difference between predefined ethnicity/birthplace groups. We do this to gauge whether difference-based diversity provides a different (and potentially more meaningful) picture of the relative diversity of NZ urban areas.

2. DATA

We use data from the 2016 NZ GSS to identify differences between specific country of birth and ethnicity groups. We refer to the differences rather loosely as 'social difference' as they include elements of differences in identity, attitudes, values, and culture. The specific questions that we use, and the approach to coding and combining them, is described below in section 3. The 2016 GSS was chosen because the Supplement to the GSS in that year focused on civic and cultural engagement, which are particularly relevant when considering interactions between groups.

The choice of countries and ethnicity groupings is somewhat limited by the sample size of the GSS. We identify 34 separate groups, based on aggregations of more detailed categories available in the GSS. Foreign-born respondents are grouped into 27 country-of-birth areas. The largest groups are identified by their specific country of birth, with smaller groups assigned to categories based on geographic region of birth.

NZ-born respondents are classified separately based on reported ethnicity. As in the NZ population census, individual respondents in the GSS may identify with multiple ethnicities. However, diversity measures such as the fractionalisation index are based on probability concepts in which each individual may belong to one and only one group. Hence, we treat each combination of reported ethnicities as a separate category. For example, someone identifying as both European and Māori would be classified as 'European-Māori'. A relatively small number of respondents who stated their ethnicity to be 'New Zealander' in a census were assigned to the 'NZ-born, European ethnicity' category. This is common practice when comparing ethnicity information across data sources (Reid *et al.*, 2016).

We aggregate the responses of the NZ-born persons into 7 distinct categories, including separate residual categories for 'other single ethnicity' and 'other multiple ethnicities'. We accept that some of the foreign-born respondents may identify with multiple ethnicities too, but the GSS sample size is such that to define such groups is not feasible due to the associated large sampling errors. The resulting 34 country of birth/ethnicity categories are shown in Table 2, together with the number of observations and the estimated population sizes, based on GSS sample weights.

We can see from Table 2 that the five largest groups are the NZ-born with European ethnicity (52.5 per cent), NZ-born with Māori ethnicity (7.0 per cent), NZ-born with both European and Māori ethnicity (5.2 per cent), England born (4.0 per cent) and India born (2.7 per cent). The smallest represented group consists of those born in Southern and Eastern Africa (not further defined), who account for about 0.4 per cent.

Table 2. Country of Birth/Ethnicity Groups in the 2016 General Social Survey and their Average Factor Scores. Source: the Authors.

Country of birth / ethnicity	Obs. count	Pop. weight	Pop. share	Factor 1: Diversity	Factor 2: Trust	Factor 3: Language	Factor 4: Politics	Factor 5: Friends	Factor 6. Family	Factor 7: Local	Factor 8: Active
Australia	126	56,000	0.017	0.07	0.14	0.07	-0.28	0.01	0.29	-0.12	-0.15
China, People's Republic of	135	70,000	0.021	-0.47	0.87	-0.13	-0.07	0.33	-0.01	-0.67	-0.60
Cook Islands	36	18,000	0.005	-0.39	0.05	0.67	-0.34	0.43	-0.06	0.16	-0.72
Eastern Europe (nfd)	27	15,000	0.004	-0.33	0.53	-0.11	-0.02	0.31	-0.11	-0.43	-0.31
England	312	136,000	0.040	0.59	0.37	-0.09	-0.12	0.15	-0.07	0.07	-0.35
Fiji	108	57,000	0.017	-0.38	0.65	0.55	-0.38	0.38	0.16	0.19	-0.74
India	165	91,000	0.027	-0.35	1.06	0.34	-0.24	0.46	0.15	-0.37	-0.62
Korea, Republic of	36	20,000	0.006	-0.43	0.66	-0.20	-0.26	0.50	-0.07	-0.60	-0.33
Mainland South-East Asia (nfd)	33	15,000	0.004	-0.41	0.29	-0.04	-0.31	0.02	0.36	-0.53	-0.59
Malaysia	27	15,000	0.004	-0.17	0.63	-0.08	-0.12	0.10	0.36	-0.19	-0.68
NZ born, Asian ethnicity	39	27,000	0.008	0.61	0.25	0.27	-0.34	0.42	0.10	-0.02	-0.26
NZ born, European and Māori ethnicity	393	176,000	0.052	-0.13	-0.20	0.57	-0.25	0.24	0.23	0.10	-0.16
NZ born, European ethnicity	4,341	1,774,000	0.525	-0.08	0.05	-0.14	-0.21	0.12	0.20	0.16	-0.20
NZ born, Māori ethnicity	582	236,000	0.070	-0.27	-0.48	1.05	-0.30	0.13	0.25	0.42	-0.11
NZ born, Other multiple ethnicities	114	58,000	0.017	0.59	-0.02	0.52	-0.32	0.36	0.29	-0.08	0.08
NZ born, Other ethnicity	126	43,000	0.013	-0.11	-0.20	-0.43	-0.12	0.04	-0.01	0.27	-0.26
NZ born, Pasifika ethnicity	138	86,000	0.025	-0.34	-0.12	0.28	-0.04	0.71	0.45	-0.08	0.32
Netherlands	39	14,000	0.004	-0.11	0.22	-0.16	0.05	-0.13	0.29	0.12	-0.55
North Africa & Middle East (nfd)	33	14,000	0.004	0.02	0.90	-0.11	-0.14	0.50	0.20	0.00	-0.77
North-East Asia (nfd)	48	24,000	0.007	-0.49	0.82	-0.03	-0.18	0.40	0.13	-0.87	-0.40
North-West Europe (nfd)	27	15,000	0.004	0.74	0.34	0.45	0.07	0.16	-0.16	-0.39	0.21
Other	66	30,000	0.009	-0.23	0.57	-0.02	-0.16	0.23	0.25	-0.25	-0.46
Philippines	87	56,000	0.017	-0.52	1.31	0.41	-0.15	0.51	-0.13	-0.41	-0.52
Polynesia (excludes Hawaii) (nfd)	21	16,000	0.005	-0.36	0.04	0.24	-0.24	0.30	0.25	-0.24	-0.68
Samoa	99	57,000	0.017	-0.44	0.35	0.27	-0.31	0.49	0.40	-0.02	-0.67
Scotland	69	27,000	0.008	0.18	0.22	-0.11	-0.05	0.11	0.06	-0.01	-0.36
South Africa	114	65,000	0.019	0.53	0.56	-0.07	-0.13	0.31	-0.16	-0.13	-0.16
Southern Asia (nfd)	36	20,000	0.006	-0.38	0.77	0.33	-0.25	0.20	-0.14	-0.31	-0.53
Southern and East Africa (nfd)	27	13,000	0.004	0.78	0.51	-0.29	-0.20	0.47	0.03	-0.52	-0.50
The Americas (nfd)	48	24,000	0.007	0.94	0.83	0.26	-0.16	-0.06	0.29	-0.24	-0.24
Tonga	42	24,000	0.007	-0.45	0.29	0.28	-0.25	0.64	0.34	0.13	-0.60
United Kingdom (nfd)	126	57,000	0.017	0.69	0.30	-0.14	0.03	0.22	-0.13	-0.44	-0.26
United States of America	39	17,000	0.005	0.84	0.35	0.33	0.56	0.11	0.28	-0.47	-0.18
Western Europe (nfd)	48	16,000	0.005	-0.02	0.46	0.36	-0.19	0.18	0.00	-0.40	-0.27
Total	7707	3,382,000	1.000								

