Urban composition and diversity

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Disclaimer

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Abstract

More diverse cities offer higher wages and higher rents, consistent with local productive amenities. In this paper, we examine whether skill diversity and ethnic diversity are sources of local production or consumption amenities, using the analytical framework of Roback (1982) and estimated city wage and rent premiums from hedonic regressions. We distinguish the contribution of skill and ethnic diversity from composition effects, arising from the correlation between diversity and the presence of particular subgroups. Our estimates are based on complete census data from New Zealand, for 97 urban areas. After controlling for composition and other sources of cross-city variation, we find weak evidence of the amenity value of diversity, and suggest that the effects of skill diversity and ethnic diversity differ.

JEL codes

J31; R21; R23; R31

Keywords

Diversity; fractionalisation; local amenity; urban wages and rents; hedonic

Summary haiku

Diverse locations

Nice places to live and work

If the price is right

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1 Introduction

Almost 40 percent of New Zealand's largest city, Auckland, was born overseas, and only 56 percent identified as part of the dominant (European) ethnic group. Auckland's population mix makes it one of the most diverse cities in the world[1], with over 150 different ethnic identities and 120 languages reported in the 2006 census (Gilbertson & Meares, 2013). In this paper we examine the impact of such diversity on the attractiveness of cities to business and to residents. We also consider whether diversity of skills operates in the same way as ethnic diversity.

We follow the approach of Ottaviano and Peri (2005) in using cross-city variation in wages and rents to identify the economic value of cultural diversity. Section 3 outlines the theoretical framework that summarises these links and the empirical approach to estimating the value of diversity. A key contribution of the current paper is to test the robustness of estimates to controlling for the mix of ethnicities and skills, in addition to the diversity of the mix. A city with diverse skills may also a high proportion of workers with specialised skills and we want to distinguish the prevalence of particular sorts of skills (or ethnic groups) from diversity *per se*.

Section 2 summarises possible explanations for the economic impacts of diversity, and empirical evidence on the nature and strength of impacts. Section 0 documents the census data on wages, rents, and diversity across New Zealand urban areas, which we use in implementing the framework outlined in section 3. The resulting estimates are presented in section 4.4, followed by a concluding summary and discussion.

2 The value of diversity in consumption and production

2.1.1 Diversity as a local productive amenity

The impact of diversity on the productivity of teams, workplaces, cities, or economies could be positive or negative. Standard production theory suggests that diversity within a firm can raise productivity if different groups of workers are imperfect substitutes. Recent studies of diversity and productivity discuss a range of mechanisms that could generate such relationships, and which may operate not only within firms, but also at the level of cities and regions.

The literature has distinguished different forms of diversity that operate in distinct ways (Kemeny, 2014; Page, 2007). A key distinction is between cognitive diversity and identity diversity. Cognitive diversity includes the diversity of knowledge held by different members of a group. It also includes the diversity of cognitive function – the diverse ways that people perceive and solve problems. Diversity of knowledge or of cognitive function enables a group to be more

[1] Census 2013 data for the Auckland local boards area (Tables 7 & 15 from http://www.stats.govt.nz/Census/2013-census/profile-and-summary-reports/quickstats-culture-identity.aspx - retrieved 2 August 2017). International comparison from IOM (2015)

effective at solving complex problems than a homogeneous group, even able to outperform a group with high average ability (Hong & Page, 2004). It also enables groups to outperform individuals in tasks involving prediction.

Ethnic diversity is a form of identity diversity. People who identify with the same ethnic group are likely to share some common perspectives, preferences, or ways of approaching issues. Page (2007) thus characterises ethnic diversity as a source of cognitive diversity as well as diversity of preferences, which can confer benefits for decision-making and prediction.

For the purpose of collective decision-making, however, the benefits of diversity are less clear-cut. Cognitive diversity may make decision-making more costly or difficult, due to the challenges of reaching agreement among people with different knowledge, cognitive functions, or preferences. When considering the contribution of preference diversity to decision-making, Page distinguishes fundamental preference diversity (pursuing different objectives) from instrumental preference diversity (preferring different means to a common end), noting that fundamental diversity may make collective decision-making more difficult. Another impact of diversity is that it may reduce the ease with which people interact, diminishing the potential benefits of diversity or magnifying the adverse impacts.

Estimates of the net productivity impacts of diversity have been made using direct productivity estimation, or using wages as a proxy for productivity. Existing studies find weak or negative overall effects of firm-level diversity on productivity, but positive effects within some subsets of firms. Parrotta et al. (2014) consider both ethnic (language and nationality) and qualification diversity within firms and find that both are negatively related to firm TFP. However, skill diversity among high skilled workers is found to increase productivity in at least some sectors. This finding is similar to that of Iranzo et al (2008), who found that skill diversity within broadly defined occupations raises productivity even though skill differences between production and non-production workers have a negative effect. Trax et al. (2015) consider the productivity impact of ethnic diversity, as captured by country of birth, at both the firm and regional levels. They find that the share of foreigners is not associated with differential productivity performance, but the diversity of foreigners in the firm or in the region enhances productivity for some firms. Diversity of foreigners within the firm is associated with higher productivity among manufacturing firms whereas diversity of foreigners at the regional level appears to benefit small plants and service sector firms. In the New Zealand context, Maré & Fabling (2013) find that the positive relationship between local workplace diversity and productivity is largely accounted for by associated differences in skill composition.

Estimates of the wage impacts of diversity also vary across studies and contexts. Ottaviano and Peri (2005) find a positive and significant effect of linguistic diversity on average wages across US cities, but a negative effect of skill fractionalisation, measured across four qualification-based skill groups. Kemeny and Cooke (2015) find a robust positive effect of birthplace diversity within US cities and within firms on wages. They find that a one standard deviation increase in city diversity is associated with an increase in wages of nearly 6 percent. Their use of linked employer-employee data on US firms allows them to control for firm, worker, and region-year variation. In contrast, Niebuhr and Peters (2017) consider the wage effects of gender, age, and cultural diversity in German firms and find few general patterns. Age dispersion is associated with lower average wages, even controlling for mean age and unobserved worker and firm heterogeneity. The effects of cultural diversity are negligible and insignificant, although the presence of foreign workers is associated with higher average wages for low and medium skilled workers. They also find that controlling for unobserved heterogeneity weakens the estimated impact of diversity, implying that observed diversity is positively correlated with other forms of diversity.

2.1.2 Diversity as a local consumption amenity

Local ethnic or skill diversity can also act as a local consumption amenity. As in the case of productive amenities, this effect could be positive or negative. Residents of an area may value local diversity because of the opportunities it provides for variety in consumption and social interaction (Lazear, 1999). Alternatively, they may prefer to live in more homogeneous communities that provide stronger opportunities to build bonding social capital. Card et al (2012) interpret reported attitudes to diversity as a reflection of 'compositional amenities' – the value that people associate with being in a more or less diverse country. They report considerable variation in attitudes to immigration, and find that compositional amenities provide a stronger explanation of this variation than reported views on the economic, fiscal and labour market impacts of migration.

In New Zealand, there is strong support for multiculturalism, with 89 percent of people agreeing with the statement that "it is a good thing for a society to be made up of people from different races, religions, and cultures" (Ward & Masgoret, 2008). This is stronger support than is found in Australia or Europe, but less positive than in Canada. The positive value placed on cultural diversity will make diverse cities more attractive, acting as a local consumption amenity

2.1.3 Diversity and spatial equilibrium

Following Ottaviano and Peri (2006), a number of studies have identified the joint impact of diversity as both a production and consumption amenity, based on relative wages and rents across cities. As shown by Roback (1982), in a spatial equilibrium model, positive local production amenities are reflected in high relative wages and rents – firms locating in high-wage, high-rent areas can compete only if there are productive advantages of locating there. For workers, positive consumption amenities are reflected in low relative wages and high relative rents. They are willing to locate in high-amenity areas despite real earnings being low locally. A more formal exposition of this model is included in the next section.

Ottaviano and Peri (2006) document an economically significant and robust relationship between high birthplace diversity in US cities and higher levels of both wages and rents. This pattern is consistent with the dominant effect of diversity being to raise local productivity. Bellini et al (2013) report similar findings across European NUTS regions, using local restaurant prices instead of rents as a proxy for local price effects, and GDP per capita as a wage measure. They find that the share of foreigners, rather than diversity among foreigners is most closely related to the productive effect of birthplace diversity.

Bakens et al (2013) document a positive relationship between local cultural diversity (based on parental birthplace) and both wages and rents across Dutch metropolitan areas. This finding is robust to controls for endogeneity, but not to controlling for selection. The selection patterns suggest that residents of diverse cities would earn high wages and pay high rents wherever they were to live. Adjusting for this, diversity is associated with lower rents, and generally no difference in wages, consistent with diversity acting as a negative production or consumption amenity. The authors show that the negative consumption amenity arises despite a positive contribution from quality of living advantages and the diversity of consumption, as proxied by restaurant variety.

3 Framework

Our analysis and estimation of the local impacts of diversity are built on a model of spatial equilibrium. We adopt the framework introduced by Roback (1982, 1988), which models optimal location choices of both workers and firms, and derives equilibrium wage and rent expressions as a function of local consumption and production amenities. In this context, diversity within a city is considered as a local amenity, which can potentially affect the attractiveness of the city for both consumption and production.

