The B.E. Journal of Economic Analysis & Policy

Topics

Volume 12, *Issue* 1 2012 *Article* 5

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Recommended Citation

Jeremy Clark and Bonggeun Kim (2012) "The Effect of Neighborhood Diversity on Volunteering: Evidence From New Zealand," *The B.E. Journal of Economic Analysis & Policy*: Vol. 12: Iss. 1 (Topics), Article 5.

DOI; 10.1515/1935-1682.2971

The Effect of Neighborhood Diversity on Volunteering: Evidence From New Zealand*

Jeremy Clark and Bonggeun Kim

Abstract

A growing empirical literature has found that neighborhood heterogeneity lowers people's likelihood of contributing to public goods. However, this literature has been mostly cross-sectional, and so struggled to address the effects of unobserved influences on contributions that may be correlated with heterogeneity. It has also paid little attention to how heterogeneity's estimated effects are influenced by neighborhood size or the concavity of heterogeneity measures. With access to a panel of three waves of census data on volunteering rates in New Zealand, released at two fine levels of aggregation, we can control for stable unobserved neighborhood characteristics that may affect volunteering rates. We use pooled cross-section, between and fixed effects regressions to test whether volunteering rates are lowered by heterogeneity in race/ethnicity, language, birthplace, or income. We find that estimates are affected by neighborhood definition, and that ethnic and language heterogeneity are robustly associated with lower volunteering rates in New Zealand.

KEYWORDS: heterogeneity, neighborhood effects, volunteering

*Acknowledgments The authors would like to thank Rachel Croson, John Helliwell, Janet Johnson, Sherry Xin Li, Andrea Menclova, Bob Reed, Eik Sweek, Samuel Thornton, and anonymous referees for their helpful comments, as well as the discussant and participants at the 2009 Canadian Economics Association meetings in Toronto and 2010 American Economics Association meetings in Atlanta, and seminar participants at Seoul National University. This work was supported by Research Settlement Fund for new faculty at Seoul National University, and by funding from the College of Business and Economics at the University of Canterbury.

1. Introduction

Do individuals in communities that become more heterogeneous lose concern for the welfare of others? Support for this provocative claim has emerged in the past decade using various dimensions of "heterogeneity" and manifestations of "concern for others." To address this question empirically, researchers have generally used cross section data to test for an effect of neighborhood heterogeneity along some dimension on people's propensity to give time or money to public goods, become members of organizations, return census forms, express trust in others, and so on. Methodologically, researchers have typically captured neighborhood heterogeneity using a mathematically concave measure of dispersion, such as an index of fragmentation, the Gini coefficient, etc. This use of concave measures of dispersion is not unusual; researchers asking whether various neighborhood characteristics affect people's behavior often use concave measures of those characteristics. Examples include the effect of neighborhood income inequality on mortality rates (Lynch et al. 1998, Mellor and Milyo 2001, Deaton and Lubotsky 2003, Lochner et al. 2001), self-reported health (Blakely et al. 2002, Mellor and Milyo 2002), and homicide rates (Mellor and Milyo 2001), or the effect of neighborhood racial diversity on population and economic growth (Rappaport 1999, Alesina and La Ferrara 2005), and adolescent sexual activity (Brewster 1994).[1] We contribute to the literature studying the effects of heterogeneity by providing a neighborhood panel data examination of its effects, and by considering the implications of the concavity of standard heterogeneity measures.

To do this, we use three waves of census data from New Zealand to examine both cross-sectional and time-series variation in volunteering rates and heterogeneity. Specifically, we test whether local heterogeneity by ethnicity/race, language, birthplace, or household income affects New Zealander's likelihood of volunteering. We use neighborhoods defined at the unusually fine levels of "meshblock" (roughly 100 people) and "area unit" (roughly 2000 people). Questions regarding volunteering were asked of all New Zealanders in 1996, 2001 and 2006, enabling us to construct both pooled cross-section and neighborhood fixed effects regressions for the entire population. The New Zealand census releases a comprehensive list of covariates for all three years, allowing our cross-section regressions to control for many confounding neighborhood characteristics that may be correlated with heterogeneity, such as deprivation, crime, housing and

[1] There is a larger empirical literature testing for the effect of *non-linear* (but not necessarily concave) neighborhood characteristics on various outcomes, covering a wider range of applications (for surveys, see Deaton (2003) or Durlauf (2004)). While neighborhood boundary choice may affect results for all non-linear measures, we have focused here on the consequence of using concave measures in particular.

employment status. Our fixed effects regressions that follow neighborhoods over time can also go part way to addressing residual endogeneity by controlling for unobserved, time-invariant neighborhood characteristics that affect the demand or supply of volunteers.

With access to census data at two levels of aggregation, we are also able to address the effect of neighborhood definition on heterogeneity's estimated effects. The size of neighborhood used to estimate the effect of a concave heterogeneity measure on people's behavior may introduce bias if it is defined too broadly or narrowly. Using areas that are so large as to contain people whose heterogeneity has no bearing on an individual's behavior is likely to incorrectly capture the effect of differences in heterogeneity between constituent smaller areas, even when these differences have no economic effect. Conversely, using areas that are so small they omit the relevant effects of heterogeneity in adjacent areas will also bias heterogeneity's estimated effect. A second advantage of using two levels of neighborhood analysis is that there may be an interaction between area size and people's endogenous self-selection to neighborhoods. People may be more restricted by job or family constraints to live somewhere in a large area, but freer to choose within it their exact neighborhood (and neighbors). Endogenous selection could be a problem if those who are less inclined to volunteer are attracted to locate in urban centres, which tend to be more heterogeneous. The literature's estimated negative cross-sectional effects of heterogeneity on volunteering might then be exaggerated.

The rest of the paper will proceed as follows. In Section 2, we review the empirical literature investigating the effect of neighborhood diversity on public good contributions and trust. In Section 3, we briefly review existing theories implying a causal relationship between neighborhood heterogeneity and volunteering. In Section 4, we present descriptive statistics regarding volunteering and various measures of heterogeneity in New Zealand, followed by our estimation methods and results. Section 5 concludes the paper.

2. Previous empirical studies on diversity and public goods or trust

In recent years, researchers have examined the effects of neighborhood heterogeneity by race, ethnicity, education, income or first language on an individual's propensity to volunteer, contribute to fundraisers, be a member of any organization, trust others or support welfare programs.[2] Most empirical studies have been carried out using data from the United States, but others have used survey samples from Australia, Kenya, Sweden, and the United Kingdom (see

[2] Political scientists such as Robert Putnam (2007) have emphasized the effects of heterogeneity on "social capital", or peoples' beliefs and actions that contribute to "social networks and the associated norms of reciprocity and trustworthiness."

below). A common approach has been to regress individuals' survey responses on their individual and neighborhood level characteristics, with the latter separately taken from census data for the neighborhood or region in which the survey respondents live. Almost all such studies have used cross-section or pooled cross-section data.

A selective summary of this literature might suggest that there is a robust negative relationship between heterogeneity and support for public goods or trust in others. Alesina and La Ferrara (2000, 2002), using pooled cross-sectional data from multiple years of the U.S. General Social Survey, find that increased neighborhood heterogeneity of income or race lowers an individual's probability of reporting membership in any organization, or generally trusting others. Costa and Kahn (2003a), using pooled cross-section data from two years of the U.S. Current Population Survey (CPS), find that increased heterogeneity of income or birthplace lowers an individual's probability of membership in any organization or of volunteering. Costa and Kahn (2003b), using the CPS and the DDB Lifestyle Survey, find that increased racial heterogeneity lowers individuals' probability of volunteering. Vigdor (2004) finds that U.S. counties that were more heterogeneous by race, age or educational attainment in 2000 had lower response rates of households mailing in completed census forms. Putnam (2007), using responses from the U.S. Social Capital Community Benchmark Survey of 2000, finds that individuals in more racially heterogeneous census tracts were less likely to give to charity or volunteer, trust others (whether of their own or other races), register to vote, or be optimistic that others would cooperate in dilemmas of collective action. Finally, Luttmer (2001), again using pooled cross-section data from multiple years of the General Social Survey, estimates that support for government welfare spending is lower in more racially heterogeneous states, and that this effect is significant in explaining some of the variation in generosity of welfare across states.

While the bulk of the adverse findings regarding heterogeneity have come from the United States, a limited number of studies have found similar results elsewhere, particularly related to trust. Leigh (2006), using the 1997/98 Australian Community Survey and census data, estimates that increased neighborhood heterogeneity of country of birth or of language spoken at home lowers the probability of individuals trusting their neighbors. Letki (2008), using data from the British Home Office Citizenship Survey of 2001 and census, finds that increased ward level racial heterogeneity has a similar effect. Miguel and Gugerty (2005), using an NGO-funded survey of schools in rural Kenya, observe that local ethnic heterogeneity is associated with sharply lower voluntary school fundraiser contributions, resulting in lower quality primary schools. Finally, alone among the studies we know of, Gustavsson and Jordahl (2008) use true panel data to estimate the effect of income, ethnic, and birthplace heterogeneity on trust in Sweden, specifically using the 1994 and 1998 Swedish Election Studies Panel and county level census data. They find that increased income inequality in the lower half of the income distribution, particularly when defined over disposable income, lowers trust in others.

While the above (selective) summary might suggest conclusive empirical evidence that heterogeneity corrodes people's contributions to public goods and trust in others, a closer inspection shows these results to be less robust and more problematic than they first appear.

Regarding robustness, papers testing for the effects of different kinds of heterogeneity often find that some kinds matter, but others do not, or that multiple kinds matter if tested individually, but not when tested jointly. The type of heterogeneity that matters can also vary from study to study. For example, Alesina and La Ferrara (2002) find that higher racial heterogeneity (white, black, Asian etc) lowers trust in other people, but higher ethnic-origin heterogeneity does not. Similarly, higher income inequality lowers trust when racial heterogeneity is excluded, but has no effect when it is included. In contrast, Alesina and La Ferrara (2000) find that while income, racial and ethnic heterogeneity all lower the probability of group membership when entered separately, only income heterogeneity matters when all three are included. And while Letki (2008) finds that higher racial heterogeneity lowers trust in the United Kingdom, it has no effect on people's likelihood of formal or informal volunteering, unlike in the United States (Putnam (2007) and Costa and Kahn (2003b)). Again, while a higher share of neighbors born overseas appears to lower trust in Australia or Sweden (Leigh 2006, Gustavsson and Jordahl 2008), the latter authors do not find this to persist in fixed effects analysis. Finally, Gustavsson and Jordahl do not find that higher ethnic heterogeneity affects trust in Sweden, unlike Letki (2008) in Britain.

Regarding problems, the cross-sectional nature of most studies on heterogeneity (Putnam 2007, Alesina et al. 1999, Letki 2008, Leigh 2006, Vigdor 2004, and Miguel and Gugerty 2005) mean they cannot be sure that effects attributed to heterogeneity are not instead caused by omitted variables that are correlated with heterogeneity. Letki (2008) in particular argues that neighborhood deprivation, poverty and crime may correlate with ethnic diversity yet be inadequately captured in preceding studies. Cross-sectional studies also cannot say whether it is the *level* or *change* in the level of heterogeneity that is affecting people's behavior.[3]

[3] Luttmer (2001), Costa and Kahn (2003a, 2003b), and Alesina and La Ferrara (2000, 2002) construct pseudo panels of cross-sectional survey data, which rely for legitimacy on the representativeness of each wave of the survey. Of the papers we have identified, only Gustavsson and Jordahl (2008) use true panel data at the individual level for 680 individuals.

An additional problem which existing studies have not generally emphasized is whether the researcher's (usually constrained) choice of neighborhood size is affecting results. The coarseness of "neighborhood" used has varied widely. Gustavsson and Jordahl (2008) use the twenty one counties of Sweden, which contain 200,000 – 300,000 or even over one million people. Alesina and La Ferrara (2000, 2002), Costa and Kahn (2003a) and Luttmer (2001) use a respondent's US Metropolitan or Primary Metropolitan Statistical Area (MSA/PMSA), which contain a urban core of at least 50,000 and surrounding suburbs. Letki uses the U.K census level of ward, which contain anywhere from hundreds to over 30,000 people. Alesina et al. (1999) use U.S. counties. Leigh (2006) uses the Australian postal area, typically containing 20,000 people. Since heterogeneity of income, race etc. can vary dramatically in just a few city blocks, the heterogeneity people experience most intimately may vary widely between sub-areas of these coarsely defined neighborhoods. Perhaps because of this, Vigdor (2004) argues that other things being equal, finer units are preferable. At the finer end, U.S. census tracts containing three to five thousand people are used by Putnam (2007), and by Vigdor (2004) as a supplement to county level analysis.[4] Aside from Vigdor (2004), few studies have examined the sensitivity of results to neighborhood size, or exploited a possible interaction between size and degree of endogenous self-selection.

