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Internal Mobility in New Zealand

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SWork in progress: Comments appreciated.

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ABSTRACT

What characteristics push people to move and what pulls them to a new location? Evidence from the US has suggested that people are pulled to cities with a high population density and with large concentrations of skilled people. But how does this apply to New Zealand? Where are people moving to and from and what are the characteristics associated with the migrants' origins and destinations? This paper investigates the effect that the characteristics of a community have on the likelihood of people leaving and/or travelling to the community. The movement of people is obtained from a mobility table produced from census data by Statistics New Zealand. We use geographical information system (GIS) tools to define variables based on aggregations of meshblocks around the area units of interest. How does migration vary geographically across New Zealand? We model migration decisions and investigate their causes. Who moves and where do they go? We investigate the broad characteristics of areas that exhibit high losses and/or gains in population through migration. We investigate the relationship between the level of turnover or 'churning' of people with the characteristics of the population in that area.

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1 INTRODUCTION

Mobility is of economic interest for two main reasons. First it is a key factor in understanding the growth and decline of regions. People, making choices to improve their own circumstances, move in ways that reflect the attractiveness of different areas. By moving they may also contribute to the relative attractiveness of the areas they leave and go to. If higher population density is economically favourable, in-migration makes an area more attractive and out-migration makes it decline. If highly educated people are valuable to the area around them, the movement of highly educated people damages the prospects of areas they leave and enhances their destination. These movements are significant for the speed of economic adjustment and the spatial evolution of the economy. The dynamics of growth and decline of communities also have social implications. If people tend to leave communities with declining living standards the effects of decline may be only transitory. If only educated people leave, the effects on those who remain may be exacerbated.

Second, as well as the overall response of communities to shocks, the mobility of individuals has important social implications. If an area suffers an adverse shock, an individual's ability to move away is one key response to maintaining living standards and avoiding persistent deprivation. An individual who grows up in a deprived area or suffers a shock that makes their current location unfavourable (e.g. loses a job in an area where there are few other suitable employment opportunities) can escape this problem if they can move to another area. If individuals move frequently for a range of reasons, they also will be more able to respond to shocks. Callister (1997) and others find strong persistence of negative social indicators in communities over time. If a community as a whole is always deprived and does not improve, but the individuals within it are turning over, the consequences for individuals may be attenuated.

This paper presents some preliminary work from a larger project on patterns of regional development and regional social outcomes in New Zealand. We explore patterns of net migration that might be related to long term economic evolution as well as investigating the characteristics of areas that experience high turnover of population. The analysis in this paper is the foundation for a more detailed examination of internal migration issues in New Zealand, which we are currently undertaking.

The economic development-related reasons for studying mobility largely relate to net mobility and the changing size and structure of communities. Previous New Zealand literature has considered in detail the patterns of movement within New Zealand (New Zealand Planning Council (1989) and more recently Goodwin and Bedford (1997)). Poot (1986) studies the movement of male workers in the 1970s in response to income, prices and employment opportunities. He also studies migrants' choices of destination depending on the distance between origins and potential destinations as well as their characteristics. He finds that workers tend to move northward, that they move to areas of higher median income and are affected by employment opportunities. Chapple (2000) studies the effect of regional adjustments and migration on labour markets and income inequality.

We study net mobility between area units (areas defined by Statistics NZ that represent three to five thousand people) between 1991 and 1996, relating it to factors that the economic geography literature suggests will encourage agglomeration as well as crudely controlling for demographic factors. We particularly focus on the effects of education and population density. As discussed in Box (2000) and Kerr and Timmins (2000) people with high education are expected through information externalities to raise the productivity of

people working in their area and possibly improve the amenities in the area. Higher population density leads to greater exchange of information, labour market advantages such as improved matching and greater security for workers because of the pool of employment opportunities. These factors may be more important over time as economies of scale increase and tacit information exchange becomes more important.[2] These effects operate over different spatial scales. Some effects operate through the people in an immediate neighbourhood or in the same school district. Others relate to the people an individual is likely to work with, while others still relate to the economic viability of the region as a whole. We test the effects of variables at different spatial scales by comparing the effects of variables within an area unit itself and the effects of the characteristics of a wider area (currently a 20km radius around the area unit).

We find that net migration is higher in areas with higher population density when this is measured on a wide scale (i.e. 20km radius) but is significantly lower when population density is higher within the area unit itself. This may reflect the attractiveness of proximity to a large city and large labour market at the same time as the attractiveness of the greater open space and lower housing costs in less dense areas. The definition of geographic neighbourhoods may be critical to correct interpretation of results. We also find that areas with more qualified people are more attractive which suggests some increasing benefits of information externalities. We find some evidence that areas focusing on agriculture are declining though this is weak.

The second reason to study mobility relates to the tendency of individuals to move. We explore this by looking at the 'churning' of individuals between communities, i.e. the sum of in-migration and out-migration relative to the initial population. Churning could relate to three things. First, it relates to the characteristics of the individuals in the area unit. If young people are mobile and there are many young people in the area then the area may experience high churning. Poot (1987) studies the effects of age sex and occupation on duration of individuals in an area. He finds lower mobility among older people, and agricultural workers. Second, churning may relate to characteristics of the area itself. An area unit that contains or is proximate to a University is likely to experience high churning as students come and go. Other area units may act as 'staging posts' for people first arriving in a city or people suffering economic shocks so people may pass through quickly. Third, an area unit that is 'close' to area units that are sometimes very attractive destinations but sometimes not, could have high churning because the costs of moving backwards and forwards are very low. For example a satellite community near Auckland could have high levels of interchange with Auckland. 'Close' could also mean similar so that the dislocation of moving from one to the other is low. Poot (1986) finds high levels of exchange among major centres in New Zealand. Here we explore only the effects of the composition of the population on the level of churning.

We find, not surprisingly, that churning appears to be higher in areas of high population density. Many people will simply be moving between suburbs within a city. We also find higher churning in areas with high numbers of educated people and people of working age.

[2] In addition, over the long term, as transportation costs fall we might expect fewer firms that serve outlying communities to be located in those communities. Thus areas with high primary production may have out-migration over time.

2 CAUSES OF MOBILITY

People move because on balance they decide that another location suits them best. This may be as a result of push factors, for example loss of employment.. We can model location choice as an individual each period facing a dynamic optimisation problem.

Each individual[3] i chooses whether to move each period and where to move to. There are s locations b_m, m = 1,..,s. At time t individual i is in location $b_m \in$ B and can move to any one of s-1 locations $\{b_1,\ldots b_{m-1}, b_{m+1}, \ldots b_s\}$. Each individual i gets a certain level of utility from a location at time t that depends on the characteristics of the location interacted with their personal characteristics.

U_{imt} (location b_m| characteristics X_{it}) = U_{imt} (b_m |X_{it})

The individual suffers dislocation costs d_{imn} from moving location that depend on the relative characteristics of the two locations, b_m and b_n and their own characteristics.[4]

$d(b_m , b_n | X_{it})$

The dislocation cost of staying in the same place $d(b_m, b_m)$ is zero by assumption.

The individual has to choose a location to solve the following dynamic problem.

$$\text{Max}_n \quad EU_{it}(b_n | X_{it}) - d(b_m, b_n | X_{it}) + \int_{s=t+1}^{\infty} [EU_{is}(b^*_n | (b_m(t)\ldots b_n(s-1), X_{is}) - d^*(b_m, b_n | X_{is})]\, e^{-rs}\, ds$$

$((b_m(t)\ldots b_n(s-1))$ is the individual's history of location decisions at time s. b_n^* are optimal choices from s=t+1 onward given future conditions and past history. d* are the dislocation costs of those optimal choices. Current choices will depend on their effect on these future options. Future options depend on previous choices because of the costs of relocating and because individual characteristics may change over time depending on the location they are in.