Workers and firms choose to locate in one of C different cities, indexed by c=1,…,C. Workers live and work in the same city, so the model abstracts from commuting behaviour. All firms use (mobile) labour and (immobile) land inputs to produce a tradeable good (Y). All workers provide a constant amount of labour, earning a locally determined wage (w_c), which they spend on housing (H_c), or on consumption of Y. The prices of housing (r_c) and of Y (p_c) are determined locally. Cities differ in their attractiveness to workers and firms through their different endowments of productive amenities (A_c) – characteristics that may have consumption value for workers, and that may raise or lower firm costs.

Workers gain utility from their consumption of housing and consumption goods, and from local amenities:

$$U_{ic} = f_u(A_c)H_{ic}^{\alpha}Y_{ic}^{1-\alpha} \quad (1)$$

Mobile workers choose to locate in the city that maximises their utility. Their expenditure (E_{ic}) is determined by city-specific wages (see below). They allocate expenditure to housing and goods consumption according to first order conditions:

$$H_{ic} = \frac{\alpha}{r_c} E_{ic}; \quad Y_{ic} = \frac{(1-\alpha)}{p_c} E_{ic} \tag{2}$$

giving them indirect utility of:

$$v_{ic} = \kappa_v f_u(A_c) \frac{E_{ic}}{r_c^{\alpha} p_C^{1-\alpha}} \tag{3}$$

where $\kappa_v = \alpha^{\alpha}(1-\alpha)^{1-\alpha}$

Firm *j* produces Y_{jc} using housing H_{jc} and labour L_{jc}, at prices of r_c and w_c respectively:

$$Y_{jc} = f_y(A_c) H_{jc}^{\gamma} L_{jc}^{1-\gamma} \tag{4}$$

Profit maximisation under perfect competition (implying zero profits) yields first order conditions for the use of housing and labour, and a marginal cost function:

$$H_{jc} = \alpha \frac{p_c Y_{jc}}{r_c}; \quad L_{jc} = (1-\alpha) \frac{p_c Y_{jc}}{w_c} \tag{5}$$

$$p_c = \frac{r_c^{\gamma} w_C^{1-\gamma}}{\kappa_p \, f_y(A_c)} \tag{6}$$

where $\kappa_p = \gamma^{\gamma}(1-\gamma)^{1-\gamma}$

The traded good sells at the same price everywhere, so its price is set as the numeraire ($p_c = 1$). Spatial equilibrium requires that indirect utility and marginal costs are equalised across cities. For firms, equation 6 implies that $r_c^{\gamma} w_C^{1-\gamma} = \kappa_p f_y(A_c)$. For workers, equation 3 implies that $r_c^{-\alpha} w_c = \bar{\bar{v}} / \left(\kappa_v f_u(A_c)\right)$, where $\bar{\bar{v}}$ is the equilibrium level of utility. Solving for rents and prices yields the following equilibrium conditions:

$$lnr_c = \left(\frac{1}{1-(1-\gamma)(1-\alpha)}\right)\left[ln\kappa_p + (1-\gamma)ln\left(\frac{\kappa_v}{\bar{\bar{v}}}\right) + lnf_y(A_c) + (1-\gamma)lnf_u(A_c)\right] \tag{7}$$

$$lnw_c = \left(\frac{1}{1-(1-\gamma)(1-\alpha)}\right)\left[\alpha ln\kappa_p - \gamma ln\left(\frac{\kappa_v}{\bar{\bar{v}}}\right) + \alpha lnf_y(A_c) - \gamma lnf_u(A_c)\right] \tag{8}$$

Although we cannot separately identify the effects of $f_y(A_c)$ and $f_u(A_c)$, we follow Roback (1982) and Chen and Rosenthal (2008) in interpreting the joint behaviour of $\frac{\partial lnr_c}{\partial lnA_c}$ and $\frac{\partial lnw_c}{\partial lnA_c}$ to identify the dominant impact of A_c as a positive or negative consumption or production amenity.

3.1 Estimation and identification

We estimate the relationship between local amenities and local rents and wages respectively, as suggested by equations 7 and 8. Obtaining meaningful estimates requires us to control for other sources of variation in local wages and rent. Equation 9 summarises the framework. Z_{ict} represents either the log of wages or the log of rents in city *c* in time period *t*. The subscript *i* refers to individuals in the wage equation, and dwellings in the rent equation. The main covariates of interest are captured by a vector of local diversity measures (D_{ct}) being measures of ethnic fractionalisation, skill fractionalisation, and income inequality. The coefficients on these measures (γ_D^Z) are the partial derivatives as shown in Table 1. Equation 9 also includes controls for observed characteristics of individuals or dwellings $\left(X_{ict}^Z\right)$ and for city-level characteristics that may vary over time (a_{ct}^Z).

$$Z_{ict} = D_{ct}\gamma_D^Z + X_{ict}^Z\beta_X^Z + a_{ct}^Z + e_{ict}^Z \qquad (9)$$

One obvious identification challenge is the omitted variable bias from unobserved city characteristics. Both D_{ct} and a_{ct}^Z vary by city and year, so the use of city-year fixed effects is infeasible as the fixed effects would be perfectly collinear with local diversity. We instead assume that a_{ct}^Z is a correlated random effect, allowing correlation with the concurrent local means of other included covariates, and including city-specific and time fixed effects. This specification is shown in equations 10 and 11.

$$Z_{ict} = X_{ict}^Z\beta_X^Z + a_{ct}^Z + e_{ict}^Z \qquad (10)$$

$$\text{where } a_{ct}^Z = D_{ct}\gamma_D^Z + \bar{X}_{ct}^Z\gamma_X^Z + a_c^Z + \tau_t^Z + u_{ct}^Z \qquad (11)$$

In the case of the wage equation, individual ethnicity or qualifications enter the estimation in three distinct ways. These characteristics are included in the vector X_{ict}^Z, and are used to adjust local wages, using the estimated coefficient β_X^Z. Second, we allow for a correlation between the city-year composition of the population by ethnicity or qualifications ($\bar{X}_{ct}^Z$) and the residual city-year wage level, captured by γ_X^Z. Third, individual characteristics enter equation 11 in the form of the diversity measures, which are typically non-linear functions of the area level composition variables that are included in $\bar{X}_{ct}^Z$.

The parameter estimates reported in section 4.4 below are from weighted regressions using city-year observations as shown in equation 12, and weighted by population to adjust for the marked differences in city sizes. The estimation is based on a two-stage estimation procedure. In the first stage, city-year fixed effects are estimated from year-specific wage or rent regressions with the form of equation 10. The hedonic wage regression includes controls for variation in age, gender, qualifications, and ethnicity. The first stage hedonic rent regression controls for differences in dwelling-level characteristics across cities. Controls include the number of bedrooms and other rooms, the number of storeys, and the type of dwelling (house, townhouse, flat, etc).

In the second stage, the estimated fixed effects (a_{ct}^Z) are regressed on local diversity as well as city-year means of the covariates included in the first stage, as shown in equation 12. The advantage of including city-year means of the covariates in the second stage is that it effectively distinguishes the influence of diversity *per se* from the heterogeneous contributions of different subgroups to city performance. For instance, skill diversity may be correlated with the presence of particular types of skills (eg: highly qualified engineers) that contribute to the overall city wage premium and which are correlated with skill diversity.

City fixed effects (a_c^Z) are not included in the second stage estimation. Although they can be econometrically identified, in practice, the within-city variation is too limited in the current dataset and within-city estimates are never significantly different from zero. Note also that the city-year means that are included in the second stage regression are restricted to demographic composition variables that are included in the wage equation. In principle, city-year means of property attributes, as included in the rent equation could also be included. In practice, our dataset is currently too limited to include mean property attributes as well as demographic composition measures in the second stage rent equation.

$$\hat{a}_{ct}^Z = D_{ct}\gamma_D^Z + \bar{X}_{ct}^W[\gamma_X^Z] + \tau_t^Z + u_{ct}^Z \quad (12)$$

We include demographic composition measures in both second stage regressions to ensure that our estimate of the impacts of diversity are identified from variation that is not due to cross-city composition differences that may be correlated with diversity.

4 Data

We use data from the 2006 and 2013 New Zealand Censuses of Population and Dwellings.[2] Access to the data used in this study was provided by Statistics New Zealand under conditions designed to give effect to the security and confidentiality provisions of the Statistics Act 1975. The results presented in this study are the work of the author, not Statistics NZ.

4.1 Rent equation

The rent equation is estimated using information on weekly rents paid in non-owner-occupied private dwellings. Respondents report the dollar amount paid in rent, which is converted to a weekly equivalent rate. We exclude rental payments for non-private or owner-occupied dwellings in order to more closely approximate a market price for local land and housing services.

As shown in equation 10, we adjust the raw rental weekly rate by regressing (log) rents on available housing characteristics. Specifically, we adjust for the number of rooms, the number of bedrooms, the type of dwelling, and the types of heating fuel available. The number of rooms and bedrooms are included as sets of dummy variables for each distinct value, top-coded so that the topcoded category contains at least 5 percent of observations.[3] Dwelling type distinguishes detached houses from complexes of 2 or more connected dwellings, and further classifies these according to the number of storeys, giving a 7-way classification, each of which is included as a

[2] We plan to extend the dataset to include earlier census year – possibly back to 1976 but the necessary microdata were not available at the time of analysis.
[3] The topcodes are 6 for bedrooms and 10 for total rooms.

dummy variables. Mobile dwellings and campgrounds are excluded. Respondents can identify up to 6 heating fuels ever used in the dwelling, and can also report no heating fuels, or 'other'. Dummy variables are included for each of these 8 categories, together with a count of different fuels used.[4]

4.2 Wage equation

The Census does not collect information on wage or earnings levels. The wage equation is estimated based on the reported positive annual earnings of usually-resident aged 15 and over who were full-time employees in the week prior to the census. In the absence of earnings information, this is used as a proxy for actual wage rates.