3. Theories of Causation Between Local Heterogeneity and Volunteering

Several theories have been advanced to provide a causal link between heterogeneity and people's contributions to public goods or trust in others. Models based on preferences stress that a person's desire to take actions to benefit others may depend on the similarity he perceives between himself and those others (Vigdor 2004, Luttmer 2001). More indirectly, people may prefer to interact with others like themselves, which can cause local social networks and the trust and public good activity they generate to atrophy as dissimilarities increase (Alesina and La Ferrara 2000, 2002, Putman 2007). An alternative preference-based explanation is that increased social heterogeneity increases the heterogeneity of people's preferences regarding the *type* of public goods that should be provided, and thus decreases the *amount* provided (Alesina, Baqir and Easterly (1999)). In particular, in a two-stage framework where individuals vote first on tax/amount of public goods that should be provided, and then on type, Alesina et al. (1999) show that increased social heterogeneity that increases the median distance to the type of good most favored by the median voter will reduce

[4] Vigdor (2004) compares results using census tract and county level units of homogeneity to investigate the sign and extent of endogenous selection bias. We use an analogous approach in our paper, augmented by the existence of a panel of finer unit data for all variables.

voters' prior choice of size of provision. A third approach suggests that heterogeneity may affect the costs and benefits people receive from participating in local information networks. Language heterogeneity in particular may increase people's costs of communicating in such networks, and reduce the quality of information they receive, making their investment in such networks less attractive (Leigh 2006). A fourth theory suggests that heterogeneity may thwart the maintenance of social norms of cooperation needed for people's voluntary provision of public goods. It may reduce the ability of communities to impose negative social sanctions on free riders across group lines (Miguel and Gugerty 2005). Some have categorized the proposed causal mechanisms of heterogeneity via preferences, strategies, and production (Alesina and La Ferrara 2005 and Habyarimana et al. 2007).

In light of these proposed theories, particularly those operating via preferences, we consider a simple model of the supply of volunteering. Consider individual *h*, who has a continuously differentiable and strictly quasi-concave utility function over leisure ℓ, a composite commodity y, and time spent volunteering *v*. His problem is to

$$\underset{\ell,y,v}{Max} U\left(\ell, y, \delta v\right)$$
$$\text{s.t.} \quad w\ell + y + wv \leq wT + y_0, \qquad (1)$$

where T is an endowment of time per day, y_0 is nonlabor income, and w is *h*'s wage, which is also his price of leisure and volunteering. The price of y is normalized to 1. Finally, δ reflects *h*'s relative strength of preference for volunteering. We allow that $\delta = \delta(x_i)$, where x_i is a vector of social heterogeneity measures in *h*'s neighborhood *i*. If a particular dimension *k* of heterogeneity lowers (raises) *h*'s preference for volunteering, then $\delta_{x_k} < (>) 0$. Note that some dimensions of heterogeneity may be highly correlated in neighborhood *i*, such as language and ethnicity, yet have a distinct effect on *h*'s preference for volunteering.

We assume that *h* will volunteer some positive amount ($v^* > 0$) when doing so exceeds his reservation utility from not volunteering, $\bar{V}$. In other words, his decision to volunteer is coded as $Y_{hi} = 1$ if and only if $V(l^*, y^*, v^*) > \bar{V}$, where his interior solutions will be functions of exogenous variables and preferences given in equation (1). Some determinants of these preferences are captured by the covariates used in our subsequent empirical investigation.

Following the linear probability model used by Vigdor (2004), we assume that the probability an individual will volunteer can be expressed as a linear function of a vector of his individual (X_{hi}) and neighborhood (x_i) characteristics

$$\Pr(Y_{hi} = 1) = \alpha + \gamma' X_{hi} + \beta' x_i. \quad (2)$$

Aggregating across neighborhood *i*, the average proportion who volunteer, $y_i = \sum_h^H Y_{hi} / H = \bar{Y}$, can similarly be expressed as a linear function of averaged individual and neighborhood characteristics

$$y_i = \alpha + \gamma' \bar{X}_i + \beta' x_i. \quad (3)$$

While existing theories allow that an individual's volunteering decision may be affected by the heterogeneity of his neighborhood, they say little as to how broadly that neighborhood should be defined. As we demonstrate in Appendix A, problems can arise when researchers define an individual's neighborhood using overly broad or narrow boundaries when the neighborhood heterogeneity measure is concave. With concavity, a "large" neighborhood's heterogeneity will be greater than the average heterogeneity of its constituent parts. Failure to control for this difference can bias estimates of heterogeneity's effect even if people's behavior is unaffected by heterogeneity outside their "small" neighborhoods.

With theory silent as to correct boundary, however, a prudent robustness check is to start by using two (or more) nested boundary levels simultaneously. The coefficient on the small boundary heterogeneity measure will capture its effect on volunteering rates in the small boundary. The coefficient on the large boundary measure will capture any remaining effects on small boundary volunteering of heterogeneity in adjacent small neighborhoods, or of differences in heterogeneity levels between the small neighborhoods. If the coefficient on large boundary heterogeneity is significant, this may indicate the small boundary is too narrow, and that the large unit is either correct or itself too narrow. If instead the coefficient on the large boundary is insignificant, this may indicate it is too broad. Testing between alternative boundary specifications can greatly affect results, as we shall see.

Our approach will thus be to present the results of dual, small and large boundary regressions, first in pooled cross-section, and then separately using between- and fixed effects estimators.[5]

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[5] Our analysis can also be related to the extensive literature on inequality decomposition. Pioneered by Lerman and S. Yizhaki (1985), decomposition seeks to identify the determinants of overall inequality by decomposing it into component sources, and estimating the effects of these component sources on an outcome of interest. Our model can be thought of as providing decomposition by spatial boundary into within- and between small neighborhood effects. This

4. Empirical Analysis

4.1 The case of New Zealand

Common to other Western nations, New Zealand has experienced a marked increase in social diversity over the past 25 years. Starting as a British colony in the mid-nineteenth century, New Zealand's population was predominantly of British ancestry, with a significant indigenous Maori population (Phillips, 2008). Immigration from other European and Commonwealth countries increased from the time of the Second World War, and from neighboring Pacific Island and South East Asian nations. Changes to the Immigration Act of 1987, and the introduction of an ethnicity-blind points system in 1991 were followed by a substantial further diversification of migrants from China, India, and North African and Middle Eastern countries (Phillips, 2008). For more detail about social diversity and volunteering in New Zealand, we turn to the data.

4.2. Data and descriptive statistics

Our data comes from the New Zealand census rounds of 1996, 2001 and 2006. The New Zealand census collects data on individual and household characteristics including volunteering activities, ethnicity/race, languages spoken, birthplace and household income. These data are released by Statistics New Zealand at the unusually small size of meshblock (≈ 100 people) as well as area unit (≈ 2000 people). Constant 2006-defined neighborhood boundaries are used for all three rounds to ensure consistency. Our sample is restricted to those neighborhoods without missing or censored explanatory variables.[6] Our pooled sample over the three census rounds is 3,504 area units and 49,600 meshblocks.

A description of all dependent and explanatory variables used is provided in Appendix B, and corresponding descriptive statistics are provided in Appendix C. To provide a description of contemporary New Zealand, Figure 1 illustrates how the volunteering rate and ethnic, language, birthplace and nominal household income shares have changed between 1996, 2001 and 2006. These shares are population-weighted mean values, based on those meshblocks providing complete

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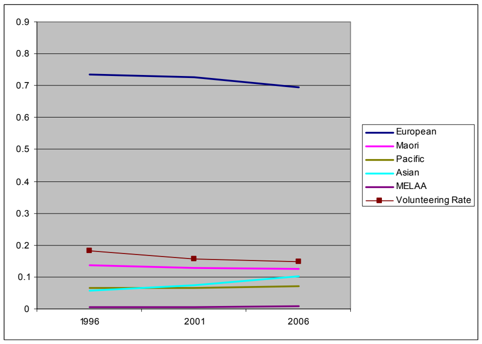
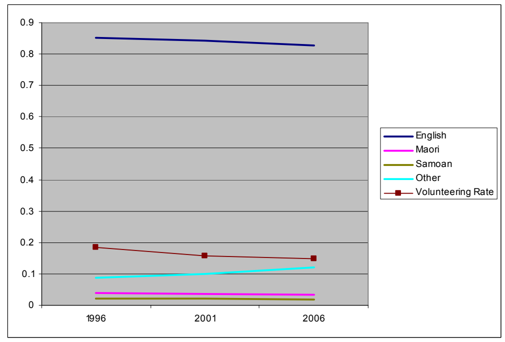
approach might prove fruitful for researchers examining the effects of income inequality on outcomes such as growth; inequality can arise not only from component sources of income, but also from within- and between neighborhood effects.

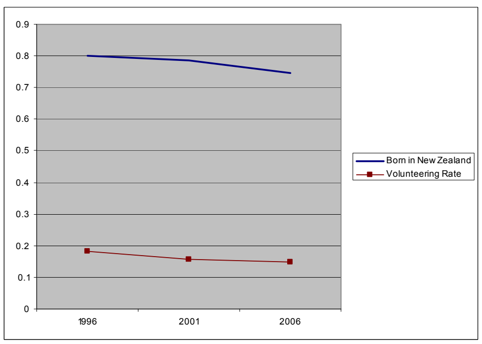
[6] In general, we constructed share variables for each neighborhood so as to ensure they were weakly positive and summed to one. In the case of gender, for example, we constructed "ShareFemale" by dividing the frequency of "Number Female" by ("Number Female"+"Number Male"). This assumes that non respondents had the same gender composition as respondents. See Appendix B for details of each variable's construction.



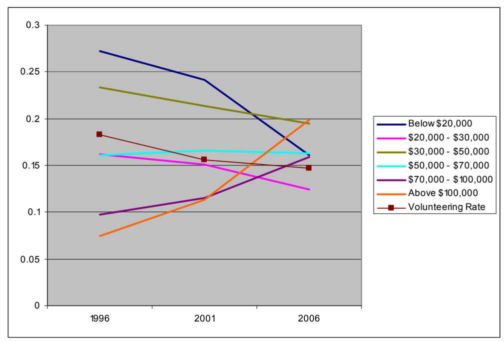
Ethnic Affiliation Shares
(a)



Languages Spoken Shares
(b)



Born in New Zealand Share
(c)



Nominal HH Income Shares (NZ$)
(d)

Fig. 1: Population Weighted Mean Meshblock Ethnicity, Language, Birthplace and Nominal Household Income Shares in New Zealand
(N_{1996} = 11658, N_{2001} = 18574, N_{2006} = 19368)

observations for our analysis, or our "common sample."[7] The population-weighted meshblock average proportion of New Zealanders aged 15 or over who reported volunteering at least once outside the household in the previous four weeks was 18.3% in 1996, and then, using a slightly different definition, 15.6% in 2001 and 14.7% in 2006.[8] At the same time as volunteering rates have declined,

[7] Corresponding descriptive statistics using all meshblocks providing observations for a given variable (our "maximum sample"), are provided in Appendix D.
[8] For 1996 volunteering was defined as having "Attended Committee Meeting etc Unpaid for Group, Church or Marae." For 2001 and 2006 the definition was changed to be defined as any "Other Helping or Voluntary Work For or Through any Organisation, Group or Marae." For all three years our definition excludes those caring for a child or someone who was ill, elderly, or

Figure 1 suggests that New Zealand has been increasing in diversity along most dimensions. The (population-weighted) mean meshblock share with European ethnic affiliation fell from 76.4% in 1996 to 74.2% in 2001, to 71.5% in 2006 with an offsetting rise in the share with Asian and Pacific Island affiliations. The share speaking English out of all languages spoken fell from 86.8% to 85.4% to 83.9%, with an offsetting rise in the share speaking "Other" languages (neither Maori nor Samoan). Similarly, the share born in New Zealand dropped from 82.4% to 80.5% to 77.0%, though this reflected in part continuing strong migration from the United Kingdom. Finally, the population-weighted average of meshblock real median household income rose from NZ$37,800 in 1996 to $39,300 in 2001 to $45,300 in 2006.