This problem can be broken down into two parts.

1. Whether to move at time t.

2. If the individual moves, where do they decide to move to.

This separation provides insight and facilitates empirical estimation by recognising that in reality the decision of whether or not to move is very different from the decision between two alternative destinations. We might expect much greater differences between movers and non-movers than between people who choose different destinations. We contend that many people face such high dislocation costs or such high unobservable attachments to particular locations that their behaviour is fundamentally different from that of movers.

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[3] Note individual decisions may be closely related to those of their household. Therefore in an analysis of individual data we would need to control for within household correlation.

[4] Dislocation costs could also depend on the time since the shock that induces movement.

The characteristics of each area vary and are valued differently by different individuals. Why might individuals not be in their optimal location? Why might some locations be systematically more favourable and so experience net in-migration? Who would we expect to move and why? What characteristics of locations and people will drive mobility?

Individuals move for many reasons. Some of these movements occur even in 'equilibrium' where there are no changes in the economic status or composition of communities. Others are manifestations of economic change that could be long-term trends or idiosyncratic shocks.

2.1 Equilibrium Mobility

In equilibrium people sometimes move in order to match their specific skills with jobs. Different locations will offer jobs with different incomes and opportunities for learning and advancement. Young people may be observed moving several times for job-related reasons until they find an occupation and job that suits them. In addition they may move to match their preferences to the characteristics of a location. People may grow up in a place that does not suit their preferences and hence move when they leave home. For example, someone who loves the fast pace of city life may grow up in a rural area. Alternatively their preferences may change through their lives and lead them to relocate. Preferences could be a function of age and income.

Equilibrium mobility is partly a demographic phenomenon. Young people move to get education or training. Working people move to better jobs. People with children may move to areas with good schools or with other amenities for children. Older people may move to a different place to retire. The demographic structure of a community will affect how many people move and what type of people come in and leave.

Preferences for particular locations may be partly culturally determined (e.g. Maori attachment to land) as well as determined by an individual's history (attachment to family and friends). These factors will affect the level of mobility as well as affecting exchange of people between places. For example Ngati Porou have a strong connection with Wellington and anecdotally there are significant movements between Hawkes Bay and Wellington. The costs of moving between familiar areas are much lower. If people are closely attached to a particular community they may not want to move at all. Rural Maori may be expected to have lower mobility. As Poot (1987) found, older people will be more likely to exhibit these strong attachments.

2.2 Long-term movements – economic geography

The second cause of mobility, and the one of primary interest here is long run trends in the economy that lead to the contraction and growth of communities. The economic geography literature models a trade-off between the need to have services near location-specific activities such as agriculture and hence the development of rural communities vs. the scale and scope economies of cities through information exchange, larger markets, and larger labour pools (Krugman (1991). As the structure of the economy changes over time, possibly toward the 'information economy' as well as toward services, the economies of scale change and the value of larger agglomerations may increase. As transport costs fall, the need for production of non-agricultural products to be close to rural markets falls so the raison d'être of rural communities diminishes.

Population growth tends to persist (Glaeser (1994) so that high population density leads to higher population growth. In US data this has been found to have an inverted U relationship where the fastest growth occurs in medium density cities. One possible

explanation for the positive part of this relationship is that greater population density creates larger labour markets that tend to raise productivity (Ciccone and Hall (1996)). Larger labour markets create more opportunities for workers to specialise (Becker and Murphy (1992), Diamond and Simon (1989) Krugman (1991)). Larger labour markets also improve the matching between workers and jobs and thus increase the productivity of workers. A larger market is more able to attract 'superstars' who benefit from large market but also raise the productivity of those around them (Rosen (1981)). Workers who invest in education and skills in a large market face reduced risk to these human capital investments because even if they lose their current job they will be likely to find other work that matches their qualifications well.

"Cities" or areas of high population density also have important dynamic effects through the transmission of knowledge. This knowledge is complementary to physical capital. Human capital externalities become an urban amenity because those who move to cities experience growth in productivity and hence earnings (Rauch (1991), Glaeser and Maré (forthcoming)). Not only do workers learn from those around them, but also new knowledge is more likely to be created through innovation (Jaffe, Trajtenberg and Henderson (1993)).

At a macroeconomic level knowledge is found to empirically important for growth. Intellectual spillovers are the key theoretical reason why growth can coexist with decreasing returns on capital (Lucas (1988)). Human capital and political variables are key empirically in determining growth (Barro (1991), Alesina and Perrotti (1993)). At a national level this growth may be reflected simply in higher per capita incomes. Within a country, different growth in productivity will induce migration. Population and income, which is associated with higher skills, empirically tend to move together (Glaeser (1994). Educated people go to cities with educated people (Glaeser (1994)). Over time this effect may be becoming more important so that higher education/ high intellectual spillover areas become even more productive and hence attractive for new migrants. The skills premium is rising with time (Murphy and Welch (1992), Glaeser (1994)).

The geographic nature of these information spillovers might be argued to be less important with the current revolutions in telecommunications and the falling cost of travel. While it is clear that more remote areas do receive more information now than previously, relatively speaking, those in dense urban areas may be even more advantaged as they too benefit from telecommunications (Henderson and Mitra (1993), Gaspar and Glaeser (1998)). Some evidence suggests that internet communication and face-to-face contact or telephone calls are complements not substitutes. 'Tacit' knowledge, or knowledge that can only easily be transmitted through constant interaction, may be the most important part of intellectual spillovers.

In contrast to the positive external effects of educated people, unemployment tends empirically to be associated with lower future growth (Glaeser (1994)). This could be interpreted as a negative demand shock that persists or a slow adjustment of either labour or capital to a negative shock. Alternatively high unemployment may be a negative indicator of the skills of the local labour force or of the city characteristics.

High-density areas offer consumption benefits that may attract people: greater variety in goods, lower transport costs and more competition maylower costs, and a broader rates base will allow more local public goods. In equilibrium these are simply urban amenities that will raise house values and hence not induce additional migration. But if, as incomes rise, people value these amenities more they may migrate toward them.

The spatial area affected by the benefits of agglomerations, of educated people or simply large markets and high levels of economic activity depend on the path through which the scale and scope economies function. Some US analysis has compared county level effects with city scale effects but this work, at least in relation to positive externalities, is more limited.

Finally specific shocks to locations can change the local conditions and either attract new migrants or lead to out-migration. These could be short run manifestations of long run trends or related to exogenous government policies. For example the contraction of railways in New Zealand had major effects on many small towns. The closing of large plants such as freezing works or the Bendon factories are another example. Changes in government regulation such as the removal of Supplementary Minimum Prices in the 1980 or introduction of tax credits for forestry could have systematic effects over a range of locations. Changes in government service provision such as hospitals, universities or post offices could lead to change or be symptoms of regional decline.

These factors that drive individual migration decisions cumulate to drive overall patterns of development, growth and decline in regions. We explore some simple hypotheses to see if New Zealand's aggregate mobility patterns display some of the same relationships found in the US data and in earlier New Zealand work.

3 DATA

Table 2 below shows the definitions for variables that are used in the subsequent analysis, together with some basic descriptive statistics. All statistics are weighted by 1991 population.

