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Working Paper

Economic Geography and Spatial Statistics: Theory and Empirics of New Zealand Regions

New Zealand Treasury Working Paper, No. 00/11

Provided in Cooperation with:

The Treasury, New Zealand Government

Suggested Citation: Kerr, Suzi; Timmins, Jason (2000) : Economic Geography and Spatial Statistics: Theory and Empirics of New Zealand Regions, New Zealand Treasury Working Paper, No. 00/11, New Zealand Government, The Treasury, Wellington

This Version is available at:

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TREASURY WORKING PAPER

00/11

Economic Geography and Spatial Statistics: Theory and Empirics of New Zealand regions.

Suzi Kerr & Jason Timmins*

(Contract to Treasury)

ABSTRACT

This paper sets the stage for current Treasury research on New Zealand regional socio-economic issues by:

- Outlining a basic theoretical framework;
- Introducing a regional database and Geographic Information Systems, a new empirical tool for data analysis; and
- Illustrating the potential of this data and tools for analysing policy relevant issues by testing some empirical hypotheses derived from the theoretical framework.

*The New Zealand Treasury has funded this project. We would particularly like to thank Benedikte Jensen, Sarah Box and David Maré for helpful comments and feedback. Thank you also to David Kennedy for research assistance. Any errors and omissions are our own. Any views represented are our own and do not represent those of the New Zealand Treasury.

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1 INTRODUCTION

This paper sets the stage for research on New Zealand regional and socio-economic issues by outlining a basic theoretical framework. This builds on the work by Sarah Box (Box, 2000), which identified key factors identified in international literature as driving location and discussed why the theory of economic geography might matter for policy. In contrast to her work, this paper focuses only on domestic location decisions and uses a more formal modelling approach to provide a clearer basis for empirical work. This paper does not attempt to survey literature explicitly but draws on a wide range of existing research.

The paper provides an introduction to a New Zealand regional database and introduces a new empirical tool for analysing the data. This paper does not answer any policy questions. We present descriptive statistics outlining the current distribution of demographic, economic and social indicators across New Zealand and the patterns of change over time. The paper demonstrates the value of Geographic Information Systems (GIS) through analyses of population density in the Auckland and Northland regions and analysis of the national level distribution of unemployment.

Finally, the paper aims to suggest the future potential of this type of data and these tools for analysing policy relevant issues. We demonstrate the value of using disaggregated regional data by providing a series of descriptive statistics relating to regional development, local governance and regional social policy. The choice of descriptive statistics is motivated by empirical hypotheses generated from the theoretical framework. The paper does not provide proof of any hypothesis but provides some cautionary tales and suggests interesting directions for future analysis.

This paper is intended to be part of a wider project on economic geography. In this project we have three broad policy questions in mind. Is there a regional dimension to economic development and social policy? If so, how could this effectively be addressed using regionally differentiated policies? What levels of government would most appropriately carry out these policies? We aim to develop research that can give insights into why regional patterns and trends occur and how government policies could change the static and dynamic regional picture. The project aims to provide a clearer diagnosis of regional problems and offer alternatives to the traditional solutions. Understanding the causes of regional differences and trends allows us to identify real lasting problems rather than fall into the trap of focusing on transitory or illusory problems. The goal of understanding the pressures that drive regional development and regional social outcomes is to design policies that work with the existing forces rather than going against the tide.

2 THEORETICAL STRUCTURE OF POSITIVE ANALYSIS

A simple model can illustrate most of the key features that drive the location of people and economic activity.¹ We will first present this model and discuss the key implications.

¹ This is based on Krugman's simple model presented in Krugman (1995)

Although this seems extremely simple it can illustrate most of the important features of locational patterns. We will then discuss additions to this model that represent some key real world features that have been omitted. This modelling will provide the basis for the development of empirical hypotheses.

2.1 Basic Model

Key model features

1 *Land and natural resources are immobile.*

People / firms who work directly with immobile factors will, by necessity, be dispersed to where these are found. Land-based industries include parts of agriculture, forestry, fishing, and tourism. Production associated with these (e.g. fish processing or pulp and paper manufacture) may not be tied to specific areas.

2 *'Manufacturing' or non-land-based activities have economies of scale (or external economies) and compete monopolistically.*

In each location a limited number of distinct goods are produced. Without economies of scale firms could produce tiny quantities of each item everywhere and location would not be an issue. When efficient production requires a minimum scale, it cannot be located in all the places where the dispersed people are. The alternative is subsistence.

3 *Transport costs are positive.*

'Manufacturing' cannot all be in one place that simply ships output to other areas.

4 *Workers choose where to live and firms choose where to locate simultaneously.*

If workers and locations were identical, real wages would be identical.

5 *Workers / Firms move gradually in response to real wage / profit differences.*

This introduces some dynamics into the model. What we observe is not an equilibrium but a point along a path of dynamic change. This gradual adjustment introduces the possibility of path dependence. The pattern of locational choice depends on the historical path taken. Many outcomes can be stable (multiple equilibria).

Workers and manufacturing firms move together in this model. Agriculture does not move. We can equivalently talk about workers moving or firms moving (i.e. the model allows no unemployment). Two competing forces push people together or encourage them to disperse. We call these dispersing forces and agglomerating forces.

Dispersing forces

The key dispersing force is that some economic activity, for example agriculture, is dispersed, and so some workers are spread around the country. If all manufacturing firms were in the same place they would all compete to supply goods to these dispersed workers. Some firms can gain an advantage by moving closer to the agricultural workers and hence reducing their transport costs.

Agglomerating forces

Essentially there are two. The first is that where there are people there is more demand so firms can make more profits. Thus more firms (people) will move to dense areas. The second is that where there are many firms, goods are cheaper to purchase so both firms and workers (consumers) want to be near existing firms.

The balance between the dispersing and agglomerating forces depends on three factors.

- 1 size of transport costs,
- 2 percentage of 'agriculture' in total economy and
- 3 strength of economies of scale in firms.

If transport costs are low, dispersed markets can be served easily from the 'city' so the city is larger. If agriculture is relatively unimportant the dispersed market is small so few firms will disperse to serve it. If economies of scale are strong it is very valuable to serve a larger market and it will be more costly to move away from the 'city'.

Different sectors experience different levels of economies of scale. Different products have different transport costs relative to their value. This will affect the extent to which they tend to agglomerate. Sectors with low economies of scale and high transport cost will disperse; those with high economies of scale and low transport costs will agglomerate. If transport costs are extremely low, the benefits of agglomeration in providing access to markets – both input and output – will disappear and dispersing factors may again dominate.

Static implications for New Zealand domestic economic geography

Immobile primary industries (agriculture, fishing, forestry and tourism) are important in New Zealand; this will tend to disperse our population. If primary industry declines, the regional economy that has developed around it will tend to decline as well.

In areas where transport costs to a nearby city are low, regional towns will tend to be smaller. High transport costs produce more dispersion of non-land-based production. Manufactured goods that are costly to transport relative to their value (e.g. bread or consumer services that require face to face contact) will tend to be dispersed, while those that are low cost to transport (e.g. clothing or services that can be provided by phone or mail) will be concentrated. As transport costs fall, manufacturing and services production will fall in low density regions.

Industries with strong economies of scale will tend to be concentrated in large cities. Whether they agglomerate in generally large cities or in cities with other similar businesses depends on the importance of consumer demand relative to supply from other businesses. Manufacturing with lesser economies of scale will be more dispersed.

In New Zealand another feature that is not as important in the US centred literature is that for many outputs the key market is an export market. Thus proximity to markets really means proximity to ports and airports not necessarily proximity to domestic cities.

2.2 Model Dynamics

Because workers only adjust gradually to differentials in real wages, the process of agglomeration or dispersion from initial conditions or after exogenous changes in conditions is dynamic. Workers may move gradually for three reasons. Relocation costs for individuals and firms often depend on the speed of the move. Fast relocation is often expensive. New jobs (or business opportunities if the person is an entrepreneur), housing and communities need to be found. If communities are going to decline it may be less painful if it happens gradually. People may only move across generations. Movement may depend on the turnover of capital. If existing physical capital cannot be moved, it may be used until it becomes obsolete even if a new firm would not locate in the area. Information about better opportunities in other regions may only gradually diffuse. Some individuals may move first and send back information to the remaining people. They may also assist in relocation for more vulnerable members of the community. For example, young skilled people may move first and then later assist their elderly parents to relocate.

During the adjustment process, if one factor is more immobile than another, the price of the immobile factor will fall in the declining region. For example, if entrepreneurs with capital move out of a declining region faster than the unskilled labour force, the wages for unskilled labour will have to adjust downward or there will be unemployment. Conversely if there is an IT boom in an area led by entrepreneurs, but skilled IT workers are slow to move to the region, the wages in that region will be raised above their long run equilibrium.

If adjustment is extremely slow for some groups or areas, unemployment and low incomes may persist for long periods of time and may become self perpetuating (see later discussion of neighbourhood effects in section 2.2).

The equilibrium reached even for identical technology and transport costs is not unique but depends on initial conditions and the speed of adjustment. The outcome is path dependent.

Dynamic implications for New Zealand

Gradual adjustment probably means that the adjustment to a lower transport cost, more city oriented economy. If that is the way New Zealand is going, it will happen slowly.

This will probably mean that some people (possibly older people and the less skilled) will be left behind in declining areas and that there will be unemployment either in the declining areas, because people do not move to the jobs, or in the cities because the people move faster than jobs are created for them. Wages and incomes will tend to be lower in declining areas if workers do not move rapidly. In areas where economic growth outstrips population inflow, income will be high. Both of these effects are part of the natural adjustment process but also have some social effects.

The path dependent nature of adjustment could mean that some unexpected areas develop a critical scale in a particular industry and grow rapidly, but also less optimistically, that some areas could be caught in a negative cycle.

2.3 Additions to the model

The model presented above is simplistic in the extreme. Below we discuss the effects of some real life complexities in locational patterns and dynamics.

Natural features

In the model above, the only thing that distinguishes locations is their distance from each other and their initial conditions. In reality natural features such as climate, topography, soil fertility, and proximity to coast and harbours are important drivers of location. These alter the productivity of economic activity and also provide amenity value to consumers who enjoy the natural environment. Workers may be willing to accept lower incomes to live in an area they attracted to. Measured real wages could vary even with identical people and perfect equilibrium.

Differences in workers / consumers

Preferences

If consumers have different tastes for goods that are differentially priced across locations they will no longer equalise real wages across regions but utility.

If consumers have different tastes for local amenities such as beaches, parks, and climate, or if they have cultural attachments to specific locations, their measured real wages will vary in ways that depend not only on location but with unobservable individual tastes. Their true utility will reflect the quantity of amenity they consume at a zero cost as well as the goods they purchase. Differences in incomes don't necessarily reflect inequality in welfare.

Skills

Workers are not identical and their wages will reflect this. Real wages will vary depending on education, experience and ability. This means that real wages will appear to vary in unexplained ways across locations if skills are not controlled for. For example, incomes may be lower in East Cape but this may not be because of the location

but simply because the people in East Cape have, on average, fewer qualifications. People with low qualifications tend to have low incomes wherever they live.

External economies

In the simple model above, the agglomerating forces were potential market size and access to inputs / consumption goods. Firms and workers have interactions other than through their roles as buyers and sellers. These can be positive, leading to more agglomeration, or negative leading to diffusion. These factors are discussed in more detail in Box (2000).

Positive

Positive external economies arise in the labour market from knowledge spillovers that often require face-to-face contact. They also arise from thick labour markets that allow specialisation, better matching of firms and workers, assurance of job availability for workers and skilled labour for firms, and bargaining power for workers that encourages them to invest in human capital.

Positive external economies can also arise through network externalities. These could be networks of suppliers, distribution, technological infrastructure or personal networks. The key to network externalities is that once a network exists it offers good services to those thinking of joining the network. Well functioning existing networks can attract new growth. For example, if a group of manufacturing companies share common inputs and outputs establish a network of supply relationships among themselves in an area, it may be a valuable place for a new manufacturing firm in a related, but not competing business, to locate because it can access the existing network by increasing the size of the network they offer increased value to all the existing members of the network. Thus areas with good networks may thrive.

Negative

Negative externalities include pollution, and traffic congestion. If these are appropriately regulated the marginal costs of activities in cities will be higher (e.g. driving a car) but the average negative externality borne by city residents will be lower so cities will be relatively more attractive with the regulation.

Negative Neighbourhood Effects

Crime and other social problems such as social and racial segregation also tend to be greater problems in larger cities. People with similar characteristics may have grouped together because they can afford similar housing, need similar social services and provide some community support but grouping can also have negative effects. Social segregation can lead to the perpetuation of social problems in an area. An individual's behaviour depends in part on the characteristics of the area in which they live. An area with a high level of benefit recipients may not offer good role models to young people entering the labour force. Welfare support may be seen as more socially acceptable and young people

may even learn about how to exploit the system through ‘knowledge spillovers’. An area with low levels of education may not have a pool of parents to draw on to help in effective running of local schools and may not have an environment where education is valued.

Pecuniary Externalities – Land rents

One key feature missing from our simple model is that increasing agglomeration raises the cost of fixed factors in the area of increased density; land prices will rise and create an additional dispersing factor.²

Government effects on location

Regulating Externalities

By implementing policies to regulate negative externalities, government decreases dispersing forces. Environmental regulation has been particularly successful in this regard in developed countries. Improved traffic flows also help. Policies to reduce negative social externalities are more complex and often less successful.

Infrastructure

Because national governments are often major providers of infrastructure, because of the necessary scale of projects and the likelihood of natural monopoly, government decisions can affect future location choices.

Human created features alter locations in ways that are not captured in the model above. Government investments in infrastructure (roads, airports, port facilities) and long term amenities (national parks) respond to current activity in different locations but also influence future location decisions.

Local Public Goods – Local Government

Local governments provide local public goods that are demanded by and paid for by local residents. People who like similar rates / public good packages will tend to want to live together. Packages that subsidise some groups are unsustainable with free mobility because those groups will tend to grow and the locality will not be able to continue to subsidise them. Only some packages of rates and services can lead to equilibrium for each area and these packages will change over time in response with dynamic location decisions and the locality will not be able to continue to subsidise them. Local government activities can be considered endogenous – i.e. determined by the characteristics of their region and the preferences of the people in it. In the extreme, local governments can be thought of as yet another type of firm where people have to buy the package offered when they choose their location.³

² The Von Thunen model shows the effects of rent gradients on location in equilibrium.

³ This is explored in the Tiebout model.

Central Policies with 'equal' Entitlements Across Space

Policies such as benefits that offer equal dollar payments regardless of location are effectively more generous in low cost areas. This could encourage dependency to concentrate in those areas. This would improve beneficiary welfare because beneficiaries would be better off in the short run, but may result in negative long run dependency traps and may lead to negative neighbourhood effects.

Similarly, some central government policies may be inappropriate in isolated areas, for example environmental requirements that are too prescriptive such as a requirement for all communities to build sanitary landfills. The high fixed costs may far outweigh the local benefits. This type of policy disadvantages rural areas and will discourage their development.

2.4 Summary

This section has outlined a range of factors that can affect location choices and the outcomes of locational choices. The following sections attempt to link these ideas to empirical evidence that can suggest the importance of different effects and, in the long run, attempt to identify causality and facilitate prediction.

3 CURRENTLY USED DATASETS

Our current data is derived from Census information. Our primary database is the Statistics New Zealand 'Supermap' data. The Census96 product from Statistics New Zealand publishes select variables from the 1996 New Zealand census and includes equivalent historical data from the 1991 and 1986 census', (only when the data is consistent between the census'). If new questions have been introduced or variables re-classified, only the 1996 data is included.

The data is broadly split into Census Night and Usual Residence. Census night variables reflect the picture on the night the data was collected. Usual residence variables have been collated based upon the interviewee's address in New Zealand.

Statistics New Zealand use the spatial unit Meshblock (MB) for census data collection. The size of a meshblock depends on the number of people and the types of area covered. Generally, meshblocks in rural areas have a population of approximately 60, whereas urban meshblocks contain on average 110 people (city block). The meshblock (there are 36,787) is the building block for aggregation into larger 'Area Units' (1,766), 'Territorial Authorities' (74) and 'Regional Councils' (16).

All Statistics New Zealand geographic area (e.g. meshblock) structures changes across New Zealand through time, for example MBs are often split due to growth in the population. With the 1996 census product all variables, including historical ones, have

been mapped to the 1996 MB series. This enables the comparison of variables between all three census datasets.

Data provider Critchlow Associates (CA) supplied the Census96 data and ArcView software. The census data has been organised into new groupings (decided by CA) and provided at the Meshblock (1996), Area Unit (1996), Territorial Authority (1995) and Regional Council (1995) level.

The following tables are available within the CA dataset:

- | |
|---|
| <ol style="list-style-type: none">1. Geographic Boundaries2. Summary Variables3. Household and Dwelling Data4. Socio-economic Data5. Labour Force Data6. Demographic Data7. Census Night Demographic Ages Data8. Usually Resident Demographic Ages Data9. Work Place Data (Available at Area Unit Level or Higher Only)10. Geographic Area Details (Meshblock Data Set Only) |
|---|

4 REGIONAL ECONOMIC CHARACTERISTICS

4.1 Introduction

We consider the distribution and relationship among seven different population characteristics. See Appendix 1 for a description of the variables used.

- Population distribution
- Age
- Income
- Education
- Occupational mix
- Unemployment / Labour force participation
- Welfare Dependency

This first section shows the current geographic variation and the recent changes in these characteristics. By presenting the information in tables and maps of equivalent information disaggregated to the territorial local authority we show the value of using GIS maps to present detailed regional information.

We also demonstrate the value of disaggregated information by showing the breakdown in the variance of different variables into variance within spatial areas and variance between those areas. For example some variables vary relatively little between regions while the variance within those regions is large.