To see how the corresponding dispersion measures have changed over time we move to Table 1. From 1996 to 2006, fragmentation (or one minus the Herfindahl index of concentration) by ethnicity/race, languages usually spoken and birthplace increased, while nominal household income inequality (as measured by the Gini coefficient) decreased. Regarding ethnicity, a fragmentation index could range between 0 and .8 when defined over five categories. Population-weighted mean ethnic fragmentation across all meshblocks rose from .347 in 1996, to .352 in 2001, to .378 in 2006. A similar index for language fragmentation, which could range from 0 to .75 over four categories, rose from 0.246 in 1996 to .254 in 2001 to .275 in 2006. The index for birthplace fragmentation, which could range from 0 to .5 over two categories (inside or outside of New Zealand), rose from .293 in 1996 to .300 in 2001 to .329 in 2006. In contrast, the Gini coefficient of nominal household income inequality fell from .346, to .344, to .316.[9] Changes to the distributions of meshblock heterogeneity and volunteering rates between 1996 and 2006 are illustrated in Figure 2. Over this decade the distribution of ethnic, language and birthplace fragmentation in New Zealand shifted to the right, while the distribution of nominal household income inequality shifted left.

Are the changes in neighborhood ethnic, language and birthplace fragmentation simply moving in lockstep? Table 2 provides the correlations between each type of heterogeneity, both in variation *between* neighborhoods, and in variation *within* neighborhoods over time. The correlations based on variation

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disabled outside the household. See Appendix B. Because of the change in volunteering question, we have repeated all the analysis to follow using only 2001 and 2006 data. The results are very similar to what we report here, other than that the evidence for an effect of income inequality is further weakened under fixed effects. In particular, meshblock level income inequality loses significance at any reasonable level.

9 We assign all households in each income band the midpoint income, with the top-coded midpoint set at NZ$115,000. Because the six household income bands were not adjusted for inflation between each census, we can only measure how the dispersion of *nominal* income has changed over time.

Table 1: Population weighted means and standard deviations of key variables at the meshblock level, using a common sample.

Census Year	*Variable*				
	Volunteer Rate Mean (St. Dev	Ethnic Fragment. Mean (St. Dev)	Language Fragment. Mean (St. Dev)	Birthplace Fragment. Mean (St. Dev)	Household Income Gini Mean (St. Dev)
1996 N=11658	.183 (.064)	.347 (.185)	.246 (.136)	.293 (.126)	.346 (.055)
2001 N=18574	.156 (.064)	.352 (.191)	.255 (.141)	.300 (.132)	.344 (.058)
2006 N=19368	.147 (.060)	.378 (.192)	.275 (.143)	.330 (.129)	.316 (.065)

within neighborhoods are surprisingly weak, indicating a lack of co-movement in heterogeneity dimensions over time. In contrast, correlations based on variation between neighborhoods are higher, particularly between language and ethnic heterogeneity (.88), and between language and birthplace heterogeneity (.72). This suggests the need in cross-section estimation to try specifications with and without all types of heterogeneity simultaneously controlled.

We begin our examination of a relationship between heterogeneity and volunteering by illustrating pair-wise correlations. In Figure 3 we use our pooled sample to graph 95% confidence intervals of the best fit polynomial relationship between each meshblock's volunteering rate and each dimension of heterogeneity. A clear negative relationship appears between volunteering and ethnic, language and birthplace fragmentation, while a more diffuse inverted U relationship appears for nominal income inequality. This latter non-monotonic relationship might suggest volunteering is increasing in low levels of local inequality, and falling in extreme inequality.

Or, the greater diffusion may suggest that a correlation does not exist, at least with our dispersion measure based on nominal incomes. Thus, consistent with the findings in the literature, the fall in volunteering rates in New Zealand coincided with increasing heterogeneity by several, though not all dimensions. Nonetheless, other changes were taking place in New Zealand over this time which could have influenced people's decision to volunteer (via their tastes or opportunity costs), or organizations' decisions to demand volunteers (via volunteers' non-wage costs and productivity (Handy and Srinivasan (2005))). We

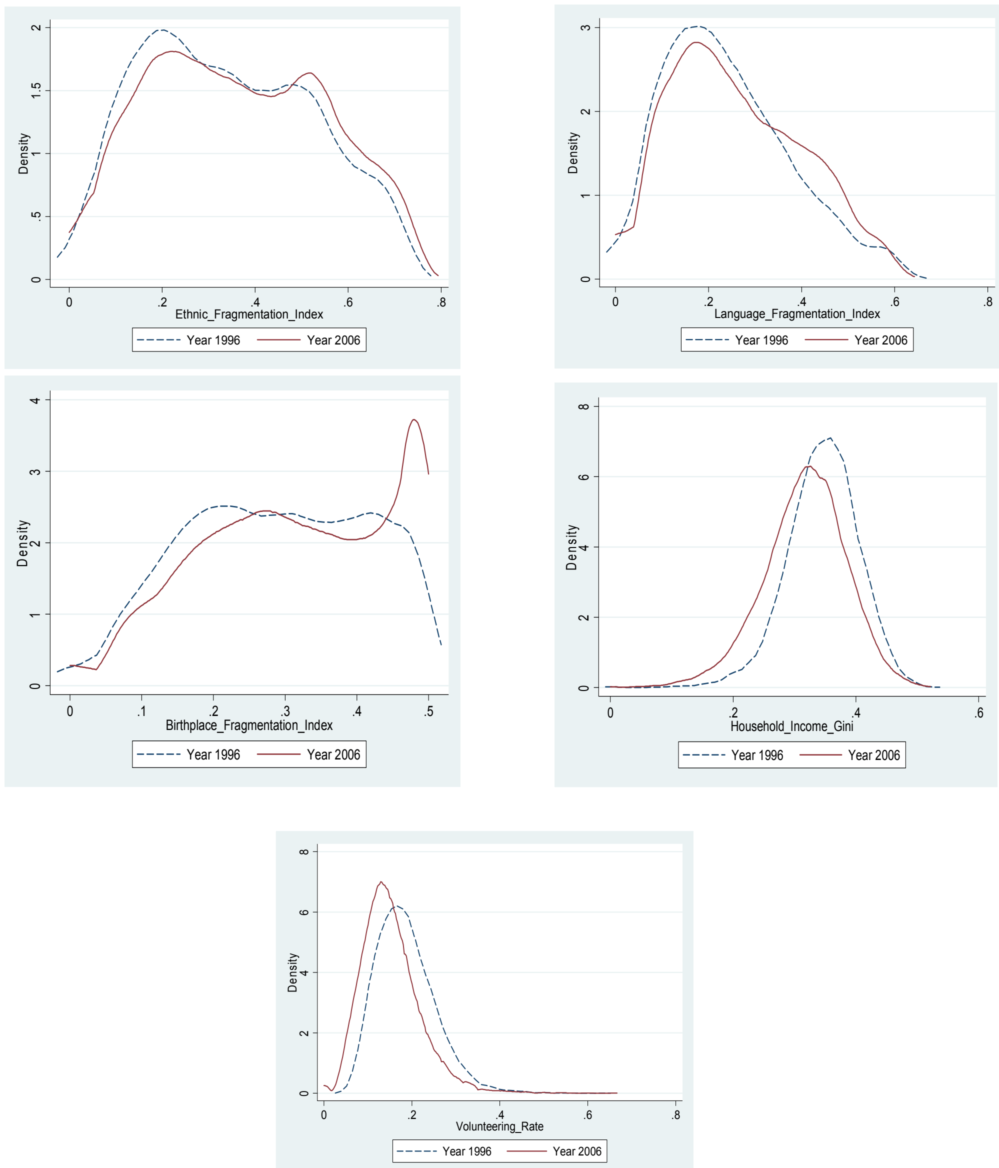

Fig. 2: Changes in the distribution of ethnic, language, and birthplace fragmentation, income inequality and volunteering rates from 1996 to 2006

construct measures for many of these confounding factors, which are described in Appendices B and C, including real median household income, and the ethnicity, language, and birthplace shares that underlie our fragmentation measures. The mean share of females remained steady at 51%, while the mean percentage whose

Table 2: Correlations of between- and within variation for each type of heterogeneity (area unit N = 3504).

Between Variation	Ethnic Fragmentation	Language Fragmentation	Birthplace Fragmentation	Household Income Gini
Ethnic Fragment.	1.000			
Language Fragment.	.878	1.000		
Birthplace Fragment.	.491	.717	1.000	
Household Inc. Gini	.161	.045	-.246	1.000

Within Variation	Ethnic Fragmentation	Language Fragmentation	Birthplace Fragmentation	Household Income Gini
Ethnic Fragment.	1.000			
Language Fragment.	.307	1.000		
Birthplace Fragment.	.013	.004	1.000	
Household Inc. Gini	.003	.001	-.552	1.000

highest education was a bachelor's or honour's degree rose from 8% to 10% to 12%. At the same time, the mean percentage of those aged 15 or over not in the labor force fell from 34% to 33% to 31%. The mean percentage claiming Christian religious affiliation also fell from 67% to 62% to 56%, while the mean percentage claiming no religious affiliation rose from 28% to 31% to 36%. We will try to untangle the effects of these various changes on volunteering rates in the regression analysis that follows.

Finally, to examine the effect of neighborhood boundary, Table 3 compares the mean and standard deviation of meshblock and area unit fragmentation measures.[10] As predicted by Jensen's inequality, the means of all

[10] The descriptive statistics in Tables 1 and 3 use the common sample used for subsequent regression analysis.

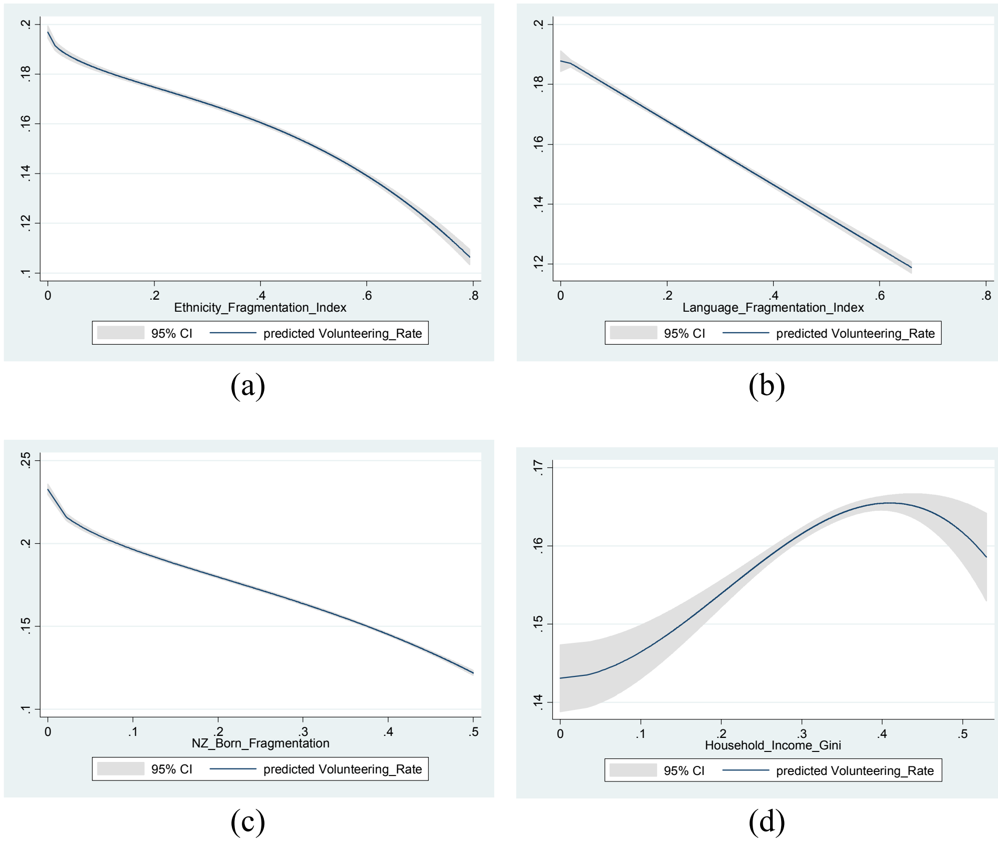

Fig. 3: Best Fit Polynomial Relationship Between Meshblock Volunteering Rate and (a) Ethnic, (b) Language, (c) Birthplace and (d) Household Income Fragmentation. Pooled Sample (N = 49,600)

types of heterogeneity are greater over area units than meshblocks. The standard deviations of area unit measures are also consistently smaller.