Notes: nfd='Not further defined'. Observation counts are all randomly rounded to base 3. The surveyed population is the usually resident population aged 15 and over.

When we estimate diversity for each main and secondary urban area, we use population counts from each of the Censuses of Population and Dwellings spanning 1976 to 2018, re-coded to the same country-ethnicity groupings reported in Table 2. The population counts are calculated for the usually-resident adult (15 years of age and over) population in each census year.

3. MEASUREMENT OF DIVERSITY

Recent empirical studies of diversity in NZ have relied on information on population shares belonging to different country of birth or ethnic groups. The degree of diversity has been captured by fractionalisation measures (Maré and Poot, 2019a, 2019b) or entropy measures (Mondal *et al.*, 2021). Each of these approaches treats people from different countries of birth or ethnic groups as different. We compare fractionalisation-based measures of diversity with variants that allow for social difference between groups. As noted previously, the standard fractionalisation measure captures the probability that a meeting between two randomly chosen residents involves people from different groups. Difference-based fractionalisation captures the average degree of difference between two residents meeting randomly.

The standard fractionalisation measure of diversity is calculated as:

$$F = 1 - \sum_g \left(p_g\right)^2 = 1 - \boldsymbol{p}'\boldsymbol{p} \qquad (1)$$

where p_g is the proportion of the population that belongs to group 'g'. The index takes a minimum value of 0 when the entire population belongs to a single group ($p_1 = 1$), and maximal diversity is $F = 1 - {}^{1}/_{G}$, which occurs when each of *G* groups accounts for an equal proportion of the population ($p_g = {}^{1}/_{G}$ for any *g*). Maximum fractionalisation for our analysis of 34 country/ ethnicity categories is therefore $1 - {}^{1}/_{34}$= 0.97. The right-hand side of Eq. (1) expresses the formula in matrix notation, where $\boldsymbol{p}$ is a column vector of population shares.

A related diversity measure, which reflects the fact that some pairs of groups are more similar to each other than others, is a difference-based fractionalisation index (Nijkamp and Poot, 2015). This measure captures the idea that a given level of fractionalisation represents a lower level of diversity when the groups are similar to each other. Difference-based fractionalisation, which we refer to as 'social difference' is calculated as:

$$F^D = \sum_g \sum_h p_g p_h \sigma_{gh} = \boldsymbol{p}' \Sigma \boldsymbol{p} \qquad (2)$$

where σ_{gh} is a measure of the 'difference' or 'distance' between groups *g* and h. Hence $\sigma_{gg} = 0$. In matrix notation, $\boldsymbol{\Sigma}$ is a square matrix with elements σ_{gh}. The fractionalisation measure of Eq.(1) is a special case of F^D which results when $\sigma_{gh} = 1$ for all g and h. Also, note that $\boldsymbol{\Sigma}$ is assumed symmetric: $\sigma_{gh} = \sigma_{hg}$. The difference between the two groups is measured objectively and we cannot take into account that one of the two groups may subjectively gauge the difference to be larger or smaller than the other. In the next sub-section, we describe the calculation of this social difference matrix.

Calculating 'Social Difference'

We estimate the pairwise difference between any two country/ethnicity groups based on how different their average pattern of responses were to various questions asked in the 2016 GSS and its Supplement. We combine responses to questions across the following broad domains: associational membership, acceptance of diversity, cultural identity, cultural participation, language, political participation, social connectedness, social identity, and trust. The selected questions are a pragmatic mix of identity, behaviour, values, and attitudes. They are chosen to capture a range of possible differences, and are not intended to represent any particular conceptual construct such as culture, values, or identity. The GSS includes a broader range of questions than those that are included in our analysis. Our choice of questions was guided in part by the quality of responses – questions with low item-response rates and/or high proportions of 'do not know' responses were not included.