Maps

The maps given in Appendix 2 summarise the basic static and dynamic patterns of the variables in New Zealand. In each map the territorial local authorities are shaded in three ways depending on whether they are significantly (more than one standard deviation) below, not significantly different, or significantly above either the national mean or mean growth rate (or, where it seems more relevant, above or below zero). Tables 1 through 5 provide the underlying data for each map together with means and standard deviations of each variable.

Observations from the maps include the following. Growth in population density is highest in the Auckland region, Tauranga, north of Christchurch and the Queenstown lakes area (Map 27). The demographics do not vary greatly among territorial local authorities (see Table 6 and discussion below) but some patterns do emerge. Children are concentrated more in the Far North, the East Cape, parts of the central North Island and in Porirua (Map 1). The working age population is largest as a share of population in cities and also in the Queenstown Lakes and MacKenzie Districts (Map 3). The share of working age population is growing significantly slower than the national mean in Northland and parts of the East Cape. Older people are more concentrated in Otago, the Kapiti Coast, Wanganui and Thames / Coromandel.

In terms of education, degree qualifications are concentrated in cities with universities (Map 7). Key areas where the percentage with degrees are not growing quickly are the Far North, the northern West Coast and the East Cape (Maps 8 and 9). People with no qualifications are most heavily concentrated in rural areas including the northern West Coast and parts of East Cape (Map 10). This situation is generally not improving; areas with many people with no school qualifications are also areas where this percentage is not falling.

The percentage of the working age population receiving the unemployment benefit is clearly concentrated in three areas, the Far North, the East Cape and the North of the West Coast (Map 12). Only in Opotiki is this percentage also growing faster than the national average (1986 – 1996), but in none is it growing more slowly (Map 13). High concentration of domestic purposes benefit recipients occurs in the Far North and East Cape but also spreads further across the North Island (Map 14). Growth in DPB recipients is higher than the mean in Opotiki and the Far North (Map 15). This partly relates to the concentration of children under 15. The South Island generally has quite a low number of benefit recipients (excluding superannuation), especially in the southern half. Growth in per capita income appears to be lower in areas with smaller current incomes (Maps 28 and 29).

Areas with unusually high percentage employment in primary industry have unusually low percentage employment in services. Growth service sector employment is highest in areas where the service sector was below or around the national average in 1996. This indicates some convergence in sectoral development. There is no immediately relationship between sectoral composition and unemployment, education, or benefit

support other than that the importance of the service sector is greatest in cities where the percentage with degrees is also highest.

It is hard to draw any conclusions from these maps though many interesting questions arise. One thing that is clear is that parts of the East Cape suffer from a number of adverse indicators both in terms of current conditions and trends. The Buller district (north of West Coast) and the Far North also suffer multiple bad indicators though less consistently. These indicators do not clearly relate to sectoral characteristics. Something worth investigating would be the effects of poor access to these areas.

Tables

Tables 1–5 provide the basic data used for the maps. They are difficult to interpret on their own but allow more information to answer simple questions that arise from the simplified map data. Tables with this amount of data are not very useful for presentational purposes. A table that summarises the information at a regional level would be simpler but may lose a lot of important variation as we discuss below.

Value of disaggregated data: decompositions of variance.

Table 6 presents a breakdown of the variance of each variable depending on the level of aggregation. The maximum amount of variation in the data, normalised to 100%, is captured at the meshblock level (more would be captured with individual level data). If we aggregate data to area unit level, only the variation between area units, and not within them, is captured. Aggregation is more of a problem for some variables than others. When looking at the composition of employment across sectors we can capture more than 40% of the variation in the share of primary production at the regional level and 65% at territorial local authority level. Most of the variation is across large areas not within small areas.

In contrast, the age structure of the population varies very little among regions (only 13% in the variance in the percentage of older people is among regions), and even varies a lot within area units (roughly a city suburb). Regional analysis of the age structure needs to use highly disaggregated data. Interestingly, dependency on benefits does not vary that much at the regional council or even territorial local authority level. Analysis of unemployment and benefit dependency would require area unit or even meshblock level data. Education characteristics are more variable at the regional level, with 60% of variability in the percentage with degrees, and nearly half of the variability in the percentage with no schooling, being between territorial local authorities.

While disaggregated data cannot be easily analysed in tables or even in maps (except with GIS tools) it can be used in statistical analysis. Section 4.2 presents a number of different descriptive statistics that take advantage of the variation at all levels of the data.

4.2 What is a Geographic Information System – GIS?

A definition

A Geographical Information System (GIS) is a collection of tools for assembling, storing, manipulating, and displaying geographically referenced information. The power of GIS lies in its ability to integrate many different types of data because most data can be referenced to the earth's surface.

What is special about GIS?

Data stored in a GIS can be identified based upon its location in space different datasets can be overlaid. For example, information about bus-stops could be overlaid onto a data layer containing residential housing (their only association being through space). GIS can recognise and analyse spatial relationships within a data layer and between layers.

A GIS can determine conditions of:

- Adjacency: Who lives next door to you?
- Containment: Identify all residential houses within your local council administration boundary.
- Proximity: How close is your house to the nearest bus-stop?

Once you have identified the nearest bus-stop to your house, the next question is how do I get there, or what is the quickest route to the bus-stop? A GIS can solve these questions using a network, in this case the streets around your home, to determine the quickest or shortest route to a bus-stop.

Finally, you will need a map so you can navigate along your chosen route to the bus-stop. A GIS can produce graphics to help the user visualise and understand the results.

Value of GIS for considering spatial patterns

In this section we show how GIS can be used to create useful measures of distance and density. The previous section demonstrated some problems with using aggregated socio-economic data at a regional level. Large amounts of variation within key characteristics are lost.

Using the census data and the digital boundaries from Statistics New Zealand (SNZ) it is possible to visualise census variables across space. Figure 4.1 displays the percentage of unemployment benefit recipients in each of the Territorial Local Authorities (TLAs) within New Zealand.

The advantage of using SNZ geographic areas (e.g. TLAs) is that there is no work involved to display information. The disadvantage is that variation in the data may not match pre-defined boundaries (e.g. TLA), for example, an area of high unemployment

may be split by a TLA boundary and become masked within the two TLAs. Another drawback is that there are only four different digital boundaries. This restricts the number of spatial scales available to explore the data.

By using pre-defined boundaries to aggregate the data an assumption is made that a boundary marks a real division in the data, for example, between an area of high unemployment and low unemployment. A better approach would be to explore the data for divisions that actually exist and are not based on any assumptions.

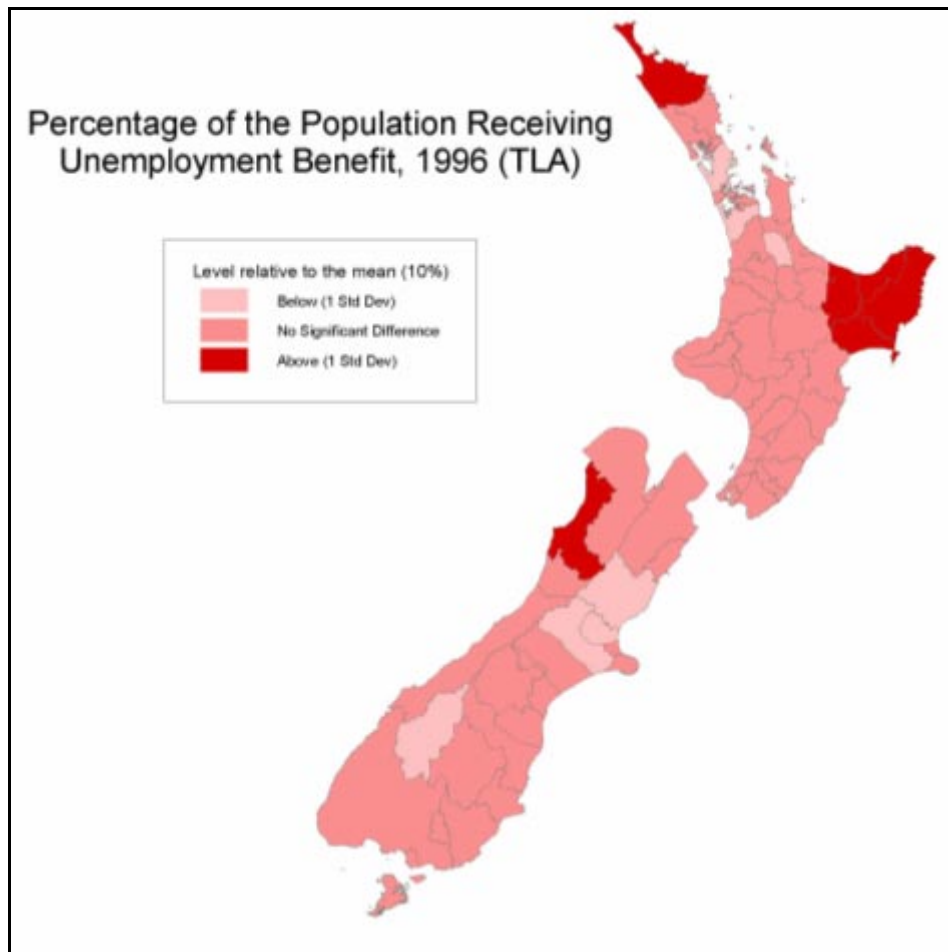


Figure 4.1, Percentage of the population receiving unemployment benefit in 1996, aggregated to Territorial Local Authorities (TLAs).

Aggregating of spatial data is necessary to allow patterns to become visible. This need becomes apparent when we look at the raw data (MB). The MB data contains high variation between adjacent MB cells. For example, one MB may contain a large number of people, whereas the MB next to it contains no population (because it is a car park), yet both MBs are within an area of high population. The other danger of using raw MB values is that SNZ, due to confidentiality, round the MB value.

The approach adopted is to recode MBs so that they reflect their surrounding area (e.g. is the MB in an area of high or low unemployment?). By applying this method to a number of variables it is possible to characterise an area that contains a particular MB and compare it with other MBs and the area that surrounds them. This method removes noise caused by large fluctuations in population between MBs and allows easier pattern detection within the data.

For an individual MB, an area (of interest) is defined from the MB centroid for particular radius. This area is used to capture surrounding MBs and their attribute data (e.g. population totals). The attribute data is summed and the MB (being processed) is recoded with the total (e.g. total population or average unemployment). A graphical illustration is provided in Figure 4.2.

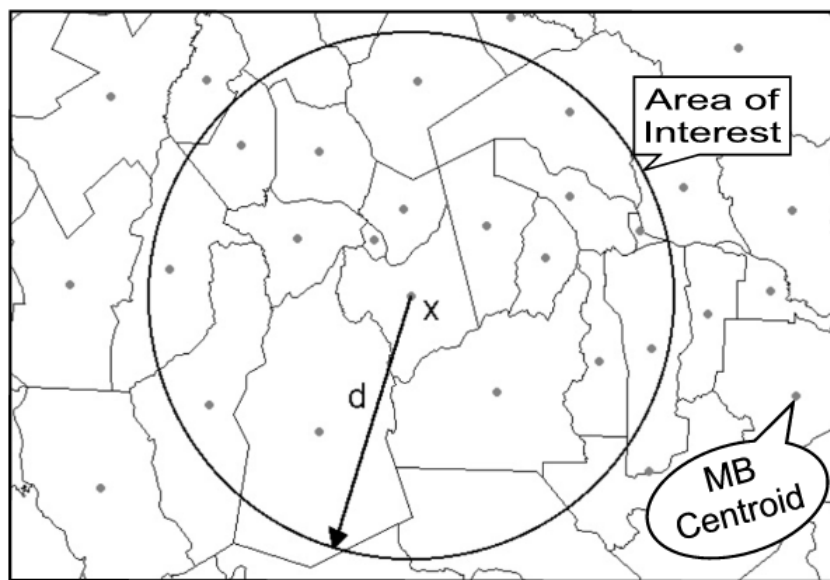


Figure 4.2, MB smoothing algorithm. X = MB being processed. d = radius of area (of interest).

Figure 4.3 represents the algorithm described above and displayed in Figure 2. The area of interest is 100km, this was chosen because it is similar to the radius of a TLA and will allow a rough comparison with Figure 1.

Figure 4.3 presents a different picture of where the high rates of unemployment benefit recipients are located within New Zealand. The same classification has been attached to both maps. In Figure 4.3 the two areas indicated by the markers A and B are not visible in Figure 4.1. Area B (centred around Dunedin), for example, spans across several TLA boundaries, whereas, it becomes masked in Figure 4.1. The advantages of aggregating the MBs are two-fold. Firstly the user can define relevant boundaries based on the MB data, for example, areas of high unemployment. Secondly, the area of interest or spatial scale can be controlled.

In this case the term spatial scale refers to the size of the area, surrounding a MB, to be explored. For example, if you want to find small, local groupings of people, the area of interest would be set to a few kilometres, but if you want to locate high population areas equivalent to the size of a town, an area of interest of tens of kilometres would be needed. An example of changing the spatial scale and the effect on the resultant pattern is shown in Figure 4.4.

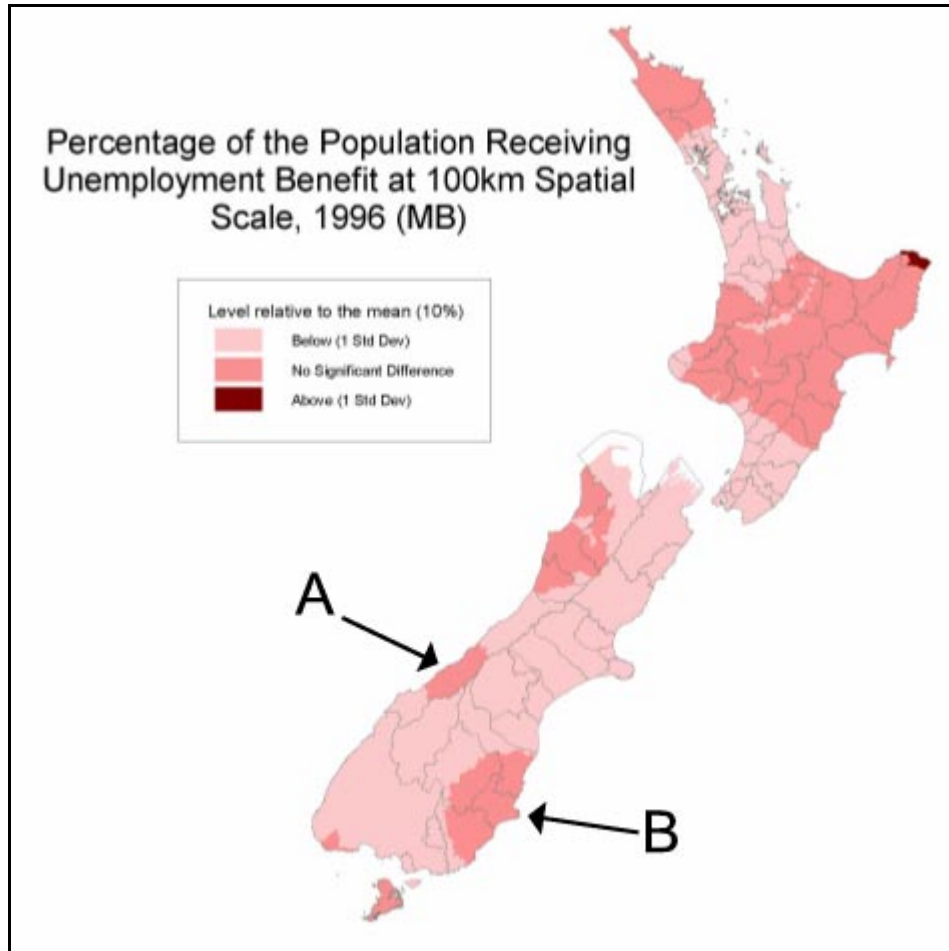


Figure 4.3, Percentage of population receiving unemployment benefit in 1996. Data aggregated using an area of interest with a radius of 100km.

When the area of interest is set to 5km a number of high population density areas (darkest shade) are detected. Enlarging the area of interest reduces the number of clusters to 3 (10km) and finally to one (20km).

Without GIS we have four spatial levels, Meshblock (MB), Area Unit (AU), Territorial Local Authority (TLA) and Regional Councils (RC). Depending on the issue studied we will want to use areas of varying size. For some issues, such as neighbourhood effects on schooling and welfare support, an area unit may be too large while a meshblock is too small. By using means across a larger unit you also immediately lose the rich variation in the data contained at meshblock level. In addition, if we want to study the effect on a group of people of the area around that group it quickly becomes clear that existing

boundaries are arbitrary. A meshblock in the centre of a territorial authority is treated the same as one on the border. An Area Unit's boundary will not recognise the distribution of variables, e.g. unemployed, because the boundary is more for administrative purposes, rather than representing groupings within the data.

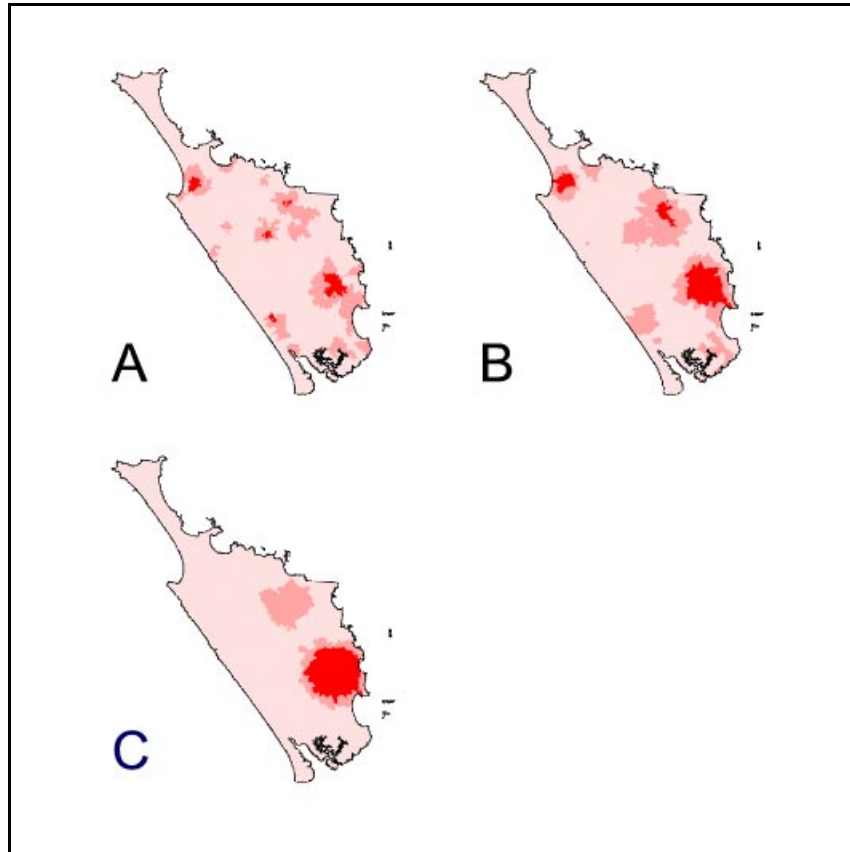


Figure 4.4, The effect of changing the area of interest for population density in northland. A = 5km, B = 10km and C = 20km.