4.3. Estimation strategy and results

In this section, we lay out and implement our strategy for estimating the cross-sectional and longitudinal empirical relationship between social heterogeneity and volunteering. In line with the vast majority of studies in our literature review, we shall begin by using pooled cross-section OLS as our baseline specification. This approach averages together the effects of variation between neighborhoods and variation within neighborhoods over time. To address the problem of omitted variable bias and check the robustness of our results, we shall then add two steps. First, we will repeat the baseline cross- sectional analysis using various additional

Table 3: Pooled population weighted means and standard deviations of heterogeneity at the meshblock and area unit levels, using a common sample.

Neighbor-hood Size	*Variable*			
	Ethnic Fragment. Mean (St. Dev)	Language Fragment. Mean (St. Dev)	Birthplace Fragmentation Mean (St. Dev)	Household Inc. Gini Mean (St. Dev)
Small (Meshblock) N=49600	.361 (.190)	.261 (.141)	.310 (.130)	.334 (.062)
Large (Area Unit) N=3504	.402 (.176)	.283 (.127)	.318 (.120)	.355 (.041)

groups of control variables. Second, we will divide our neighborhood panel according to its cross-sectional (between) variation and longitudinal (within) variation. Estimates of heterogeneity's effects based on within variation using fixed effects can control for omitted time-invariant characteristics of neighborhoods that may be affecting volunteering rates. By comparing within estimators to between estimators of heterogeneity's effects, we can check the degree to which the latter are biased due to unobserved neighborhood characteristics that may be correlated with heterogeneity. Throughout this process, we shall provide regressions using both (small) meshblocks and (large) area units.

Beginning with our baseline cross-sectional analysis, we run regressions of the form

$$y_{ijt} = X'_{ijt}\beta + u_{ijt} \quad (4)$$

where y_{ijt} is meshblock i's volunteering rate in area unit j in year t. X_{ijt} is a vector of neighborhood characteristics, year dummies, and social heterogeneity measures, while u_{ijt} is a random error. In each case, we regress volunteering rates on one type of heterogeneity at a time, along with its underlying level variables (e.g. ethnic shares for ethnic fragmentation, language or birthplace shares for language or birthplace fragmentation, and median household income for the income Gini). To these we add the baseline covariates of share female, median age, population density, mean household size, share married, shares of families comprised of couples with children, couples without children, and year dummies.[11]

Table 4 provides the results. Starting with our hybrid specification in Column (1), a 10 percentage point increase in *area unit* ethnic/racial heterogeneity decreases *meshblock* volunteering by .4 percentage points and is significant. This indicates the existence of significant between-effects and/or the effect of heterogeneity in other meshblocks $\Delta x_{i'j}, i \neq i'$, which suggests that meshblock boundaries are overly narrow. When area units alone are used in Column (2), a 10 percentage point increase in area unit ethnic fragmentation significantly decreases the (area unit) volunteering rate by 1.4 percentage points. It is interesting to note that if we had used meshblocks instead, as in Column (3), a 10 percent increase in ethnic fragmentation would still have decreased the (meshblock) volunteering rate by 1.3 percentage points. Thus even though meshblocks are too narrow, ethnic heterogeneity's pooled cross-section effect on volunteering is not greatly affected by our choice of neighborhood boundary. We shall check subsequently whether this remains true as we better control for unobserved neighborhood characteristics.

The estimated effects of language, birthplace and household income heterogeneity are similarly provided in Columns (4) – (12) of Table 4. Once again, the significant effect of (residual) area unit heterogeneity in two- boundary regressions (Columns (4), (7) and (10)) indicate that meshblocks are too narrow, and that area unit analysis is preferable. Like ethnic heterogeneity, language and birthplace heterogeneity are negatively associated with area unit volunteering rates. From Column (5), a 10 percentage point increase in language fragmentation decreases an area unit's volunteering rate by 3.7 percentage points. A similar increase in birthplace fragmentation has less effect (Column (8)), reducing the volunteering rate by only .3 percentage points. In contrast, a 10 percent increase in the nominal household income Gini *increases* the area unit volunteering rate by 1.5 percentage points (Column (11)).

A final point of interpretation concerns the relative size of heterogeneity coefficients in the hybrid vs. single boundary specifications in Table 4. For meshblocks, each type of heterogeneity's estimated effect on volunteering turns out to be smaller (in absolute terms) in the hybrid regressions than when meshblocks alone are used, or $|\beta_W| < |\beta_S|$. This is because heterogeneity's effects within meshblocks are augmented by a between-meshblock effect of similar sign (and because the covariance of meshblock and between-meshblock heterogeneity

[11] We have also added ethnic share composition to the baseline covariates when examining the effects of birthplace or income fragmentation on volunteering. This is because of the clear positive effect that Maori ethnic affiliation has on volunteering rates. Ethnic shares remain omitted when examining the effects of language fragmentation, because ethnic and language shares are highly correlated.

Table 4: Volunteering determinants: baseline OLS (N_{MB} = 49,060 N_{AU} = 3504)

	(1)	(2)	(3)	(4)	(5)	(6)
Variable	Ethnic Frag. Hybrid	Ethnic Frag. AU	Ethnic Frag. MB	Lang. Frag. Hybrid	Lang. Frag. AU	Lang. Frag. MB
Intercept	.219	.010	.219	.372	.282	.345
	(.018)***	(.019)	(.018)***	(.022)***	(.013)***	(.020)***
Fragmentation:	-.105		-.128	-.244		-.275
Meshblock	(.004)***		(.004)***	(.015)***		(.015)***
Fragmentation:	-.040	-.135		-.068	-.372	
Area Unit	(.003)***	(.002)***		(.004)***	(.009)***	
Asian Ethnic Sh.	-.048	.076	-.059			
	(.016)***	(.018)***	(.017)***			
Pacific Ethnic Sh.	-.044	.070	-.051			
	(.016)**	(.017)***	(.016)***			
Maori Ethnic Sh.	.161	.317	.157			
	(.016)***	(.017)***	(.016)***			
European Ethnic Sh.	-.082	.010	-.084			
	(.017)***	(.018)	(.017)***			
English Lang. Share				-.253	-.350	-.232
				(.020)***	(.011)***	(.020)***
Maori Lang. Share				.552	.792	.574
				(.009)***	(.006)***	(.009)***
Samoan Lang. Share				.076	.232	.074
				(.008)***	(.005)***	(.008)***
Female Share	.010	-.007	.007	.019	.089	.016
	(.007)	(.010)	(.007)	(.007)	(.010)***	(.007)
Median Age	.000	.001	.000	.000	.001	.000
	(.000)***	(.000)***	(.000)***	(.000)***	(.000)***	(.000)***
Household Size	-.007	-.009	-.007	-.003	-.007	-.004
	(.001)***	(.000)***	(.001)***	(.001)***	(.000)***	(.001)***
Marriage Share	.099	.024	.102	.101	.031	.106
	(.003)***	(.003)***	(.003)***	(.003)***	(.003)***	(.003)***
Share of Families	.037	.171	.037	.041	.221	.039
"Couple with Kids"	(.004)***	(.005)***	(.004)***	(.004)***	(.005)***	(.004)***
Share of Families	.018	.116	.017	.025	.168	.027
"Couple w/o Kids"	(.003)***	(.004)***	(.003)***	(.003)***	(.003)***	(.003)***
Population Density	.000	.000	.000	.000	.000	.000
	(.000)***	(.000)***	(.000)***	(.000)***	(.000)***	(.000)***
Year 2001	-.026	-.000	-.026	-.027	.000	-.025
	(.001)***	(.000)	(.001)***	(.001)***	(.000)	(.001)***
Year 2006	-.031	-.000	-.030	-.031	-.000	-.029
	(.001)***	(.000)	(.001)***	(.001)***	(.000)	(.001)***
R^2	.269	.593	.266	.263	.612	.262

Table 4 (Cont'd):

Variable	(7) Birthplc. Frag. Hybrid	(8) Birthplc. Frag. AU	(9) Birthplc. Frag. MB	(10) HH Inc Gini Hybrid	(11) HH Inc Gini AU	(12) HH Inc Gini MB
Intercept	.092	-.380	.080	.028	-.374	-.053
	(.017)***	(.018)***	(.017)***	(.018)	(.018)***	(.016)**
Fragmentation:	-.052		-.108	.021		.036
Meshblock	(.006)***		(.006)***	(.006)***		(.006)***
Fragmentation:	-.087	-.027		.207	.153	
Area Unit	(.005)***	(.004)***		(.009)***	(.007)***	
Born in NZ Share	-.031	.073	-.031			
	(.007)***	(.004)***	(.007)***			
Real Median HH Inc				.000	.000	-.000
				(.000)***	(.000)***	(.000)***
Asian Ethnic Sh.	-.004	.238	-.013	.021	.019	.025
	(.016)	(.018)***	(.016)	(.016)	(.011)	(.017)
Pacific Ethnic Sh.	.041	.268	.039	.067	.065	.076
	(.016)**	(.017)***	(.016)**	(.016)***	(.016)***	(.016)***
Maori Ethnic Sh.	.169	.428	.181	.263	.260	.272
	(.016)***	(.017)***	(.017)***	(.016)***	(.017)***	(.017)***
European Ethnic Sh.	.047	.227	.051	.123	.127	.126
	(.016)***	(.017)***	(.016)***	(.016)***	(.016)***	(.016)***
Female Share	.018	-.034	.016	.004	.003	.002
	(.007)	(.011)***	(.007)**	(.007)	(.009)	(.007)
Median Age	.001	.001	.001	.001	.001	.000
	(.000)***	(.000)***	(.000)***	(.000)***	(.000)***	(.000)***
Household Size	-.002	-.005	-.003	-.001	.000	-.001
	(.001)***	(.000)***	(.001)***	(.001)	(.000)	(.001)
Marriage Share	.100	.025	.106	.119	.118	.118
	(.003)***	(.004)***	(.003)***	(.003)***	(.003)***	(.006)***
Share of Families	.047	.233	.043	.048	.048	.049
"Couple with Kids"	(.004)***	(.006)***	(.004)***	(.004)***	(.007)***	(.004)***
Share of Families	.028	.180	.028	.026	.026	.029
"Couple w/o Kids"	(.003)***	(.004)***	(.004)***	(.004)***	(.004)***	(.004)***
Population Density	.000	.000	.000	.000	.000	.000
	(.000)***	(.000)***	(.000)***	(.000)***	(.000)***	(.000)***
Year 2001	-.025	.001	-.025	-.023	-.026	-.024
	(.001)***	(.000)**	(.001)***	(.001)***	(.000)***	(.001)***
Year 2006	-.028	.001	-.029	-.026	-.026	-.026
	(.001)***	(.000)***	(.001)***	(.001)***	(.000)***	(.001)***
R^2	.256	.560	.251	.249	.249	.242

Note: ***, **, * represent the levels of statistical significance of 1%, 5%, and 10% respectively. Run on Stata 9.2. Robust standard errors in parentheses.

is positive - see equation A.6 of Appendix A). Moving to area units, ethnic and language heterogeneity's estimated effects on volunteering also turn out to be smaller in absolute terms in the hybrid regressions than when area units are used alone, or $|\beta_B|<|\beta_L|$. This is because the effect on volunteering of within-meshblock ethnic or language heterogeneity is greater than the effect of between-meshblock heterogeneity $|\beta_W|>|\beta_B|$, as illustrated by equation A.9 of Appendix A. In contrast, birthplace and income heterogeneity's effects are larger in the hybrid regressions than when area units are used alone. This suggests the effect of within-meshblock birthplace or income heterogeneity is less than the effect of between-meshblock heterogeneity on volunteering, or $|\beta_W|<|\beta_B|$.

This comparison suggests that people's volunteering decisions are more depressed by the ethnic or language heterogeneity of their immediate neighborhood than by heterogeneity in adjacent neighborhoods (or by differences in heterogeneity between the two). In contrast, people's volunteering decisions appear more depressed by birthplace heterogeneity and elevated by income inequality outside their immediate neighborhoods. We shall return to this finding in the conclusion.[12]

So far, our baseline cross-section results might suggest that New Zealand's shifting immigration (more diversity) and tax policies (less income inequality) have been responsible for a drop in the country's volunteering rate. All estimated effects are statistically significant.

4.4 Addressing Endogeneity With Additional Covariates

At the same time, these results could simply reflect the omission of other influences on volunteering that are correlated with heterogeneity. Omitted factors could include variation in religious affiliation, neighborhood deprivation, labor force status, or education. We have also yet to test whether one type of heterogeneity affects volunteering when other dimensions of heterogeneity (and their underlying shares) are controlled for. Thus, in Table 5 we extend our pooled cross-sectional analysis to include groups of other confounding variables one at a time.[13] These groups are: 1) religious affiliation: Christian, other, and no religion affiliation rates, 2) neighborhood deprivation: home ownership rates, median number of bedrooms, crime rates, and percentage receiving single parent domestic

[12] Subsequent fixed effects results will suggest these larger out-of-meshblock effects of birthplace and income heterogeneity on meshblock volunteering are due to unobservable neighborhood characteristics.