Income information is collected in bands. This is converted to a cardinal measure using the log of income midpoints provided by Statistics New Zealand based on estimated median income within each band.[5]

In the wage version of equation 10, the log of annual earnings is regressed on a quartic in age, a gender dummy, and a set of dummy variables for categories of ethnic identity and qualification. For ethnicity and qualification, the categorisation used in the wage equation is the same as the categorisation used to calculate the diversity indices.

4.2.1 Ethnicity

Ethnicity is self-identified in the Census, with respondents able to identify multiple ethnic groups to which they belong. Up to 6 responses are coded. We group responses using an hierarchical algorithm that is described in more detail in the Appendix. The resulting classification allocates each person to a single composite ethnic group. Dummy variables are included for each of 16 distinct groupings of ethnicities each year. Two of the groupings are year-specific, so there are 17 separate groupings.

4.2.2 Qualifications

We combine census information on level of qualification and, for higher-level qualifications, by field of study to classify skill composition. For people with post-school qualifications, we distinguish level 4-6 certificates and diplomas from level 7 and above (Bachelor's degree and above). Post-school qualifications are further classified by one of 12 'fields of study' categories, including one 'not-stated' category.

There are three categories capturing people with lower levels of qualification: those with no school qualifications; those with school-level qualifications (level 1-3 certificates, including

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[4] For each variable, we also include a residual category that combines non-responses with unidentifiable responses. The omitted categories of dummy variables are for 0-bedrooms; 1 rooms; and occupied detached dwellings nfd.

[5] In 2006, there were 12 bands for positive income, with a top-code of $100,001. In 2013, there were 14 positive income bands topcoded at $150,001. As an alternative to using estimated band medians, we tested the robustness of our findings to using range midpoints (with the estimated median for the top bracket) and also to using interval regression assuming a lognormal income distribution. Our findings are consistent across these specifications.

overseas school qualifications), and people who did not state the level of their qualification. Each of these is undifferentiated by field of study.

Any groupings containing fewer than 40,000 people nationally are consolidated, as described in the Appendix. The resulting classification has 17 distinct groupings in 2013, and 15 in 2006.

4.3 Diversity Measurement

We capture diversity across three different dimensions – ethnicity, qualifications, and income. For the first two, we use measures based on the commonly used fractionalisation index (Nijkamp & Poot, 2015):

$$FR = 1 - \sum_{g=1}^{G} \left(\frac{P_g}{P}\right)^2 \tag{13}$$

where P_g is the population of group g and P is the size of the total population. For ethnic diversity, we distinguish diversity that arises from the prevalence of minority groups and that arising from diversity within minority groups, using two components of the Fractionalisation index, as in Alesina et al (2016).

$$\begin{aligned} FR &= \left[2\frac{P_1}{P}\left(1-\frac{P_1}{P}\right)\right] + \left[-\left(1-\frac{P_1}{P}\right)^2 \sum_{g=2}^{G} \frac{P_g}{P-P_1}\left(1-\frac{P_g}{P-P_1}\right)\right] \\ &= [FR_1] + [FR_2] \end{aligned} \tag{14}$$

For qualification diversity, we use the FR measure shown in equation 13, since no category contains a majority of people, making the interpretation of FR1 problematic..

Income diversity is captured by a Theil measure of inequality.[6] This is calculated from banded income data using the robust Pareto midpoint estimator of von Hippel et al (2014), using an estimate of the geometric mean for the top bracket and imposing a minimum Pareto coefficient of 2.

$$Theil = \sum_i \left(\frac{y_i}{Y}\right) ln\left(\frac{y_i}{\bar{Y}}\right) \tag{15}$$

4.4 Sample selection

There are 143 urban areas or zones defined in the official NZ urban area classification. We consolidate urban zones into their corresponding urban areas, which affects Auckland (4 zones), Hamilton (3 zones), Wellington (4 zones) and Napier-Hastings (2 zones). Of the resulting 134 urban areas, we restrict attention to larger urban areas because population shares for particular ethnic or qualification groups, and therefore the associated measures of diversity, can be

[6] Similar results were obtained using the mean log deviation $MLD = \sum_i \left(\frac{-1}{N}\right) ln\left(\frac{y_i}{\bar{Y}}\right)$

unstable for small urban areas. The first stage estimation is therefore restricted to the 97 urban areas with at least 500 full-time employees each year available for inclusion in the wage equation.

The second stage regression is further restricted to a subset of 59 larger urban areas in each year. The selection of urban areas is based on the size of the sample of full-time employees used in the wage equations, excluding urban areas with a mean sample size smaller than 1,000. This captures approximately the same set of cities as a population-based cutoff of 4,250 usual residents.[7] Weighted statistics for a broader sample of cities would be very similar to those presented in Table 2, even if all 134 main (consolidated), secondary, and minor urban areas were included – a set that includes some urban areas with populations of fewer than 1,000 people.

5 Results

Our estimates of the relationship between wage and rent levels and local diversity are based primarily on differences across urban areas. Table 2 summarises the cross-city variation in each census year, and highlights changes over time. The top panel of the table presents weighted statistics, placing greater weight on cities with estimates based on larger samples of full-time employed adults. The regression analysis that follows is based on weighted estimation although lower panel provides unweighted estimates for comparison.

The unweighted mean city population is 57.6 thousand. The distribution of city size is, however highly skewed, with only 9 urban areas having larger populations, and Auckland having a population that is more than 20 times larger than the mean. Weighted by the sample size used in the wage regression, mean population is 550.8 thousand. Population growth between 2006 and 2013 in the selected urban areas was 9.1 percent, higher than the 6 percent growth in the country as a whole over that period.

Ethnic fractionalisation declined between 2006 and 2013, reflecting declines in both majority fractionalisation (FR1) and minority fractionalisation (FR2). This time variation is largely attributable to the spike in 'national identity' ethnic identification in the 2006 census (Kukutai & Didham, 2009; Statistics New Zealand, 2009). Around 290,000 people in 2006 identified their ethnicity as 'New Zealander' and there was consequently a relatively low number of people identifying as part of the dominant "New Zealand European" group. The number of people identifying as "New Zealander" in 2013 declined to around 45,000 and there was a significant increase in the size of the dominant group (See counts in Appendix Table 1). This generated an increase in the majority share, lowering FR1, and a decline in the measured diversity of minority ethnic groups (lowering FR2). It is partly for this reason that we focus our

[7] A population-based selection would include 5 urban areas that are excluded from our selection, and would exclude 7 urban areas that we include.

identification primarily on cross sectional variation rather than on within-city changes over time. In future we plan to include earlier censuses, to capture more systematic time variation in diversity.

The cross-sectional variation in ethnic fractionalisation (weighted standard deviation of 0.125 around a mean of 0.672) is dominated by variation in minority ethnic fractionalisation (s.d of 0.100 around a mean of 0.204). Ethnic diversity varies more than diversity of skill (s.d of 0.014) or income inequality (s.d of 0.031). In contrast to ethnic diversity, the diversity of skill and inequality of income both increased over time, by 1.7 percent and 3.7 percent respectively.

The final 2 rows of Table 2(a) show the dispersion and growth of incomes and rents. There is considerable variation across cities, with rent variation (s.d. of log rent = 0.189) more pronounced than variation in incomes (s.d. of log income = 0.088). Both incomes and rents grew between 2006 and 2013 – by 7.7 percent and 12.2 percent respectively (adjusted for CPI movements).

The raw relationships between wages and rents, and the various types of diversity are shown graphically in the left column of Figure 1 for 2013. A positive relationship of diversity with wages and rents is most clearly evident for skill diversity and income inequality, consistent with the dominant contribution of these forms of diversity being as a productive amenity. Ethnic fractionalisation is also positively associated with both wages and rent, though the relationship is less strong.

The second column of Figure 1 presents an analogous set of graphs using regression adjusted wages and rents ($\hat{a}^{Z}_{ct}$ estimated from the year-specific first-stage regressions[8]). The adjusted and raw wage and rent premiums are highly correlated, leading to a high similarity across the two columns.[9] While the hedonic wage and rent regressions are necessary to control for selection on observables, in practice they do not have much impact. Figure 1 shows only the 2013 patterns, although the patterns for 2006 are very similar, justifying the pooling of census years for second stage estimates. Regression-adjusted patterns for 2006 and 2013 are shown in Appendix Figure 1.

The strength of the regression-adjusted relationships is estimated formally in Table 3. The first four panels of Table 3 show estimates from separate regressions of wages and rents on each set of diversity measures and on city size, as captured by the log of population[10]. The first and fourth columns summarise the raw relationship between the diversity measures and local wages and rents – as graphed in the first column of Figure 1. The two years are pooled, and the

[8] Estimates from the first stage wage and rent regressions are included as Appendix Table 5 and Appendix Table 6. The demeaned estimates of city-year fixed effects are shown in Appendix Table 4, labelled as 'adjusted' premiums. They are presented with the unadjusted wage and rent premiums, which are also demeaned for ease of comparison.

[9] The correlations between adjusted and unadjusted premiums are around 0.90 for wages and around 0.98 for rents, as shown in Appendix Table 7.