GIS can address these issues in sophisticated ways. By using spatial analysis techniques (described above) we are able to retain the richness of the meshblock data, and aggregate the data according to how individual variables vary spatially. We have produced three illustrations of the use of GIS.

4.3 Illustrations

Illustration 1 – Population density in Auckland

Map 26 shows territorial local authority density. This shows very little variation among TLAs within the Auckland Region. Map 30 shows the population density at meshblock level. The darker colours represent high population densities. The data has been classified to highlight natural groups within the dataset. The map is highly fragmented

and although the spread of Auckland can be broadly identified it is difficult to identify any areas of very high population density.

What is important to know, is not so much whether a meshblock has a high population, but whether the meshblock is located within an area of high population. It is also interesting to investigate how important a meshblock is within a community. A meshblock can be deemed important if it is found to act as a centrepiece with the population congregating around it. Its importance will vary depending on distance. For example, suburbs may centre around their local shops and services, but this pattern only exists for short distances, e.g. 1–2 kms. For larger distances the population is located around town and city centres.

Map 31 shows the population density at area unit level. This begins to capture the variation within Auckland in a meaningful way. Areas of medium density can be distinguished on the outskirts and major communities are clear.

Map 32 was produced by the GIS using a radius of 1km. This means that for each meshblock the population density recorded represents the area around the meshblock, up to 1km. It is immediately obvious that several clusters exist and represent areas of high population density. This may be an appropriate radius for studying the location of retail centres and community services or for the location of key public transit routes and nodes. This map is similar to the area unit map but at a rough glance appears to pick up key suburban centres more accurately.

At 5km the clutch of centres revealed at 1km die out to be replaced by one large group with the cluster centre beginning to represent central Auckland. Map 33 demonstrates this. A 5 kilometre radius may begin represent the area that most people will want to commute to work, where people employed in similar occupations could easily meet for meetings, and where people may travel frequently to visit large supermarkets or more specialised stores. The central city is most able to provide this density of population. The differences in density within South Auckland become unimportant. This is an area of aggregation not matched by any existing boundaries. Map 34 uses a 10km radius but shows a similar pattern that is even more compact and drawn northward.

These methods not only provide interesting patterns on maps but can also be used to create variables that can be used statistically. For each meshblock we now have a variable that gives the number of people living within 1, 5 or 10 km radiuses. We can look at the relationship between this density and the characteristics of the population.

When these techniques are applied in rural areas they will distinguish between low density areas that are close to towns or cities, or are well serviced by the road network and those that are generally isolated.

Illustration 2 – Population density in Northland.

A map of Northland highlighting area units with high density (Map 35) shows Whangarei and the area around it, Paihi, KawaKawa, Kaikohe and Kaitaia. Which towns are high

density seems largely a matter of chance and there is no distinction among lower density areas.

A map with a 1 km radius for density begins to pick up a similar set of major towns but cannot easily distinguish among rural areas with different characteristics. These towns and the areas close to them become more obvious at 5km (Map 37). The 10 km radius identifies Whangarei as the only major area of consistently high population density. Even more than in the city, area units are inadequate for capturing meaningful variation even in a variable as simple as population density. Comparing maps 35 (area unit) and 38 (10km radius), we see a very different and economically much more meaningful picture in the latter case.

Extensions to this use of GIS could take three forms. First, our analysis is simply done using direct distance. As is obvious in Auckland this does not take into account geographic features such as harbours. Road distance or even travel time is a more relevant measure for economic analysis. GIS can calculate road travel times relatively easily. We could map density within 5 minutes drive from each location.

We can also study variables other than population density. Interesting variables could include a number of beneficiaries within a certain radius of travel time, concentration of employees in particular sectors or occupational groups, income concentration, or groupings of senior citizens.

Illustration 3 – National unemployment patterns

A third possibility would be to make the areas endogenous and calculate, for example, the travel time radius necessary to reach 100 people in the same occupation group as each individual. This could be thought of as an area where an occupation reaches critical mass. If face-to-face contact or rapid transfer of inputs is critical and this area is too large, the occupation is unlikely to thrive in the defined location.

5 EMPIRICAL ILLUSTRATIONS FOR POLICY ANALYSIS

In this section we begin to explore a number of hypotheses that our model generates. The exploration is primarily intended to show a range of possible forms of analysis and the way data at different levels of aggregation is useful. It is intended more to focus questions that provide any answers. The analysis is broken into three sections, regional development, local governance and regional social policy.

5.1 Regional Development

In this section we outline a few empirical hypotheses that are implied by the model in section 2. Then we give some statistics that relate to these hypotheses.

Hypothesis 1: As transport costs fall and manufacturing rises as a percentage of the total economy, non-primary production will cluster more.

This will mean that population will tend to move toward areas where the density is already high and move away from areas with a high proportion of primary production. Figure 1 shows the relationship between regional population levels and population growth. Auckland clearly drives the correlation because of its large size and high growth. More generally the correlation is not obvious at this level. Figure 2 shows the same relationship at the territorial local authority level. The larger TLAs have consistently high growth but some less populated areas are also growing rapidly. When we look at this relationship in a regression (Regression 1) we see that the relationship is positive but not significant. Population clustering does seem to be observable but it is clearly only part of the picture.

Regression 1 Dependent Variable: Percentage Change in TA Population, from 91 to 96

	Coefficient	Standard Error
TA Population density in 1991	0.5 e-04	0.4 e-04
Constant	0.05***	0.01
R squared.	2%	
Number of observations	74	

Population does not seem to move into already dense area units probably because they are experiencing congestion (Regression 2). The correlation is negative though this is insignificant in a regression. Further analysis of cluster formation will have to look at population growth near to dense areas, i.e. using GIS techniques. These results may also be strongly affected by the predominance of Auckland. Movement in areas outside of big cities may show a different pattern.

Regression 2: Dependent Variable: Percentage Change in AU Population, 91 to 96

	Coefficient	Standard Error
AU Population density in 1991	-0.4 e-03***	0.01e-03
Share of AU Respondents with No School Qualifications in 1991	-0.5***	0.09
Constant	0.3***	0.04
R squared.	2.8%	
Number of observations	1686	

* = significant at 10%; ** at 5% and *** at 1%

Population growth is lower in areas with a large percentage of employment in primary sectors (see Regression 3 below). This is consistent with the idea that manufacturing and services will no longer have to be located close to primary production so that population will fall where primary production is important. However this result does not hold up

when additional variables are added. At first glance, schooling appears to be the most important variable that relates with population growth (Regression 2).

Regression 3: Dependent Variable: Percentage Change in TA Population, 91 to 96

	Coefficient	Standard Error
Share of TA Employment in Primary Industry in 1991	-0.1*	0.07
Constant	0.09***	0.02
R squared.	4.4%	
Number of observations	74	

* = significant at 10%; ** at 5% and *** at 1%

Hypothesis 2: Industries with higher economies of scale will tend to be more concentrated in areas with high population density.

This does not hold at the level of sectoral aggregation that we are currently using. Manufacturing may be expected to have economies of scale but it is highly concentrated in some unexpected areas where there is low population density (Map 21). More manufacturing happens in denser areas but it does not necessarily grow disproportionately. In New Zealand manufacturing may show close links with primary sectors – e.g. pulp and paper, fish processing, and dairy factories. If the primary customer base is foreign, proximity to ports and to primary input providers may be more important than proximity to local markets. This would need to be examined at a finer sectoral breakdown.

Hypothesis 3: Population will adjust to changes in employment opportunities and hence wages.

Population will leave areas with high unemployment and declining primary production and go to areas with low unemployment and high manufacturing / services. We do see some evidence of this.

Regression 4: Dependent Variable: Percentage Change in AU Population, 91 to 96

	Coefficient	Standard Error
AU population density in 1991	-0.3e-04***	0.1 e-04
Unemployment rate in TA, 1991	-0.03	0.6
Constant	0.1**	0.06
R squared.	0.5%	
Number of observations	1686	

* = significant at 10%; ** at 5% and *** at 1%

The unemployment rate is negatively related to population growth though highly insignificant even when controlling for population density.

However, this is never strong and when schooling is also controlled for unemployment and population growth become positively related. This may relate to the difference between unemployment caused by regional shocks and that caused by the characteristics of workers, such as low skills in a time when low skilled workers face decreasing demand.

Regression 5: Dependent Variable: Percentage Change in AU Population, 1991 to 1996

	Coefficient	Standard Error
AU population density in 1991	-0.5 e-04***	0.1 e-04
TA Unemployment rate in 1991	0.9	0.6
Share of AU's Respondents with No School Qualifications, 1991	-0.5***	0.1
TA population density in 1991	0.0001***	0.00003
Constant	0.2***	0.06
R squared.	3.3%	
Number of observations	1686	

* = significant at 10%; ** at 5% and *** at 1%

Hypothesis 4: Differences will persist across time

Because people take a while to adjust to changes, if a major shock hits an area its effects will tend to persist. People will need to move locations or change sectors to gain employment. Unemployment will be persistent over time. In contrast, where unemployment is relatively low it may be simply cyclical. A cyclical downturn can be rapidly corrected without retraining or mobility. Between 1991 and 1996, unemployment rates were generally falling. However, they seem to have fallen less in areas where unemployment is high. This effect is strongly seen at the both the regional and local authority levels. See Figures 3 and 4. This is consistent with the idea that areas that need to make large adjustments do so slowly.

This may be slow adjustment to large shocks but it could also arise because much of unemployment is not a result of structural adjustment but long run changes in the demand for low skilled people. Thus areas with existing high unemployment will tend to have low skilled people who are unlikely to find new jobs quickly. More analysis would be needed to separate these effects.

The regression below (Regression 6) suggests that unemployment is persisting in areas of high unemployment, and areas with high numbers of low-skilled workers. It does not suggest that high population density areas have a different unemployment dynamic. It does suggest that areas with high primary production have lower unemployment growth in this period. This may be because they are recovering from shocks after agricultural subsidies were removed in the mid 1980s.

Regression 6: Dependent Variable: Percentage Change in AU Unemployment Rate, 1991 to 1996

	Coefficient	Standard Error
TA Unemployment rate 1991	0.4**	0.2
Share of AU's Respondents with No School Qualifications, 1991	0.4***	0.07
Share of TA Employment in Primary Industry in 1991	-0.4***	0.06
TA population density in 1991	-0.7 e-07	0.7 e-07
Constant	-0.3***	0.02
R squared.	7.3%	
Number of observations	1686	

* = significant at 10%; ** at 5% and *** at 1%

Hypothesis 5: Population density will increase in areas with more educated populations with higher incomes.

We would expect this because high skilled people are likely to improve the productivity of people around them; they are likely to be employed in professions with larger economies of scale and external economies and their income increases the size of markets. We can see the inverse of this in the regressions above (see for example Regression 6). Population grows least in areas with high levels of low-skilled people. This is a very robust result.

Hypothesis 6: Agglomerations will occur in areas with natural advantages e.g.: climate, ports.

Consideration of Map 26 supports this. Population density is highest near deep ports (Auckland, Tauranga, Wellington Nelson, Christchurch, Dunedin, Invercargill) that were historically very important and generally in the North where the weather is more clement. Major growth in the Queenstown-Lakes area is directly related to the spectacular local scenery. Growth in the Kapiti Coast and around Auckland (e.g.: Coromandel) can be related to the proximity to a large city. It may also reflect the lovely climate in those areas that attracts people particularly as they retire.

Hypothesis 7: Government provision of infrastructure will affect paths of regional development

It is hard to separate the natural advantages of the current cities from the provision of infrastructure within them. We would need to look for a 'natural experiment' where infrastructure was provided (such as rural areas near SH1) to analyse the effect of infrastructure decisions.

Advantages of disaggregated data in analysing regional development.

As we can see above, the patterns of regional development are less obvious than we might expect. Analysis at the regional council level is seriously limited. Disaggregated

data allows more statistical power in studying relationships. It allows the use of regression techniques that can control for other variables. Even with our rich data set we have to be very careful in the definitions of areas and variables and will need to be relatively sophisticated to understand the true drivers of regional changes.

Local government

Local government has two basic justifications. First, that it better represents the diverse interests of a nationally heterogeneous population and second, that it is more efficient at providing local services. Here we look at some evidence that might bear on this (Table 6).

One area where local government is unlikely to be an effective agent is in redistributing income. This is particularly true if a lot of the national income variation is between local authorities rather than within them. In New Zealand around 44% of the variation in per capita income occurs between local authorities. Poorer local authorities will have few resources to support the poor in their areas. Redistribution really needs to be funded at a national level. This does not mean that local authorities may not have a role in administering redistributive and social programs.

Local authorities are often used to provide local infrastructure. If infrastructure is funded and provided at a regional council level this will allow similar resources per unit area. The variance in income density per km² is mostly within regions not between them. If the cost of providing infrastructure relates to the area that needs to be serviced this is an appropriate measure. Income density still varies significantly between local authorities so funding at this level would lead to very variable levels of infrastructure. Some would argue that it is efficient to provide less infrastructure in areas with less economic activity. While this is true, significant variations in infrastructure may lead to dynamic inefficiency through negative feedbacks (low activity leads to low infrastructure leads to low activity) and may have adverse regional social outcomes. These are tradeoffs that can be dealt with within regional councils.

Some territorial local authorities in large cities have relatively homogeneous population density. They are dealing primarily with an urban community. However many TLAs include significant rural and urban areas and must balance the services they require between the needs of two very different populations.

Most variance in the age distribution is within TLAs so all TLAs have to deal with demographically heterogeneous populations. They cannot generally bias toward providing services to one age group. Much of the variance in income is within TLAs though so they could choose to provide services that suit their income level to a certain extent. Education levels vary more between TLAs than within them so if education is an indicator of preferences for public services (either in individuals' roles as consumers or workers for firms) TLAs are able to match services more accurately to their population.

Much of the variability in occupations at a broad sectoral level is between TLAs so in their services to firms TLAs can take account of different needs across sectors.

Territorial local authorities have advantages in dealing with populations with education levels and occupational mixes that are homogeneous relative to national variation and which may indicate similarities in preferences for services. However the homogeneity of income within TLAs relative to between them make them poor at carrying out redistributive functions or funding infrastructure that should be relatively evenly provided across localities. Regional councils on the other may be well resourced to provide infrastructure.

The evidence can so far tell us nothing about the efficiency of local authorities. Information on relative levels of spending and growth could indicate something about variance in efficiency but may also be driven by differences in needs and historical infrastructure.

5.2 Regional Social Policy

Hypothesis 1: Long term beneficiaries will move to places with lower cost of living

Density of population will tend to be associated with higher rents. Thus we might expect that beneficiaries will be concentrated in low density areas. At a superficial glance this is not true. When controlling for education and other variables, population density is positively associated with government welfare support. This may be dominated by South Auckland and Porirua and might be worth more analysis.

Hypothesis 2: Patterns of deprivation and privilege will persist over time

This could occur for two reasons. First, areas that are attractive to people who are likely to be dependent (e.g.: low cost areas with good services for poorer people – e.g.: bus service) are likely to stay attractive. Second, areas with high levels of deprivation may cause the people in them to have more trouble finding work or getting education and may make them more likely to become or stay dependent.

The data shows unemployment persisting strongly over 5 years and significantly over 10 years at the meshblock level. The correlation over time is even stronger at the area unit suggesting that it is not individuals but communities that suffer persistence in unemployment. Benefit dependency is even more strongly correlated across time and is extremely high at the area unit level. Whether these are the same people or families or whether the areas simply keep attracting dependent people who later move cannot be seen without considering mobility data.

Education is very strongly correlated at the meshblock level and close to 1 at the area unit level even over 10 years. Whether this is because of the income necessary to live in certain areas or a passing of education characteristics between generations is not clear.

Hypothesis 3: Patterns of deprivation and privilege will cluster across space.

We expect and find high correlations of meshblock level characteristics with its surrounding AU. Schooling variables demonstrate the highest clustering. Income is closely related to schooling and also very highly clustered. Unemployment clustering is high but not as high as benefit dependency in general.

This does not say anything about causality. Dependency could be created by neighbourhood effects, dependent people could move together because they can afford a similar location and have similar preferences, or a factor such as education could cause people to group together and have high dependency ratios.

Mobility data could tell us something about the directions of causation in future analysis.

Hypothesis 4: Regions that have recently declined will tend to have more beneficiaries and lower incomes

Growth in unemployment is negatively associated with growth in the manufacturing, and primary sectors and with growth in population overall as the regression below (Regression 7) shows.

Regression 7: Dependent Variable: Percentage Change in TA Unemployment Rate, 1991 to 1996

	Coefficient	Standard Error
Percentage Change in TA Manufacturing Employment, from 91 to 96	-0.3**	0.13
Percentage Change in TA Primary Employment, from 91 to 96	-0.1*	0.07
Percentage Change in TA Population, from 91 to 96	-0.2	0.2
Constant	-0.2***	0.02
R squared.	16.5%	
Number of observations	74	

* = significant at 10%; ** at 5% and *** at 1%

Unemployment is highly associated with other forms of dependency which might be expected to show similar patterns. In particular it is very highly related to the domestic purposes benefit. Sickness benefit also associates with unemployment. However, if these are really related to long term unemployment and discouraged workers they may not be so responsive to changes in local economic conditions.