[13] High degrees of correlation between various covariates precluded us from including all groups of additional explanatory variables simultaneously.

benefits, 3) employment status: shares in full time work, part time work, unemployed, and not in the labor force, 4) education levels: the share of individuals lacking high school qualifications, with bachelor's or (additional year) honour's degrees, or something intermediate, and 5) including all heterogeneity measures simultaneously, together with their underlying share variables.

While many of our baseline and added covariates explain variation in volunteering rates,[14] we focus in Table 5 on the direct (remaining) effect of each type of heterogeneity. Dual boundary results still confirm that heterogeneity outside meshblocks affects volunteering rates within them, so we focus on area unit specifications. Column (2) of Table 5 shows the effect of area unit ethnic heterogeneity on area unit volunteering rates as each group of confounding variables is added to the baseline covariates of Table 4. In each case, ethnic heterogeneity retains a significant, negative effect on volunteering of between .8 to 1.4 percentage points. From Column (5), language heterogeneity similarly retains a robust and strong negative effect as other covariates are included, from 2.1 to 4.3 percentage points.

Birthplace heterogeneity (Column 8) retains its modest negative effect as covariates are added, with the exceptions of employment status, or where all types of heterogeneity and underlying share variables are entered simultaneously. In this latter case, a 10 percentage point increase in area unit birthplace fragmentation switches sign and *raises* volunteering by .9 percentage points.[15] For its part, income inequality still looks to increase volunteering when religious affiliation, deprivation or employment characteristics are controlled for, but to decrease it when education is controlled, and to lose any effect when all types of heterogeneity are entered simultaneously. The change in findings when all types of heterogeneity are controlled simultaneously (drop in estimated effect of ethnicity and language, reversal for birthplace, loss of significance for income) may reflect the high between-variation correlations that exist between types of heterogeneity as shown in Table 2.

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[14] Those covariates consistently positively related to volunteering rates were share with Maori ethnic affiliation, Maori and Samoan language shares, median age, share married, share of families that had couple with kids, and less so families that had a couple without kids, share with Christian or other religious affiliation, share who owned own home, median number of bedrooms, share with bachelors or honours degrees, and share employed part time. Those covariates consistently negatively related to volunteering rates were share with Asian or MELAA ethnic affiliation, English or "other" language share, household size, population density, share with no religious affiliation, share of families that were single parent, and share employed full time.

[15] Birthplace fragmentation is not perfectly correlated with ethnic or language fragmentation because of continuing high levels of immigration to New Zealand from the United Kingdom.

Table 5: Adding covariates to check the remaining effect of heterogeneity volunteering rates (pooled OLS, meshblock N = 49,600, area unit N = 3504)

Specification		(1)	(2)	(3)	(4)	(5)	(6)
Additional Controls[a]	Level	Ethnic Frag. Hybrid	Ethnic Frag. AU	Ethnic Frag. MB	Lang. Frag. Hybrid	Lang. Frag. AU	Lang. Frag. MB
No	Meshblock	-.105 (.004)***		-.128 (.004)***	-.244 (.015)***		-.275 (.015)***
No	Area Unit	-.040 (.003)***	-.135 (.002)***		-.068 (.004)***	-.372 (.009)***	
Religion	Meshblock	-.084 (.004)***		-.109 (.004)***	-.201 (.016)***		-.240 (.015)***
Religion	Area Unit	-.041 (.003)***	-.108 (.002)***		-.072 (.004)***	-.307 (.008)***	
Deprivation[b]	Meshblock	-.102 (.005)***		-.126 (.004)***	-.231 (.017)***		-.256 (.017)***
Deprivation[b]	Area Unit	-.041 (.003)***	-.137 (.002)***		-.065 (.005)***	-.369 (.010)***	
Employment	Meshblock	-.100 (.004)***		-.119 (.004)***	-.241 (.016)***		-.265 (.015)***
Employment	Area Unit	-.032 (.003)***	-.088 (.003)***		-.054 (.004)***	-.237 (.010)***	
Education	Meshblock	-.098 (.004)***		-.124 (.004)***	-.322 (.015)***		-.355 (.015)***
Education	Area Unit	-.043 (.003)***	-.130 (.002)***		-.081 (.004)***	-.428 (.009)***	
All Hetero. + Shares	Meshblock	-.042 (.005)***		-.086 (.005)***	-.156 (.026)***		-.187 (.025)***
All Hetero. + Shares	Area Unit	-.083 (.005)***	-.079 (.003)***		.113 (.009)***	-.209 (.021)***	

Notes: ***, **, * represent statistical significance of 1%, 5%, and 10% levels, respectively. Robust standard errors in parentheses.

[a] All regressions include baseline controls. Additional controls included are 1) Religion: Share Christian, Share Other Rel.; 2) Deprivation: OwnHomeShare, MedianBedrooms, Crime; 3) Employment: Unemployed Share, Employed Full-time Share, Not in Labor Force Share; 4) Education: No Qualification Share, Bachelor or Honours Share; 5) All Heterogeneity: Ethnic, Language and Birthplace Fragmentation, Household Income Gini, plus all underlying shares and median household income. [b] Obs.=37942 Meshblocks and 2382 Area Units, as the Crime variable is available only for 2001 and 2006.

Table 5 (Cont'd):

Specification		(1)	(2)	(3)	(4)	(5)	(6)
Additional Controls[a]	Level	Birthplc. Frag. Hybrid	Birthplc. Frag. AU	Birthplc. Frag. MB	HH Inc. Gini Hybrid	HHInc. Gini AU	HH Inc. Gini MB
No	Meshblock	-.052 (.006)***		-.108 (.006)***	.021 (.006)***		.036 (.006)***
No	Area Unit	-.087 (.005)***	-.027 (.004)***		.207 (.009)***	.153 (.007)***	
Religion	Meshblock	-.048 (.006)***		-.091 (.006)***	.023 (.006)		.037 (.006)**
Religion	Area Unit	-.069 (.005)***	-.016 (.004)***		.193 (.009)***	.183 (.007)***	
Deprivation[b]	Meshblock	-.047 (.007)***		-.097 (.006)***	.023 (.007)***		.039 (.007)***
Deprivation[b]	Area Unit	-.082 (.006)***	-.032 (.004)***		.179 (.010)***	.158 (.010)***	
Employment	Meshblock	-.048 (.006)***		-.098 (.006)***	.019 (.006)***		.033 (.006)***
Employment	Area Unit	-.080 (.005)***	-.003 (.004)		.183 (.009)***	.065 (.007)***	
Education	Meshblock	-.073 (.006)***		-.166 (.006)***	-.021 (.006)***		-.006 (.006)
Education	Area Unit	-.167 (.005)***	-.081 (.004)***		.206 (.009)***	-.021 (.007)***	
All Hetero. + Shares	Meshblock	.041 (.008)***		.021 (.008)***	.038 (.006)***		.050 (.006)***
All Hetero. + Shares	Area Unit	-.105 (.006)***	.089 (.005)***		.195 (.009)	.010 (.006)	

Notes: ***, **, * represent statistical significance of 1%, 5%, and 10% levels, respectively. Robust standard errors in parentheses.

[a] All regressions include baseline controls. Additional controls included are 1) Religion: Share Christian, Share Other Rel.; 2) Deprivation: OwnHomeShare, MedianBedrooms, Crime; 3) Employment: Unemployed Share, Employed Full-time Share, Not in Labor Force Share; 4) Education: No Qualification Share, Bachelor or Honours Share; 5) All Heterogeneity: Ethnic, Language and Birthplace Fragmentation, Household Income Gini, plus all underlying shares and median household income.

[b] Obs.=37942 Meshblocks and 2382 Area Units, as the Crime variable is available only for 2001 and 2006.

Taken together, the pooled cross-sectional evidence so far points strongly to a negative effect of heterogeneity by ethnicity and language, a possible negative effect by birthplace, and a possible positive effect by income. Nevertheless, there likely remain unobserved characteristics that are correlated with heterogeneity that are skewing its estimated effects on volunteering. We turn next to address some of these unobserved characteristics by focussing on variation within neighborhoods over time.

4.5 Addressing Endogeneity with Panel Analysis

As mentioned, pooled cross-section estimates of heterogeneity's effects effectively use an average of cross-section variation between neighborhoods, and longitudinal variation within neighborhoods over time. Since we have a genuine panel at neighborhood level, we can estimate heterogeneity's effect on volunteering based on each type of variation separately. We can thus compare heterogeneity's effects on volunteering using a between estimator based only on variation between neighborhoods, with heterogeneity's effects based on a within estimator, fixed effects. This comparison is useful because fixed effects analysis follows neighborhoods over time, and so can control for unobserved but time-invariant *geographic* characteristics that may be influencing volunteering rates. For example, opportunities to volunteer may be more readily apparent in areas with single family houses and schools than in areas with high security apartment towers or mixed residential/retail activity. Ideally, fixed effects would also be able to control for unobserved but time-invariant *individual* characteristics such as people's relative preference for volunteering (different δ's in our model). We could then address the possibility that people who are generally less sympathetic to volunteering may be attracted to live in more heterogeneous areas, exaggerating the estimated effect of heterogeneity on volunteering in cross-section. Unfortunately, our data follows neighborhoods rather than individuals, and the latter are free to move in and out of neighbourhoods over time. Unless we assume that individuals sort themselves so as to congregate with neighbors of a similar disposition towards volunteering, (in a manner akin to the Tiebout hypothesis (1956)) we cannot claim that our fixed effects are controlling for individual unobserved characteristics.

To the extent that fixed effects can address unobserved neighborhood determinants of volunteering in a way the between estimator cannot, it may provide a less biased estimate of heterogeneity's effects. Comparing heterogeneity's effects using within and between estimators may tell us something about the degree of omitted variable bias present in between-estimator analysis, and therefore in pooled cross-section analysis as commonly used in the social capital literature.

As a final preliminary, we note there may be a potentially useful interaction between the coarseness of neighborhood boundary and degree of endogenous self-selection. As argued by Vigdor (2004), people may face fewer constraints of family and job when choosing their small- rather than large neighborhood. Thus, while the direction of bias in cross-sectional estimates of the effect of heterogeneity on volunteering may be unknown *ex ante*, the degree of bias should be greater when smaller units are used. Secondly, as argued, fixed effects may provide less biased estimates of heterogeneity's effects than the between estimator or pooled cross-section to the extent it can better control for at least some unobserved characteristics. Combining these two points, we would expect that fixed effects estimates will be in closer agreement with between or pooled cross-section estimates when larger rather than smaller units are used.

To proceed, we start with our panel data on the area unit volunteering rates in New Zealand:

$$y_{jt} = X'_{jt}\beta + \alpha_j + \varepsilon_{jt}. \qquad (5)$$

α_j are unobservable area unit-specific fixed effects which may be correlated with X_{jt}, while ε_{jt} is a pure random error term. While we repeat the analysis in (5) using meshblocks, we shall emphasize results based on area units. This is because of evidence from pooled cross-section that heterogeneity outside meshblocks is influencing volunteering rates within them, and because meshblocks seem likely to suffer from a greater degree of endogenous selection. To control for the potential correlation between α_j and X_{jt}, we apply OLS to the mean-differenced equation

$$y_{jt} - \overline{y_j} = (X_{jt} - \overline{X_j})'\beta + \varepsilon_{jt} - \overline{\varepsilon_j}. \qquad (6)$$

Here, for any variable Z, $\overline{Z_j} = \sum_t Z_{jt}/3$.[16] The β from (6) are our fixed effects estimators.

To derive our between estimator, we convert all panel data into neighborhood-specific averages over time and apply OLS to the equation

$$\overline{y_j} = \overline{X_j}'\beta + \overline{\varepsilon_j^*} \qquad (7)$$

[16] In corresponding analysis for meshblocks we control for an analogous α_{ij} term.

Here, the error term consists of α_j and ε_{jt}. The β from (7) are our between estimators.