3.1 Mobility Data

The mobility data have been drawn from the 1996 census of population and dwellings. An origin-destination table, produced by Statistics New Zealand (SNZ), provides gross movements of people in and out of Area Units within New Zealand. An Area Unit (AU) is a SNZ-defined spatial unit roughly equivalent to a city suburb and normally contains 3,000–5,000 people, but AUs can be considerably larger and contain fewer people in rural areas. There are 1,766 area units defined for New Zealand. For this project, we have excluded area units with very small populations because of problems with rounding. Many of the excluded units are offshore islands.

The mobility data captures movements only of people who were in New Zealand at the times of both the 1991 and 1996 censes. The analysis therefore excludes flows arising from international migration.

The origin-destination table provides previous residence information at Area Unit level and for overseas countries. Current residence, however, is only provided for New Zealand (at Area Unit level). Fixed period questions (as above) tend to underestimate geographic turnover and are unable to capture the following return and repeated migration (Poot, 1986).

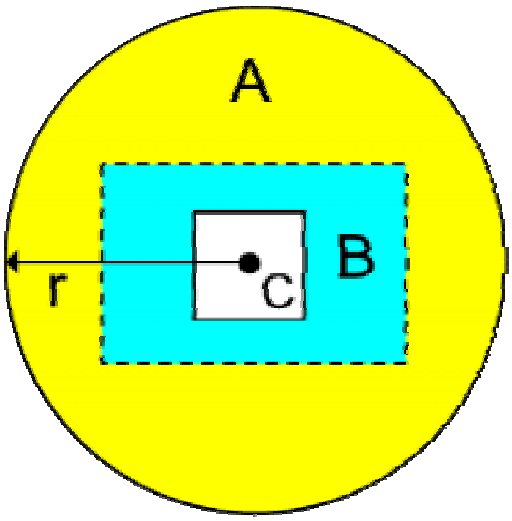
3.1.1 Census Data

The census and dwelling dataset was used to create variables to provide characteristics about individual AUs. The variables were all created from the 1991 dataset. This assumes that people are more likely to make decisions to move based upon the characteristics of the AU in the recent past.

3.1.2 GIS Variables

Geographic Information Systems tools were used to define a neighbourhood around each AU. The aim is to analyse the effect upon an AU of its neighbourhood. The neighbourhoods were created using the SNZ Meshblocks (the smallest of the SNZ spatial units which contain 150–200 people in urban areas, 100–150 persons average nationally). For each AU, we define the neighbourhood by selecting a central MB (which contains the AU centroid) and then selecting the MBs that lie within 20km of the central MB. In Figure 1, the white box C is the central MB for AU B. The circle A is the neighbourhood with a radius (r) of 20km.

Figure 1 Defining an area's neighbourhood



The characteristics of a neighbourhood are defined by summing the individual characteristics of MBs, which fall within the neighbourhood zone A. Variables can then be created that represent only the neighbourhood area (around the AU), i.e. excluding the area in B. This methodology could be improved upon by using the AU centroid to define the neighbourhood, instead of identifying a central MB. Secondly, some AUs (e.g. large rural areas) may have an extent greater than the 20km neighbourhood perimeter. In the future we aim to explore different neighbourhood definitions. We discuss this further in the conclusions.

4 ESTIMATION AND RESULTS

The regression results reported in this paper are based on population-weighted least squares regressions of the form:

$$Net\ migration_{1991\text{-}96} = f(1991\ area\ density,\ 1991\ area\ demographics,\ 1991\ area\ employment) + \varepsilon \qquad (1)$$

where the weights are the 1991 area unit population.

4.1 Net migration patterns

The first set of relationships that we investigate is that between net migration between 1991 and 1996, and area unit characteristics. We focus particularly on density and education characteristics, although we also consider ethnicity, age, employment, and income variables. Given the spatial nature of the questions that we are addressing, it is instructive to see a topographical presentation of key variables. The following maps (Figures 2 to 4) show how three key variables vary across New Zealand. The four

different shadings represent population quartiles – each shading represents areas within which approximately a quarter of the population resides.

On the national map, we see that areas around Queenstown and Fiordland have had relatively high net in-migration. Their importance for understanding where people are moving to is visually overemphasised, however, because the population is relatively small in these areas. The city-focus maps at the left of Figure 2 show visually small areas that account for a large proportion of net immigration.

Figure 3 shows areas for which gross migration is "large". In this context, migration is defined as large if the sum of the inflows and outflows is a high proportion of the initial population. This could be because inflows are high, because outflows are high, or both. As discussed above, there are a number of explanations for what is going on in high "churning" areas. Future work will need to differentiate and distinguish more carefully the various patterns behind Figure 3.

Figure 4 shows population densities across New Zealand. For this graph, the different shadings are *not* chosen to each represent a quarter of the population. Half the population lives in the areas shaded darkest. Even so, the land area covered by these most dense areas is very small, and is concentrated, not surprisingly, in the main urban areas, and a few provincial towns.

We now begin to examine the relationships between these mapped variables and other area unit characteristics. Figure 5 and 6 show the raw relationship between net migration and population density across area units, using two different measures of population density – the density of the area unit itself, and the density of surrounding area units (the "neighbourhood" as defined above). As before, each area unit is weighted by the size of its 1991 population.