Hypothesis 5: Unemployed people will tend to move to areas with high employment density and low unemployment rates.

Analysis of this will require the use of mobility data at a meshblock level.

6 OTHER DATA SOURCES AVAILABLE

6.1 Recent Additions to the Database

Improved mobility data

The dataset is derived from the census question: “Usual residence 5 years ago”. It is possible to determine the movement of population (but not individuals) between AUs and the following time periods:

- 1986 and 1991
- 1991 and 1996

New Zealand 1:50,000 topographic dataset

Contains all the information held on the New Zealand 1:50,000 map series, for example, roads, hospitals, rivers etc. The data is intelligent in other words, it knows where it is and what it is (e.g. State Highway One). The main purpose of the dataset is to enable further analysis to use real travel distances (i.e. along the road network) and not straight-line distance.

New Zealand deprivation index

An index of deprivation, mapped at the meshblock, available for 1991 and 1996. The index was produced by Clare Salmond and Peter Crampton from the Health Services Research Centre, Victoria University of Wellington.

6.2 Potential Data Sources

To enable analysis between different datasets and through time, potential datasets must meet the following criteria:

1. The data can be supplied for the census (snap-shot) years (1986, 1991 and 1996)
2. The data can be supplied aggregated to SNZ 1996 geographic areas (MB, AU, TLA and RC).

Other data from the department of statistics

- *More detailed Income data*
Statistics have currently provided us with income data at the meshblock level in 1996 but only at area unit level for 1986 and 1991. See Appendix 1 for more details.
- *Import/Exports for New Zealand ports*
This data is drawn from the SNZ Overseas Cargo Statistics and has been collected monthly since 1826. The following variables are available: Item (e.g. meat/fish), Country of Origin, Destination Country, New Zealand Port (Air/Sea), Overseas port, Period (Updated monthly, any period available), Value, (Imports/Exports), Quantity, Gross Weight.
- *Business Demographic Statistics*
Business (17 major industry categories; NZSIC or ANZSIC) and employment available to meshblock
Whole economy only in 1998 – previously only some sectors
Data on foreign activities of New Zealand firms
Available back to 1987, but business criteria selection changed in 1994 and business classification changed from NZSIC to ANZSIC in 1997.
The following is an example of a previous data request together with the quote. The variables were: 1996 meshblock number, 5-digit ANZSIC code for each different industry, number of geographic units (individual company), number of full-time equivalents, total workforce.
- *Household Economic Survey*
Quarterly survey. Available at Treasury since 1988. Cross sections not panel. Regional since 1995.
- *Household income survey*
Annual. Regional since 1995. Available at Treasury. Sample of 28,000 – subset of HES. Cross sections.
- *Accommodation Survey: Short term accommodation*
- *Building Statistics*
Building authorisations: dwelling type, type of work required, value and floor area.
- *Streets file and street address*
- *Building consents:*
by building type, Area unit level.
New and alterations.
No of permits, \$ value, floor area, number of units
- *Annual Enterprise survey.*
Financial info about businesses in construction industry (and others?)
Non geographic but can link on ANZSIC
- *Labour Force Survey regional:* created by Stats team since 1995
- *Regional CPI*

- *Retail trade by region*
- *Local Government: Quarterly and Annual Survey of Local Government Finance*
- *Time Use Survey – travel times*
- *GST data:*
 - Stats is working to derive regional statistics from this.
 - Earnings and expenditure by quarter by industry
 - Will go back to 1995
 - To local authority level.

Potential Data from sources other than the Statistics Department

- *Quotable Value New Zealand*
Residential Property Valuations.
Variables: number of sales, average/median sale price, valuation of land plus improvements.
- *New Zealand Bond centre*
Residential Rental Data.
Variables available: weekly rent, dwelling type, number of bedrooms (all variables can be provided at the mean, median, upper and lower quartile).
The data is readily available at AU back to 1992.
Data was collected from 1987, however, it has a higher data drop-out rate.

Other Data Vendors / Collectors

- *Land Transport Safety Authority*
- *Land Information New Zealand (LINZ)*
- *Land Care*
- *Terra Link*
- *Climate - Met Office*
- *Maori Education, Employment and Training Commission regional database*
- *Police – offences by region.*
- *Vehicle Registrations - Transport*
- *New Zealand Health Information Service*
- *WINZ*
- *National Bank Regional Statistics*
- *Reserve Bank*
- *Political Boundaries and voting patterns*

SNZ Data-lab

SNZ have developed a data-lab to provide the approved bodies with access to unit record data, i.e. information on individuals. Access is granted as long as the proposed use meets the conditions set by SNZ.

7 CONCLUSION

This paper aimed to introduce a new dataset and demonstrate both its value and the value of using Geographic Information Systems techniques. We have presented the data in many different forms, maps, tables, correlations, and regressions. Each demonstrates the value of being able to look at and use data at different levels of aggregation.

At present these analyses mostly indicate the complexity of relationships among variables. Regions and even territorial authorities do not show strong consistent patterns. Some patterns do emerge, particularly with the statistical analysis of disaggregated data, but many require closer analysis, particularly to separate causation from simple correlation. The data currently used easily can be supplemented by a number of readily available complementary data sets. In particular, data on mobility over time will allow us to more clearly understand mobility and its drivers in certain groups of the population. Mobility data will also help us identify causality in the relationships among clusters of social problems and their dynamics.

The existing forms of aggregation are not adequate for studying some relationships particularly in rural areas where boundaries are clearly only for administrative purposes. In particular, aggregation units do not match aggregations of economic interest. This can be remedied by using GIS to create new aggregations endogenous to the natural clustering of the data on the variables of interest. These also have the merit of being responsive to the particular meshblock they are associated with.

One cautionary lesson is that any statistical analysis needs to take account of the predominance of large cities, and particularly Auckland in the data. Variations within Auckland can mask interesting relationships within more rural areas and between Auckland and the rural areas.

Two policy relevant patterns seem to emerge and deserve closer analysis. The first is that three territorial authorities seem to exhibit persistent negative indicators both in the static and dynamic picture. The most problematic is East Cape, but the Far North and the Buller areas also have persistent patterns. These seem to be areas with poor connections to the general road network and centres of economic activity. Second, education, and specifically areas with high percentages of people with no school qualification, seems to be associated with population decline and poor social indicators. This merits more investigation.

The key areas for further research seem to be first, to improve our understanding of population flows, disaggregating into different types of people and identifying more clearly the characteristics of the areas they are moving from and to. Second, unravelling the directions of causality in the relationship between social problems and their geographic clustering is critical to addressing regional social problems.

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- Krugman, Paul (1995) *Development, Geography and Economic Theory* (MIT Press: Cambridge, Mass.)

Appendix 1 **Descriptive Statistics generated from the Census data (1986 – 1996)**

Appendix 2 **Maps**

Appendix 3 **Tables**

Appendix 4 **Figures**

APPENDIX 1: DESCRIPTIVE STATISTICS GENERATED FROM THE CENSUS DATA (1986 – 1996)

Map data

The maps display different variables at the Territorial Local Authority (TLA) spatial unit.

For each variable the following has been calculated:

The current state of the variable (1996) in relation to the national mean (as a percentage)
The growth in the share of population between 1986 and 1996 (as a percentage) – set against zero, or the mean if all TLAs record an increase.

74 TLAs are included except the Chatham Islands and areas that fall outside TLA boundaries, for example, offshore islands. Mean values were calculated from the 74 TLAs.

Map presentation

For 1996 static maps, presented using 3 categories:

- Below (less than 1 standard deviation from the mean)
- Little/No difference (within 1 standard deviation from the mean)
- Above (greater than 1 standard deviation from the mean)

The mean value is the average for the 74 TLA's included in the study.

Maps denoting growth in the variables display growth in the share of the population, not actual growth in numbers. Most variables report growth for 1986 – 1996, except Degree Qualification which reports growth between 1986 – 1991 and 1991 – 1996 due to changes in the law regarding the awarding of degrees.

For 1986 – 96 growth maps, presented using 3 categories:

- Decrease (less than 1 standard deviation from zero)
- No significant difference (within 1 standard deviation from zero)
- Increase (greater than 1 standard deviation from zero)

For a few maps depicting growth, the mean was used instead of zero.

Mapped Variables

The following variables have been mapped:

Topics	Variables
1 Population:	Less than 15 15 to 64 Greater than 64
2 Education:	Degree No qualifications
3 Government Benefit:	Unemployment benefit Domestic purposes benefit
4 Labour Force Status:	Gainfully employed (full/part-time) Unemployed and seeking work
5 Occupation (Industry sector):	Primary Manufacturing Services

Personal Income

Applied to: Population resident in NZ aged 15 years and over.

Smallest spatial resolution: MB (1996) AU (1986,1991)

Temporal resolution: 1986 – 1996 (at AU and above only)

Variables available

Year	Variable
1996	Loss
	Zero income
	\$1 - \$5,000
	\$5,001 - \$10,000
	\$10,001 - \$15,000
	\$15,001 - \$20,000
	\$20,001 - \$25,000
	\$25,001 - \$30,000
	\$30,001 - \$40,000
	\$40,001 - \$50,000
	\$50,001 - \$70,000
	\$70,001 - \$100,000
V	\$100,001 or more
1996	Not specified
1986, 1991, 1996	Per Capita Personal Income
1986, 1991, 1996	Average (Mean) Personal Income
1986, 1991, 1996	Median Personal Income

Education

The census question asks for the highest qualification gained

Applied to: Population resident in NZ aged 15 years and over.

Smallest spatial resolution: MB

Temporal resolution: 1986 – 1996

Variables available:

The variables have been grouped under the following categories:

		Education			
Degree	Tertiary	School	None	Not_Spec	
1986	Post_Graduate_Degree_UR86 Bachelor_Degree_UR86	Under_Grad_Cert_Dip_UR86 Technical_Cert_NZ_Cert_Dip_UR86 Teachers_Nurses_Cert_Dip_UR86 Trade_or_Adv_Trade_Cert_UR86 Other_Tertiary_Qual_UR86	Higher_School_Cert_Bursary_UR86 Sixth_Form_Cert_Uni_Ent_UR86 School_Certificate_Qual_UR86 Other_School_Qual_UR86	Still_at_School_UR86 No_Qualification_UR86	Highest_Qual_Not_Specified_UR86
1991	Post_Graduate_Degree_UR91 Bachelor_Degree_UR91	Under_Grad_Cert_Dip_UR91 Technical_Cert_NZ_Cert_Dip_UR91 Teachers_Nurses_Cert_Dip_UR91 Trade_or_Adv_Trade_Cert_UR91 Other_Tertiary_Qual_UR91	Higher_School_Cert_Bursary_UR91 Sixth_Form_Cert_Uni_Ent_UR91 School_Certificate_Qual_UR91 Other_School_Qual_UR91	Still_at_School_UR91 No_Qualification_UR91	Highest_Qual_Not_Specified_UR91
1996	Higher_Degree_UR96 Bachelor_Degree_UR96	Advanced_Vocational_Qual_UR96 Intermediate_Vocation_Qual_UR96 Skilled_Vocational_Qual_UR96 Basic_Vocational_Qual_UR96 Post_School_Not_Specified_UR96	Higher_School_Qual_UR96 Sixth_Form_Qual_UR96 School_Certificate_Qual_UR96 Overseas_School_Qual_UR96 School_Qual_Not_Specified_UR96	No_Qualification_UR96	Highest_Qual_Not_Specified_UR96

Labour Force Status

Applied to: Population resident in NZ aged 15 years and over.

Smallest spatial resolution: MB

Temporal resolution: 1986 – 1996

Variables available:

1986/1991	1996
Gainfully_Emp_Full_time_UR86(91)	Gainfully_Emp_Full_time_UR96
Gainfully_Emp_Part_time_UR86(91)	Gainfully_Emp_Part_time_UR96
Unemp_and_Actively_Seeking_UR86(91)	Unemp_and_Seeking_LF_UR96
Non_Labour_Force_UR86(91)	Not_in_Labour_Force_UR96
Emp_Status_Not_Specified_UR86(91)	Labour_Force_Not_Available_UR96

The labour force has been defined as those in full and part time employment, and those who are unemployed and actively seeking re-employment.

Occupation

Applied to: Population resident in NZ aged 15 years and over and gainfully employed in labour force.

Smallest spatial resolution: MB

Temporal resolution: 1986 – 1996

Variables available (ANZSIC 2 digit level):

	Primary	Manufacturing	Construction	Services	Not_specified
1986	Agric_Hunt_Forestry_Fish_UR86 Mining_and_Quarrying_UR86	Manufacturing_UR86	Construction_UR86	Electric_Gas_Water_Supply_UR86 Construction_UR86 Wsale_Retail_Trade_Hotels_UR86 Transport_Storage_Comm_UR86 Bus_and_Financial_Services_UR86 Comm_Social_Personal_Serv_UR86	Industry_Not_Specified_UR86
1991	Agric_Hunt_Forestry_Fish_UR91 Mining_and_Quarrying_UR91	Manufacturing_UR91	Construction_UR91	Electric_Gas_Water_Supply_UR91 Construction_UR91 Wsale_Retail_Trade_Hotels_UR91 Transport_Storage_Comm_UR91 Bus_and_Financial_Services_UR91 Comm_Social_Personal_Serv_UR91	Industry_Not_Specified_UR91
1996	Agriculture_Forestry_Fish_UR96 Mining_UR96	Manufacturing_UR96	Construction_UR96	Electric_Gas_Water_Supply_UR96 Wholesale_Trade_UR96 Retail_Trade_UR96 Accom_Cafes_Restaurants_UR96 Transport_and_Storage_UR96 Communication_Services_UR96 Finance_and_Insurance_UR96 Property_and_Bus_Services_UR96 Govt_Admin_and_Defence_UR96 Education_UR96 Health_and_Community_Ser_UR96 Cultural_and_Recreational_UR96 Personal_and_other_Service_UR96	Industry_Not_Specified_UR96

Population

Applied to: Population resident in NZ.

Smallest spatial resolution: MB

Temporal resolution: 1986 – 1996

Variables available

Less than 1 year

1 year

2 years

3 years

4 years

5 years

.....

98 years

99 years

100 years and over

For analysis the age categories were grouped as follows:

Less than 15 (Not Working Age)

15 – 64 (Working Age Population)

Greater than 64 (Senior Citizens)

The categories were chosen because the census questions recognise 15 year olds as able to work.

Benefit

Applied to: Population resident in NZ.