Appendix Table 1 of the working paper version of this article (Maré and Poot, 2022) lists the GSS questions that were used in our analysis. We use exploratory factor analysis (see e.g. Joliffe and Morgan, 1992, for an introduction) to capture the main patterns of variation in responses across all of these questions. We first calculate a matrix of correlations between the responses for each pair of questions. Where the number of response categories is 10 or fewer, polychoric correlations are calculated (Olsson, 1979). Polychoric correlations are appropriate for measuring correlations between ordinal measures, using the assumption that responses for each pair of questions follow an underlying bivariate normal distribution. Based on the resulting correlation matrix, we identify eight factors, using the iterated principal factor method. Appendix Table 2 of Maré and Poot (2022) shows the rotated factor loadings on each question for the eight factors, based on a varimax (orthogonal) rotation of the Kaiser-normalised matrix (Kaiser, 1958). We have assigned subjective names to each of the eight factors, reflecting the questions that have the highest weightings for the factor. The eight factors, in descending order of importance in accounting for variation in response patterns, relate to: 1) acceptance of diversity; 2) trust; 3) attitudes to *te reo* (the language of the indigenous Māori population); 4) political participation; 5) social connections with friends; 6) social connections with family; 7) local sense of identity with neighbourhood, country or region; and 8) active participation in sports or other club membership.

Each factor is normalised to have a mean of zero and a variance of 1 across the NZ population (using the GSS population weights). We calculated the median factor score for each factor separately by country of birth/ethnicity group. These scores are shown in Table 2 above. For example, The Americas (nfd) scores the highest (0.94) on acceptance of 'Diversity', the Philippines scores the highest (1.31) on 'Trust', while NZ-born, Other Ethnicity scores the lowest (-0.43) on 'Language'.

The social difference between the two groups is calculated as the (Euclidean) distance between the two rows that contain the median scores on each of these eight factors for the two groups. The matrix of pair-wise differences calculated in this way is used as the (symmetric) difference/distance matrix Σ in equation (2) to calculate the group-share weighted average social difference in each urban area. The resulting social difference measure F^D is bounded below by zero (when all groups have the same vector of median factor scores across the eight factors), and is unbounded above. We therefore normalise F^D so that it takes on values between zero and one. We achieve this rescaled social difference score by applying a monotonic transformation to F^D that uses a scaled half-normal cumulative density function:

$$\widetilde{F^D} = 2\Phi(F^D) - 1 \quad (3)$$

where Φ() is the standard normal cumulative density function.

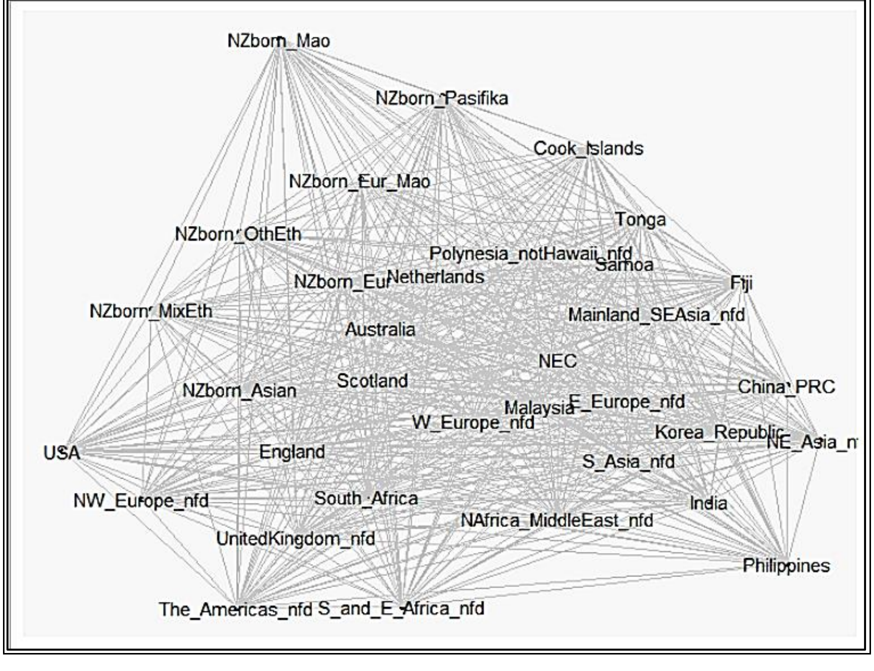


Figure 1. Social Difference Map. Source: the Authors. Notes: See Table 2 for the full description of the country of birth/ethnicity groups and the number of observations in the 2016 General Social Survey.

Figure 1 provides a visual summary of the social differences between the different country/ethnicity groups. Groups that are located away from other groups do so because they have distinctive patterns of responses to GSS questions, as demonstrated by relatively high or relatively low factor scores on one or more factors. For instance, NZ-born residents identifying Māori as their sole ethnicity report relatively lower levels of trust than other groups, and are more likely to respond positively to questions about the use of and support for *te reo* Māori.

In contrast, respondents born in the Philippines report relatively high levels of trust, as noted above, which contributes to their being positioned away from Māori in Figure 1. USA-born respondents report unusually high participation in political activities, contributing to their positioning at one edge of Figure 1. Generally, we see some geographical clustering with the distances between groups from the same continent being closer than the distances between groups from different continents. However, we attach no subjective interpretation to high or low scores on any of the dimensions. We aim to identify only how different groups are from each other.

4. RESULTS

Table 3 shows the values of the two measures of diversity in 2018, the level of change in diversity by both measures between 1976 and 2018, as well as the relative growth. The urban areas are listed in descending order of $\widetilde{F^D}$ in 2018. It should be noted that, although both measures are bounded between zero and one, their values are not directly comparable. They are conceptually different – as discussed above. However, we can gauge where each urban area sits with respect to either measure in relative terms. Additionally, it is meaningful to interpret the relative percentage changes between 1976 and 2018 and to assess the extent to which there has been conditional divergence or convergence in terms of a possible relationship between the level of diversity in 1976 and the rate of change between 1976 and 2018.