Figure 2 Map of net migration

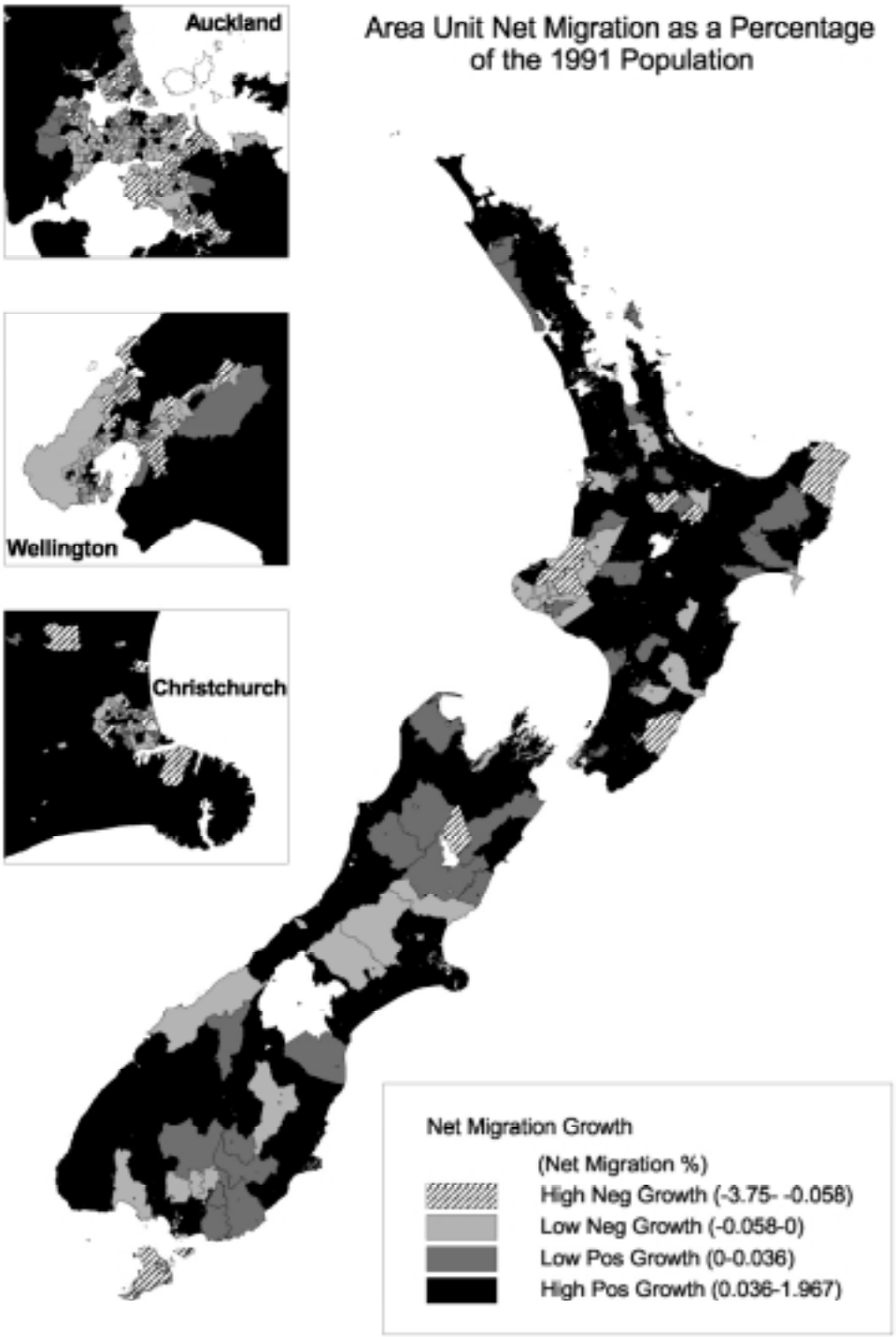


Figure 3 Map of migration 'churning'