Table 6 presents the between- and within- estimators of heterogeneity's effects. The control variables included are identical to those used in baseline cross-section (Table 4). As seen in Table 6, the within estimators of heterogeneity's effects differ, sometimes substantially, from the between estimators (with the previous pooled cross-section estimators somewhere between the two as expected). In general, evidence that heterogeneity is affecting volunteering is weaker using within- rather than between estimators. The change tends to be more pronounced for analysis using meshblocks than area units, consistent with Vigdor's (2004) self-selection argument. As shown in the first two columns of Table 6, ethnic fragmentation's (negative) 1.35 percentage point effect estimated in the baseline pooled cross-section separates into a 1.69 percentage point effect based on the between estimator, and a 1.12 percentage point effect from the within estimator. Thus, neighborhoods that experience an increase in ethnic heterogeneity do experience a decrease in volunteering rates on average, but the effect is more modest after unobserved neighborhood characteristics are controlled for. Similarly, from the third and fourth column of Table 6, language fragmentation's (negative) 3.72 percentage point effect estimated in pooled cross-section separates into a 4.97 percentage point between-estimator effect, and only a 2.11 percentage point within-estimator effect. Consistent with this attenuating pattern, birthplace fragmentation's between estimator effect is (negative) .86 percentage points, but its within-estimator effect is near zero and not significant. Similarly, nominal income inequality's between estimator effect is (positive) 1.88 percentage points, but its within-estimator effect is near zero and not significant.

To sum up, fixed effect estimates that best control for unobserved neighborhood characteristics still find that ethnic and language heterogeneity have a (negative) effect on volunteering rates, but less than that suggested by estimators that do not take these characteristics into account. In contrast, fixed effects estimates find that birthplace or nominal household income inequality have no effect on volunteering rates. All of our findings are qualitatively summarized in Table 7.

5. Discussion and conclusions

This paper contributes to the growing social capital literature that estimates the effects of neighborhood heterogeneity on outcomes of interest, such as people's

Table 6: Baseline Between and Within (Fixed effects) estimated effects of heterogeneity on volunteering rates (meshblock N = 49,600, area unit N = 3504).

Specification (Basic)	Ethnic Fragmentation		Language Fragmentation	
	Between Estimator	Within Estimator (Fixed Effect)	Between Estimator	Within Estimator (Fixed Effect)
Fragmentation Meshblock	-.136 (.004)***	-.046 (.006)***	.303 (.017)	.019 (.021)
Fragmentation Area Unit	-.169 (.013)***	-.112 (.004)***	-.497 (.063)***	-.211 (.013)***

Specification (Basic)	Birthplace Fragmentation		Household Income Gini	
	Between Estimator	Within Estimator (Fixed Effect)	Between Estimator	Within Estimator (Fixed Effect)
Fragmentation Meshblock	-.119 (.008)***	-.033 (.009)***	.055*** (.009)	.013* (.006)
Fragmentation Area Unit	-.086** (.035)	.001 (.002)	.188*** (.049)	-.001 (.002)

Note: ***,**, * represent the levels of statistical significance of 1%, 5%, and 10% respectively.

likelihood of volunteering. We make use of a rare data source: three waves of census data at unusually fine geographical detail on New Zealanders' volunteering rates and neighborhood characteristics. These waves encompass a time of increasing social diversity in the country. The panel nature of the data enables us to construct a fixed effects specification that controls for unobserved but stable neighborhood characteristics that may influence volunteering and be correlated with heterogeneity. We also highlight a methodological issue that the estimated effect of concave measures of neighborhood characteristics like heterogeneity may be biased by the size of neighborhood used in analysis. Ideally, for concave dispersion measures like fragmentation or Gini coefficients, researchers should use the smallest boundary whose composition includes all likely effects on the behavior of those in the boundary. Using boundaries larger than this will incorrectly capture the effect of differences in heterogeneity

Table 7: Summary regarding the effects of heterogeneity on volunteering rates using area unit neighborhoods

	(1)	(2)	(3)	(4)	(5)
	Baseline Cross-Section	Extended Cross-Section 1 Fragment. At a Time	Extended Cross-Section All Fragment. At Once	Baseline Between Estimator	Baseline Fixed Effects
Ethnic/Racial	-	-	-	-	-
Language	-	-	-	-	-
Birthplace	-	-/0	+	-	0
Nominal HH Income	+	+/-	0	+	0

between constituent small neighborhoods, which can bias estimates of heterogeneity's effect even when such "between heterogeneity" has no effect on people's behavior. Using boundaries smaller than this will again lead to biased estimates of heterogeneity's total effect.

In practice, given that existing theories of heterogeneity's causal effects provide researchers with little guidance as to the correct size of boundary to use, there are advantages to starting with dual boundary specifications. These can distinguish the effect of heterogeneity within small neighborhoods, vs. its combined effects from adjacent small neighborhoods and from differences between these small neighborhoods. If the latter combined effect is significant, researchers may conclude the small boundary is "too" small, and the large boundary correct or itself too narrow.

We put this approach into practice using New Zealand census data on volunteering in 1996, 2001 and 2006. We test for a negative relationship between volunteering and heterogeneity by ethnicity/race, language, birthplace, and household income. The New Zealand census releases data in neighborhoods as small as meshblocks (≈ 100 people), and asks all New Zealanders whether they have volunteered in the four weeks prior to the census night. It thus provides an unusual opportunity to carefully examine the effects of unobserved but time-invariant neighborhood characteristics and boundary size on estimates of the effect of heterogeneity on volunteering rates.

Our baseline pooled cross-section analysis suggests that volunteering rates are affected by the heterogeneity of an individual's area unit, not just his meshblock. It also suggests that some dimensions of heterogeneity discourage volunteering, as has been found by Putnam (2007) for the United States, but not by Letki (2008) for the United Kingdom. Volunteering rates appear to be decreasing in ethnic, language and birthplace fragmentation, yet increasing in nominal household income inequality.

However, recognizing that our pooled cross-section results may be suffering from omitted variable bias, we repeat the analysis in two ways. We first augment our cross-section specifications with additional covariates relating to religious affiliation, deprivation, employment, and education, as well as including the four types of heterogeneity simultaneously. This does not greatly affect the magnitude of our estimates of ethnic and language fragmentations' negative effects. In contrast, birthplace fragmentation switches to having a positive effect on volunteering rates when all types of heterogeneity and their underlying shares are included. Income inequality also has more volatility, switching to having a small negative effect when education is controlled for, and having no effect when all types of heterogeneity are included simultaneously.

Second, we repeat our baseline cross-sectional analysis using between- and fixed effects estimators. These yield estimates of heterogeneity's effects based solely on variation between neighborhoods, and variation within neighborhoods over time, respectively. Fixed effects in particular control for unobserved neighborhood characteristics, and so should be less affected by omitted variable bias. We find that ethnic/racial and language heterogeneity retain a negative effect on volunteering, but of a smaller magnitude than suggested by between- or pooled cross-section estimation. A ten percentage point increase in ethnic or language fragmentation lowers area unit volunteering rates by 1.1 and 2.1 percentage points, respectively. In contrast, birthplace and household income fragmentation lose any significant effect. This attenuation or loss of effects from cross-section to fixed effects is similar to that found by Gustavsson and Jordahl (2008) for the effects of share foreign born or ethnic fragmentation on trust in Sweden.

Our results also clearly illustrate the effect of boundary size upon estimation. Our dual boundary specifications indicate that meshblock volunteering rates are affected by heterogeneity outside meshblocks, so that coarser area units are either appropriate, or themselves too narrow. Yet heterogeneity's estimated effects on volunteering are sensitive to boundary. From our fixed effects analysis, the (incorrect) use of meshblocks rather than area units as a sole boundary would lessen ethnic fragmentation's effect (from 1.1 to .5 percentage points), eliminate language fragmentation's effect, and create small but significant effects for birthplace and income heterogeneity.

Summarizing, we find robust evidence from the population of New Zealand that increases in ethnic and especially language fragmentation at the area unit level over three census rounds have been associated with a small to moderate fall in the nation's volunteering rate. We find much less conclusive evidence regarding the effect of birthplace fragmentation or nominal income inequality. These too appear correlated with volunteering in cross-section, but not in fixed effects where unobserved neighborhood characteristics are controlled.

Our data is unfortunately silent regarding *where* New Zealanders volunteer, or the characteristics of those for whom they volunteer. Thus, our results can do little to discern between the various theories advanced for heterogeneity's effects on volunteering. Our findings are consistent with "preference for affinity" theories based on language or ethnicity (Vigdor 2004, Luttmer 2001, Alesina and La Ferrara 2000, 2002, Putman 2007). Our findings are similarly consistent with Miguel and Gugerty's (2005) proposal that ethnic or linguistic heterogeneity may weaken the enforcement of social norms against free riding, or to Alesina, Baqir and Easterly's (1999) theory that they increase disagreements over the types of public goods that should be provided.

More constructively, the fact that language fragmentation consistently had the largest magnitude of effect gives strongest support to Leigh's (2006) cost-based network investment theory. Language fragmentation increases people's costs and reduces their benefits from investing in local information networks. Such networks may serve to inform people of needs for volunteers, and participation in them may increase people's willingness to fill those needs. Our additional finding from pooled cross section that people's volunteering rates were more affected by the language and ethnic fragmentation of their immediate neighborhoods than of adjacent ones would imply that the information networks affected by heterogeneity are those closest to home.

Appendix A: The Effects of Concavity and Boundary Size on Estimation

However neighborhood boundaries are defined, it seems reasonable to assume that *h*'s likelihood of volunteering may be affected directly by the heterogeneity of his own neighborhood, or indirectly by either the heterogeneity of adjacent neighborhoods, or the differences in heterogeneity between own- and adjacent neighborhoods. These indirect effects seem less likely to matter, the more broadly *h*'s neighborhood is defined. Yet as we demonstrate below, problems can arise when researchers use single boundaries to measure *h*'s community that are overly broad or narrow. This follows from the property that most measures of neighborhood heterogeneity are concave.

I. Concavity and Boundary Size

Consider a society with the neighborhood characteristic of ethnic heterogeneity, where for simplicity there are only ethnicities 1 and 2. Assume the society can be divided into "small" neighborhoods, each of equal size. We start by assuming that people's likelihood of volunteering is affected only by the heterogeneity of the people in their immediate small neighborhood *i*, and relax this later. Suppose next that each small *i* is one of *n* constituent parts of a "large" neighborhood *j*. Following the literature, we measure ethnic heterogeneity using a fragmentation index, but our argument holds for any concave measure.[17] Ethnic fragmentation x_{ij} can be expressed as the product of the two ethnicities' shares:

$$x_{ij} = [1-\theta_{1ij}^2 - \theta_{2ij}^2] = [1-\theta_{1ij}^2 - (1-\theta_{1ij})^2] = 2\theta_{ij}(1-\theta_{ij})\ . \qquad \text{(A.1)}$$

Here $\theta_{ij} \equiv \theta_{1ij}$ is ethnicity 1's share of the population in small neighborhood *i* of large neighborhood *j*. In the same way, we can construct a fragmentation index x_j for the large neighborhood. This is the product of the two ethnicity's shares in the large neighborhood, but can be equivalently expressed as each ethnicity's average share over the n constituent small neighborhoods.

$$x_j = [1-\theta_{1j}^2 - \theta_{2j}^2] = [1-\theta_{1j}^2 - (1-\theta_{1j})^2] = 2\theta_j(1-\theta_j)\ , \qquad \text{(A.2)}$$

where $\theta_j \equiv \theta_{1j} = \frac{\sum_{i=1}^{n}\theta_{1ij}}{n}$ is ethnicity 1's share in large neighborhood *j*. From

the (strict) concavity of x_{ij} and x_j in (A.1) and (A.2), it follows from Jensen's inequality that

$$E(x_{ij}) = E(f(\theta_{ij})) < f(E(\theta_{ij})) = f(\theta_j) = x_j, \qquad \text{(A.3)}$$

or the fragmentation of large neighborhood *j* will be (strictly) greater than the average fragmentation of its *n* constituent small neighborhoods. We can define "between" heterogeneity x_j^B as the difference between the fragmentation index of

[17] Other concave measures used in studies of neighborhood effects include the Gini coefficient, Theil entropy index, Atkinson deprivation index, coefficient of variation, or neighborhood entropy index (see Hansmann and Quigley 1982).

large neighborhood *j*, and the average fragmentation of its $i = 1,\ldots,n$ constituent small neighborhoods, or its "within" heterogeneity x_j^W :

$$x_j^B = x_j - E(x_{ij}) = x_j - \frac{\sum_i x_{ij}}{n} = x_j - x_j^W \, . \tag{A.4}$$

II. Between Heterogeneity and Bias in Small Boundary Estimation

The existence of "between" heterogeneity can bias the estimated effect of fragmentation on volunteering when researchers use only "small" boundaries.