Relative Diversity

Relative diversity across NZ urban areas looks similar whether based on a fractionalisation or social difference-based measure. As shown in Table 3, Auckland was the most diverse urban area in 2018, whichever measure is used ($\widetilde{F^D}$ = 0.683; F = 0.876). The two most diverse (Auckland and Queenstown) and the ten least diverse urban areas are identically ranked across the two measures. At intermediate levels of diversity, the rankings differ for some urban areas. The largest differences in ranking are for Wellington and Kapiti. $\widetilde{F^D}$ suggests that these areas are relatively less diverse than is implied by simple fractionalisation. Hawera and Whakatane appear relatively more diverse when measured using the social difference measure.

Table 3. Diversity of New Zealand's Main and Secondary Urban Areas.
Source: the Authors.

	Level of diversity (2018)		Change in diversity 1976-2018		Relative
	Fractionalisation (F)	Social difference $(\tilde{F}^D)$	Fractionalisation (ΔF)	Social difference $(\widetilde{\Delta F^D})$	Growth $(g\tilde{F}^D/gF)$
Auckland	0.876	0.683	0.25	0.24	1.36
Queenstown ^	0.871	0.658	0.43	0.38	1.40
Rotorua	0.781	0.642	0.15	0.17	1.52
Tokoroa	0.786	0.618	0.08	0.09	1.50
Gisborne	0.723	0.597	0.16	0.17	1.40
Hamilton	0.722	0.590	0.23	0.23	1.37
Whakatane	0.715	0.586	0.09	0.11	1.60
Pukekohe	0.728	0.583	0.19	0.15	0.98
Wellington	0.751	0.583	0.16	0.17	1.52
Whangarei	0.719	0.582	0.19	0.19	1.35
Napier/Hastings	0.655	0.528	0.16	0.16	1.35
Palmerston North	0.652	0.525	0.25	0.24	1.35
Taupo	0.659	0.523	0.07	0.09	1.75
Tauranga	0.638	0.507	0.13	0.14	1.49
Christchurch	0.633	0.498	0.23	0.23	1.50
Levin	0.632	0.491	0.14	0.13	1.27
Whanganui	0.598	0.487	0.16	0.17	1.47
Hawera	0.554	0.454	0.17	0.17	1.35
New Plymouth	0.597	0.442	0.06	0.09	2.29
Masterton	0.563	0.442	0.17	0.17	1.44
Kapiti	0.565	0.442	0.16	0.15	1.30
Nelson ^	0.551	0.425	0.18	0.18	1.51
Dunedin ^	0.547	0.421	0.19	0.19	1.55
Blenheim ^	0.536	0.416	0.22	0.20	1.33
Invercargill ^	0.495	0.389	0.17	0.17	1.48
Feilding	0.494	0.387	0.14	0.13	1.28
Ashburton ^	0.470	0.367	0.23	0.21	1.40
Rangiora ^	0.456	0.334	0.21	0.17	1.21
Oamaru ^	0.439	0.332	0.18	0.16	1.34
Timaru ^	0.413	0.32	0.16	0.16	1.58
Greymouth ^	0.385	0.295	0.11	0.11	1.49

Notes: Urban areas are listed in descending order of $\widetilde{F^D}$ in 2018. ^ indicates an urban area located in the South Island of New Zealand.

To illustrate the factors behind differences between the F and $\widetilde{F^D}$ values of urban areas, Appendix Table 3 of Maré and Poot (2022) provides a partial summary of ethnic/birthplace composition in 2018 across the main urban areas (i.e. the shares of the six largest groups nationally), with urban areas listed in descending order of $\widetilde{F^D}$. Kapiti has a relatively high proportion of English-born residents (at 10.8 per cent, over twice the national average). This mix contributes to diversity as measured by fractionalisation but contributes less to social difference-based diversity because of the relatively low social difference between English-born residents and members of the dominant NZ-born-European group.

For Wellington, the high proportion of 'other' country of birth groups (29.7 per cent) contributes to high (simple) fractionalisation, but the mix of groups contributes relatively less to the average social difference measure. More generally, diversity is negatively related to the size of the largest (NZ-born European ethnicity) group, which ranges from around 30 per cent in Auckland and in Queenstown to 78 per cent in Greymouth, and positively related to the share of the local population from groups other than the six overall largest. The latter ranges from below 10 per cent in Greymouth and Feilding, to over 40 per cent in Queenstown and Auckland. There is, however, also considerable variation in the shares of local populations in each of the 6 overall largest groups.