Smallest spatial resolution: MB

Temporal resolution: 1986 – 1996

Variables used

1986 Domestic_Purposes_Benefit_UR86
Unemployment_Benefit_UR86

1991 Domestic_Purposes__Benefit_UR91
Unemployment__Benefit_UR91

1996 Unemployment_Benefit_UR96
Domestic_Purposes_Benefit_UR96

TABLE 2

TLA No.	TLA Name	Percentage of Population Aged 15 and Over						Growth in the Share of the Population (%)			
		Degree Qualification			No Qualification			Degree Qualification		No Qualification	
		1986	1991	1996	1986	1991	1996	1986 - 1996	1986 - 1991	1991 - 1996	1986-1996
1	Far North	3.2	3.1	3.6	41.0	36.2	37.8	12.5	-1.5	14.3	-7.7
2	Whangarei	3.3	3.5	4.4	36.5	32.1	36.0	31.7	6.5	23.6	-1.3
3	Kaipara	2.2	2.2	2.9	44.1	38.7	42.3	29.2	-3.9	34.5	-4.1
4	Rodney	3.9	4.5	5.6	34.7	28.6	31.2	43.1	13.2	26.4	-10.1
5	North Shore City	6.4	7.9	11.1	27.8	21.2	22.4	72.6	22.9	40.5	-19.5
6	Waitakere City	3.5	4.2	5.9	36.4	30.4	31.6	65.8	19.6	38.6	-13.4
7	Auckland City	8.5	11.1	15.4	32.9	24.9	23.1	81.1	30.3	38.9	-29.7
8	Manukau City	3.1	3.7	5.5	39.6	33.7	35.0	75.6	20.3	46.0	-11.7
9	Papakura	3.0	3.4	4.3	39.8	34.6	36.4	43.7	16.3	23.6	-8.7
10	Franklin	3.1	3.5	4.5	39.2	32.8	35.6	45.2	12.0	29.6	-9.1
11	Thames-Coromandel	3.3	3.5	4.1	38.5	35.8	38.4	24.3	5.3	18.0	-0.3
12	Hauraki	2.3	2.4	2.6	45.5	40.0	43.8	11.0	2.5	8.3	-3.8
13	Waikato	3.1	3.7	5.1	43.1	37.1	38.5	62.2	17.9	37.6	-10.6
14	Matamata-Piako	2.6	2.8	3.5	44.1	38.6	40.1	36.6	9.4	24.9	-9.0
15	Hamilton City	6.1	7.8	10.2	34.1	26.8	28.3	66.0	27.0	30.7	-17.0
16	Waipa	3.0	3.9	5.6	38.8	34.7	35.6	82.1	26.6	43.9	-8.3
17	Otorohanga	2.0	2.3	2.9	46.5	39.7	41.8	44.7	15.5	25.3	-10.2
18	South Waikato	2.8	2.9	3.1	43.4	40.0	42.8	8.5	3.4	4.9	-1.3
19	Waitomo	2.7	2.9	3.7	44.9	41.5	43.2	37.4	7.4	27.9	-3.7
20	Taupo	3.3	3.5	4.3	40.1	34.8	36.5	28.7	4.1	23.6	-9.1
21	Western Bay Of Plenty	3.4	3.4	4.3	38.6	33.5	36.3	27.3	0.2	27.0	-6.0
22	Tauranga	3.5	3.6	4.8	38.5	31.8	35.5	36.5	3.1	32.4	-7.7
23	Rotorua	3.8	4.1	5.5	38.0	33.8	33.9	45.6	7.8	35.0	-10.8
24	Whakatane	2.9	3.2	4.4	42.5	36.8	38.6	51.6	10.7	37.0	-9.1
25	Kawerau	2.6	2.3	2.0	41.8	39.1	46.0	-22.1	-9.8	-13.6	10.1
26	Opotiki	2.7	2.4	2.4	44.9	41.9	46.0	-10.1	-12.2	2.4	2.4
27	Gisborne	2.9	3.2	3.9	44.0	37.2	38.0	32.8	7.3	23.9	-13.7
28	Wairoa	1.4	1.9	2.2	46.2	45.5	46.5	54.8	36.5	13.4	0.6
29	Hastings	3.2	3.7	4.7	43.3	37.3	37.1	47.7	15.3	28.2	-14.2
30	Napier City	3.6	3.8	5.2	40.4	35.6	36.8	46.6	6.1	38.1	-9.1
31	Central Hawke's Bay	3.1	3.2	3.8	41.1	38.0	40.1	24.6	3.9	19.9	-2.6
32	New Plymouth	3.6	3.9	5.0	40.2	34.0	37.0	39.7	8.8	28.4	-8.0
33	Stratford	2.7	2.6	3.3	46.5	42.9	44.4	23.7	-2.8	27.3	-4.6
34	South Taranaki	2.3	2.6	3.0	48.7	44.8	44.8	34.5	14.1	17.8	-7.9
35	Ruapehu	2.4	2.6	3.1	40.1	37.9	39.2	27.9	8.9	17.4	-2.2
36	Wanganui	3.2	3.5	4.3	42.6	36.6	38.5	33.7	8.1	23.7	-9.6
37	Rangitikei	2.4	3.2	3.8	40.8	38.3	39.1	57.4	30.8	20.3	-4.0
38	Manawatu	3.4	4.0	5.1	42.6	34.9	38.5	48.7	18.5	25.5	-9.6
39	Palmerston North City	7.3	8.8	11.5	32.9	26.7	26.9	57.2	20.5	30.5	-18.2
40	Tararua	2.7	2.7	3.4	43.8	38.0	42.8	30.1	3.2	26.0	-2.2
41	Horowhenua	2.6	2.7	3.4	47.2	42.1	45.3	33.7	7.5	24.3	-3.9
42	Kapiti Coast	4.6	5.8	7.2	33.7	27.9	31.3	55.7	25.7	23.9	-7.1
43	Porirua City	4.5	5.7	7.0	37.5	33.3	33.2	57.3	27.3	23.5	-11.6
44	Upper Hutt City	5.0	5.6	6.4	32.9	27.6	31.1	28.2	12.2	14.3	-5.3
45	Lower Hutt City	6.3	7.3	9.2	34.2	28.8	31.2	46.6	17.0	25.3	-8.8
46	Wellington City	15.2	18.9	23.2	23.0	17.2	17.3	52.4	23.9	23.0	-24.8
47	Masterton	3.4	3.7	4.7	41.3	35.0	39.4	38.9	7.9	28.7	-4.6
48	Carterton	2.6	2.6	3.5	45.8	36.8	40.5	35.9	-0.8	37.0	-11.5
49	South Wairarapa	3.4	3.7	4.6	42.2	37.0	38.7	37.0	10.4	24.1	-8.4
50	Tasman	3.7	4.2	5.1	38.7	31.5	34.2	38.4	13.0	22.5	-11.6
51	Nelson City	4.7	5.4	6.9	35.4	30.2	31.7	47.2	14.3	28.8	-10.4
52	Marlborough	3.1	3.3	4.3	38.7	32.3	34.6	36.0	4.3	30.4	-10.6
53	Kaikoura	2.3	2.4	3.7	47.2	42.2	40.0	62.6	6.3	53.0	-15.3
54	Buller	2.3	2.4	2.7	45.2	40.0	44.2	16.1	0.6	15.3	-2.2
55	Grey	2.6	2.7	3.3	45.4	37.7	41.1	28.5	4.2	23.3	-9.5
56	Westland	2.8	3.1	3.9	41.0	37.0	38.9	41.7	10.9	27.8	-5.1
57	Hurunui	3.5	3.8	4.4	39.2	33.7	34.9	24.5	8.5	14.7	-11.0
58	Waimakariri	2.9	3.4	4.5	41.9	34.6	36.3	56.1	18.3	32.0	-13.3
59	Christchurch City	6.0	7.1	9.2	35.5	29.2	30.1	54.4	18.5	30.2	-15.2
60	Banks Peninsula	5.7	8.0	11.6	33.2	27.6	27.2	103.3	40.8	44.4	-18.2
61	Selwyn	5.1	5.6	7.4	34.1	28.8	28.1	46.0	9.6	33.2	-17.4
62	Ashburton	2.6	2.8	3.6	42.3	39.0	41.0	38.7	7.5	29.0	-3.3
63	Timaru	3.0	3.2	4.1	43.3	37.3	39.6	35.4	7.8	25.6	-8.7
64	Mackenzie	2.9	3.4	5.4	35.2	32.1	30.2	87.7	17.1	60.4	-14.2
65	Waimate	2.4	2.4	2.9	45.1	41.3	43.6	24.1	0.2	23.9	-3.3
66	Waitaki	2.8	2.9	3.7	43.6	38.6	41.4	29.8	2.9	26.1	-5.1
67	Central Otago	3.8	4.0	5.0	38.2	30.3	36.7	30.2	5.5	23.4	-4.1
68	Queenstown-Lakes	5.0	6.1	8.2	25.7	20.1	21.0	62.1	21.5	33.4	-18.3
69	Dunedin City	7.1	8.8	11.0	35.8	27.6	28.8	56.1	24.9	24.9	-19.4
70	Clutha	2.6	2.7	3.1	45.6	41.1	43.3	19.7	3.1	16.1	-5.0
71	Southland	2.6	2.6	3.2	45.2	41.8	42.1	23.7	-0.9	24.8	-6.9
72	Gore	2.7	2.6	3.4	47.6	42.2	45.0	29.4	-2.4	32.6	-5.4
73	Invercargill City	3.1	3.6	4.7	42.7	39.6	41.1	54.0	17.1	31.5	-3.8
Mean		3.7	4.2	5.3	40.2	34.9	36.8	41.4	11.2	26.8	-8.7
StDev		1.9	2.5	3.3	5.1	5.7	6.2	20.5	10.3	10.8	6.3
Map No.		N/A	N/A	7	N/A	N/A	10.0	N/A	8	9	11

TABLE 3

TLA No.	TLA Name	Percentage of Population Aged 15 to 64						Growth in the Share of Population	
		Unemployment Benefit			Domestic Purposes Benefit			Unemployment Benefit	Domestic Purposes Benefit
		1986	1991	1996	1986	1991	1996	1986 - 1996	1986 - 1996
1	Far North	7.2	17.4	16.6	3.1	6.0	7.1	129.5	128.7
2	Whangarei	4.8	13.9	12.1	2.6	5.3	6.0	149.8	132.0
3	Kaipara	3.5	12.1	11.4	2.7	4.4	4.9	225.0	81.3
4	Rodney	1.5	6.5	5.2	1.7	2.9	3.5	244.8	110.3
5	North Shore City	1.6	5.3	4.4	1.7	2.2	2.5	172.6	52.3
6	Waitakere City	2.3	8.6	7.1	2.6	3.9	4.4	209.0	71.8
7	Auckland City	3.4	9.5	9.1	2.6	3.4	3.2	166.3	22.8
8	Manukau City	2.8	10.0	8.9	2.9	4.6	5.0	224.2	71.6
9	Papakura	3.1	9.2	7.6	2.8	5.5	5.9	143.9	114.2
10	Franklin	2.1	6.7	5.7	1.7	3.3	4.4	178.6	157.1
11	Thames-Coromandel	3.3	11.5	10.3	2.4	4.1	4.9	209.0	106.7
12	Hauraki	4.9	13.0	10.9	3.2	5.1	6.3	122.7	98.2
13	Waikato	4.6	12.5	10.5	2.9	5.7	5.8	127.7	100.8
14	Matamata-Piako	3.1	8.2	6.2	2.5	3.4	3.9	102.7	55.8
15	Hamilton City	4.0	11.2	11.4	3.4	4.4	4.7	185.1	35.9
16	Waipa	2.6	8.1	6.8	2.3	3.8	3.7	164.3	62.0
17	Otorohanga	5.3	11.4	9.3	2.0	3.9	4.0	75.5	100.0
18	South Waikato	5.6	14.3	11.5	4.0	6.8	6.8	105.1	69.7
19	Waitomo	4.5	15.7	11.2	3.9	5.9	5.8	146.7	47.5
20	Taupo	5.1	12.7	10.8	2.9	5.3	5.8	113.1	101.6
21	Western Bay Of Plenty	2.8	11.4	9.9	2.0	3.5	4.5	250.5	120.8
22	Tauranga	3.4	10.6	10.2	2.9	4.8	5.6	200.0	95.2
23	Rotorua	4.4	13.7	10.0	3.9	6.8	6.8	126.7	73.0
24	Whakatane	6.2	17.4	14.6	3.3	6.0	6.6	134.7	98.2
25	Kawerau	6.0	18.3	16.3	4.0	8.2	9.4	173.7	136.5
26	Opotiki	8.0	24.5	24.1	3.7	7.6	9.3	199.3	154.4
27	Gisborne	7.2	16.9	15.9	4.2	7.3	7.0	120.6	67.2
28	Wairoa	10.6	22.5	16.8	4.7	6.7	6.8	58.8	45.2
29	Hastings	6.2	13.8	12.0	4.3	6.5	6.5	95.5	51.3
30	Napier City	5.6	13.0	10.8	4.0	6.2	6.3	92.4	57.4
31	Central Hawke's Bay	4.3	13.5	11.8	2.4	4.6	4.6	173.5	92.3
32	New Plymouth	4.7	12.4	11.0	3.2	5.2	5.0	132.3	58.1
33	Stratford	4.3	12.5	8.8	2.8	5.6	5.2	103.6	83.6
34	South Taranaki	5.9	12.4	9.0	3.1	5.6	4.7	52.2	50.8
35	Ruapehu	6.3	15.4	12.6	3.3	6.1	5.8	100.0	77.4
36	Wanganui	6.1	14.2	11.9	4.5	7.0	6.8	93.3	51.2
37	Rangitikei	4.4	11.1	9.4	2.8	4.8	4.5	112.8	63.4
38	Manawatu	3.9	9.7	8.3	2.2	3.4	4.4	114.8	97.0
39	Palmerston North City	4.6	11.1	10.8	2.9	3.9	4.1	137.1	42.3
40	Tararua	3.4	10.6	7.8	2.6	4.4	5.1	130.3	92.2
41	Horowhenua	5.2	11.9	10.2	3.7	5.6	6.4	95.5	71.3
42	Kapiti Coast	2.0	7.3	8.0	1.9	3.7	5.1	294.0	165.5
43	Porirua City	4.9	12.2	11.8	4.6	6.1	6.1	141.0	34.6
44	Upper Hutt City	2.4	8.1	8.6	2.4	3.4	3.9	257.7	62.9
45	Lower Hutt City	2.7	8.7	8.9	2.7	4.0	4.5	228.7	63.0
46	Wellington City	3.1	8.0	9.5	1.5	1.8	2.1	201.8	41.7
47	Masterton	6.0	14.0	10.3	3.6	5.3	5.4	70.1	50.3
48	Carterton	3.8	12.4	9.1	3.2	4.4	3.6	141.5	13.3
49	South Wairarapa	5.0	12.0	10.3	2.9	4.2	4.7	105.4	64.2
50	Tasman	4.6	11.1	10.2	1.9	2.8	3.9	118.8	105.2
51	Nelson City	3.7	11.3	9.2	2.5	3.9	5.0	152.7	96.8
52	Marlborough	4.0	10.6	8.6	2.4	3.5	3.5	114.8	43.9
53	Kaikoura	5.3	13.4	11.1	2.2	4.0	4.0	107.7	81.3
54	Buller	7.3	18.4	15.7	3.7	4.6	5.1	114.4	37.0
55	Grey	6.2	13.4	10.4	3.3	4.4	4.8	67.8	45.4
56	Westland	4.7	10.5	8.6	1.8	3.8	3.3	84.5	81.8
57	Hurunui	3.1	8.2	6.5	1.4	2.6	3.7	106.3	164.3
58	Waimakariri	3.1	8.8	5.8	1.7	2.5	3.1	84.7	82.0
59	Christchurch City	4.7	10.8	9.1	3.1	4.0	3.9	92.7	28.4
60	Banks Peninsula	3.7	10.2	7.1	1.9	3.3	3.4	88.9	78.1
61	Selwyn	2.1	5.4	4.8	0.9	1.4	1.4	128.9	54.7
62	Ashburton	3.4	8.8	6.6	1.9	2.8	2.9	91.2	51.5
63	Timaru	6.5	13.9	9.7	2.6	4.2	3.7	48.9	45.0
64	Mackenzie	5.9	11.4	10.5	1.8	3.1	2.2	76.4	17.6
65	Waimate	6.7	14.2	9.8	2.5	4.0	3.9	45.6	57.9
67	Waitaki	6.2	13.7	10.8	2.3	3.7	3.2	73.8	37.3
68	Central Otago	2.3	12.0	7.5	1.5	2.6	3.3	217.6	126.1
69	Queenstown-Lakes	1.5	7.8	5.8	0.5	1.6	1.9	279.2	261.1
70	Dunedin City	5.8	14.2	12.4	2.7	3.6	3.5	115.7	29.6
71	Clutha	5.7	14.0	9.6	1.9	3.0	2.9	68.2	56.9
72	Southland	3.5	10.4	7.0	1.2	2.5	2.5	103.1	104.9
73	Gore	6.9	14.6	9.4	2.9	4.1	3.5	34.9	22.8
74	Invercargill City	7.7	16.5	11.2	3.9	5.5	5.4	45.8	36.3
Mean		4.6	12.1	10.0	2.7	4.4	4.7	134.2	77.3
StDev		1.8	3.5	3.1	0.9	1.5	1.6	59.2	41.8
Map No.		N/A	N/A	12	N/A	N/A	14	13	15