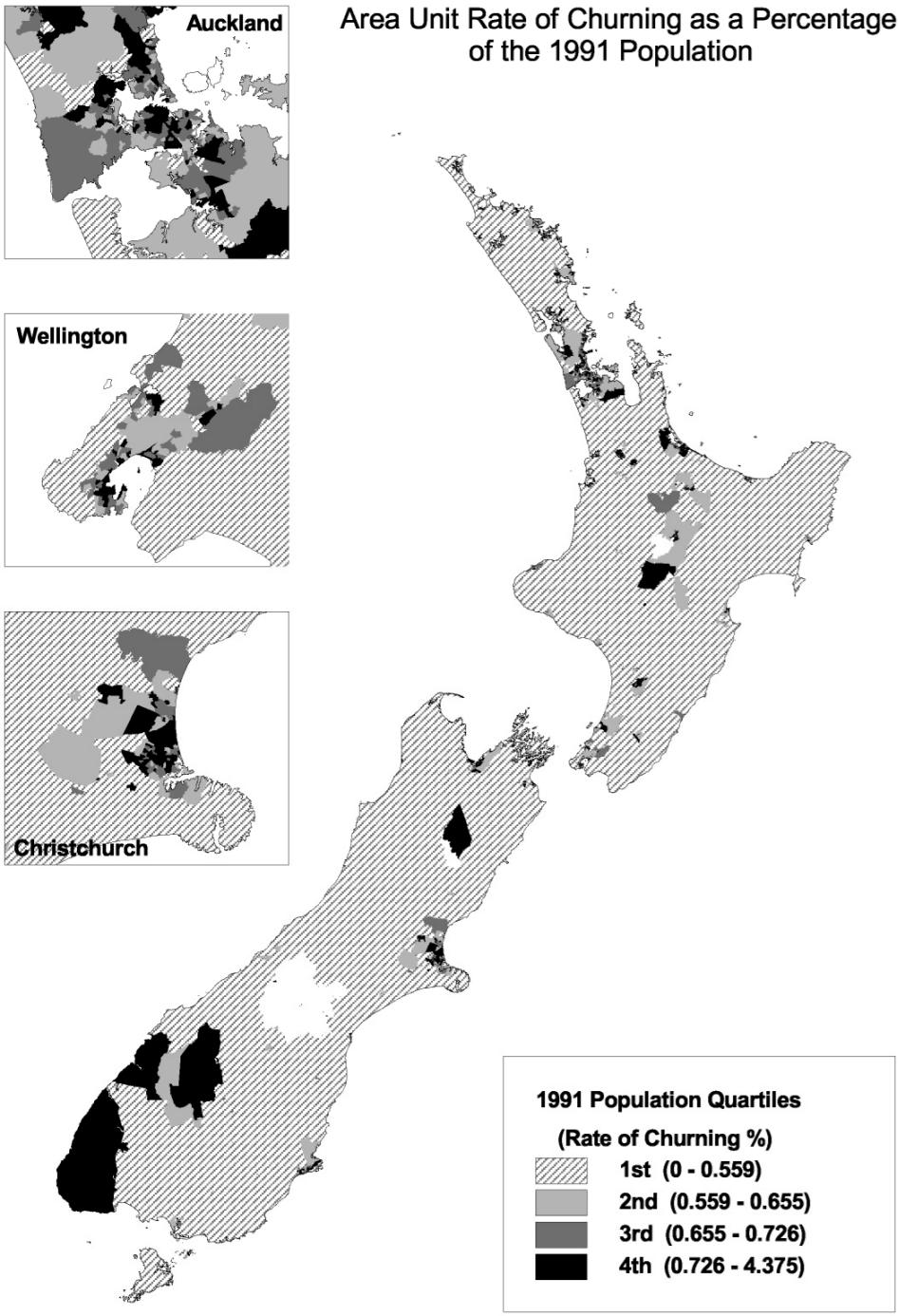


Figure 4 Map of population density

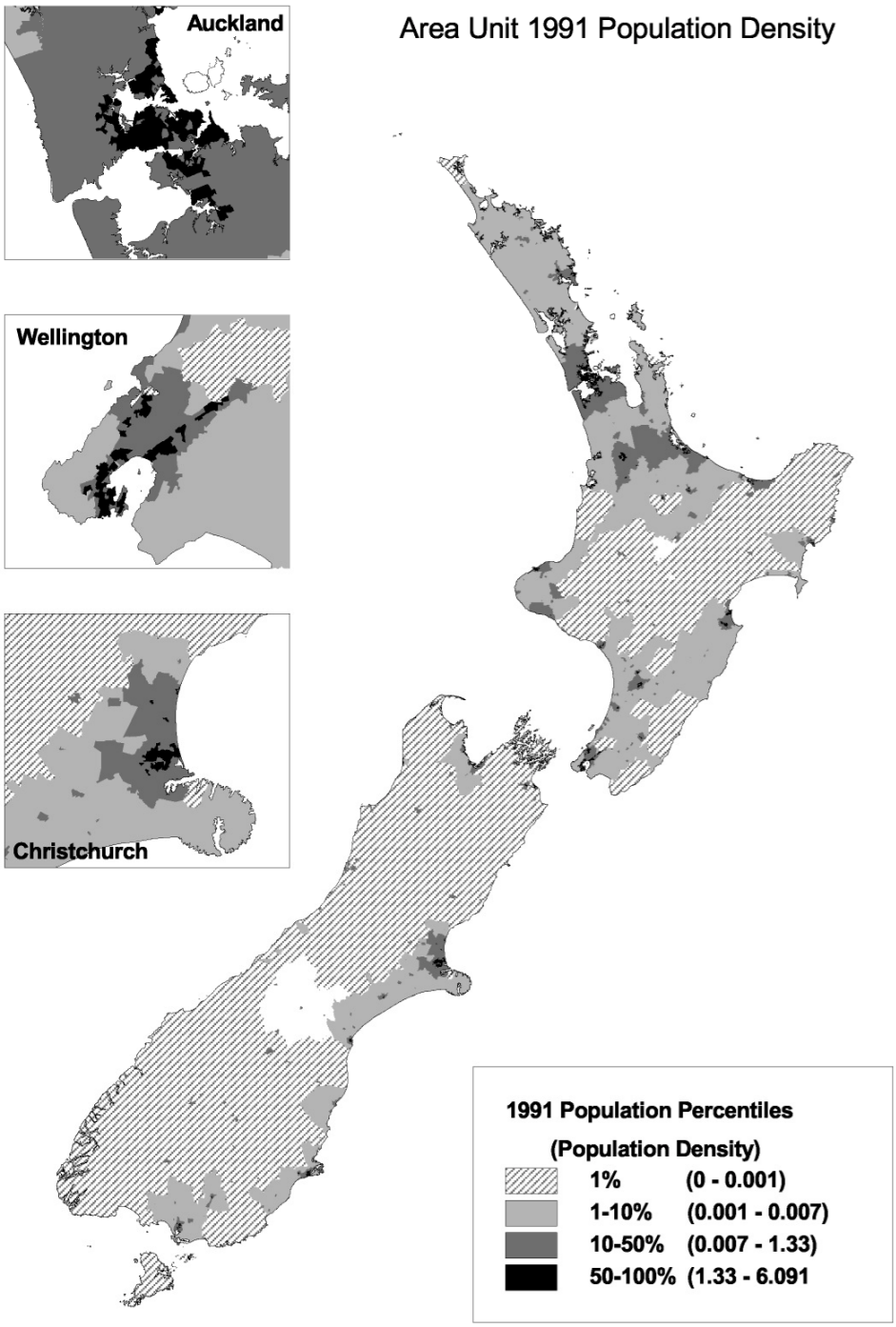


Figure 5 Net migration and area unit population density

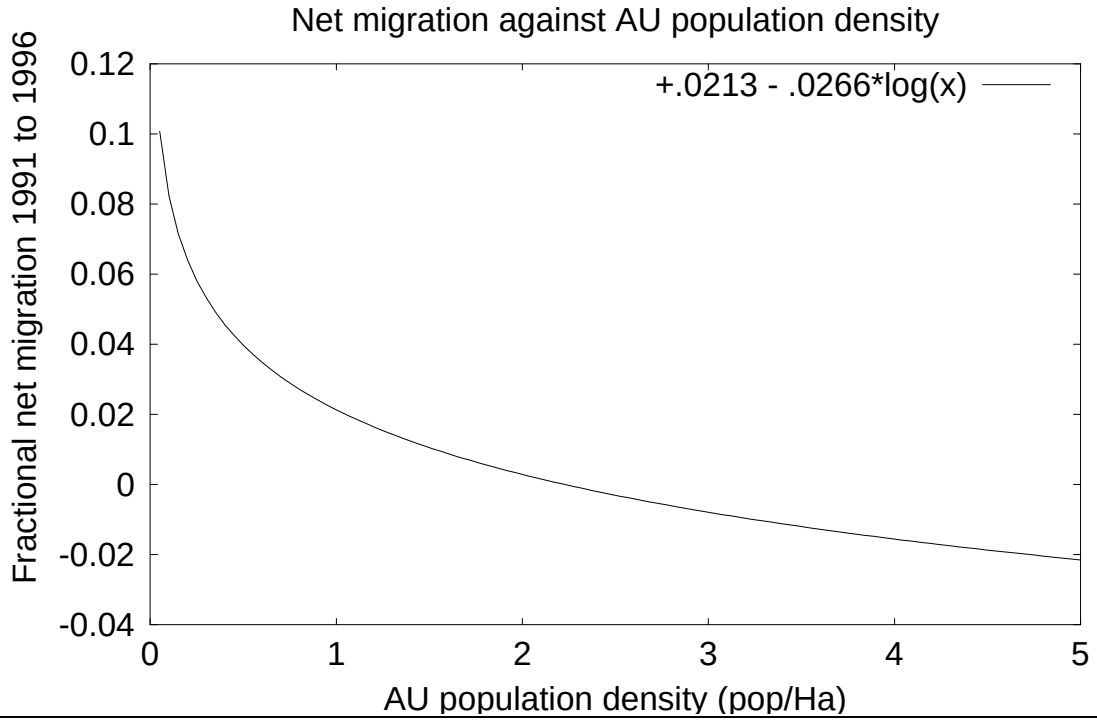
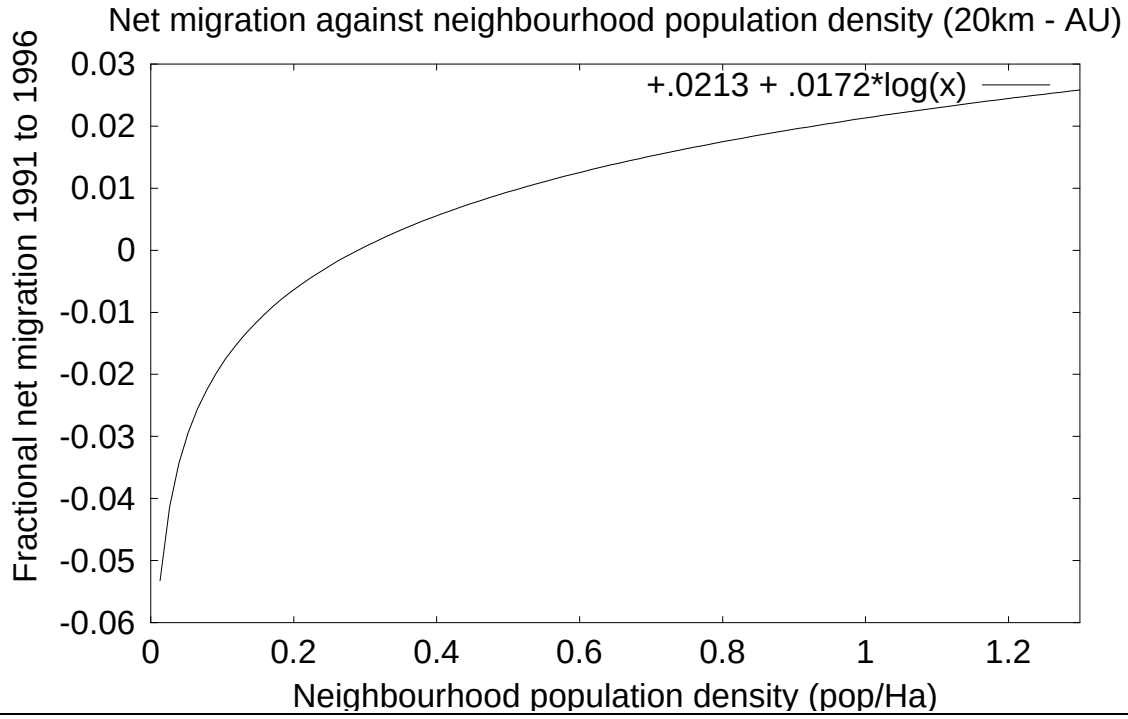


Figure 6 Net migration and neighbourhood population density



We regress net migration into an area unit as a function of the population density in both the area unit itself, and in the neighbourhood of the area unit. This neighbourhood is defined as the area within a 20km radius of the centre of the area unit, excluding the area unit itself (see Figure 1 above). Various polynomial curves were fitted to the data (with both density variables included simultaneously in the regression), but the best results from a simple functional form were found using the logarithms of the population densities.