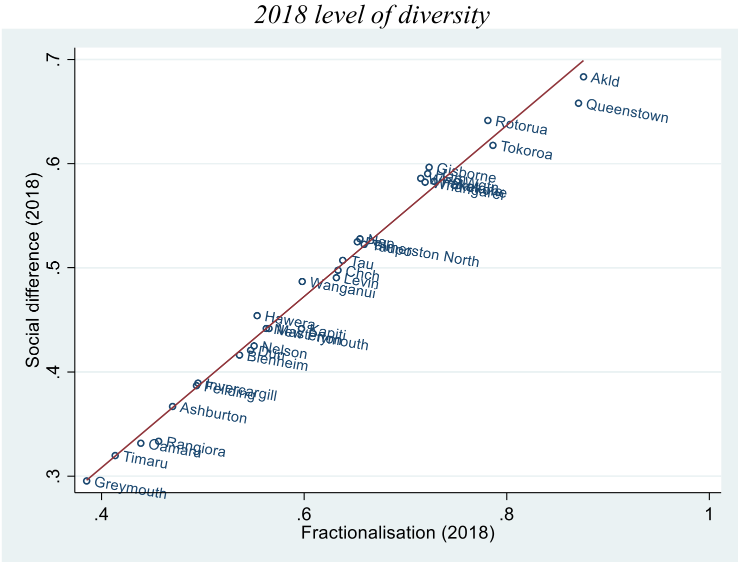
Residents born in China or India together account for less than 2 per cent of the population in over half of the urban areas. In contrast, these two groups constitute over 5 per cent of residents in 5 urban areas, and over 12 per cent in Auckland. The variation in country mixes certainly provides scope for F and $\widetilde{F^D}$ to provide contrasting pictures of relative diversity across urban areas. However, as shown in Table 3, and plotted in the top panel of Figure 2, the differences in relative diversity levels and the ranking of urban areas are modest.

Change in Diversity

The numeric change in diversity between 1976 and 2018 is very similar whether measured by fractionalisation or by group-share weighted social difference, increasing in all urban areas by between 0.06 and 0.43 (see Table 3). However, because social difference-based diversity is always smaller than simple fractionalisation, the change in difference-based diversity represents a larger proportional increase in measured diversity.

Social difference-based diversity more than doubled in three urban areas (Queenstown, Ashburton, and Rangiora). Queenstown is the urban area with the greatest increase in diversity between 1976 and 2018 by either measure ($\widetilde{F^D}$ change = 0.38; F change = 0.43). Among the 31 main and secondary urban areas in 1976, Queenstown was ranked 15th based on F (19th based on $\widetilde{F^D}$), and had risen to be the second most diverse urban area in 2018. Queenstown is an extreme case of the overall convergence of diversity levels over time.

2018 level of diversity



1976-2018 growth in diversity

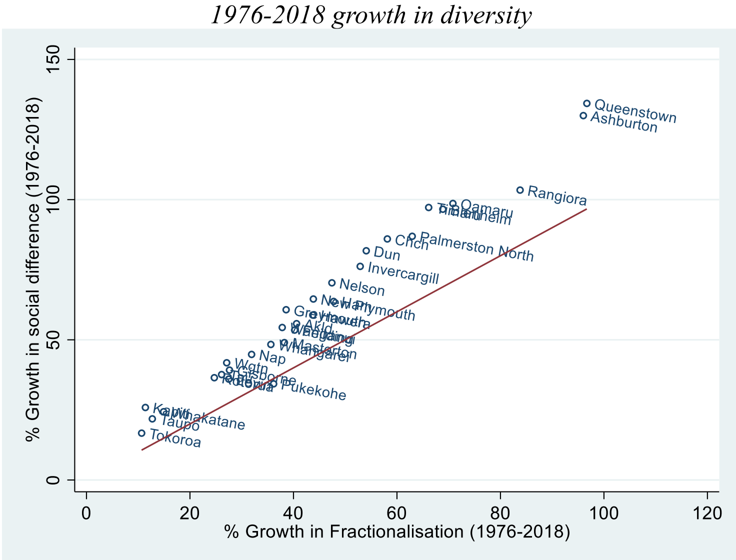


Figure 2. Level and Growth of Diversity: Comparing Two Diversity Measures. Source: the Authors. Notes: The line in the upper panel is a line of best fit. In the lower panel, the line indicates equal growth rates.

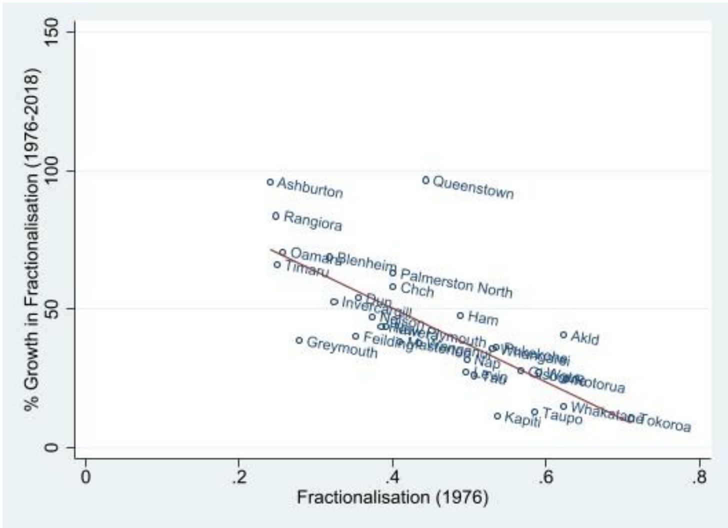
The spatial convergence in terms of both fractionalisation and group share-weighted social difference is shown in Figure 3. Urban areas that had the lowest diversity measures in 1976 experienced the greatest percentage increase in the two measures over the 1976-2018 period. Interestingly, when drawing regression lines in these scatter plots (which measure the rate of conditional convergence), we see that the line for social difference is more steeply sloping down than the one for fractionalisation. This is very plausible because of two reasons: firstly, the relative growth of the Māori and Pasifika groups among the NZ-born population and, secondly, the growth in immigration from 'non-traditional source countries' since the late 1980s. At that time the NZ immigration policy system changed from one in which preference was given to applications from traditional source countries to one with a preference for skills and other economically-motivated criteria, implemented by means of a points system (New Zealand Productivity Commission, 2021).

Both these changes led to growing population shares of groups that have a greater social distance from the NZ-born population of European descent. Table 3 shows this effect in the final column, which reports the ratio of the 1976-2018 percentage growth in social difference over the corresponding growth in fractionalisation. This ratio is much greater than one in all but one of the urban areas. The exception is Pukekohe (0.98). It is not clear what caused the relatively low social difference growth in Pukekohe (see also footnote 4 in Maré and Poot, 2022).