[10] This is currently log of wage-equation sample size. Estimates using log of population are very similar, but have not yet been cleared from the secure datalab.

regression includes only a year-specific intercept in addition to the size and diversity measures. The regression specification is

$$lnZ_{ct} = D_{ct}\gamma_D^Z + \tau_t^Z + u_{ct}^Z$$

where lnZ_{ct} is either wages or rents. Each of the diversity is separately positively correlated with local wages and with local rents. When all size and diversity measures are included together, only skill fractionalisation and income inequality remain significantly positively correlated with wages. The relationship between income inequality and rents becomes insignificant, and the independent relationship between rents and majority ethnic fractionalisation (FR1) becomes negative.

Controlling for sorting on observables with the two-stage estimation described above leads to relatively minor changes in parameter estimates. The second and fourth columns show estimates from restricted versions of equation 12, which regresses city-year fixed effects estimates from the first stage regressions on diversity measures and year effects:

$$\hat{a}_{ct}^Z = D_{ct}\gamma_D^Z + \tau_t^Z + u_{ct}^Z$$

All forms of diversity apart from Majority ethnic fractionalisation (FR1) remain significantly and positively related to both wages and rents, consistent with their being productive local amenities. However, when all the diversity measures are included simultaneously, along with the log of city population, the size and significance of the effects is reduced. In the wage equation (column 2), skill fractionalisation loses significance but minority fractionalisation becomes significant. This suggests that the significant raw relationship between wages and skill fractionalisation was biased upwards by a correlation between fractionalisation and the presence of highly paid skill groups.

The loss of significance does not appear to be due simply to collinearity, since the estimated standard errors do not increase markedly.[11] Minority ethnic fractionalisation is still significantly and positively related to both wages and rents. There is still a significant positive relationship between rents and city size but the city-size wage premium is no longer significant. Skill diversity is positively but insignificantly related to wages, and positively related to rents.

The estimates in columns (2) and (5) of Table 3 are effective descriptive summaries of the diversity-related correlates of local wage and rents but they do not control for other sources of wage and rent variation across cities. In the third and sixth columns, we report estimates from a regression that includes mean demographic characteristics as well as diversity measures and year-specific intercept, as shown in equation 12. Controlling for mean characteristics could capture local spillovers associated with the presence of particular sorts of people in a city. The estimated coefficients on the mean characteristics reflects the effect on mean wages and rents in excess of the premium that is captured in the first stage regressions based on within-city variation. More generally, the inclusion of area means serves to control for omitted city-level

[11] Correlations between the key variables by year and across years are included as Appendix Table 7.

characteristics, and is motivated by the correlated random effects specification set out in equations 10 and 11. We do not attempt to distinguish spillover explanations from other forms of omitted variables.

The composition controls are clearly jointly influential, though there are only a few that reveal significant differences from the base category of New Zealand European men with school level (level 1-3) qualifications.[12] City wages are negatively related to the proportion of women, and positively related to the presence of people identifying with more than two ethnicities. Skills that are associated with a positive city wage premium are sub-degree qualifications in engineering, and degree qualifications in 'Society and Culture' fields, which includes economics, law and human welfare fields. There is a city-rent premium associated with the presence of women, people with degrees in natural and physical sciences, and people identifying with a residual group of 'other European' ethnicities. The presence of graduates with degrees in health-related fields is associated with lower rents. Note that these effects capture the effect of city composition shares, controlling for the relative wage levels of different groups as estimated from within-city variation.

The positive rent premium and negative wage premium associated with the presence of women are consistent with a high share of women being a positive consumption amenity, or equivalently, a high share of men being a negative consumption amenity. Other patterns do not provide definitive evidence of the nature of amenities associated with the presence of particular groups.

6 Discussion

The key result is that the positive estimated relationship between skill and minority ethnic fractionalisation and rents that is shown in column 5 of Table 3, and the positive relationship between minority fractionalisation and wages in column 2 are no longer evident when we control for other observed and unobserved city-level attributes. The only statistically significant relationships that remain after composition controls are included are a positive city-size effect on rents (0.04) and a weaker negative effect of income inequality on wages.

While these findings cast doubt on the strength of skill and ethnic diversity as local productive or consumption amenities in New Zealand cities, there are reasons to be cautious in drawing strong inferences. First, the current estimates are based on a relatively small set of urban areas, including some with fewer than 4,000 residents. Bakens et al (2013) find more pronounced impacts of diversity among the 25 largest cities in the Netherlands – all of which

[12] Regression estimates for the second stage regressions are included as Appendix Table 8.

have populations in excess of 100,000. Only 7 New Zealand cities are larger than 100,000 (Appendix Table 3).[13]

Furthermore, the inclusion of composition controls in our second stage regressions comes at a cost – the regression includes 43 covariates, estimated from a sample of 118 city-year observations. There may be limited power to detect genuine relationships. It is a priority to extend the time period covered by our study.[14] This will provide a more robust foundation for analysis and inference, and will allow us to exploit time variation in diversity and relative wages and rents, including controlling for city fixed effects. We can also test the robustness of findings to the atypical pattern of 'national identity' ethnic reporting that occurred in 2006.

If our findings are confirmed and we fail to find an impacts of diversity of city average wages and rents, there may still be diversity impacts that affect only some subgroups (Bakens & de Graaff, 2016; Ottaviano & Peri, 2012) or that arise only in particular contexts, such as in the presence of inclusive institutions, or for particular types of tasks, such as complex problem solving (Cooke & Kemeny, 2017; Kemeny & Cooke, 2015). The analysis of diversity as a local amenity is. Of course, only a partial view of diversity impacts, and complements studies that focus on the more specific impacts that diversity may have on processes such as innovation (Kemeny, 2014; Maré, Fabling, & Stillman, 2014; McLeod, Fabling, & Maré, 2014; Nathan, 2016; Niebuhr, 2010), or on local political economy (Alesina et al., 2016; Alesina & La Ferrara, 2005).

While there is clearly more work to be done in the current study, our work does highlight the potential importance of distinguishing the impacts of diversity from composition effects that are correlated with city wage and rent premiums. This is an issue that we will pursue in future work, and to which we hope other studies of the impacts of diversity will pay attention.

[13] Weighted analysis further reduces the effective sample size, though as noted, estimates from unweighted estimation of the second stage regressions yields very similar results.
[14] At the time of writing (August 2017) we have just gained access to earlier census data covering from 1976 to 2013.

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Table 1: Dominant amenity impact

	$\frac{\partial lnw_c}{\partial lnA_c} < 0$	$\frac{\partial lnw_c}{\partial lnA_c} > 0$
$\frac{\partial lnr_c}{\partial lnA_c} < 0$	Negative production amenity	Negative consumption amenity
$\frac{\partial lnr_c}{\partial lnA_c} > 0$	Positive consumption amenity	Positive production amenity

Table 2: Population and diversity variation across urban areas

	2006 (s.d)	**2013 (s.d)**	**Pooled (s.d)**	**Change (%)**
			(a) Weighted	
Population (000)	550.8	600.9	575.7	50.1
	(516.3)	(565.7)	(541.0)	(9.1%)
Majority ethnic fractionalisation	0.477	0.460	0.468	-0.017
	(0.022)	(0.045)	(0.032)	(-3.6%)
Minority ethnic fractionalisation	0.215	0.193	0.204	-0.022
	(0.096)	(0.104)	(0.100)	(-10.2%)
Ethnic fractionalisation	0.692	0.652	0.672	-0.039
	(0.109)	(0.141)	(0.125)	(-5.7%)
Skill fractionalisation	0.801	0.814	0.808	0.014
	(0.015)	(0.014)	(0.014)	(1.7%)
Income inequality (Theil)	0.339	0.352	0.345	0.013
	(0.027)	(0.035)	(0.031)	(3.7%)
Ln(income)	10.685	10.760	10.723	
	(0.094)	(0.084)	(0.088)	7.7%
Ln(rent)	5.473	5.588	5.531	
	(0.197)	(0.182)	(0.189)	12.2%
			(b) Unweighted	
Population (000)	56.0	59.1	57.6	3.0
	(167.9)	(180.4)	(174.2)	(5.4%)
Majority ethnic fractionalisation	0.458	0.418	0.438	-0.041
	(0.035)	(0.064)	(0.049)	(-8.9%)
Minority ethnic fractionalisation	0.135	0.107	0.121	-0.028
	(0.071)	(0.074)	(0.072)	(-20.8%)
Ethnic fractionalisation	0.593	0.524	0.558	-0.069
	(0.100)	(0.131)	(0.115)	(-11.6%)
Skill fractionalisation	0.779	0.794	0.787	0.015
	(0.024)	(0.022)	(0.023)	(1.9%)
Income inequality (Theil)	0.298	0.303	0.300	0.006
	(0.031)	(0.036)	(0.033)	(1.9%)
Ln(income)	10.578	10.663	10.620	
	(0.092)	(0.101)	(0.094)	8.8%
Ln(rent)	5.245	5.368	5.306	
	(0.239)	(0.216)	(0.226)	13.2%