TABLE 4

TLA No.	TLAName	Percentage of Labour Force						Growth in the Share of the Labour Force	
		Gainfully Employed			Unemployed (Seeking)			Gainfully Employed 1986 - 1996	Unemployed (Seeking) 1986 - 1996
		1986	1991	1996	1986	1991	1996		
1	Far North	90.5	86.1	87.2	9.5	13.9	12.8	-4.7	33.7
2	Whangarei	93.4	87.6	89.7	6.6	12.4	10.3	-11.2	43.4
3	Kaipara	94.8	90.0	92.5	5.2	10.0	7.5	-6.1	37.8
4	Rodney	94.9	92.0	95.3	5.1	8.0	4.7	45.9	32.4
5	North Shore City	95.3	92.9	95.0	4.7	7.1	5.0	12.3	20.1
6	Waitakere City	94.4	90.3	92.8	5.6	9.7	7.2	11.0	45.2
7	Auckland City	93.7	90.1	91.7	6.3	9.9	8.3	5.5	40.9
8	Manukau City	93.2	89.0	90.4	6.8	11.0	9.6	2.9	51.2
9	Papakura	94.0	89.3	91.8	6.0	10.7	8.2	5.0	47.6
10	Franklin	95.0	93.0	94.7	5.0	7.0	5.3	25.1	32.0
11	Thames-Coromandel	93.1	89.0	92.1	6.9	11.0	7.9	21.1	40.7
12	Hauraki	93.1	88.4	90.9	6.9	11.6	9.1	-5.1	28.6
13	Waikato	93.0	90.2	91.2	7.0	9.8	8.8	-4.7	22.5
14	Matamata-Piako	94.9	93.2	95.1	5.1	6.8	4.9	-2.9	-7.3
15	Hamilton City	92.6	89.5	90.5	7.4	10.5	9.5	4.0	36.7
16	Waipa	94.7	92.2	94.6	5.3	7.8	5.4	9.4	12.7
17	Otorohanga	93.8	92.3	94.0	6.2	7.7	6.0	-0.9	-5.0
18	South Waikato	91.9	88.9	87.7	8.1	11.1	12.3	-29.5	12.5
19	Waitomo	93.3	90.3	92.6	6.7	9.7	7.4	-12.7	-3.4
20	Taupo	92.1	89.2	91.5	7.9	10.8	8.5	3.9	12.8
21	Western Bay Of Plenty	94.0	90.1	92.4	6.0	9.9	7.6	21.1	54.6
22	Tauranga	92.9	88.8	90.5	7.1	11.2	9.5	17.4	60.0
23	Rotorua	93.3	88.6	90.4	6.7	11.4	9.6	-5.9	40.5
24	Whakatane	90.8	87.6	87.7	9.2	12.4	12.3	-9.5	25.8
25	Kawerau	90.2	85.5	82.4	9.8	14.5	17.6	-32.9	31.2
26	Opotiki	89.3	83.6	83.8	10.7	16.4	16.2	-13.2	40.3
27	Gisborne	92.3	88.2	88.5	7.7	11.8	11.5	-17.3	30.2
28	Wairoa	91.0	87.9	87.7	9.0	12.1	12.3	-21.8	11.2
29	Hastings	93.1	90.6	92.5	6.9	9.4	7.5	-4.3	5.1
30	Napier City	92.6	89.2	91.6	7.4	10.8	8.4	-6.0	8.4
31	Central Hawke's Bay	94.8	92.4	94.4	5.2	7.6	5.6	0.3	9.6
32	New Plymouth	93.4	90.1	91.5	6.6	9.9	8.5	-9.3	20.0
33	Stratford	94.7	90.5	93.9	5.3	9.5	6.1	-11.5	2.2
34	South Taranaki	93.2	90.8	93.5	6.8	9.2	6.5	-10.7	-15.0
35	Ruapehu	94.3	90.6	91.8	5.7	9.4	8.2	-22.9	14.3
36	Wanganui	92.6	88.2	89.4	7.4	11.8	10.6	-12.6	28.2
37	Rangitikei	94.8	91.8	92.4	5.2	8.2	7.6	-12.4	30.5
38	Manawatu	94.2	91.7	93.9	5.8	8.3	6.1	4.7	9.2
39	Palmerston North City	91.5	89.7	90.8	8.5	10.3	9.2	-0.4	9.2
40	Tararua	95.3	92.9	94.3	4.7	7.1	5.7	-7.5	13.4
41	Horowhenua	92.6	89.4	91.1	7.4	10.6	8.9	-9.4	10.8
42	Kapiti Coast	94.5	91.3	92.5	5.5	8.7	7.5	22.5	70.7
43	Porirua City	92.2	89.7	89.0	7.8	10.3	11.0	-15.1	23.9
44	Upper Hutt City	94.7	92.2	92.2	5.3	7.8	7.8	-10.2	33.7
45	Lower Hutt City	95.1	91.6	92.0	4.9	8.4	8.0	-9.1	51.8
46	Wellington City	95.3	92.7	93.7	4.7	7.3	6.3	0.2	37.3
47	Masterton	93.5	89.0	91.9	6.5	11.0	8.1	-6.0	19.2
48	Carterton	95.4	91.5	93.6	4.6	8.5	6.4	-2.2	38.8
49	South Wairarapa	94.5	91.3	92.2	5.5	8.7	7.8	-8.7	31.6
50	Tasman	95.3	93.8	95.8	4.7	6.2	4.2	17.1	3.0
51	Nelson City	94.4	90.8	93.9	5.6	9.2	6.1	9.6	19.7
52	Marlborough	93.3	91.8	94.4	6.7	8.2	5.6	15.3	-4.8
53	Kaikoura	93.4	91.5	93.9	6.6	8.5	6.1	6.1	-2.8
54	Buller	92.7	88.6	90.4	7.3	11.4	9.6	-12.9	17.6
55	Grey	93.6	89.5	92.5	6.4	10.5	7.5	-11.6	5.2
56	Westland	94.8	93.4	94.6	5.2	6.6	5.4	-2.6	1.3
57	Hurunui	95.7	94.5	95.4	4.3	5.5	4.6	10.4	17.2
58	Waimakariri	94.4	92.5	95.4	5.6	7.5	4.6	33.0	8.4
59	Christchurch City	92.9	90.4	92.4	7.1	9.6	7.6	3.2	10.4
60	Banks Peninsula	94.4	91.2	94.2	5.6	8.8	5.8	9.8	15.2
61	Selwyn	94.8	95.1	96.3	5.2	4.9	3.7	23.2	-14.3
62	Ashburton	94.7	93.8	96.3	5.3	6.2	3.7	4.0	-28.6
63	Timaru	93.5	90.4	93.2	6.5	9.6	6.8	-6.4	-2.6
64	Mackenzie	94.7	92.7	95.4	5.3	7.3	4.6	0.1	-15.0
65	Waimate	94.2	92.2	95.8	5.8	7.8	4.2	-3.4	-30.1
66	Waitaki	93.9	91.4	94.1	6.1	8.6	5.9	-5.5	-7.8
67	Central Otago	95.5	93.6	95.7	4.5	6.4	4.3	-9.4	-14.4
68	Queenstown-Lakes	97.0	94.2	97.5	3.0	5.8	2.5	81.3	49.0
69	Dunedin City	91.8	89.3	90.5	8.2	10.7	9.5	-5.8	9.9
70	Clutha	95.2	92.7	95.8	4.8	7.3	4.2	-7.5	-20.6
71	Southland	96.4	94.8	96.9	3.6	5.2	3.1	-2.9	-17.4
72	Gore	95.0	92.4	96.3	5.0	7.6	3.7	-4.7	-31.1
73	Invercargill City	94.0	90.3	92.5	6.0	9.7	7.5	-13.4	8.8
Mean		93.7	90.7	92.5	6.3	9.3	7.5	0.0	17.2
StDev		1.4	2.2	2.8	1.4	2.2	2.8	16.7	22.5
Map No.		N/A	N/A	N/A	N/A	N/A	16	18	17

TABLE 6 DECOMPOSITIONS OF VARIATION

Variation Within and Between Geographical Areas (as at 1996):

VARIABLE:	MESHBL OCK MEAN:	Standard Deviations at:			
		Meshblock Level	Area Unit Level	Territorial Local Authority Level	Regional Council Level
Per Capita Income	\$ 16,549	\$ 5,623	\$ 4,384	\$ 2,480	\$ 1,727
		100%	78%	44%	31%
Total Income per Square Kilometre	\$ 145,769	\$ 2,433,691	\$ 1,983,014	\$ 969,005	\$ 233,456
		100%	81%	40%	10%
People per Square Kilometre	9	139	112	53	13
		100%	81%	38%	9%
% of Working Age Population With No School Qualifications	34	14	11	7	4
		100%	78%	49%	31%
% of Working Age Population With a Degree	9	9	7	5	3
		100%	83%	60%	35%
% of Population Who are Over 65	12	10	6	3	1
		100%	57%	26%	13%
% of Population Who are Under 18	23	9	5	3	2
		100%	59%	33%	20%
% of Employment in Primary Industry	10	18	17	12	8
		100%	90%	65%	41%
% of Employment in Manufacturing Industry	15	10	7	4	2
		100%	70%	44%	25%
% of Employment in Service Industry	69	18	15	12	7
		100%	84%	65%	41%
% of Working Age Population who are Dependent on Benefits	18	14	9	4	3
		100%	67%	32%	23%
% of Labour Force who are Unemployed and Actively Seeking Work	8	7	4	2	1
		100%	61%	29%	17%

APPENDIX 4: FIGURES

Key to Graphs at the Regional Council Level:

Region	
Abbreviation	Full Name
NTHL	Northland
AUCK	Auckland
WAIK	Waikato
BOP	Bay of Plenty
GISB	Gisborne
HAWK	Hawkw's Bay
TARA	Taranaki
MANA	Manawatu-Wanganui
WELL	Wellington
WEST	West Coast
CANT	Canterbury
OTAG	Otago
STHL	Southland
TASM	Tasman
NELS	Nelson
MARL	Marlborough
NOT	Not Applicable

Figure 1 Population Dynamics (at Regional Level)

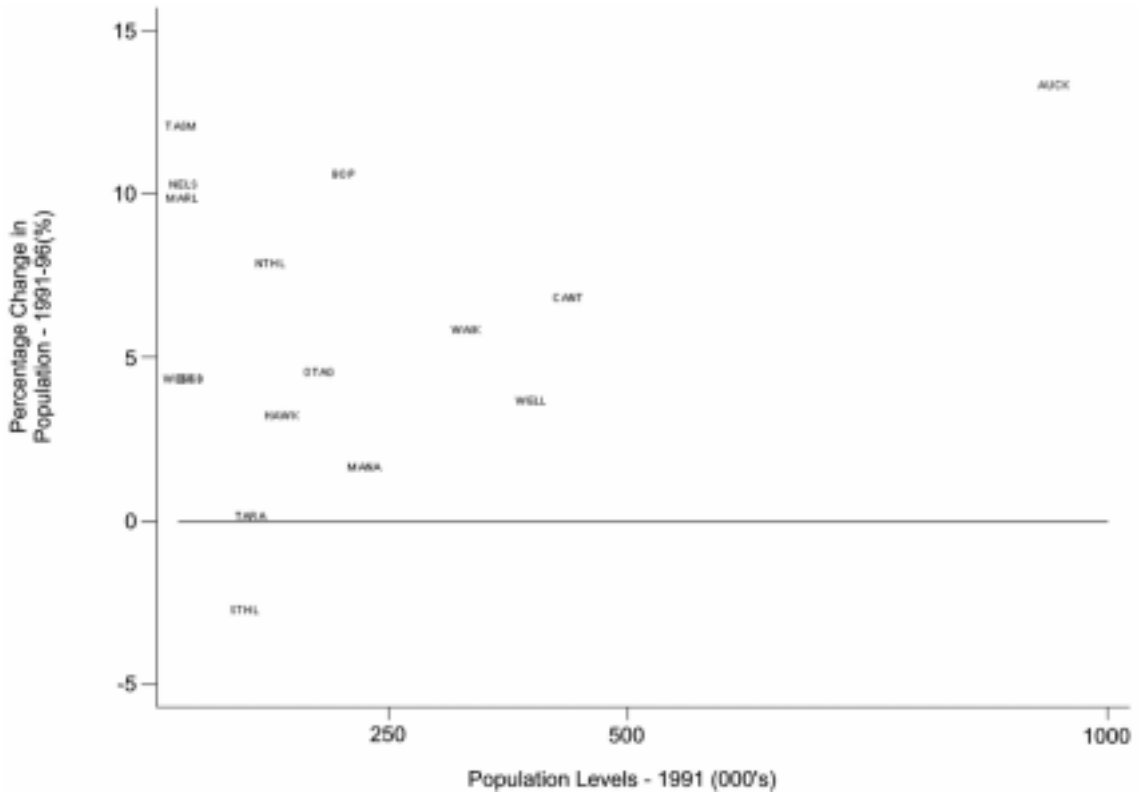


Figure 2 Population Dynamics (at Territorial Level)

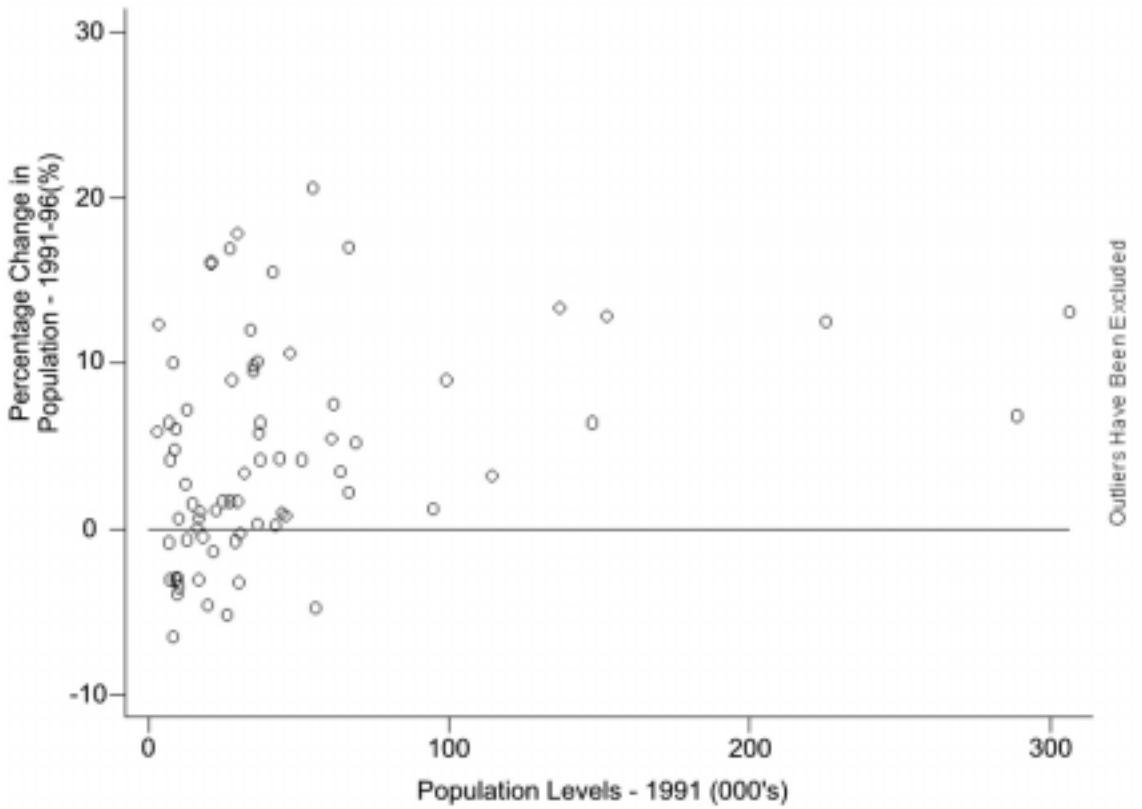


Figure 3 Unemployment Dynamics (at Regional Level)

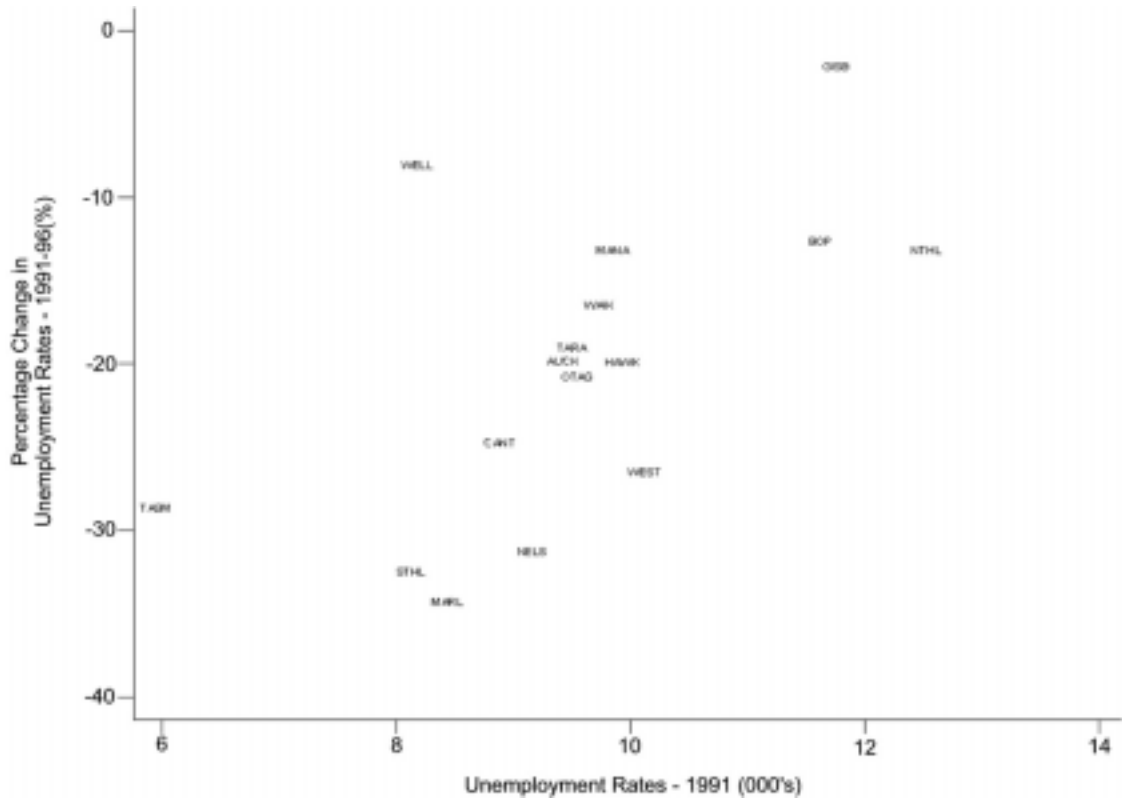
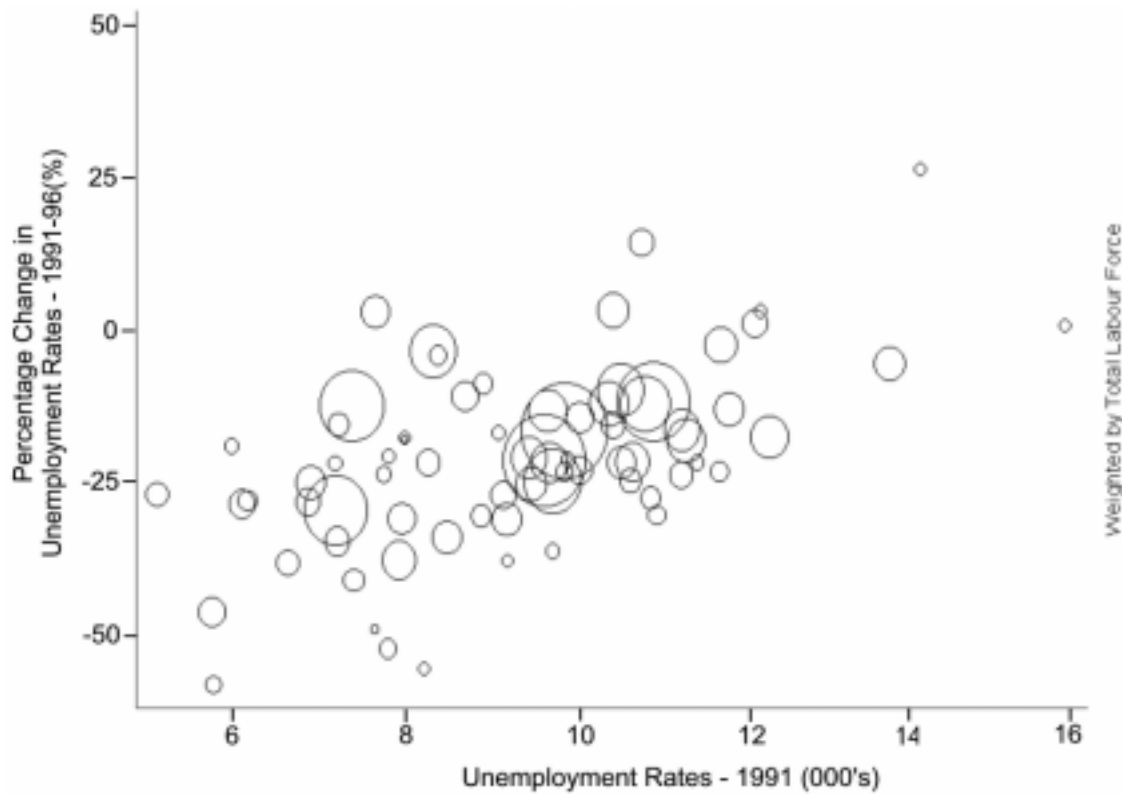


Figure 4 Unemployment Dynamics (at Territorial Level)