Nonetheless, fractionalisation and social difference generally show the same trends over time. This can be seen from Figure 4, which shows the time patterns of diversity change in the two metropolitan areas with the largest fractionalisation and social difference, Auckland and Wellington, and in Queenstown, based on both simple fractionalisation and social difference. Apart from the level difference between the two measures, the patterns are very similar. The only substantive difference is that the social difference measure was flat between 1976 and 1986 in Queenstown, while the fractionalisation measure suggested a decline. Both measures show sustained diversity growth in Queenstown from 1986, overtaking Wellington just prior to 2006, and almost matching Auckland's diversity levels by 2018. Both measures also show Auckland's diversity rising faster than Wellington's since 1991.

The faster growth in social difference-based diversity has been most pronounced in the second half of the 1976-2018 period, when immigrant growth has been most pronounced. Even while there may have been a diverse mix of countries of birth present prior to 1986, there were relatively low levels of social difference between these countries – at least compared with the degree of social difference evident in later years.

Fractionalisation



Social difference

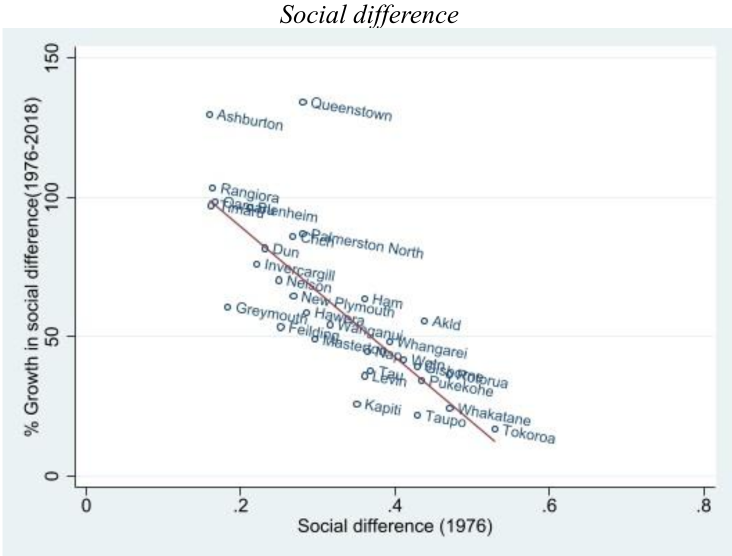


Figure 3. Convergence of Urban Area Diversity Levels Over Time. Source: the Authors. Notes: The added lines are lines of best fit. The slope parameter in the upper panel is -132.8 (s.e. = 21.4). The slope in the lower panel is -234.6 (s.e. = 33.1).

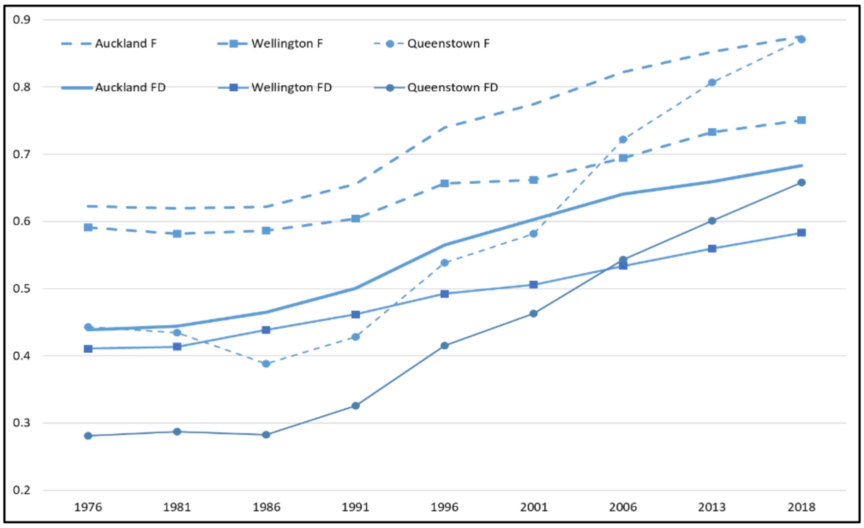


Figure 4. Diversity Trends: Selected Urban Areas. *Source*: the Authors. Notes: *FD* refers to social difference. *F* refers to simple fractionalisation.

5. DISCUSSION AND CONCLUSION

Conceptually, a social difference-based measure of diversity is more informative than simple fractionalisation because it captures not only the potential for diverse interactions within residential areas but also the strength of social differences involved in those interactions. Capturing the degree of social difference provides a more appropriate diversity measure for studying the impact of diversity where the impact depends on the frequency, intensity and nature of the interactions. Interactions between people whose views are very similar may do little to generate innovative or productive ideas that are generally associated with diversity (Ozgen, 2021).

Conversely, if interactions involve people with vastly different values, attitudes, and identities, it may be difficult to achieve effective communication. In practice, however, fractionalisation and average social difference do not show a markedly different picture of relative diversity and change in diversity across urban areas in NZ. Diversity increased in all urban areas, and by a similar amount, whether measured by simple fractionalisation or by difference-based diversity. The higher proportional change in diversity when measured by social difference reflects the fact that the increase in the proportion of migrants has also raised the average social difference between residents. Additionally, the share of those of European descent has been declining among the NZ-born population.