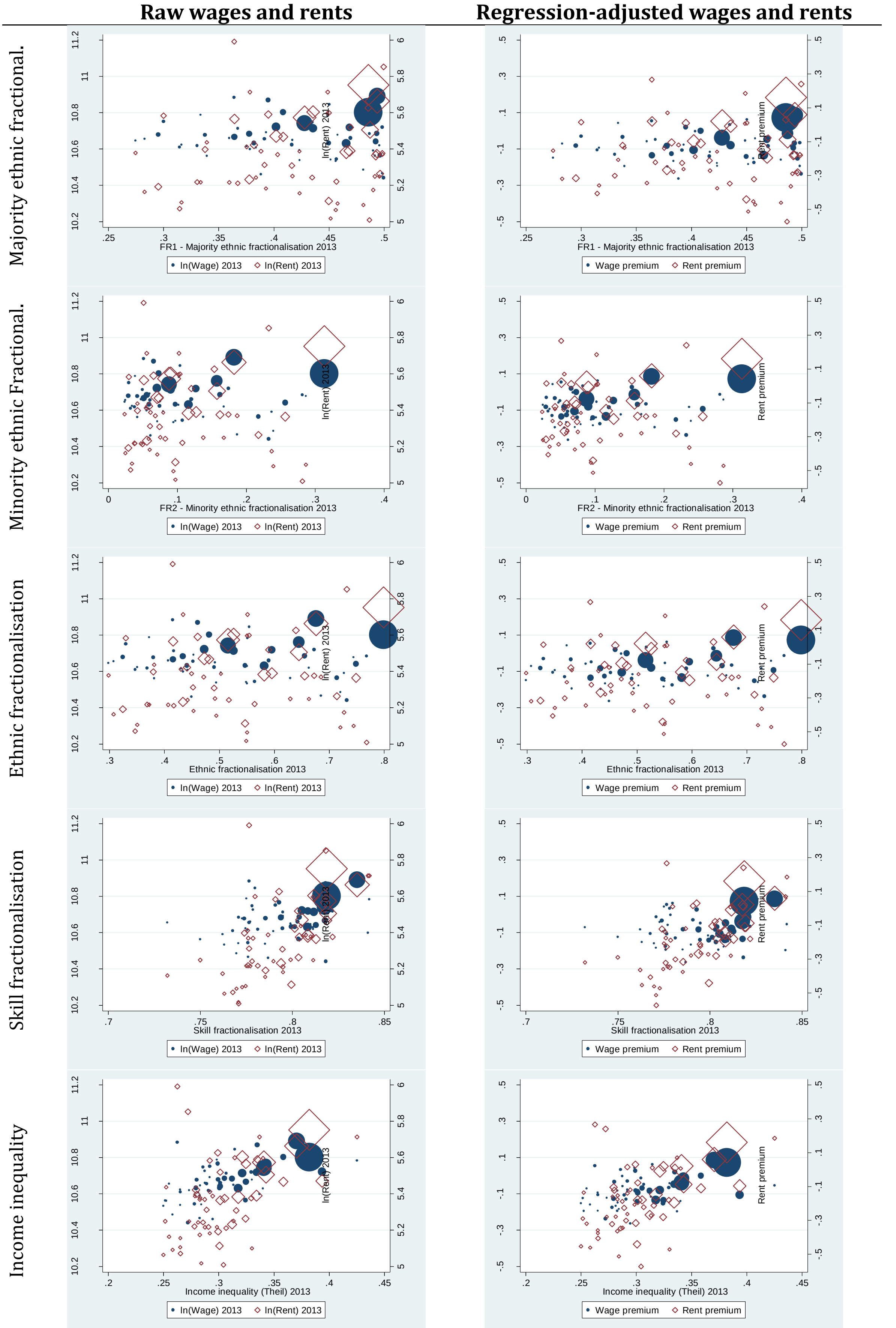
Note: Weighted estimates are weighted by the number of full-time employees in a city-year, as included in the first stage wage equation. Weighted, pooled estimates use mean sample size. Population means are based on counts that are randomly rounded to base 3.

Table 3: Regression estimates of the wage and rent impacts of diversity (OLS)

Specification	**Ln(Wage)** Unadj	Adj	Adj	**Ln(Rent)** Unadj	Adj	Adj
	Year effects		**Year and composition**	**Year effects**		**Year and composition**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
			(a) Population size			
Ln(Population)	0.04***	0.04***	-0.01	0.09***	0.08***	0.03***
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
			(b) Ethnic diversity			
Majority Ethnic Fract	1.05***	0.04	-0.22	2.34***	-0.54	0.53
	(0.21)	(0.51)	(0.16)	(0.44)	(0.51)	(0.34)
Minority Ethnic Fract	0.47***	0.67***	0.27	1.32***	1.29***	-0.13
	(0.07)	(0.13)	(0.37)	(0.12)	(0.22)	(0.79)
			(c) Skill diversity			
Skill Fractionalisation	4.53***	3.79***	-0.88	8.69***	7.36***	0.83
	(0.39)	(0.63)	(0.56)	(0.89)	(2.00)	(1.22)
			(d) Income inequality			
Income Ineq (Theil)	2.20***	2.19***	-0.49	4.34***	3.91***	0.78
	(0.17)	(0.47)	(0.25)	(0.39)	(0.93)	(0.54)
			(e) Combined			
Ln(Population)	0.00	0.01	0.00	0.04***	0.05***	0.04**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Majority Ethnic Fract	-0.35	-0.37	-0.25	-1.31***	-1.46***	-0.32
	(0.21)	(0.26)	(0.22)	(0.37)	(0.37)	(0.46)
Minority Ethnic Fract	0.15	0.50***	0.13	0.89***	0.78***	-0.58
	(0.09)	(0.12)	(0.37)	(0.16)	(0.18)	(0.78)
Skill Fractionalisation	2.78***	1.69	-1.07	5.49***	4.53***	-0.71
	(0.57)	(1.16)	(0.65)	(1.01)	(1.20)	(1.35)
Income Ineq (Theil)	1.02**	0.35	-0.71*	-0.44	-0.69	0.17
	(0.32)	(0.64)	(0.29)	(0.57)	(0.70)	(0.60)

Note: The five panels summarise estimates from five different regressions. Specifications differ across columns. All regressions are weighted by the number of full-time employees in a city-year. Estimates are based on 118 observations (59 Urban areas in each of 2006 and 2013)
*Significance indicators: * p<5%, ** p<1%, *** p<0.1%*

Figure 1: Wages, Rents and diversity (2013)



Note: Each symbol represents an urban area. Symbols are weighted by the city sample size used in the first-stage wage equation

Appendix

Ethnicity Classification

Step One: Identify prevalent ethnicity codes based on total responses:

- Five--digit ethnicity codes (NZEthnic05 v.01: 239 levels) with fewer than 40,000 responses nationally are recoded to the 4-digit level
- This is repeated for 4-digit codes – recoded to 3 digit, etc, until all ethnicity codes are allocated to a group with at least 40,000 responses nationally, or to residual group

Step Two: Identify prevalent combinations of ethnic group, based on individual responses

- Each unique combination of ethnicities is treated as a distinct ethnicity. In this way, each person is allocated to one and only one ethnic classification
- Any combinations with fewer than 40,000 people are grouped based on the number of ethnicity responses: "other single ethnicity"; "other dual ethnicity"; "other multiple (3+) ethnicity"

The resulting classification is shown in Appendix Table 1. There are 16 distinct ethnic classifications in each census year.

Appendix Table 1: Ethnicity classification

	2006	2013
New Zealand European	1,614,861	1,891,359
Māori	199,995	198,312
None Stated	124,995	171,294
NZEur Maori	110,091	147,588
Chinese nfd	102,801	119,496
Indian nfd	66,951	104,700
Other European	89,169	99,330
Other 2eth	89,883	80,100
British and Irish	65,865	74,310
Other single	37,749	70,725
Pacific Peoples	59,841	69,345
Samoan	59,151	64,428
Southeast Asian	-	53,565
Other Asian	41,718	49,665
New Zealander	292,548	45,360
Other multi	24,648	26,199
Asian	41,880	-

Note: Usually resident population counts of people aged 15 and over, from the 2006 and 2013 NZ Census of Population and Dwellings. All counts have been randomly rounded to base 3.

Qualification Classification

Highest qualification is coded by a combination of broad field of study (NZSCED.field v2.0: level 1= 12 fields) and level of qualification (4 levels)

0. No post-school qualification
1. Level 1-3 and overseas school qualification
2. Level 4-6
3. Level 7(Bachelor's degree) or above

Combinations of field and level that have fewer than 40,000 people nationally are recoded:

Other level 3 includes:

- Agriculture, environmental and related studies
- Architecture and building
- Creative Arts
- Engineering and related technologies (in 2006)
- Field not stated
- Food, hospitality and personal services
- Information technology

Other level 2 includes:

- Agriculture, environmental and related studies
- Creative Arts
- Natural and physical sciences
- Field not stated (in 2006)
- Information technology
- Society and culture
- Food, hospitality and personal services

There is also a residual category (Resid_99) to capture people who did not adequately identify their field or level of qualification. This results in a 17-level classification (15 levels in 2006), as shown in Appendix Table 2

Appendix Table 2: Qualification classification

	2006	**2013**
Resid_1	1,074,186	1,165,302
Resid_0	679,179	610,269
Resid_99	308,103	354,081
Engin_2	146,448	144,990
Other_2	140,412	132,213
Socie_3	108,912	130,761
Manag_3	86,067	114,972
Other_3	92,544	102,369
Healt_3	53,550	74,142
Manag_2	69,027	71,535
Educa_3	42,342	64,848
Archi_2	58,044	63,144
Healt_2	68,184	59,367
Natur_3	45,300	55,788
Not_S_2	-	42,627
Engin_3	-	40,545
Educa_2	49,851	38,829

Note: Usually resident population counts of people aged 15 and over, from the 2006 and 2013 NZ Census of Population and Dwellings. All counts have been randomly rounded to base 3.