The results show two different effects, relating to the scales over which the population density is measured. At the scale of the AU we find that, with the neighbourhood population density held constant, people migrate preferentially into areas with lower population density (Figure 5). The curve for the neighbourhood population density (Figure 6) shows an opposing trend, with people migrating preferentially into areas that have a high population density within a 20km radius (excluding their own area unit).

In the regressions that follow, the area density variables in equation (1) are entered in log form. The general approach of our investigation is to first estimate a simple regression that captures the relationship shown in Figure 5 and Figure 6 above, and then to progressively add other variables to the regression. This will allow us to see whether the observed relationship is actually reflecting the effects of other factors that vary across area units. It will also provide valuable information on the independent contribution of various area-level variables such as demographic and employment variables.

The first column of Table 1 presents the regression results that generate the curves from Figure 5 and Figure 6. The interpretation of the coefficients is that a 10% increase in population density (at sample means) is associated with net migration at approximately 0.27 percentage points lower or around two thirds of a standard deviation. The coefficient on neighbourhood density shows that a 10% increase in neighbourhood density is associated with approximately a 0.17 percentage point higher net migration rate.[5]

Net migration is higher into area units where density is low, particularly when high-density areas surround the low-density area. It appears that people want to live *near* dense area units, not necessarily *in* them. We have not currently controlled for land values so this could reflect land scarcity in dense areas.

The second column of Table 1 controls for the qualification composition of area units. People appear to move into areas that have higher proportion of people with higher qualifications. Note that the qualifications covariates are measured as the log of the proportion of people with a particular qualification level, to allow for observed non-linearity. The size of the coefficient therefore reflects both the underlying proportion, and the strength of the relationship between net migration and qualifications.[6]

However, the different qualification compositions of different area units are clearly not driving the observed relationship between migration and density. The coefficient on area unit density does not change significantly, although there is a more pronounced drop in the coefficient on neighbourhood density.

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[5] A one standard deviation rise in area unit density leads to a 0.15 standard deviation drop in net migration. A one standard deviation rise in neighbourhood density leads to a 0.13 standard deviation drop in net migration.

[6] A one standard deviation (5.5 percentage points) increase in the proportion of the population with a university degree is associated with net migration that is 0.005 (half of one percent) higher. The similar figure for the secondary qualification variable is that a one standard deviation (6.6 percentage points) change increases net migration by 0.02.

Columns 2 to 6 of Table 1 add various blocks of covariates to the regression. In addition to the effects of density and qualifications, areas that have experienced relatively high net in-migration are areas with relatively high proportions of older people, pakeha, services employment, or people gainfully employed, or with high average incomes. Areas with high Maori and Pacific Island population shares, more children, or more manufacturing employment experienced lower net migration. Consistent with the economic geography hypothesis, areas with high levels of employment in agriculture may be experiencing net out-migration despite the wide variance in the performance of different components of the agricultural sector in recent years in New Zealand. This would be interesting to explore with data that break the agricultural sector down further.

None of the covariates change the result that net immigration is lower into more dense areas and higher for places surrounded by higher density areas. For most of the other variables added, the patterns observed when they are entered alone (columns 2 to 6) are broadly similar to the patterns observed when they are entered together (column 7). This means that the partial correlations between the covariates that we use are not so strong that omitted variable bias could mislead us.

One exception is the relationship between net in-migration and % Maori. Column 3 suggests that net migration is lower into areas where there is a high proportion of Maori (coefficient of -0.012). Once we control for other covariates (in column 7), the contribution of % Maori becomes very small and insignificant, suggesting that these areas are unattractive, not because of the proportion of Maori in them but because of other factors correlated with where Maori live. The effect of people with degrees also loses significance.

Table 4 presents estimates of the full specification but for subsets of area units. The first column reproduces column 7 from the previous table. Columns 9 and 10 show that the relationship between density and net migration is stronger in urban than in rural areas. The positive link between net migration and neighbourhood density appears slightly stronger in rural areas, although the difference is not statistically significant.

In columns 11 and 12, we have separated out the area units with the highest proportion of Maori and those with the lowest proportion of Maori. The cut-offs (6 percent and 12 percent) are chosen so that a third of the population live in the "low Maori" areas used in column 11, and a third of the population live in the "high Maori" areas used in column 12.

In areas with a high proportion of Maori, the proportion of Maori appears to attract migrants. The estimated effect (0.075) is large and statistically significant.

4.2 Migration "churning" patterns

Tables 5 and 6 present a similar analysis but for a measure of the importance of migration flows, as defined above.

The areas for which migration flows are important tend to have similar characteristics to those that experienced net migration flows. The main exception is that the migration is important for both higher density area units and those with more dense neighbouring areas.

We noted earlier that high rates of migration churning could reflect a variety of causes. It is tempting to interpret the patterns in Table 5 as telling us about who is mobile. For instance, churning is higher in areas with high proportions of people with school qualifications.

Churning is higher in areas with higher density, areas in more dense neighbourhoods, areas with more qualified populations, areas with lower percentages of Maori and Pacific peoples, areas with fewer children or older people, areas with more services employment, and areas with higher employment shares.

These are, of course, early results, and we are hesitant to conclude too much from these patterns at this stage. Examining a broad summary measure such as our churning variable is helpful in showing where migration flows are important, but they also conceal some interesting patterns. For instance, the positive correlation between degree holders and churning results from a strong positive correlation with inflows and a weak positive correlation with outflows.

Table 6 shows that how the relationships differ between urban/rural, and between areas with high and low proportions of Maori. One broad (over-?) generalisation is that coefficients tend to be larger for the urban areas than for rural areas, suggesting the covariates that we use are better at capturing urban than rural migration patterns.

5 INTERPRETATION AND FUTURE ANALYSIS

Our work to date raises as many questions as it answers. The analysis suggests that a broad measure of population density confirms the US evidence on the attractiveness of high-density areas - though we do not see the US downturn at high densities, possibly because we do not really experience them. However, the area over which the density is defined is clearly important. The result on the effect of population density is reversed for small neighbourhoods. We plan to explore the effects of neighbourhood definitions further, not only for population density but also for education and other labour market and goods market related variables.

The analysis also confirms earlier research that suggests that the education of existing residents is an attracting force. People with degrees have a strong positive pull; school qualifications are extremely robust as an attracting force. Areas with high level of gainful employment also attract migrants, though, as with the population density variables, this was sensitive to the neighbourhood definition.

We find that areas that experience high churning are similar to those that experience in-migration; this is partly true by definition but we also found (results not reported) that areas with high inflows also have high outflows. Areas with more educated people, more people of working age and more gainfully employed people tend to experience more turnover, this could be because these people are more mobile. Areas with more Maori, more children and more older people tend to have less mobile populations. This could suggest that these people will find adjustment to economic shocks more difficult.

Our work is taking us in several different directions to refine this analysis. Still at the aggregate data level we will break net migration and churning patterns into gross flows analysis in order to address the more complex question of who is moving to where. We are working to add more data to our regional database. In particular we are including data on land values to help create a variable reflecting real income. We are also using NZDep (1991 and 1996) created by Health Services Research Centre at Victoria University to study the evolution of deprived communities and the mobility of the most deprived groups in New Zealand. We will also expand our panel to study mobility between 1986 and 1991. This is presently hindered by technical problems matching data. In terms of neighbourhood definition we plan to explore different scales of neighbourhood as well as using actual travel times rather than linear distance to define communities. We also plan to define occupational or cultural communities (e.g. number of people in the same

occupation within one hour of commuting distance) rather than simply considering the population as a whole. The definition of neighbourhoods is somewhat constrained by the mobility data being publicly available only at the area unit level.