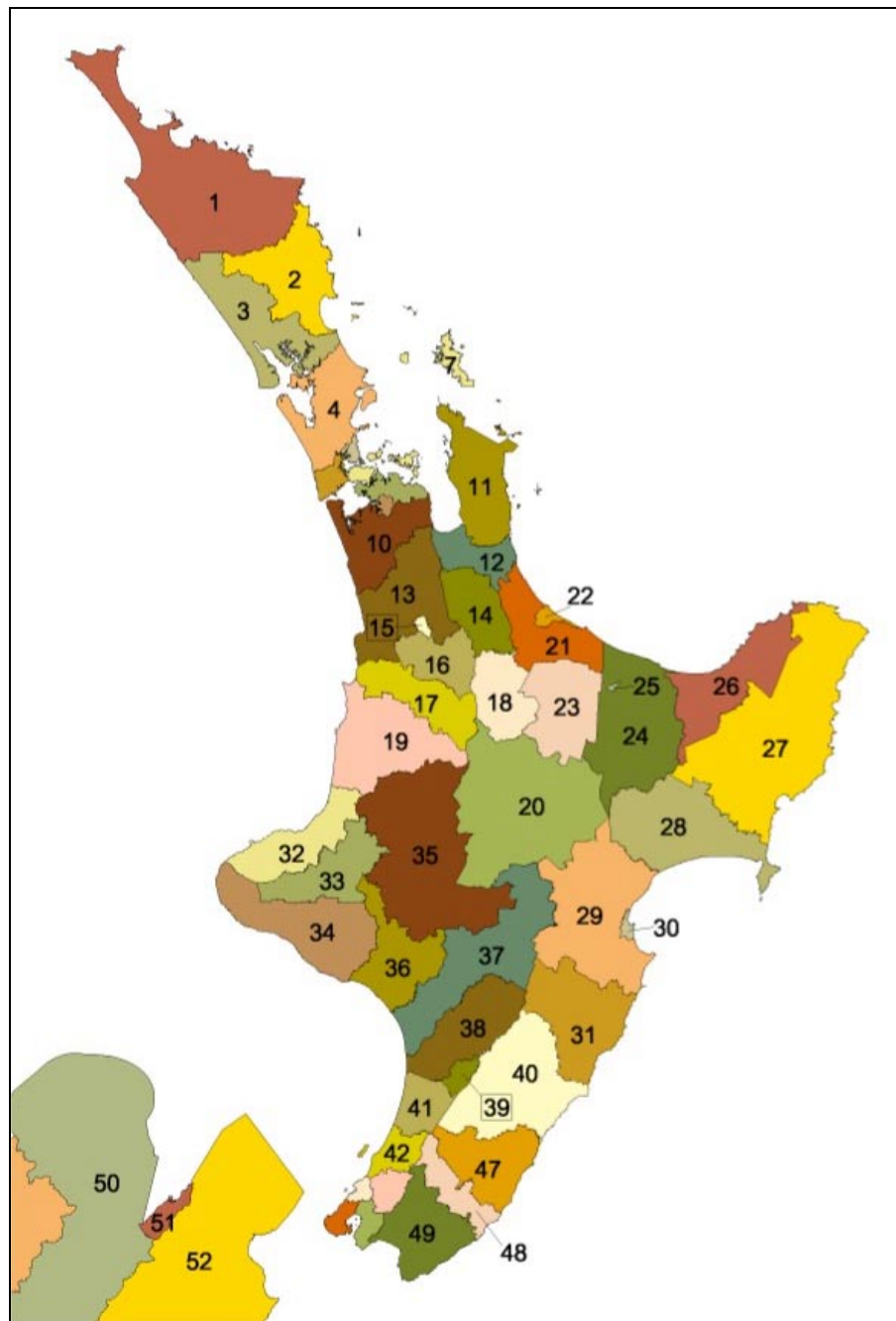


APPENDIX 2: MAPS

Map No.	Map Title	Table No.
<i>Population</i>		
1	Percentage of the Population Aged Less Than 15 (1996)	1
2	Growth in the Share of Population Aged Less Than 15 (1986 to 1996)	1
3	Percentage of the Population Aged 15 to 64 (1996)	1
4	Growth in the Share of Population Aged 15 to 64 (1986 to 1996)	1
5	Percentage of the Population Aged Over 64 (1996)	1
6	Growth in the Share of Population Aged Over 64 (1986 to 1996)	1
<i>Education</i>		
7	Percentage of the Population Aged 15 and Over with a Degree Qualification (1996)	2
8	Growth in the Share of Population Aged 15 and Over with a Degree Qualification (1986 to 1991)	2
9	Growth in the Share of Population Aged 15 and Over with a Degree Qualification (1991 to 1996)	2
10	Percentage of the population Aged 15 and Over with No Qualifications (1996)	2
11	Growth in the Share of Population Aged 15 and Over with No Qualifications (1986 to 1996)	2
<i>Government Benefit</i>		
12	Percentage of the Population Aged 15 to 64 who Receive Unemployment Benefit (1996)	3
13	Growth in the Share of Population Aged 15 to 64 who Receive Unemployment Benefit (1986 to 1996)	3
14	Percentage of the Population Aged 15 to 64 who Receive Domestic Purpose Benefit (1996)	3
15	Growth in the Share of Population Aged 15 to 64 who Receive Domestic Purpose Benefit (1986 to 1996)	3
<i>Labour Force</i>		
16	Percentage of the Labour Force who are Unemployed and Actively Seeking Work (1996)	4
17	Growth in the Labour Force of the Uemployed (1986 to 1996)	4
18	Growth in the Labour Force of Full and Part Time Workers (1986 to 1996)	4
<i>Occupation</i>		
19	Growth in the Share of Population Aged 15 and Over within Primary Industry (1986 to 1996)	5
20	Percentage of the Population Aged 15 and Over who Work within a Primary Industry (1996)	5
21	Percentage of the Population Aged 15 and Over who Work within Manufacturing (1996)	5
22	Growth in the Share of Population Aged 15 and Over within Manufacturing (1986 to 1996)	5
23	Percentage of the Population Aged 15 or Over who Work in the Service Industry (1996)	5
24	Growth in the Share of Population Aged 15 and Over within the Service Industry (1986 to 1996)	5
<i>Population Density</i>		
26	Population Density 1996 (per square km)	N/A
27	Growth in Population Density (1986 - 1996)	N/A
<i>Personal Income</i>		
28	Per Capita Personal Income for Population Aged 15 and Over (1996)	N/A
29	Growth in the Per Capita Personal Income for Population Aged 15 and Over (1986 to 1996)	N/A
<i>Auckland Region</i>		
30	Population Density at MB Level 1996	N/A
31	Population Density at AU Level 1996	N/A
32	Population Density at 1km Radius 1996	N/A
33	Population Density at 5km Radius 1996	N/A
34	Population Density at 10km Radius 1996	N/A
<i>Northland Region</i>		
35	Population Density at AU Level 1996	N/A
36	Population Density at 1km Radius 1996	N/A
37	Population Density at 5km Radius 1996	N/A
38	Population Density at 10km Radius 1996	N/A

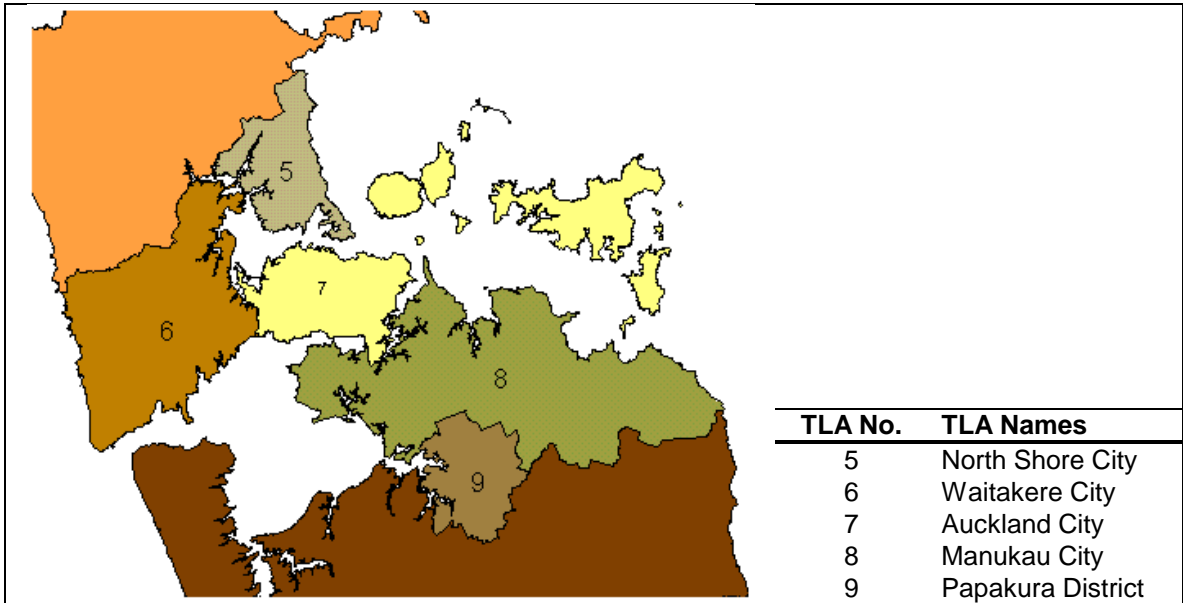
5.2 A Key to New Zealand Territorial Local Authorities (TLAs)

North Island

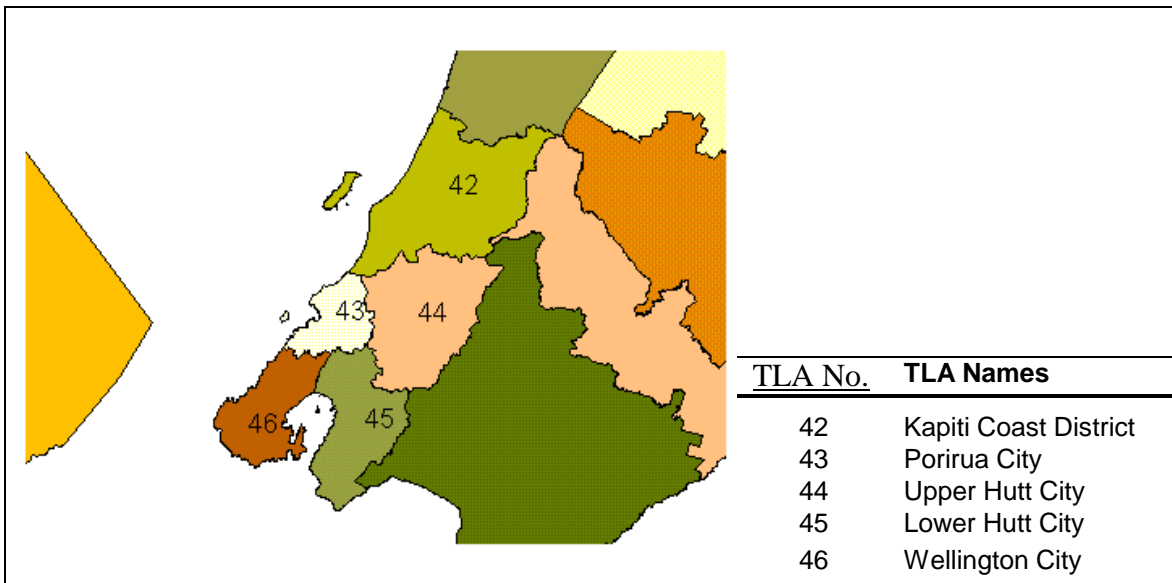


TLA No.	TLA Name
1	Far North District
2	Whangarei District
3	Kaipara District
4	Rodney District
10	Franklin District
11	Thames-Coromandel District
12	Hauraki District
13	Waikato District
14	Matamata-Piako District
15	Hamilton City
16	Waipa District
17	Otorohanga District
18	South Waikato District
19	Waitomo District
20	Taupo District
21	Western Bay Of Plenty District
22	Tauranga District
23	Rotorua District
24	Whakatane District
25	Kawerau District
26	Opotiki District
27	Gisborne District
28	Wairoa District
29	Hastings District
30	Napier City
31	Central Hawke's Bay District
32	New Plymouth District
33	Stratford District
34	South Taranaki District
35	Ruapehu District
36	Wanganui District
37	Rangitikei District
38	Manawatu District
39	Palmerston North City
40	Tararua District
41	Horowhenua District
42	Kapiti Coast District
47	Masterton District
48	Carterton District
49	South Wairarapa District

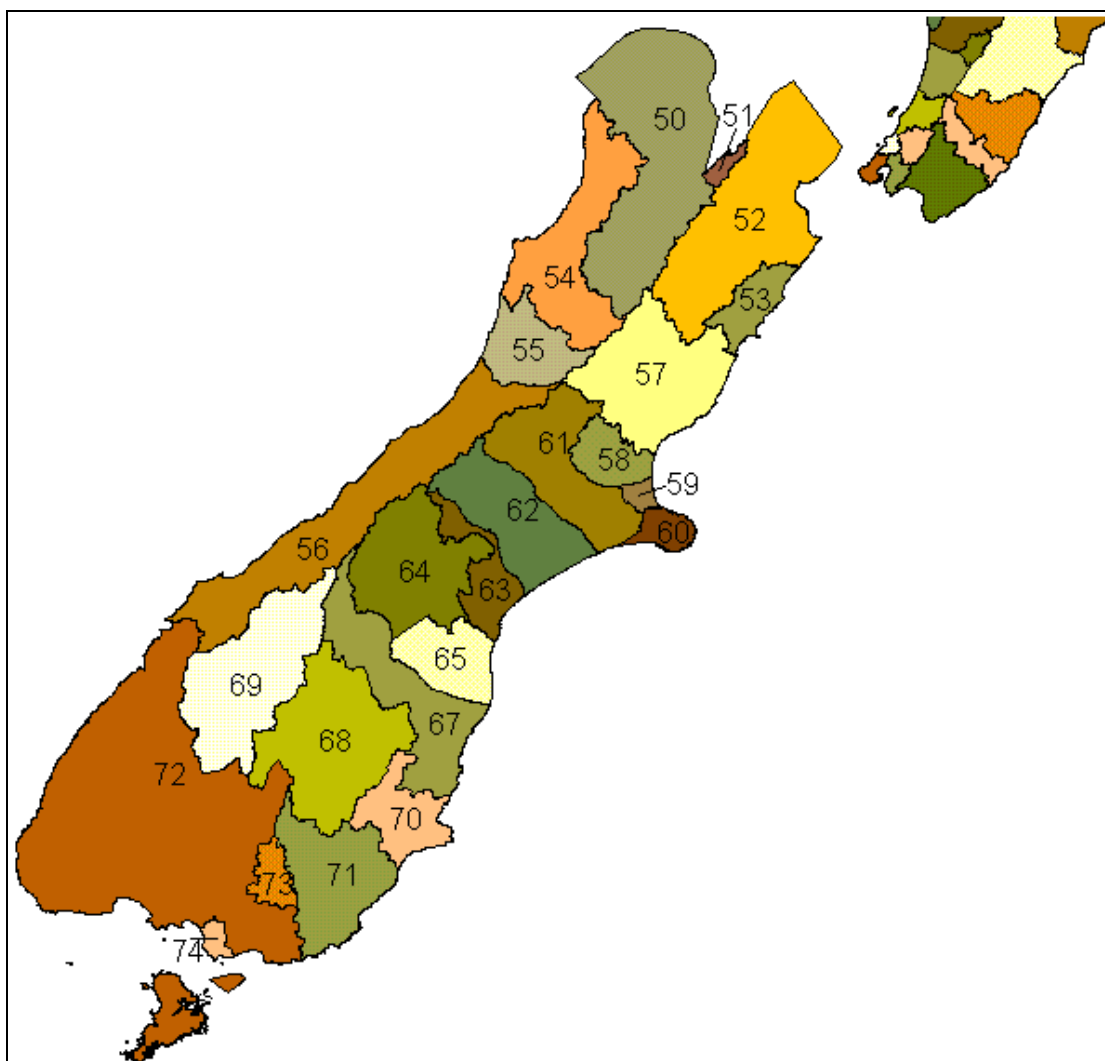
Auckland Region



Wellington Region



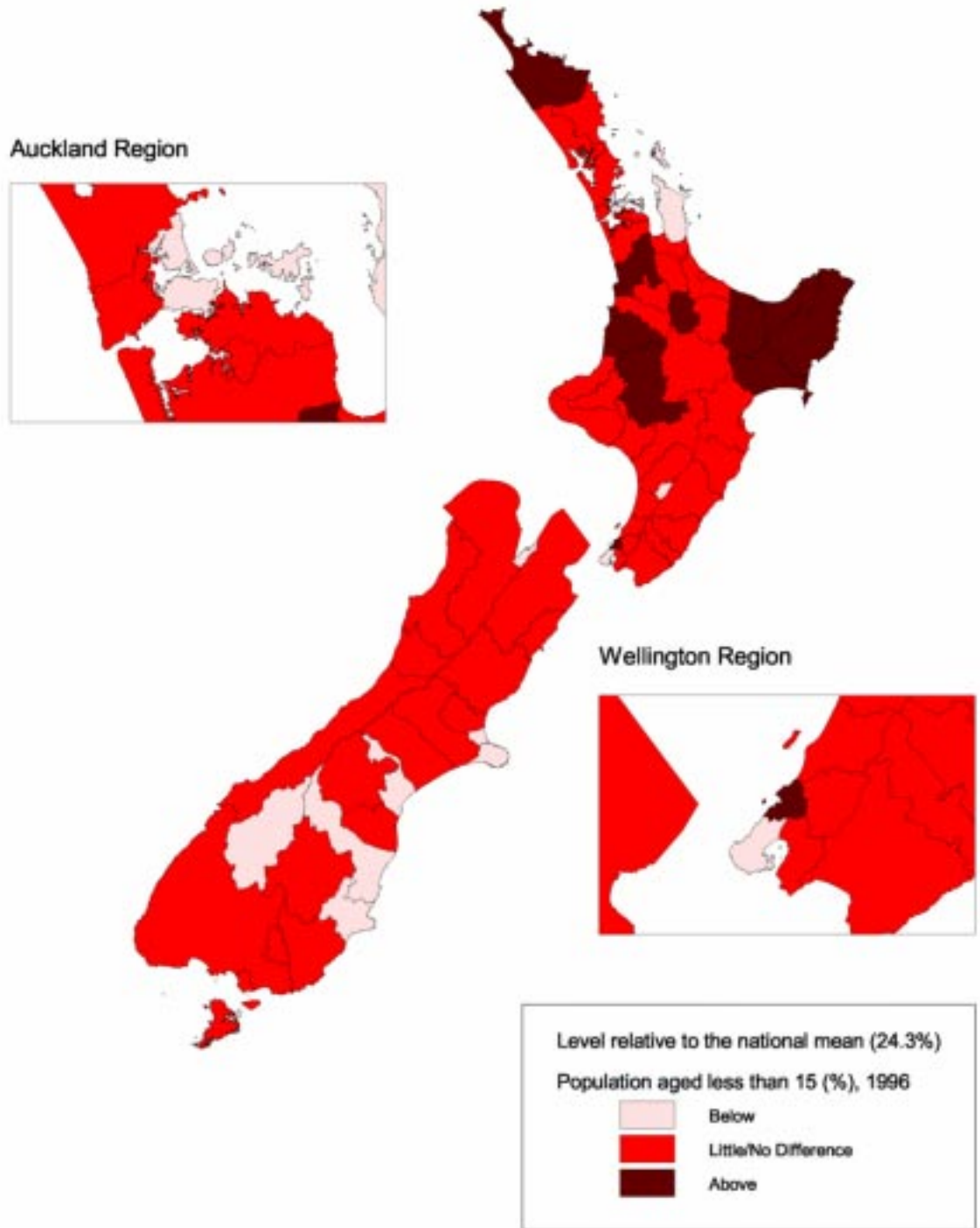
South Island



TLA No.	TLA Names
50	Tasman District
51	Nelson City
52	Marlborough District
53	Kaikoura District
54	Buller District
55	Grey District
56	Westland District
57	Hurunui District
58	Waimakariri District
59	Christchurch City
60	Banks Peninsula District
61	Selwyn District
62	Ashburton District
63	Timaru District
64	Mackenzie District
65	Waimate District
66	Chatham Islands District
67	Waitaki District
68	Central Otago District
69	Queenstown-Lakes District
70	Dunedin City
71	Clutha District
72	Southland District
73	Gore District
74	Invercargill City