Appendix Table 3: Diversity across urban areas (Average 2006 and 2013)

Urban Area	**Population (000)**	**Majority Ethnic Fract**	**Minority Ethnic Fract**	**Ethnic Fract**	**Skill Fract**	**Income Inequality (Theil)**
Auckland	1258.5	0.484	0.319	0.803	0.812	0.370
Wellington	368.9	0.497	0.197	0.693	0.829	0.367
Christchurch	357.1	0.447	0.103	0.550	0.809	0.339
Hamilton	194.2	0.492	0.172	0.665	0.812	0.340
Napier-Hastings	120.3	0.478	0.136	0.615	0.800	0.315
Dunedin	114.8	0.456	0.109	0.566	0.804	0.322
Tauranga	111.5	0.427	0.086	0.513	0.800	0.384
Palmerston North	77.2	0.478	0.140	0.618	0.802	0.332
Nelson	58.5	0.400	0.067	0.466	0.810	0.321
Rotorua	53.5	0.489	0.269	0.757	0.803	0.302
New Plymouth	51.0	0.434	0.089	0.523	0.813	0.351
Whangarei	49.1	0.496	0.175	0.671	0.798	0.306
Invercargill	47.3	0.414	0.074	0.487	0.786	0.309
Wanganui	38.5	0.462	0.110	0.572	0.793	0.300
Kapiti	38.4	0.423	0.082	0.504	0.812	0.335
Gisborne	32.6	0.492	0.234	0.727	0.797	0.321
Blenheim	28.9	0.418	0.078	0.496	0.794	0.285
Timaru	27.0	0.349	0.042	0.390	0.779	0.297
Pukekohe	24.5	0.492	0.173	0.664	0.786	0.297
Taupo	21.7	0.483	0.146	0.629	0.800	0.298
Masterton	19.8	0.436	0.088	0.524	0.788	0.308
Levin	19.3	0.465	0.116	0.582	0.767	0.282
Whakatane	18.1	0.499	0.197	0.696	0.814	0.328
Ashburton	17.6	0.356	0.045	0.400	0.763	0.283
Feilding	14.4	0.419	0.075	0.494	0.771	0.286
Rangiora	13.6	0.347	0.042	0.388	0.781	0.300
Tokoroa	13.1	0.476	0.310	0.786	0.766	0.301
Oamaru	12.9	0.349	0.042	0.391	0.774	0.285
Hawera	11.0	0.450	0.096	0.546	0.776	0.289
Queenstown	11.0	0.499	0.239	0.737	0.814	0.260
Greymouth	9.7	0.398	0.059	0.457	0.784	0.299
Gore	9.6	0.365	0.048	0.413	0.759	0.268
Waiuku	8.0	0.468	0.128	0.596	0.780	0.307
Waiheke Island	8.0	0.462	0.118	0.580	0.833	0.400
Motueka	7.4	0.415	0.075	0.489	0.776	0.280
Te Puke Community	7.3	0.497	0.180	0.677	0.771	0.297
Rolleston	7.3	0.404	0.068	0.472	0.770	0.252
Huntly	6.9	0.488	0.246	0.733	0.755	0.287
Morrinsville	6.8	0.434	0.090	0.524	0.774	0.280
Thames	6.7	0.437	0.089	0.525	0.793	0.310
Matamata	6.7	0.398	0.064	0.463	0.766	0.291
Kawerau	6.6	0.468	0.266	0.734	0.759	0.326
Waitara	6.4	0.495	0.153	0.648	0.747	0.253
Kerikeri	6.2	0.465	0.122	0.587	0.813	0.330
Wanaka	5.8	0.416	0.075	0.491	0.837	0.321
Otaki	5.6	0.498	0.180	0.677	0.800	0.263

Urban Area	Population (000)	Majority Ethnic Fract	Minority Ethnic Fract	Ethnic Fract	Skill Fract	Income Inequality (Theil)
Stratford	5.4	0.389	0.060	0.449	0.768	0.296
Dannevirke	5.3	0.467	0.108	0.575	0.758	0.248
Alexandra	4.8	0.331	0.035	0.366	0.799	0.277
Marton	4.6	0.467	0.115	0.582	0.761	0.270
Carterton	4.4	0.406	0.070	0.476	0.779	0.275
Te Kuiti	4.3	0.481	0.241	0.722	0.757	0.259
Picton	4.1	0.455	0.112	0.567	0.802	0.278
Temuka	4.0	0.339	0.039	0.378	0.728	0.261
Balclutha	4.0	0.359	0.046	0.405	0.770	0.275
Westport	4.0	0.371	0.050	0.420	0.756	0.295
Waipukurau	3.9	0.446	0.091	0.537	0.774	0.262
Cromwell	3.9	0.387	0.058	0.445	0.798	0.259
Hokitika	3.5	0.424	0.077	0.501	0.790	0.295

Note: Population counts are based on counts that have been randomly rounded to base 3, and then rounded to the nearest 1,000.

Appendix Table 4: Adjusted and unadjusted wage and rent premiums

	Log(wage)				Log(rent)			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
Urban area	**2006**	**2013**	**2006**	**2013**	**2006**	**2013**	**2006**	**2013**
Auckland	0.067	0.042	0.092	0.073	0.196	0.177	0.183	0.161
Wellington	0.138	0.132	0.092	0.086	0.048	0.088	0.017	0.060
Christchurch	-0.029	-0.017	-0.060	-0.038	-0.029	-0.002	-0.005	0.022
Hamilton	-0.017	0.001	-0.021	-0.014	-0.046	-0.070	-0.068	-0.087
Napier-Hastings	-0.142	-0.129	-0.135	-0.135	-0.190	-0.193	-0.142	-0.147
Dunedin	-0.082	-0.046	-0.085	-0.079	0.059	0.028	0.025	-0.008
Tauranga	-0.065	-0.038	-0.124	-0.106	-0.089	-0.105	-0.083	-0.096
Palmerston North	-0.053	-0.041	-0.048	-0.047	-0.181	-0.186	-0.203	-0.195
Nelson	-0.107	-0.093	-0.127	-0.135	-0.010	-0.011	0.014	0.020
Rotorua	-0.107	-0.118	-0.072	-0.093	-0.172	-0.212	-0.142	-0.180
New Plymouth	-0.010	0.043	-0.049	0.000	-0.179	-0.109	-0.187	-0.110
Whangarei	-0.078	-0.074	-0.057	-0.069	-0.207	-0.201	-0.182	-0.179
Invercargill	-0.083	-0.076	-0.090	-0.083	-0.369	-0.344	-0.279	-0.268
Wanganui	-0.140	-0.127	-0.155	-0.141	-0.447	-0.463	-0.428	-0.441
Kapiti	0.064	0.110	-0.017	0.020	0.004	0.014	-0.007	0.010
Gisborne	-0.182	-0.195	-0.144	-0.152	-0.346	-0.312	-0.315	-0.281
Blenheim	-0.168	-0.127	-0.148	-0.126	-0.136	-0.154	-0.081	-0.104
Timaru	-0.103	-0.081	-0.116	-0.082	-0.425	-0.384	-0.360	-0.316
Pukekohe	-0.006	0.007	0.025	0.027	0.045	0.050	0.040	0.030
Taupo	-0.112	-0.099	-0.072	-0.084	-0.005	-0.057	-0.041	-0.078
Masterton	-0.150	-0.136	-0.147	-0.140	-0.330	-0.267	-0.272	-0.212
Levin	-0.192	-0.215	-0.167	-0.175	-0.373	-0.356	-0.355	-0.322
Whakatane	-0.020	-0.039	-0.041	-0.065	-0.185	-0.200	-0.152	-0.180
Ashburton	-0.104	-0.082	-0.082	-0.034	-0.311	-0.178	-0.235	-0.122
Feilding	-0.108	-0.104	-0.108	-0.106	-0.317	-0.264	-0.274	-0.226
Rangiora	-0.063	-0.008	-0.093	-0.029	-0.051	0.008	-0.032	0.015
Tokoroa	-0.075	-0.075	-0.010	-0.013	-0.529	-0.567	-0.536	-0.572
Oamaru	-0.167	-0.141	-0.171	-0.130	-0.465	-0.359	-0.392	-0.301
Hawera	-0.046	-0.012	-0.011	0.034	-0.357	-0.333	-0.391	-0.348
Queenstown	-0.183	-0.318	-0.107	-0.237	0.393	0.277	0.336	0.241
Greymouth	-0.099	-0.046	-0.104	-0.047	-0.432	-0.365	-0.287	-0.222
Gore	-0.177	-0.149	-0.153	-0.105	-0.606	-0.505	-0.499	-0.406
Waiuku	0.117	0.086	0.094	0.062	0.005	0.023	0.003	0.011
Waiheke Island	0.030	0.024	-0.047	-0.054	0.167	0.138	0.192	0.185
Motueka	-0.323	-0.299	-0.268	-0.263	-0.196	-0.188	-0.099	-0.119
Te Puke Comm'ty	-0.239	-0.294	-0.179	-0.193	-0.206	-0.207	-0.177	-0.175
Rolleston	0.074	0.124	0.007	0.055	0.352	0.416	0.197	0.266
Huntly	-0.131	-0.168	-0.041	-0.082	-0.430	-0.402	-0.382	-0.364
Morrinsville	-0.022	-0.033	0.011	-0.002	-0.278	-0.207	-0.261	-0.188
Thames	-0.115	-0.111	-0.115	-0.116	-0.289	-0.326	-0.230	-0.271
Matamata	-0.105	-0.144	-0.077	-0.087	-0.220	-0.164	-0.188	-0.140
Kawerau	-0.037	-0.082	0.003	-0.042	-0.443	-0.477	-0.450	-0.472
Waitara	-0.225	-0.196	-0.159	-0.124	-0.389	-0.327	-0.372	-0.289
Kerikeri	-0.145	-0.130	-0.132	-0.140	0.092	0.021	0.086	0.007
Wanaka	-0.183	-0.161	-0.166	-0.196	0.234	0.137	0.144	0.071
Otaki	-0.204	-0.139	-0.172	-0.122	-0.357	-0.328	-0.310	-0.280
Stratford	-0.139	-0.099	-0.127	-0.058	-0.507	-0.361	-0.484	-0.345
Dannevirke	-0.217	-0.226	-0.139	-0.152	-0.441	-0.512	-0.392	-0.453
Alexandra	-0.121	-0.114	-0.126	-0.148	-0.163	-0.197	-0.121	-0.153
Marton	-0.219	-0.218	-0.189	-0.183	-0.552	-0.559	-0.504	-0.513
Carterton	-0.149	-0.152	-0.173	-0.166	-0.365	-0.333	-0.297	-0.278