Another level of future analysis will be to use census unit record data in order to model individual decisions directly (following Poot (1986) among others) in order to clearly separate who is mobile from characteristics of areas where migrants move to/from and to relate the characteristics of the individuals and their origin communities to the destinations they choose.

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Table 1 Variable Definitions

Variable name	Definition
pdegr_91	Fraction of population over 15 with a degree in 1991
pnoql_91	Fraction of population over 15 with no school qualification in 1991
Pgemptot	Fraction of population over 15 who are gainfully employed (FT + PT) in 1991 in a 20 km area including the area unit
pmaor_91	Fraction of total population with maori ethnicity in 1991
p_pi_91	Fraction of total population with pacific islander ethnicity in 1991
p1535_91	Fraction of total population aged between 15 and 35 in 1991 (ie child bearing age)
pagri_91	Fraction of those who specified an industry sector working in agriculture[7] in 1991
pmine_91	Fraction of those who specified an industry sector working in mining[1] in 1991
Pmanu_91	Fraction of those who specified an industry sector working in manufact.[1] in 1991
pcnst_91	Fraction of those who specified an industry sector working in construction[1] in 1991
pserv_91	Fraction of those who specified an industry sector working in services[1] in 1991
Ppden91	Total population in 1991 divided by area in hectares
pun15_91	Fraction of total population aged under 15
pscql_91	Fraction of population aged over 15 who have some kind of school qualification
pscnd_91	Fraction of population aged over 15 who have a school qualification but no degree
pcinc_91	Total income of the AU divided by the population over 15
pden_20k	Population density within a 20 km radius of the centre of the AU in 1991
pdnei_91	Population density within a 20 km radius of the centre of the AU, excluding the AU itself, in 1991
lnp****	is the natural log of p****_91

[7] Employed within an industrial sector. i.e. a secretary for a mining company is still employed in the mining sector.

Table 2 Sample Characteristics (weighted by 1991 population)

	Full sample		Urban		Rural		Low Maori		High Maori	
Variable	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**
pcntmigr	0.000	(0.103)	-0.011	(0.098)	0.063	(0.110)	0.024	(0.122)	-0.027	(0.085)
mobile	0.648	(0.161)	0.677	(0.149)	0.479	(0.121)	0.668	(0.172)	0.610	(0.147)
ppden_91	1.355	(1.032)	1.578	(0.950)	0.057	(0.180)	1.383	(1.018)	1.297	(1.047)
pdnei_91	0.327	(0.382)	0.377	(0.390)	0.034	(0.083)	0.381	(0.394)	0.262	(0.354)
lnppden	-0.645	(2.205)	0.119	(1.058)	-5.107	(1.844)	-0.672	(2.313)	-0.649	(2.127)
lnpdnei	-2.124	(1.809)	-1.798	(1.560)	-4.331	(1.831)	-1.842	(1.834)	-2.497	(1.812)
pdegr_91	0.059	(0.055)	0.063	(0.058)	0.037	(0.019)	0.087	(0.066)	0.030	(0.021)
pscnd_91	0.626	(0.066)	0.627	(0.067)	0.616	(0.061)	0.663	(0.055)	0.583	(0.062)
pscql_91	0.685	(0.101)	0.690	(0.104)	0.653	(0.072)	0.750	(0.091)	0.613	(0.074)
pnoql_91	0.315	(0.101)	0.310	(0.104)	0.347	(0.072)	0.250	(0.091)	0.387	(0.074)
pmaor_91	0.129	(0.126)	0.125	(0.117)	0.149	(0.167)	0.037	(0.013)	0.252	(0.135)
p_pi_91	0.045	(0.094)	0.052	(0.100)	0.005	(0.006)	0.011	(0.014)	0.084	(0.136)
pcold_91	0.113	(0.058)	0.119	(0.059)	0.075	(0.037)	0.129	(0.063)	0.093	(0.049)
pun15_91	0.232	(0.062)	0.225	(0.061)	0.273	(0.050)	0.206	(0.053)	0.271	(0.056)
pagri_91	0.099	(0.172)	0.039	(0.060)	0.447	(0.201)	0.091	(0.175)	0.106	(0.166)
pmine_91	0.004	(0.014)	0.003	(0.010)	0.007	(0.026)	0.003	(0.008)	0.004	(0.017)
pserv_91	0.659	(0.158)	0.705	(0.104)	0.392	(0.152)	0.701	(0.163)	0.612	(0.137)
pgemptot	0.630	(0.067)	0.628	(0.054)	0.641	(0.116)	0.643	(0.079)	0.614	(0.063)
pcinc_91	13656	(3781)	13972	(3904)	11810	(2195)	16039	(4110)	11091	(2343)
urbdum	0.854	(0.353)	1.000	(0.000)	0.000	(0.000)	0.860	(0.347)	0.852	(0.355)
N	1668		438		1230		621		602	
Sum of weights	3363708		491685		2872023		1190676		1215270	

Table 3 Net Migration into area units – 1991-1996

Dependent variable: Net in-migration (as a percent of 1991 population)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ln(1991 pop density)	-0.027*** (0.001)	-0.024*** (0.001)	-0.025*** (0.001)	-0.031*** (0.001)	-0.035*** (0.002)	-0.026*** (0.001)	-0.033*** (0.002)
ln(1991 neighbourhood pop density)	0.017*** (0.002)	0.011*** (0.002)	0.017*** (0.002)	0.016*** (0.002)	0.015*** (0.002)	0.013*** (0.002)	0.014*** (0.002)
Education variables							
1991 ln(% with degree qualification)		0.008*** (0.004)					0.001 (0.006)
1991 ln(% with school qualification, but no degree)		0.19*** (0.03)					0.16*** (0.03)
Ethnicity variables							
1991 % Maori			-0.12*** (0.02)				0.022 (0.03)
1991 % Pacific peoples			-0.13*** (0.03)				-0.017 (0.03)
Age variables							
1991 % less than 15 years old				-0.43*** (0.05)			-0.34*** (0.06)
1991 % over 65 years old				0.13*** (0.05)			0.19*** (0.05)
Employment mix							
1991 % Agriculture					-0.0003 (0.04)		-0.09** (0.04)
1991 % Mining					-0.14 (0.17)		-0.12 (0.17)
1991 % Services					0.18*** (0.03)		-0.03 (0.04)
Employment, income							
1991 % Gainfully employed in 20km radius						0.11*** (0.04)	0.09** (0.04)
1991 Average Income						0.003*** (0.0007)	-0.002* (0.001)
_cons	0.021*** (0.004)	0.12*** (0.01)	0.043*** (0.004)	0.10*** (0.014)	-0.11*** (0.02)	-0.10*** (0.02)	0.14*** (0.06)
R-squared	0.19	0.24	0.23	0.27	0.22	0.21	0.29
N	1615	1610	1615	1615	1612	1612	1609

Note: Standard errors are in parentheses; * = Significant at 10%, ** = at 5% and *** = 1%.