To see this, consider a benchmark regression model that correctly recognizes that changes in small neighborhood heterogeneity x_{ij} can affect small neighborhood volunteering rates y_{ij} directly, or indirectly via its effects on differences in heterogeneity between small neighborhoods x_j^B:

$$y_{ij} = \alpha + \beta_W x_{ij} + \beta_B x_j^B + u_{ij} \, . \tag{A.5}$$

Here β_W and β_B are the population regression coefficients of within and between neighborhood heterogeneity, respectively, and u_{ij} is a pure random error. A study that instead uses only small boundaries, and regresses y_{ij} on x_{ij} alone, will yield a population regression coefficient β_S. From comparison with (A.5), β_S may be thought of as a biased estimate of the within effect of heterogeneity, β_W because of the omission of x_j^B. Using a standard result from omitted variable bias,

$$\beta_S = \beta_W + \beta_B \frac{\operatorname{cov}(x_{ij}, x_j^B)}{\operatorname{var}(x_{ij})} \, . \tag{A.6}$$

The good news from (A.6) is that if the small neighborhood is 'big enough' to include all relevant composition characteristics that will affect people's likelihood of volunteering ($\beta_B = 0$), the total effect of heterogeneity will come from the within effect, and be captured by β_S without bias. On the other hand, if the small neighborhood is drawn so narrowly as to omit the relevant effects of heterogeneity outside the boundary on volunteering rates within it ($\beta_B \neq 0$), β_S will be a biased estimate of heterogeneity's total effect.

III. Between Heterogeneity and Bias in Large Boundary Estimation

The existence of "between" heterogeneity will bias the estimated effect of fragmentation on volunteering when researchers use only "large" boundaries, even if that between heterogeneity has no economic effect.

A simple aggregation over the correct small neighborhood specification in (A.5) yields the correct large neighborhood specification:

$$y_j (= \frac{\sum_i y_{ij}}{n}) = \alpha + \beta_W x_j^W + \beta_B x_j^B + u_j \quad . \tag{A.7}$$

By adding and subtracting a common term, (A.7) can be re-expressed as:

$$\begin{aligned} y_j &= \alpha + \beta_W (x_j^W + x_j^B) + (\beta_B - \beta_W) x_j^B + u_j \\ &= \alpha + \beta_W (x_j) + (\beta_B - \beta_W) x_j^B + u_j \end{aligned} \tag{A.8}$$

Using (A.8) as a benchmark, we can compare this to a study that uses only large neighborhood boundaries, regressing y_j on x_j without a term involving x_j^B. The resulting estimated effect of large neighborhood heterogeneity, β_L , can be expressed as

$$\beta_L = \beta_W + (\beta_B - \beta_W) \frac{\text{cov}(x_j, x_j^B)}{\text{var}(x_j)} . \tag{A.9}$$

The bad news from (A.9) is that even if people's likelihood of volunteering is affected only by the heterogeneity they perceive in their small neighborhood, ($\beta_B = 0$), β_L will remain a biased estimate of heterogeneity's total effect.

In sum, studies estimating the effect of neighborhood fragmentation on volunteering will yield biased estimates if they use only "small" neighborhoods that do not contain all the relevant heterogeneity of those whom volunteers work for or with. Studies will yield unbiased estimates if they use only "small" neighborhoods that are just large enough to contain all relevant heterogeneity. And studies will yield biased estimates if they use neighborhood units that are larger than this. It is not clear *ex ante* whether "overly narrow" or "overly broad" boundaries would be less biased.

Appendix B: Description of Variables

Variable	Description
Volunteering	
Volunteering *VolNarr06* *VolNarr01* *VolNarrAAlt96*	2006, 2001 Proportion of meshblock reporting "Other Helping or Voluntary Work For or Through any Organisation, Group or Marae" in the previous four weeks. Excludes following unpaid activities outside the household: caring for a child or someone who is ill, elderly, or disabled. Construction: "Other Helping…."/(Total – Not Stated) Assumes: "Not Stated" identical in likelihood of volunteering as those who state. 1996 Proportion of meshblock reporting "Attended Committee Meeting etc Unpaid for Group, Church or Marae" in the previous four weeks. Construction: "Attended…"/(Total – Not Specified) Assumes: "Not Specified" identical in likelihood of volunteering as those who state. Excludes the non mutually exclusive categories of "Did Unpaid Training, Coaching, Teaching etc." and "Did Fundraising, Selling etc Unpaid for Group, Church or Marae" and "Did Other Unpaid Work". This was because the latter categories had massive censoring, and had such overlap with the included category that retaining them would have resulted in implausibly high volunteering rates in comparison to 2001 and 2006.
Heterogeneity Measures	
Ethnic/Racial Fragmentation *EthFrag06* *EthFrag01* *EthFrag96*	2006,2001,1996. A fragmentation index for each meshblock, where the five possible ethnic shares s_i are "European", "Maori", "Pacific Peoples", "Asian", and "Middle Eastern/Latin American/African". Individuals could select more than one ethnicity, so the ethnic share is calculated from a baseline of total ethnic affiliations rather than total people. Construction: $1-\sum_{i=1}^{5} s_i^2$ See construction of ethnic shares

Appendix B (Cont'd): Description of Variables

Variable	Description

Heterogeneity Measures (Cont'd)

Language Fragmentation *LanFrag06* *LanFrag01* *LanFrag96*	2006, 2001, 1996. A fragmentation index for each meshblock, where the four possible language shares s_i are "English", "Maori", "Samoan" and "Other". Individuals could select more than one language spoken, so the language share is calculated from a baseline of total language responses rather than total people. Construction: $1-\sum_{i=1}^{4} s_i^2$ See construction of language shares.
Birthplace Fragmentation *BornFrag06* *BornFrag0* *BornFrag96*	2006,2001,1996. A fragmentation index for each meshblock's usually resident population, where the two possible shares s_i of each meshblock are "Born in New Zealand" and "Born Overseas". Construction: $1-\sum_{i=1}^{2} s_i^2$ See construction of birthplace shares.
Household Income Gini coefficient *HHIncGini06* *HHIncGini01* *HHIncGini96*	2006, 2001, 1996. A Gini coefficient constructed using the distribution of households across six nominal household income bands reported by the census. Each HH was assigned the midpoint of the bands: \$0-\$20,000; \$20,001 - \$30,000; \$30,001 - \$50,000; \$50,001 - \$70,000; \$70,000 - \$100,000; \$100,001 and greater. Top band assigned \$115,000 midpoint. Construction: $\sum_{i=1}^{n}\sum_{j=1}^{n}\frac{1}{2}\frac{\lvert x_i - x_j \rvert}{n^2\mu}$ where μ is mean income.

Control Variables

Ethnic Shares *EthEurSh06,01,96* *EthMaoSh06,01,96* *EthPacSh06,01,96* *EthAsnSh06,01,96* *EthMELAA06,01,96*	2006,2001,1996. The proportion of meshblock usual residents reporting one of five ethnic identifications: European, Maori, Pacific, Asian, & Middle Eastern/Latin American/African. Individuals could select more than one ethnicity, so each ethnic share is calculated from a base of the total ethnic affiliations across these five categories rather than total people.

Appendix B (Cont'd): Description of Variables

Variable	Description
Control Variables (Cont'd)	
Ethnic Shares	Construction: frequencies were summed across the five categories to create a base of total ethnic affiliations from which shares were calculated. For 1996 and 2001, the very small fraction of individuals with "other" ethnicities, such as North American Inuit or Indian, Mauritian, etc. are excluded from the baseline. Statistics NZ assigned the small fraction answering "New Zealander" in 1996 and 2001 as European. For 2006, a much larger proportion of respondents replied "New Zealander", and though 90% of these are thought to be European, they were classified by Statistics NZ under "other." Because "New Zealander" responses made up over 99% of "other" in 2006, we assigned the "other" category as European for that year.
Language Shares *EngLanSh06,01,96* *MaoLanSh06,01,96* *SamLanSh06,01,96* *OthLanSh06,01,96*	2006, 2001, 1996. The proportion of meshblock usual residents indicating they spoke one of four language classifications: English, Maori, Samoan and Other. Individuals could select more than one language (or none), so the language share is calculated from a baseline of total languages spoken rather than total people. Construction: frequencies were summed across the four language categories, omitting "None" or "Not Elsewhere Included", to create a base of total meshblock languages spoken from which shares were calculated.
Birthplace Shares *NZBornSh06* *NZBornSh01* *NZBornSh96*	2006, 2001, 1996. The proportion of meshblock usual residents born in New Zealand vs. born overseas. Construction: frequences were summied across the two birthplace categories, excluding those "Not Elsewhere Specified". Assumed: that those who did not answer this question were as likely to be born overseas as those who did answer.
Real Median Household Income *RHHIncMed06* *RHHIncMed01* *RHHIncMed96*	2006, 2001, 1996. The median household income from all sources for usual residents of meshblock aged 15 or older. Provided by Statistics New Zealand. Deflated by GDP deflator (1995 = 1000) of 1996 (1016.00), 2001 (1103.50) and 2006 (1224.50).

Appendix B (Cont'd): Description of Variables

Variable	Description
Control Variables (Cont'd)	
Female *FemaleSh06* *FemaleSh01* *FemaleSh96*	2006, 2001, 1996. The proportion of a meshblock's usually resident population that is female. Construction: frequencies were summed across the two categories of "Male" and "Female" to create a base from which shares were calculated. Assumes: sex frequencies are more reliable than the "totals" with rounding provided by Stats NZ.
Number of Residents *UsRes06,01,96*	2006, 2001, 1996. Size of meshblock in terms of usually resident population. Only needed if we try weighted least squares to weight meshblock observations by population size.
Population Density *PopDens06*	2006 only. Census meshblock usually resident population divided by meshblock square kilometers.
Median Age *AgeMed06,01,96*	2006, 2001, 1996. Median age of meshblock usually resident population.
Marital Status *MarrSh06* *MarrSh01* *MarrSh96*	2006, 2001, 1996. The share of each meshblock's usually resident population 15 and over who were currently married, as opposed to 1) never married or 2) separated/divorced/widowed or 3) who did not answer the question. Construction: the four categories were summed to calculate the base. This assumes that all non-responders are not married
Crime *Crime06* *Crime01*	2006, 2001. The number of recorded offences per capita for each of the 43 Police Areas in New Zealand. Construction: Statistics New Zealand map all meshblocks into one of 43 Police Areas for which per capita offences data is released.
Family Type *CoupNKSh06,01,96* *CoupKSh06,01,96* *SinParSh06,01,96*	2006, 2001, 1996. The share of meshblock families in private dwellings of three possible types: couples without children, couples with children, and single parent families. Construction: frequencies were summed across the three possible categories to provide a baseline.

Appendix B (Cont'd): Description of Variables

Variable	Description
Control Variables (Cont'd)	
Religious Affiliation *ChrSh06,01,96* *NoRel06,01,96* *OthRSh06,01,96*	2006, 2001, 1996. The share of each meshblock's usually resident population identifying with one of three categories: Christian, No Religion and Other Religion. For 2001 and 2006 individuals could identify with more than one religion, so that the base is calculated from total religious affiliations, rather than total people. Construction: Other Religion summed frequencies of Buddhist, Hindu, Islam/Muslim, Judaism, Maori Christian, Spiritualist/New Age and Other Religions. "Not Elsewhere Included" excluded from base, which assumes non-responders similar to responders.
Education High *BHSh06* *BHSh01* *BHSh96*	2006, 2001, 1996. The share of each meshblock's usually resident population 15 or over whose highest degree is a bachelor's or honours degree. Construction: summed frequencies of "Bachelor's Degree or Level 7 Qualification" and "Postgraduate and Honours Degrees" (which excludes masters and PhD degrees), and divided by total people. Assumes "Not Elsewhere Included" individuals do not have a bachelor's or honour's degree.
Education Low *NoQualSh06* *NoQualSh01* *NoQualSh96*	2006, 2001, 1996. The share of meshblock's usually resident population ≥15 who left high school without any qualification. Construction: "No Qualifcation" divided by total people. This assumes all "Not Elsewhere Included" had one of the other eight sub-university or four university level degrees.
Mean Household Size *HHSize06* *HHSize01* *HHSize96*	2006, 2001, 1996. The average number of usually resident people per household in the meshblock. Used as a proxy for household crowding and neighborhood deprivation. Construction: provided directly from Statistics New Zealand to zero decimal places.
Number of Bedrooms *MedBedrms06* *MedBedrms01* *MedBedrms96*	2006, 2001, 1996. Median number of bedrooms in privately occupied dwellings in meshblock. Another proxy for neighborhood deprivation. Construction: provided directly by Statistics New Zealand.