	Log(wage)				Log(rent)			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
Urban area	**2006**	**2013**	**2006**	**2013**	**2006**	**2013**	**2006**	**2013**
Te Kuiti	-0.205	-0.274	-0.077	-0.159	-0.486	-0.485	-0.463	-0.461
Picton	-0.226	-0.166	-0.222	-0.178	-0.145	-0.189	-0.111	-0.159
Temuka	-0.104	-0.104	-0.109	-0.070	-0.474	-0.412	-0.364	-0.319
Balclutha	-0.133	-0.136	-0.123	-0.093	-0.532	-0.470	-0.421	-0.358
Westport	-0.136	0.029	-0.121	0.043	-0.563	-0.359	-0.409	-0.207
Waipukurau	-0.211	-0.221	-0.150	-0.193	-0.371	-0.420	-0.346	-0.375
Cromwell	-0.177	-0.198	-0.153	-0.194	-0.007	-0.139	-0.006	-0.136
Hokitika	-0.134	-0.068	-0.154	-0.077	-0.475	-0.394	-0.351	-0.262

Note: Adjusted measures are city-year fixed effects estimates obtained from a first-stage regression: (α_{ct}^{Z} as shown in equation 10).

Appendix Table 5: First-stage hedonic wage regression

			2006	2013
Age			0.498***	0.528***
			(0.003)	(0.003)
Age2			-0.014***	-0.015***
			(0.000)	(0.000)
Age3			0.000***	0.000***
			(0.000)	(0.000)
Age4			-0.000***	-0.000***
			(0.000)	(0.000)
Female			-0.246***	-0.234***
			(0.001)	(0.001)
Qualifications	Architecture	Level 2	0.056***	0.042***
			(0.004)	(0.004)
	Education	Level 2	0.125***	0.110***
			(0.004)	(0.005)
		Level 3	0.247***	0.256***
			(0.004)	(0.003)
	Engineering	Level 2	0.123***	0.135***
			(0.002)	(0.002)
		Level 3		0.448***
				(0.004)
	Health	Level 2	0.110***	0.104***
			(0.004)	(0.004)
		Level 3	0.425***	0.452***
			(0.004)	(0.003)
	Management	Level 2	0.184***	0.164***
			(0.003)	(0.003)
		Level 3	0.447***	0.437***
			(0.003)	(0.002)
	Natural Science	Level 3	0.319***	0.326***
			(0.004)	(0.004)
	Field Not stated	Level 2		0.085***
				(0.005)
	Other	Level 2	0.027***	0.004
			(0.003)	(0.003)
		Level 3	0.305***	0.252***
			(0.003)	(0.003)
	No qualifications		-0.198***	-0.224***
			(0.002)	(0.002)
	School and not stated		-0.218***	-0.201***
			(0.003)	(0.004)
	Society	Level 3	0.271***	0.282***
			(0.003)	(0.002)
Ethnicity	Asian		-0.432***	
			(0.005)	
	British and Irish		-0.025***	-0.029***
			(0.004)	(0.003)
	Chinese nfd		-0.523***	-0.399***

		2006	2013
		(0.004)	(0.003)
	Indian nfd	-0.399***	-0.360***
		(0.003)	(0.003)
	Māori	-0.158***	-0.172***
		(0.002)	(0.002)
	NZ European - Māori	-0.046***	-0.051***
		(0.003)	(0.003)
	New Zealander	0.028***	-0.018***
		(0.002)	(0.004)
	None stated	-0.168***	-0.214***
		(0.008)	(0.009)
	Other 2-ethnicity	-0.082***	-0.129***
		(0.003)	(0.003)
	Other Asian	-0.467***	-0.458***
		(0.006)	(0.005)
	Other European	-0.113***	-0.102***
		(0.003)	(0.003)
	Other multiple ethnicities	-0.083***	-0.115***
		(0.006)	(0.006)
	Other single ethnicity	-0.218***	-0.248***
		(0.005)	(0.004)
	Pacific Peoples	-0.365***	-0.417***
		(0.004)	(0.004)
	Samoan	-0.347***	-0.397***
		(0.004)	(0.004)
	Southeast Asian		-0.448***
			(0.004)
Intercept		4.377***	4.098***
		(0.028)	(0.033)
Observations		1,005,747	1,041,114
Between-city R-sq		0.474	0.532
Within-city R-sq		0.328	0.329
Overall R-sq		0.322	0.325
Between-city variance %		0.017	0.021

Note Observation counts have been randomly rounded to base 3. The sample is restricted to residents of 97 urban areas with at least 500 full-time employees in each year.
*Significance indicators: * p<5%, ** p<1%, *** p<0.1%*

Appendix Table 6: First-stage hedonic rent regression

		2006	2013
Heating Fuel	Electricity	0.129***	0.102***
		(0.006)	(0.012)
	Mains Gas	0.069***	0.083***
		(0.018)	(0.016)
	Bottled Gas	0.131***	0.137***
		(0.027)	(0.018)
	Wood	0.042**	0.023
		(0.014)	(0.015)
	Coal	0.000	0.004
		(0.014)	(0.014)
	Solar Power	-0.073***	-0.074*
		(0.013)	(0.030)
	No fuels	-0.039	-0.023
		(0.055)	(0.055)
	Other	-0.012	-0.052
		(0.029)	(0.038)
Number of bedrooms	1	-0.010	-0.042
		(0.077)	(0.042)
	2	0.267***	0.235***
		(0.054)	(0.028)
	3	0.397***	0.417***
		(0.046)	(0.023)
	4	0.501***	0.539***
		(0.050)	(0.023)
	5	0.630***	0.655***
		(0.060)	(0.041)
	6 or more	0.534***	0.747***
		(0.067)	(0.082)
Total number of rooms	2	-0.010	0.014
		(0.029)	(0.011)
	3	0.008	0.015
		(0.034)	(0.026)
	4	0.058	0.042*
		(0.033)	(0.021)
	5	0.081*	0.054**
		(0.032)	(0.021)
	6	0.166***	0.113***
		(0.035)	(0.019)
	7	0.224***	0.166***
		(0.038)	(0.022)
	8	0.218***	0.157***
		(0.046)	(0.022)
	9	0.198***	0.146***
		(0.047)	(0.030)
	10 or more	-0.113***	-0.119***
		(0.014)	(0.013)
Dwelling type	Separate house, storeys unkn	-0.070**	-0.094**

		2006	2013
		(0.023)	(0.035)
	Separate one-storey	0.110***	0.113***
		(0.011)	(0.012)
	Separate, 2 or more storeys	0.326***	0.317***
		(0.044)	(0.036)
	Two or more - storeys unknown	0.005	0.004
		(0.046)	(0.033)
	Two or more - one storey	0.058	0.072*
		(0.039)	(0.035)
	Two or more - 2 -3 storeys	0.250***	0.265***
		(0.047)	(0.026)
	Two or more - 4 or more storeys	0.542***	0.571***
		(0.056)	(0.019)
Number of heating fuels	1	0.060*	0.056
		(0.024)	(0.032)
	2	0.040	0.038
		(0.042)	(0.053)
	3	-0.001	-0.009
		(0.059)	(0.073)
	4 or more	-0.026	-0.043
		(0.083)	(0.094)
Intercept		4.594***	4.882***
		(0.123)	(0.079)
Observations		325,341	368,322
Between-city R-sq		0.524	0.461
Within-city R-sq		0.202	0.193
Overall R-sq		0.200	0.195
Between-city var %		0.158	0.134

Note: Observation counts have been randomly rounded to base 3. The sample is restricted to dwellings in 97 urban areas with at least 500 full-time employees in each year.
*Significance indicators: * p<5%, ** p<1%, *** p<0.1%*

Appendix Table 7: Correlations

(a) Year-specific

	ln(Wage)	Adj. Wage	ln(Rent)	Adj. Rent	Ethnic FR1	Ethnic FR2	Skill	Income Ineq
ln(Wage)		0.91	0.68	0.65	0.44	0.44	0.70	0.73
Adjusted Wage	0.94		0.77	0.74	0.58	0.72	0.58	0.77
ln(Rent)	0.72	0.78		0.99	0.51	0.70	0.65	0.76
Adjusted Rent	0.68	0.76	0.99		0.46	0.69	0.63	0.75
Ethnic FR1	0.47	0.51	0.41	0.35		0.75	0.57	0.54
Ethnic FR2	0.62	0.83	0.73	0.73	0.53		0.37	0.69
Skill	0.76	0.65	0.70	0.65	0.62	0.44		0.68
Income Ineq	0.82	0.75	0.70	0.68	0.41	0.57	0.77	

Note: 2006 Correlations are below the diagonal. 2013 correlations are above the diagonal. Correlations are weighted using year-specific wage-equation sample sizes for each of 59 urban areas.