Table 4 Net Migration for subgroups of area units – 1991-96

Dependent variable: Net in-migration (as a percent of 1991 population)

	(8)Total (same as col 7 of previous	(9) Urban areas only	(10) Rural areas only	(11) Areas where Maori<6%	(12) Areas where Maori>12%
ln(1991 pop density)	-0.033*** (0.002)	-0.034*** (0.003)	-0.026*** (0.004)	-0.044*** (0.005)	-0.27*** (0.003)
ln(1991 neighbourhood pop density)	0.014*** (0.002)	0.012*** (0.002)	0.19*** (0.004)	0.014*** (0.005)	0.019*** (0.002)
Education variables					
1991 % with degree qualification	0.001 (0.006)	-0.001 (0.006)	0.013 (0.012)	-0.18 (0.015)	0.001 (0.007)
1991 % with secondary school qualify	0.16*** (0.03)	0.15*** (0.035)	0.25*** (0.07)	0.18** (0.07)	0.18*** (0.039)
Ethnicity variables					
1991 % Maori	0.022 (0.03)	-0.014 (0.032)	0.089* (0.046)	-0.25 (0.41)	0.075** (0.030
1991 % Pacific peoples	-0.017 (0.03)	0.016 (0.037)	-0.24 (0.91)	-0.27 (0.41)	0.011 (0.033)
Age variables					
1991 % less than 15 years old	-0.34*** (0.06)	-0.35*** (0.065)	-0.28** (0.14)	-0.33*** (0.13)	-0.11 (0.078)
1991 % over 65 years old	0.19*** (0.05)	0.17*** (0.056)	-0.066 (0.19)	0.095 (0.095)	0.41*** (0.086)
Employment mix					
1991 % Agriculture	-0.09** (0.04)	0.091 (0.07)	-0.097 (0.07)	-0.18* (0.11)	0.037 (0.048)
1991 % Mining	-0.12 (0.17)	-0.14 (0.25)	-0.042 (0.19)	-0.29 (0.69)	-0.057 (0.16)
1991 % Services	-0.03 (0.04)	0.005 (0.049)	-0.047 (0.091)	0.10 (0.13)	-0.037 (0.041)
Employment, income					
1991 % Gainfully employed in 20km radius	0.09** (0.04)	0.15*** (0.052)	0.075 (0.053)	0.11* (0.069)	0.15*** (0.052)
1991 Average Income ('000s)	-0.002* (0.001)	-0.002 (0.001)	-0.000 (0.003)	-0.002 (0.002)	0.001 (0.002)
_cons	0.14***	0.066***	0.27**	0.024*	-0.012
R-squared	0.29	0.25	0.32	0.18	0.45
N	1609	1225	384	597	576

Note: Standard errors are in parentheses; * = Significant at 10%, ** = at 5% and *** = 1%.

Table 5 Migration "Churning" – 1991-96

Dependent variable: [Inflows + Outflows] as a percent of 1991 population

	(13)	(14)	(15)	(16)	(17)	(18)	(19)
ln(1991 pop density)	0.023*** (0.002)	0.028*** (0.002)	0.025*** (0.002)	0.025*** (0.002)	0.001 (0.003)	0.025*** (0.002)	0.012 (0.003)
ln(1991 neighbourhoood popdensity)	0.021*** (0.002)	0.008*** (0.021)	0.023*** (0.003)	0.08*** (0.002)	0.013*** (0.002)	0.013*** (0.002)	0.012*** (0.003***
Education variables							
1991 ln(% with degree		0.016*** (0.005)					-0.004 (0.008)
1991 ln(% with school		0.4*** (0.039)					0.2*** (0.042)
Ethnicity variables							
1991 % Maori			-0.17*** (0.03)				-0.063* (0.035)
1991 % Pacific peoples			-0.32*** (0.04)				-0.23*** (0.046)
Age variables							
1991 % less than 15 years old				-1.27*** (0.066)			-0.91*** (0.078)
1991 % over 65 years old				-0.75*** (0.071)			-0.69*** (0.07)
Employment mix							
1991 % Agriculture					0.027 (0.055)		-0.015 (0.057)
1991 % Mining					-0.51** (0.25)		-0.33 (0.22)
1991 % Services					0.51*** (0.4)		0.35***
Employment, income							
1991 % Gainfully employed in 20km radius						0.32*** (0.05)***	0.22*** (0.051)
1991 Average Income						0.005 (0.001)	-1.2e-05***
_cons	0.71***	0.93***	0.75***	1.06***	0.34***	0.42***	0.87***
R-squared	0.21	0.32	0.28	0.36	0.32	0.25	0.45
N	1615	1610	1615	1615	1612	1612	1609

Note: Standard errors are in parentheses; * = Significant at 10%, ** = at 5% and *** = 1%.

Table 6 Migration "Churning" for subgroups of area units - 1991-96

Dependent variable: [Inflows + Outflows] as a percent of 1991 population

	(20) Total (same as col 19 of previous	(21) Urban areas only	(22) Rural areas only	(23) Areas where Maori<6%	(24) Areas where Maori>12%
ln(1991 pop density)	0.012*** (0.003)	0.005 (0.005)	0.016*** (0.004)	-0.004 (0.007)	0.025*** (0.004)
ln(1991 neighbourhood pop density)	0.012*** (0.003	0.013*** (0.004)	-3.4e-05 (0.004)	0.014** (0.006)	0.015*** (0.004)
Education variables					
1991 % with degree qualification	-0.004 (0.008)	0.001 (0.01)	0.0004 (0.011)	0.002 (0.018)	-0.011 (0.011)
1991 % with secondary	0.2*** (0.042)	0.21*** (0.049)	0.22*** (0.68)	0.1 (0.087)	0.27*** (0.062)
Ethnicity variables					
1991 % Maori	-0.063* (0.035)	-0.041 (0.046)	0.007 (0.044)	0.38 (0.51)	-0.12** (0.048)
1991 % Pacific peoples	-0.23*** (0.046)	-0.25*** (0.053)	0.28 (0.89)	-1.3** (0.51)	-0.3*** (0.052)
Age variables					
1991 % less than 15 years old	-0.91*** (0.078)	-0.95*** (0.092)	-0.53*** (0.14)	-0.93*** (0.16)	-0.76*** (0.12)
1991 % over 65 years old	-0.69*** (0.07)	-0.67*** (0.08)	-0.49*** (0.19)	-0.53*** (0.12)	-0.88*** (0.14)
Employment mix					
1991 % Agriculture	-0.015 (0.057)	-0.11 (0.099)	-0.038 (0.073)	-0.17 (0.14)	0.15** (0.076)
1991 % Mining	-0.33 (0.22)	-0.68* (0.35)	-0.007 (0.19)	-0.81 (0.86)	-0.21 (0.26)
1991 % Services	0.35***	0.35*** (0.07)	0.23*** (0.09)	0.39** (0.16)	0.42*** (0.064)
Employment, income					
1991 % Gainfully employed in 20km radius	0.22*** (0.051)	0.27*** (0.074)	0.14*** (0.052)	0.21** (0.085)	0.25*** (0.082)
1991 Average Income	-1.2e-05*** (0.001)	-1.4e-05*** 0.001	0.004 (0.003)	-1.0e-05*** (0.002)	-1.0e-05*** (0.003)
_cons	0.87***	0.90***	0.65***	0.78***	0.80***
R-squared	0.45	0.35	0.43	0.36	0.54
N	1609	1225	383	597	576

Note: Standard errors are in parentheses; * = Significant at 10%, ** = at 5% and *** = 1%.