Appendix B (Cont'd): Description of Variables

Variable	Description

Control Variables (Cont'd)

Variable	Description
Labor Force Status *EmpFTSh06,01,96* *EmpPTSh06,01,96* *UnempSh06,01,96* *NotLFSh06,01,96*	2006, 2001, 1996. The share of usually resident population in each meshblock aged 15 or over in one of four possible categories of labor force status: employed full time, employed part-time, employed part-time, unemployed, or not in labor force. Construction: frequencies for four categories summed to provide a baseline from which shares calculated. "Status Unidentifiable" excluded, which assumes those who did not disclose their labor force status were similar to those who did.
Home Ownership Status *OwnHmSh01* *OwnHmSh96*	2001, 1996. The share of dwellings owned or partially owned by heir usual residents. Excludes residents who owned or partially owned their own homes via family trusts. Construction: frequencies for dwellings 1) owned/partially owned by residents, and 2) not owned by residents, summed to provide a base from which share of owner occupied dwellings calculated. Excludes dwellings held in family trust or Not Elsewhere Included
Home Ownership Status *AltOwnHmSh06*	2006 only. The share of dwellings owned or partially owned by their usual residents, or held in a family trust. Dwellings held in a family trust are treated as owned/partially owned. Construction: frequencies for dwellings 1) owned/partially owned by residents, 2) not owned by residents and 3) held in family trusts, summed to provide a base from which the share of owner/trust occupied dwellings calculated. Excludes "Not Elsewhere Included", which assumes non responders are similar in distribution to responders.
Receiving Domestic Purposes Benefit *DomBenSh06* *DomBenSh01* *DomBenSh96*	2006, 2001, 1996. Share of meshblock individuals ≥ 15 receiving the Domestic Purposes Benefit (a welfare program for single parents). Another proxy for neighborhood deprivation. Construction: frequency of individuals ≥ 15 receiving income from the domestic purposes benefit in meshblock divided by the total number of people who disclosed their sources of income. This assumes the distribution of Benefit recipients similar among those who did and did not disclose sources of personal income.

Appendix C: Descriptive Statistics (Meshblock Level, Maximum Sample)

Variable	Obs	Simple Mean	Weighted Mean	Simple Std. Dev.	Min	Max
Volunteering						
VolNarrAAlt96	16712	.1943	.1889	.0702	.0195	.75
VolNarr01	32888	.1682	.1625	.0796	0	1
VolNarr06	34710	.1621	.1540	.0819	0	1
Heterogeneity						
Ethnicity/Race Fragmentation (5 categories)						
EthFrag96	34563	.2955	.3179	.1877	0	.7778
EthFrag01	35150	.3115	.3367	.1932	0	.7951
EthFrag06	34089	.3393	.3629	.1916	0	.7937
Language Fragmentation (4 categories)						
LanFrag96	34791	.2044	.2213	.1414	0	.685
LanFrag01	35323	.2209	.2406	.1449	0	.72
LanFrag06	35975	.2353	.2587	.1467	0	.6837
Birthplace Fragmentation (2 categories)						
BornFrag96	36533	.2389	.2634	.1424	0	.5
BornFrag01	37057	.2509	.2797	.1463	0	.5
BornFrag06	37637	.2754	.3089	.1474	0	.5
Household Income Fragmentation (6 categories)						
HHIncFrag96	25582	.7346	.7421	.0809	0	.8333
HHIncFrag01	26534	.7478	.7556	.0744	0	.8333
HHIncFrag06	27576	.7589	.7652	.0714	0	.8333

Appendix C (Cont'd): Descriptive Statistics (Meshblock, Maximum Sample)

Variable	Obs	Simple Mean	Weighted Mean	Simple Std. Dev.	Min	Max
Controls for Neighborhood Characteristics						
Ethnic Shares						
EthEurSh96	34563	.7803	.7643	.1976	0	1
EthEurSh01	35150	.7615	.7423	.2108	0	1
EthEurSh06	34089	.7362	.7148	.2180	0	1
EthMaoSh96	34563	.1323	.1333	.1438	0	1
EthMaoSh01	35150	.1327	.1313	.1466	0	1
EthMaoSh06	34089	.1337	.1292	.1420	0	1
EthPacSh96	34563	.0438	.0521	.0992	0	1
EthPacSh01	35150	.0489	.0583	.1105	0	1
EthPacSh06	34089	.0533	.0622	.1140	0	1
EthAsnSh96	34563	.0399	.0462	.0695	0	.8857
EthAsnSh01	35150	.0517	.0619	.0865	0	1
EthAsnSh06	34089	.0697	.0855	.1100	0	.925
EthMELAASh96	34563	.0036	.0040	.0143	0	.80
EthMELAASh01	35150	.0052	.0062	.0174	0	.52
EthMELAASh06	34089	.0071	.0083	.0198	0	.52
Language Shares						
EngLanSh96	34791	.8772	.8675	.0976	.2857	1
EngLanSh01	35323	.8658	.8537	.1016	.2222	1
EngLanSh06	35975	.8549	.8393	.1055	.4	1
MaoLanSh96	34791	.0387	.0385	.0595	0	.5714
MaoLanSh01	35323	.0391	.0382	.0579	0	.5172
MaoLanSh06	35975	.0369	.0347	.0571	0	.5
SamLanSh96	34791	.0138	.0168	.0401	0	.5
SamLanSh01	35323	.0147	.0179	.0406	0	.4444
SamLanSh06	35975	.0143	.0174	.0395	0	.4444
OthLanSh96	34791	.0703	.0772	.0690	0	.5714
OthLanSh01	35323	.0803	.0903	.0769	0	.7778
OthLanSh06	35975	.0939	.1086	.0866	0	.6

Appendix C (Cont'd): Descriptive Statistics (Meshblock, Maximum Sample)

Variable	Obs	Simple Mean	Weighted Mean	Simple Std. Dev.	Min	Max
Controls for Neighborhood Characteristics (Cont'd)						
Born in New Zealand Shares						
NZBornSh96	36533	.8402	.8243	.1218	0	1
NZBornSh01	37057	.8260	.8050	.1353	0	1
NZBornSh06	37637	.7998	.7703	.1498	0	1
Real Median Household Meshblock Income (1995 New Zealand Dollars)						
RHHIncMed96	25587	37307	37768	14760.5	0	98425
RHHIncMed01	26534	38767	39328	15965.8	7250	90621
RHHIncMed06	27576	44333	45276	17038.2	2858	81666
Sex						
FemaleSh96	37103	.5015	.5088	.0781	0	1
FemaleSh01	37544	.5051	.5123	.0770	0	1
FemaleSh06	38090	.5052	.5121	.0741	0	1
Population Density of Meshblock 2006						
PopDens06	41362	1783.5	2503.3	2595.6	0	143775
Median Age						
AgeMed96	31903	33.65	33.44	8.0842	10	86
AgeMed01	32471	35.42	35.16	8.3549	11	88
AgeMed06	33210	36.60	36.22	8.7959	13	88
Share Married (Of Age 15 or Older)						
MarrSh96	35542	.4936	.4858	.1649	0	1
MarrSh01	36068	.4707	.4654	.1633	0	1
MarrSh06	36812	.4513	.4879	.1627	0	1
Average Household Size						
HHSize96	27936	3.0056	2.8102	2.4534	1	35
HHSize01	28824	2.9295	2.7418	2.4105	1	37
HHSize06	29807	2.9289	2.7613	2.3576	1	39

Appendix C (Cont'd): Descriptive Statistics (Meshblock, Maximum Sample)

Variable	Obs	Simple Mean	Weighted Mean	Simple Std. Dev.	Min	Max
Controls for Neighborhood Characteristics (Cont'd)						
Per Capital Recorded Offences						
Crime01	41376	.1115	.1099	.0699	.0689	.7073
Crime06	41376	.1009	.1012	.0436	.0641	.4178
Family Type Shares						
CoupleNKSh96	32340	.3757	.3680	.1631	0	1
CoupleNKSh01	32875	.3924	.3833	.1663	0	1
CoupleNKSh06	33660	.4034	.3931	.1698	0	1
CoupleKSh96	32340	.4507	.4505	.1586	0	1
CoupleKSh01	32875	.4202	.4225	.1552	0	1
CoupleKSh06	33660	.4157	.4204	.1542	0	1
SingleParSh96	32340	.1736	.1815	.1433	0	1
SingleParSh01	32875	.1874	.1942	.1440	0	1
SingleParSh06	33660	.1808	.1865	.1423	0	1
Religious Affiliation Shares						
ChrisSh96	33546	.6826	.6794	.1243	0	1
ChrisSh01	34123	.6251	.6215	.1278	0	1
ChrisSh06	34763	.5664	.5634	.1304	0	1
NoRelSh96	33546	.2760	.2761	.1139	0	1
NoRelSh01	34123	.3150	.3140	.1177	0	1
NoRelSh06	34763	.3651	.3613	.1262	0	1
OthRSh96	33546	.0415	.0445	.0630	0	.9565
OthRSh01	34123	.0599	.0644	.0752	0	1
OthRSh06	34763	.0685	.0753	.0842	0	.9583
Share Receiving Domestic Purposes Benefit						
DomBenSh96	29504	.0416	.0427	.0472	0	.4545
DomBenSh01	30153	.0414	.0423	.0453	0	.4286
DomBenSh06	31110	.0339	.0342	.0407	0	.4444

Appendix C (Cont'd): Descriptive Statistics (Meshblock, Maximum Sample)

Variable	Obs	Simple Mean	Weighted Mean	Simple Std. Dev.	Min	Max
Education Shares High or Low						
Bach/HonsSh96	31128	.0777	.0784	.0861	0	.7778
Bach/HonsSh01	31824	.0974	.0990	.0967	0	.75
Bach/HonsSh06	31646	.1134	.1162	.0913	0	.7
NoQualSh96	31128	.3301	.3265	.1384	0	.9512
NoQualSh01	31824	.2455	.2405	.1158	0	.96
NoQualSh06	31646	.2335	.2264	.1157	0	.8313
Labor Market Shares						
EmplFTSh96	34989	.4741	.4640	.14007	0	1
EmplFTSh01	35559	.4847	.4747	.13909	0	1
EmplFTSh06	36263	.5113	.5023	.13149	0	1
EmplPTSh96	34989	.1419	.1398	.0671	0	1
EmplPTSh01	35559	.1444	.1424	.0652	0	.6667
EmplPTSh06	36263	.1504	.1486	.0652	0	1
UnempSh96	34989	.0498	.0521	.0520	0	.5
UnempSh01	35559	.0492	.0513	.0504	0	.5
UnempSh06	36263	.0339	.0357	.0403	0	1
NotLFSh96	34989	.3342	.3441	.1414	0	1
NotLFSh01	35559	.3218	.3315	.1370	0	1
NotLFSh06	36263	.3044	.3134	.1304	0	1
Median Number of Bedrooms						
MedBedrms96	26867	2.9106	2.913	.4489	0	6
MedBedrms01	27868	2.9693	2.974	.4742	1	6
MedBedrms06	28885	3.0010	3.010	.5031	1	6
Share Owning or Partially Owning Own Home						
OwnHmSh96	33809	.7002	.7049	.2100	0	1
OwnHmSh01	34511	.6796	.6754	.2025	0	1
AltOwnHmSh06	34106	.6619	.6624	.2046	0	1

Appendix D: Population Weighted Means and Standard Deviations of Key Variables at the Meshblock and Area Unit Levels, using Maximum Sample.

Variable	*Neighbor-hood Size*	*Census Year* 1996 Mean N (St. Dev)	2001 Mean N (St. Dev)	2006 Mean N (St. Dev)
Volunteering Rate	Meshblock	.189 16712 (.066)	.163 32888 (.069)	.154 34710 (.068)
	Area Unit	.193 1757 (.044)	.163 1779 (.042)	.154 1780 (.039)
Ethnic/Racial Fragmentation	Meshblock	.318 34563 (.184)	.337 35150 (.190)	.363 34089 (.190)
	Area Unit	.342 1786 (.161)	.362 1781 (.170)	.387 1772 (.173)
Language Fragmentation	Meshblock	.221 34791 (.137)	.241 35323 (.140)	.259 35975 (.143)
	Area Unit	.231 1791 (.114)	.250 1784 (.120)	.268 1787 (.124)
Birthplace Fragmentation	Meshblock	.263 36533 (.130)	.280 37057 (.134)	.309 37637 (.132)
	Area Unit	.271 1806 (.112)	.289 1798 (.118)	.319 1803 (.117)
Household Income Fragmentation	Meshblock	.742 25582 (.075)	.756 26534 (.069)	.765 27576 (.067)
	Area Unit	.782 1748 (.039)	.796 1755 (.033)	.805 1753 (.033)

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