(b) Between-years

	2013 ln(Wage)	2013 Adjusted Wage	2013 ln(Rent)	2013 Adjusted Rent	2013 Ethnic FR1	2013 Ethnic FR2	2013 Skill	2013 Income Ineq
2006 ln(Wage)	0.96	0.84	0.61	0.57	0.40	0.45	0.73	0.79
2006 Adj. Wage	0.96	0.97	0.72	0.69	0.42	0.72	0.62	0.76
2006 ln(Rent)	0.78	0.81	0.99	0.98	0.38	0.69	0.70	0.71
2006 Adj Rent	0.74	0.78	0.97	0.98	0.32	0.68	0.67	0.70
2006 Ethnic FR1	0.57	0.68	0.55	0.50	0.92	0.77	0.60	0.52
2006 Ethnic FR2	0.62	0.83	0.73	0.73	0.49	1.00	0.42	0.58
2006 Skill	0.72	0.60	0.64	0.61	0.59	0.39	0.98	0.74
2006 Income Ineq	0.80	0.78	0.75	0.74	0.38	0.68	0.72	0.97

Note: Correlations are weighted using mean wage-equation sample sizes for each of 59 urban areas.

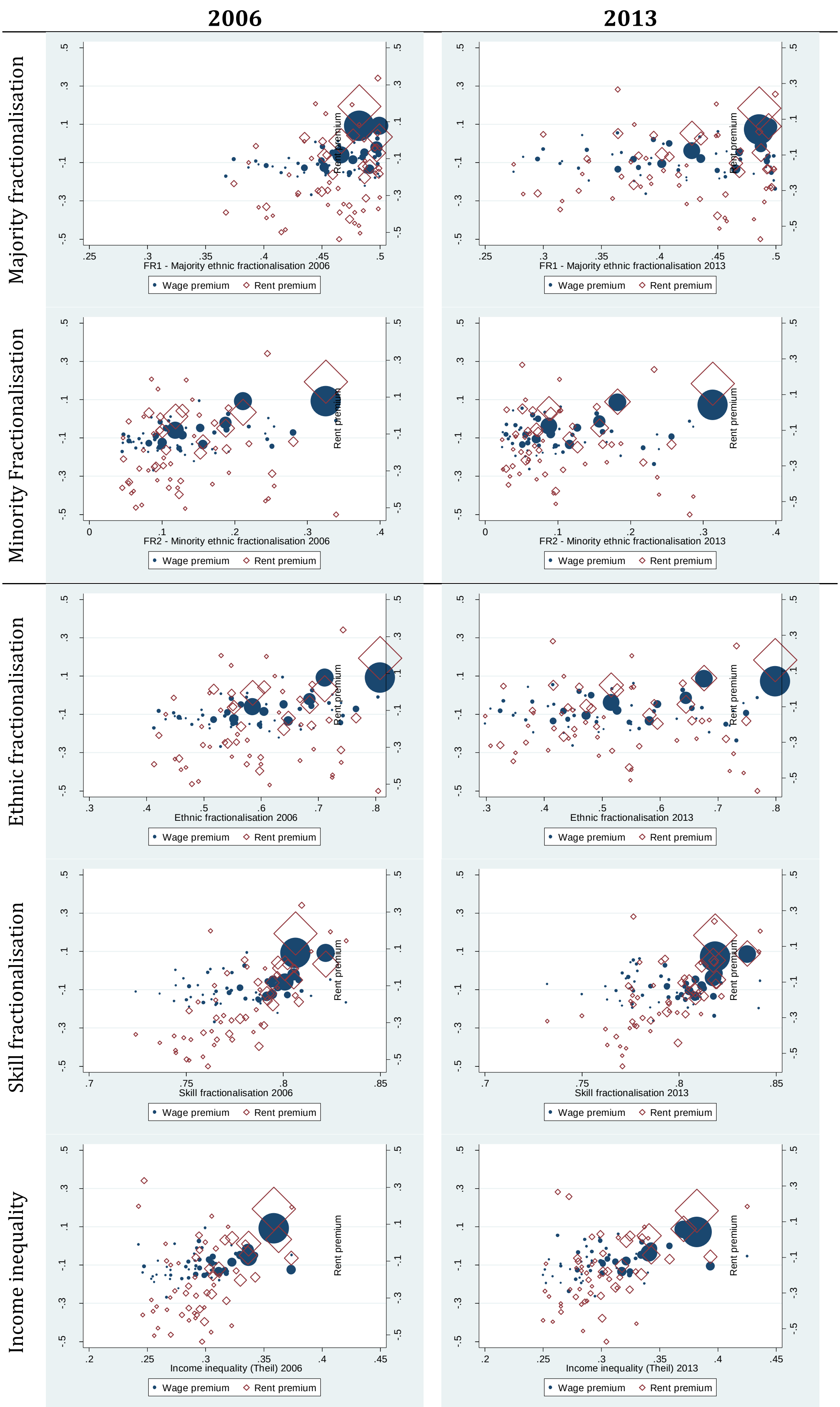
Appendix Table 8: Full second stage regression estimates

		Adjusted Wage (α_{ct}^{lnW})	Adjusted Rent (α_{ct}^{lnR})
Ln(population)		0.00	0.04**
		(0.01)	(0.01)
Majority Ethnic Fractionalisation		-0.25	-0.32
		(0.22)	(0.46)
Majority Ethnic Fractionalisation		0.13	-0.58
		(0.37)	(0.78)
Skill Fractionalisation		-1.07	-0.71
		(0.65)	(1.35)
Income inequality (Theil)		-0.71*	0.17
		(0.29)	(0.60)
Age		0.03	-3.38*
		(0.69)	(1.45)
Age^2		-0.00	0.13*
		(0.03)	(0.05)
Age^3		-0.00	-0.00*
		(0.00)	(0.00)
Age^4		0.00	0.00*
		(0.00)	(0.00)
Female share		-0.91*	2.51**
		(0.38)	(0.79)
Qualification shares	Archi_2	-0.11	2.16
		(0.92)	(1.93)
	Educa_2	2.65	-2.70
		(1.71)	(3.57)
	Educa_3	-0.25	-4.38
		(1.12)	(2.33)
	Engin_2	2.15***	0.55
		(0.61)	(1.27)
	Healt_2	-0.31	0.79
		(1.11)	(2.32)
	Healt_3	0.40	-5.85***
		(0.81)	(1.70)
	Manag_2	0.29	4.15
		(1.19)	(2.49)
	Manag_3	1.65	2.20
		(1.16)	(2.43)
	Natur_3	-1.60	4.72*
		(0.86)	(1.80)
	Other_2	-2.24*	0.10
		(0.87)	(1.82)
	Other_3	-0.14	-3.29
		(0.97)	(2.02)
	Resid_0	-0.42	-0.44
		(0.36)	(0.76)
	Resid_99	-0.18	-0.51
		(1.24)	(2.58)

		Adjusted Wage (α_{ct}^{lnW})	Adjusted Rent (α_{ct}^{lnR})
	Socie_3	2.23**	-0.67
		(0.66)	(1.38)
	Engin_3	1.61	2.45
		(0.99)	(2.07)
	Not_Stated_2	-0.21	-5.67
		(2.08)	(4.34)
Ethnicity shares	Asian	-0.08	0.68
		(1.21)	(2.53)
	British_and_Irish	-0.44	1.34
		(0.86)	(1.79)
	Chinese_nfd	0.83	-1.89
		(1.08)	(2.25)
	Indian_nfd	0.60	1.67
		(0.53)	(1.11)
	Māori	-0.18	0.18
		(0.27)	(0.56)
	NZEur_Maori	0.18	0.96
		(0.57)	(1.19)
	New_Zealander	-0.57	1.24
		(0.35)	(0.73)
	None_Stated	-3.20	-5.07
		(2.93)	(6.12)
	Other_2eth	2.69	-3.25
		(1.35)	(2.83)
	Other_Asian	-2.63	2.80
		(1.95)	(4.07)
	Other_European	1.58	12.10***
		(1.02)	(2.13)
	Other_multi	5.22*	4.66
		(2.52)	(5.26)
	Other_single	-1.64	-5.56*
		(1.27)	(2.65)
	Pacific_Peoples	-0.98	1.12
		(0.84)	(1.76)
	Samoan	-0.63	0.00
		(0.83)	(1.74)
	Southeast_Asian	-0.71	-1.98
		(1.28)	(2.68)
2013.year		-0.05	0.26*
		(0.06)	(0.12)
_cons		1.34	29.20*
		(6.69)	(13.98)
N (59: UA * 2 years)		118	118

Note: The sample includes 59 urban areas in each year, being those with an average number of full-time employees of at least 1,000.
*Significance indicators: * p<5%, ** p<1%, *** p<0.1%*

Appendix Figure 1: Wages, Rents and diversity - Regression-adjusted (2006 and 2013)



Note: Scaling

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