Overall, relying on simple fractionalisation to capture relative diversity differences across urban areas, or patterns of diversity change, provides a reliable picture, despite the conceptual superiority of a social difference-based measure. Simple fractionalisation measures are certainly much easier to calculate, given that they require only population shares for each group. Nonetheless, we conclude that measuring the growth in diversity by fractionalisation is likely to underestimate the experience of diversity by population groups, given that the group-share weighted average social difference has been growing faster than fractionalisation.

One limitation of our study is that, due to limitations to available data, we measured average social distance in urban areas by means of GSS data from 2016 only. Norms and attitudes with respect to cultural diversity are likely to change over time, both for individuals and at the group level. In the NZ context, Mondal *et al.* (2020) find for example that changes in self-identification of ethnicity by adolescents may result after they leave the parental home. Similarly, immigrant attitudes toward the cultural norms of the destination country may change as part of a process of acculturation (Sam and Berry, 2010). Social distance between groups may also change over time when younger cohorts have quite different attitudes from older generations. For example, recent European research shows that there are distinct differences between birth cohorts in attitudes to immigration (McLaren and Paterson, 2020). Hence, a future project could consider replication and comparison of our results when a future GSS has the same set of questions as those we used from the 2016 GSS. Additionally, it may be possible to identify alternative questions that are common to some or all GSS surveys but that are also considered to be meaningful to quantify trends in social differences between groups.

However, given the similarity in the ranking of urban areas and trends, when comparing the standard fractionalisation index and our social difference index, it is unlikely that time-varying social-difference weights would change the key conclusions of this article, although the calculated extra growth in social difference vis-à-vis fractionalisation may be less when everyday lived diversity increases over time in the large cities, as is shown in the research on growing 'superdiversity' of such cities (Vertovec, 2023).

Our study provides a valuable corroboration of the existing studies of diversity across NZ urban areas. Our analysis could, of course, be further extended in various ways. First, social difference-based diversity measures could be calculated to reflect potential interactions at spatial scales other than urban areas, even going down to meshblocks. This could be done to extend the measurement of segregation at different spatial scales (Reardon *et al.*, 2008), or to gauge the nature of potential interactions at other locations, such as workplaces, as in Maré and Poot (2019a). Second, although our focus has been on applying difference-based measures to diversity between country-of-birth and ethnicity groups, the approach of using survey-based social difference measures could be applied to compare within-group diversity with between-group diversity in the same way as, for example, Alimi *et al.* (2022) compared within-group income inequality with between-group income inequality. Internationally, it has been shown that within-group variation in culture trumps between-group variation (Desmet *et al.*, 2017). There is undoubtedly marked social difference within the groups we have considered. Investigating this should be a priority for future research, to develop a richer picture of urban diversity that focuses not only on inter-group differences. Finally, an obvious additional direction for future research is to estimate how social difference-based diversity in urban areas relates to social, economic, and political outcomes and then compare these relationships with the corresponding ones estimated with simple fractionalisation measures.

REFERENCES

Alimi, O., Maré, D. C. and Poot, J. (2022). Immigration, skills and changing urban income inequality in New Zealand. *Australian Journal of Labour Economics*, 25(1), pp. 81-109.

Ashraf, Q. and Galor, O. (2011). *Cultural diversity, geographical isolation, and the origin of the wealth of nations*, National Bureau of Economic Research, Cambridge, MA 02138.

Ashraf, Q. and Galor, O. (2013). The 'Out of Africa' hypothesis, human genetic diversity, and comparative economic development. *American Economic Review*, 103(1), pp. 1-46.

Barker, V. E. (2012). Is contact enough? The role of vicarious contact with racial outgroups via social networking sites. Proceedings of the 62nd International Communication Association (ICA) Conference, 24-28 May, Phoenix AZ, pp 24-38.

Beugelsdijk, S., Klasing, M. J. and Milionis, P. (2019). Value diversity and regional economic development. *The Scandinavian Journal of Economics*, 121(1), pp. 153-181.

Desmet, K., Ortuño-Ortín, I. and Wacziarg, R. (2012). The political economy of linguistic cleavages. *Journal of Development Economics*, 97(2), pp. 322-338.

Desmet, K., Ortuño-Ortín, I. and Wacziarg, R. (2017). Culture, ethnicity, and diversity. *American Economic Review*, 107(9), pp. 2479-2513.

Eberle, U. J., Henderson, J. V., Rohner, D. and Schmidheiny, K. (2020). Ethnolinguistic diversity and urban agglomeration. *Proceedings of the National Academy of Sciences*, 117(28), pp. 16250-16257.

Farber, S., O'Kelly, M., Miller, H. J. and Neutens, T. (2015). Measuring segregation using patterns of daily travel behavior: A social interaction based model of exposure. *Journal of Transport Geography*, 49, 26-38.

Fearon, J. D. (2003). Ethnic and cultural diversity by country. *Journal of Economic Growth*, 8(2), 195-222.

Galiana, L., Sakarovitch, B. and Smoreda, Z. (2018). Understanding socio-spatial segregation in French cities with mobile phone data [Unpublished manuscript].

Ginsburgh, V. and Weber, S. (2020). The economics of language. *Journal of Economic Literature*, 58(2), 348-404.

Grbic, D., Ishizawa, H. and Crothers, C. (2010). Ethnic residential segregation in New Zealand, 1991-2006. *Social Science Research*, 39(1), pp. 25-38.

Hägerstrand, T. (1970). What about people in regional science? *Papers in Regional Science*, 24(1), pp. 6-21.

Hofstede, G. (1991). *Cultures and Organizations: Software of the Mind*. McGraw-Hill, New York.

Hofstede, G. (2011). Dimensionalizing cultures: The Hofstede model in context. *Online Readings in Psychology and Culture*, 2(1).

Hofstede, G., Hofstede, G. J. and Minkov, M. (2010). *Cultures and Organizations: Software of the Mind, Third Edition*, McGraw-Hill Education, New York.

Hudson, M. C. and Taylor, C. L. (1972). *World Handbook of Political and Social Indicators*, Yale University Press, Conn. and London.

Inglehart, R. and Baker, W. E. (2000). Modernization, cultural change, and the persistence of traditional values. *American Sociological Review*, pp. 19-51.

Johnston, R. J., Poulsen, M. F. and Forrest, J. (2011). Evaluating changing residential segregation in Auckland, New Zealand, using spatial statistics. *Tijdschrift Voor Economische En Sociale Geografie*, 102(1), pp. 1-23.

Joliffe, I. T. and Morgan, B. J. T. (1992). Principal component analysis and exploratory factor analysis. *Statistical Methods in Medical Research*, 1, pp. 69-95.

Kaiser, H. F. (1958). The varimax criterion for analytic rotation in factor analysis. *Psychometrica*, 69, pp. 257-273.

Li, J. Z., Absher, D. M., Tang, H., Southwick, A. M., Casto, A. M., Ramachandran, S., Cann, H. M., Barsh, G. S., Feldman, M. and Cavalli-Sforza, L. L. (2008). Worldwide human relationships inferred from genome-wide patterns of variation. *Science*, 319(5866), pp. 1100-1104.

Maré, D. C., Pinkerton, R. M. and Poot, J. (2016). Residential assimilation of immigrants: A cohort approach. *Migration Studies*, 4(3), pp. 373–401.

Maré, D. C. and Poot, J. (2019a). Commuting to diversity. *New Zealand Population Review*, 45, pp. 125–159.

Maré, D. C. and Poot, J. (2019b). Valuing cultural diversity of cities. Motu Working Paper 19–05. Motu Economic and Public Policy Research, Wellington.

Maré, D. C. and Poot, J. (2022). Accounting for social difference when measuring cultural diversity. Motu Working Paper 22–04. Motu Economic and Public Policy Research, Wellington.

Massey, D. S. and Denton, N. A. (1988). The dimensions of residential segregation. *Social Forces*, 67(2), pp. 281-315.

Mauro, P. (1995). Corruption and growth. *Quarterly Journal of Economics*, 110(3), pp. 681-712.

McLaren, L. and Paterson, I. (2020). Generational change and attitudes to immigration. *Journal of Ethnic and Migration Studies*, 46(3), pp. 665-682.

Mondal, M., Cameron, M. P. and Poot, J. (2020). Determinants of ethnic identity among adolescents: Evidence from New Zealand. Working Paper in Economics 5/20, University of Waikato, Hamilton.

Mondal, M., Cameron, M. P. and Poot, J. (2021). Cultural and economic residential sorting of Auckland's population, 1991-2013: An entropy approach. *Journal of Geographical Systems*, 23(2), pp. 291-330.

Nijkamp, P. and Poot, J. (2015). Cultural diversity: A matter of measurement. In P. Nijkamp, J. Poot and J. Bakens (Eds), *The Economics of Cultural Diversity*, Edward Elgar Publishing Limited, Cheltenham.

Nijkamp, P., Poot, J. and Bakens, J. (2015). *The Economics of Cultural Diversity* (Eds), Edward Elgar Publishing Limited, Cheltenham.

New Zealand Productivity Commission (2021). International migration to New Zealand: historical themes and trends. NZPC Working

Paper No. 2021/04. New Zealand Productivity Commission, Wellington.
Olsson, U. (1979). Maximum likelihood estimation of the polychoric correlation coefficient. *Psychometrica*, 44, pp. 443-460.
Östh, J., Shuttleworth, I. and Niedomysl, T. (2018). Spatial and temporal patterns of economic segregation in Sweden's metropolitan areas: A mobility approach. *Environment and Planning A: Economy and Space*, 50(4), pp. 809-825.
Ottaviano, G. I. P. and Peri, G. (2006). The economic value of cultural diversity: Evidence from US cities. *Journal of Economic Geography*, 6(1), pp. 9-44.
Ozgen, C. (2021). The economics of diversity: innovation, productivity and the labour market. *Journal of Economic Surveys*, 35(4), pp. 1168-1216.
Park, Y. M. and Kwan, M. P. (2018). Beyond residential segregation: A spatiotemporal approach to examining multi-contextual segregation. *Computers, Environment and Urban Systems*, 71, pp. 98-108.
Reardon, S. F., Matthews, S. A., O'Sullivan, D., Lee, B. A., Firebaugh, G., Farrell, C. R. and Bischoff, K. (2008). The geographical scale of metropolitan racial segregation. *Demography*, 45(3), pp. 489-514.
Reid, G., Bycroft, C. and Gleisner, F. (2016). *Comparison of ethnicity information in administrative data and the census*, Statistics New Zealand, Wellington.
Reynal-Querol, M. (2002). Ethnicity, political systems, and civil wars. *Journal of Conflict Resolution*, 46(1), pp. 29-54.
Sam, D. L. and Berry, J. W. (2010). Acculturation: When individuals and groups of different cultural backgrounds meet. *Perspectives on Psychological Science* 5(4), pp. 472-481.
Spolaore, E. and Wacziarg, R. (2009). The diffusion of development. *The Quarterly Journal of Economics*, 124(2), pp. 469-529.
Stone, G., Collins, F. L., Praat, A., Terruhn, J. and Peace, R. (2021). Population Diversity in Aotearoa New Zealand: Insights from the CaDDANZ Research Programme. University of Waikato, Hamilton. Online version accessed 18 October 2023, https://www.waikato.ac.nz/caddanz/.
Vertovec, S. (2023). *Superdiversity: Migration and Social Complexity*, Routledge, New York.