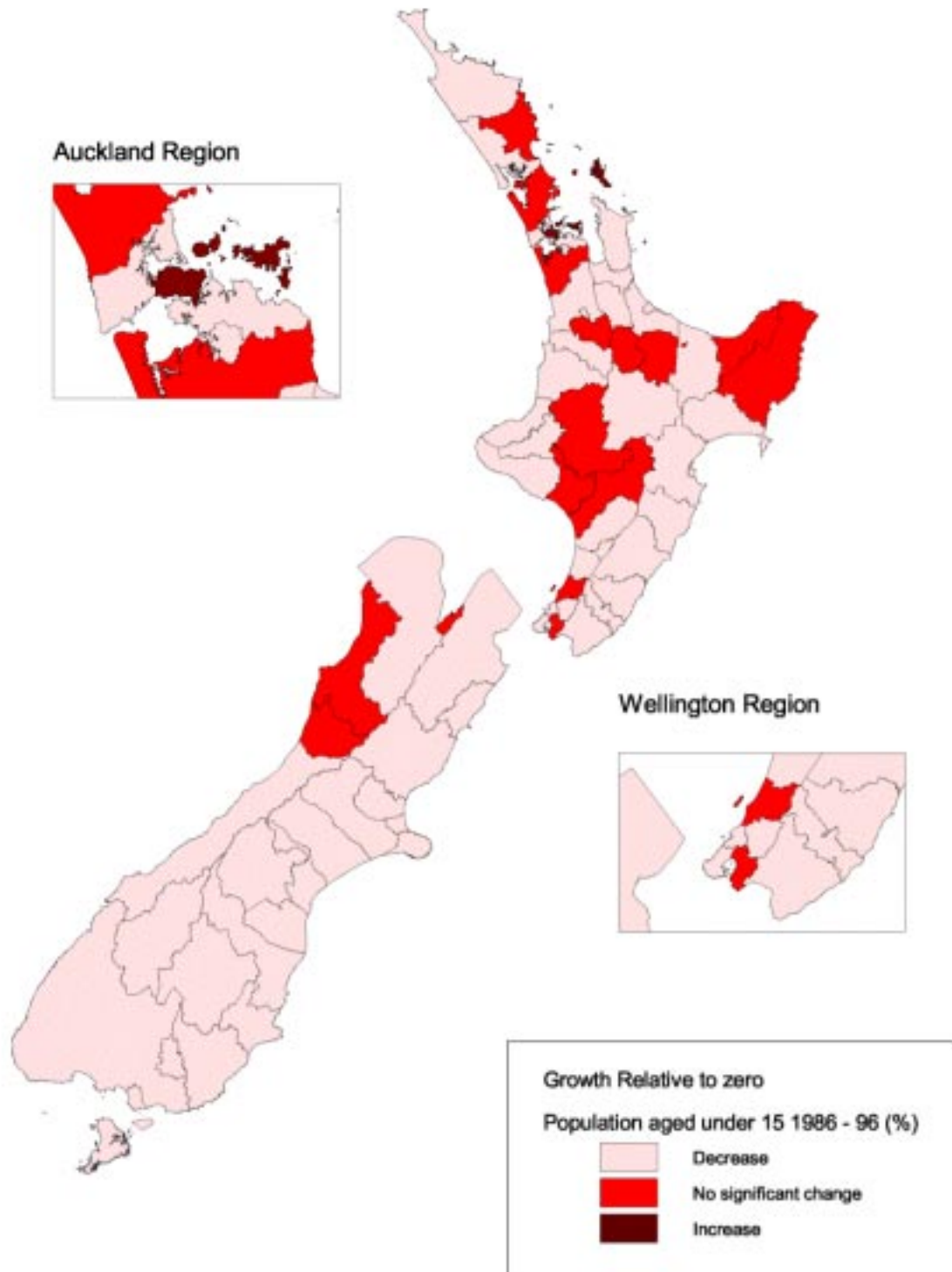
Map 1

Percentage of the Population Aged Less Than 15 (1996)

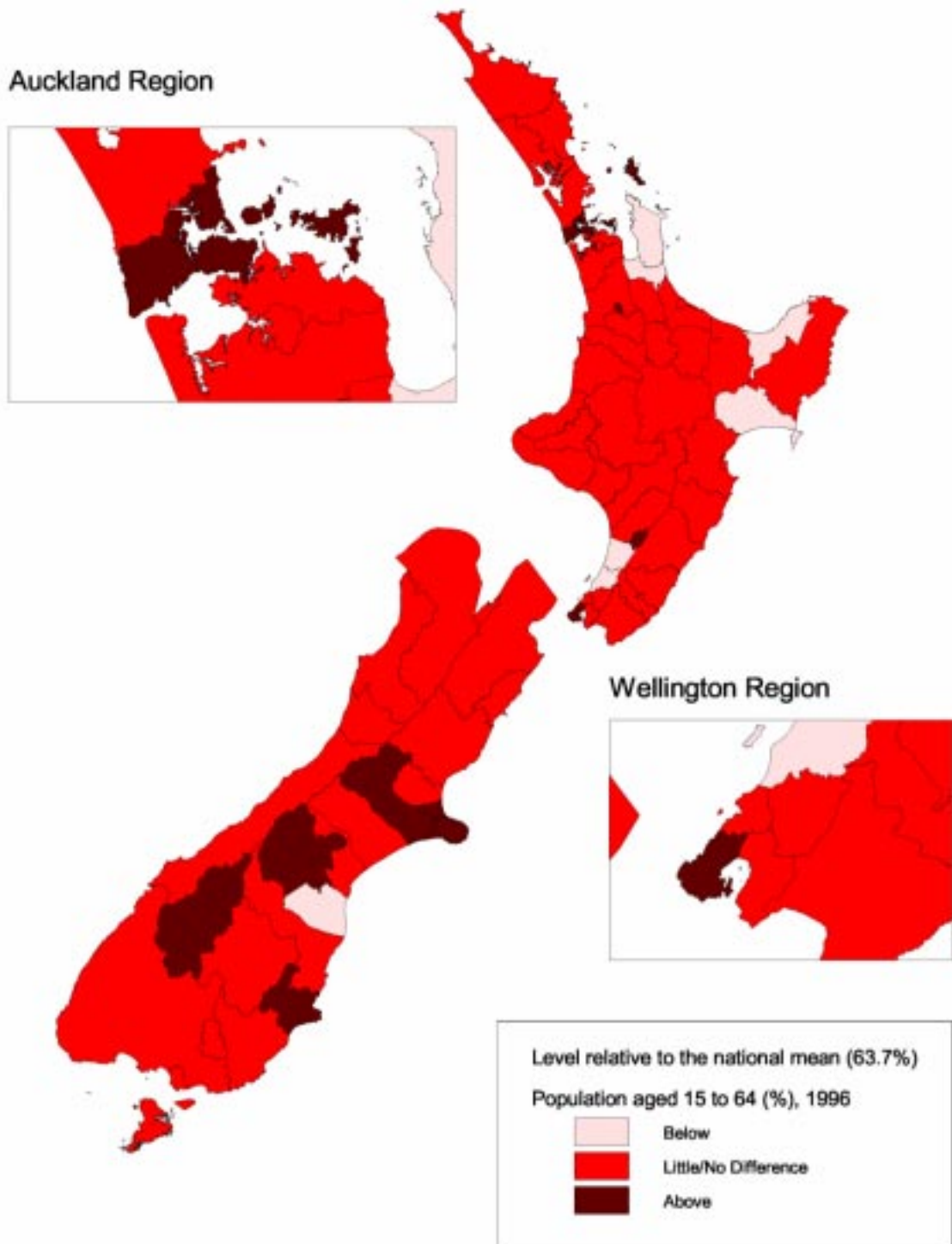


Map 2

Growth in the Share of Population Aged Less Than 15 (1986 to 1996)

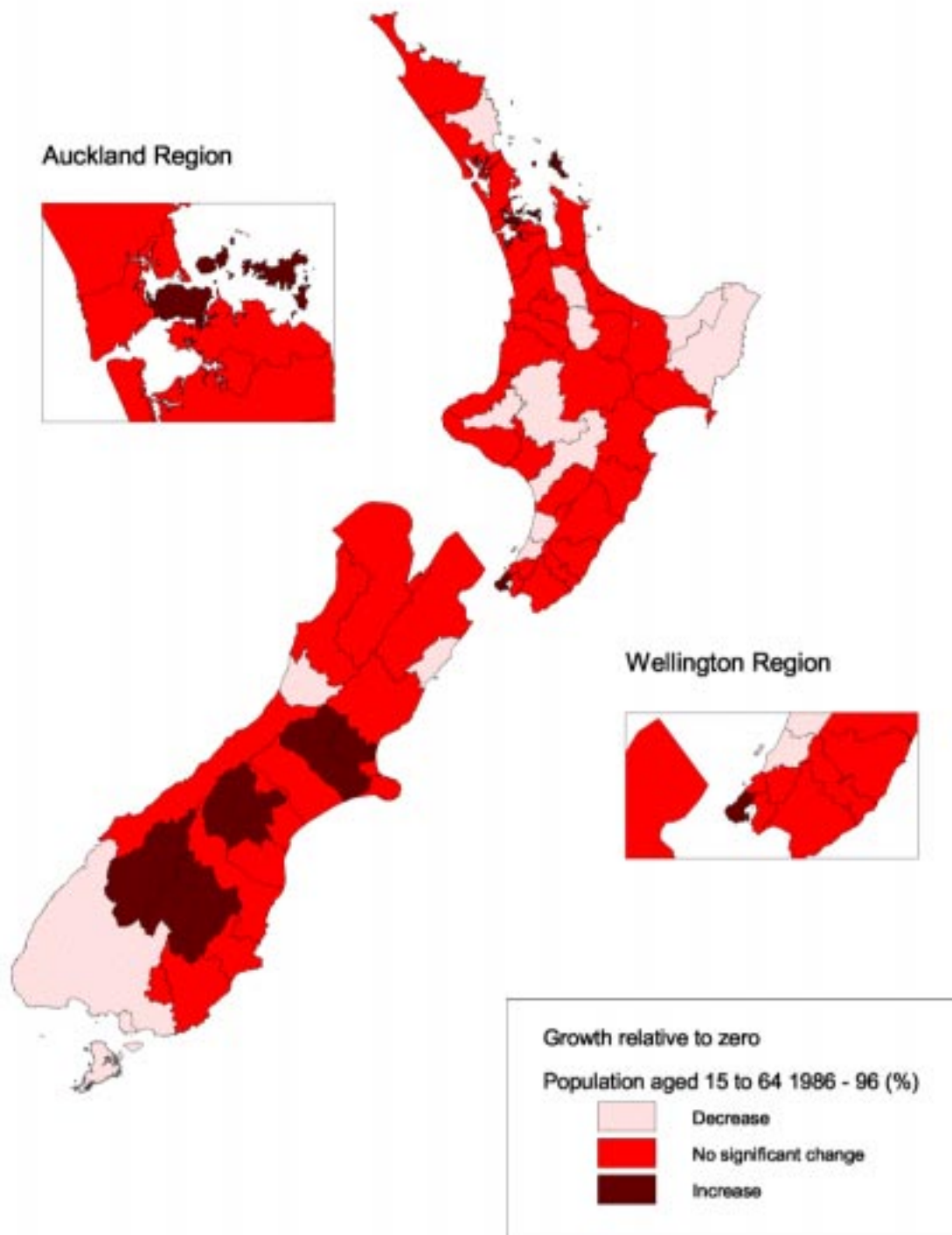


Map 3
Percentage of the Population Aged 15 to 64 (1996)



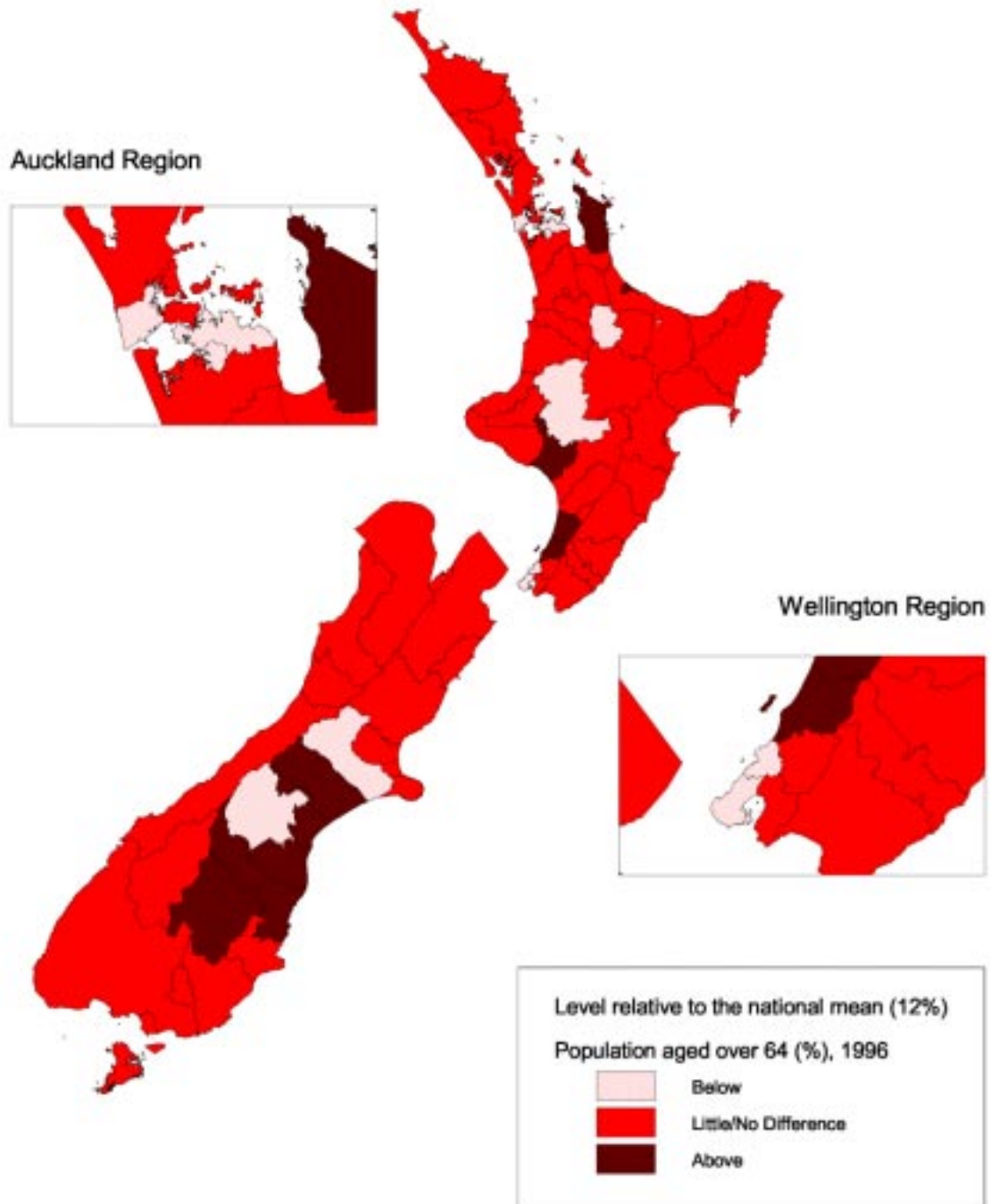
Map 4

Growth in the Share of Population Aged 15 to 64 (1986 to 1996)



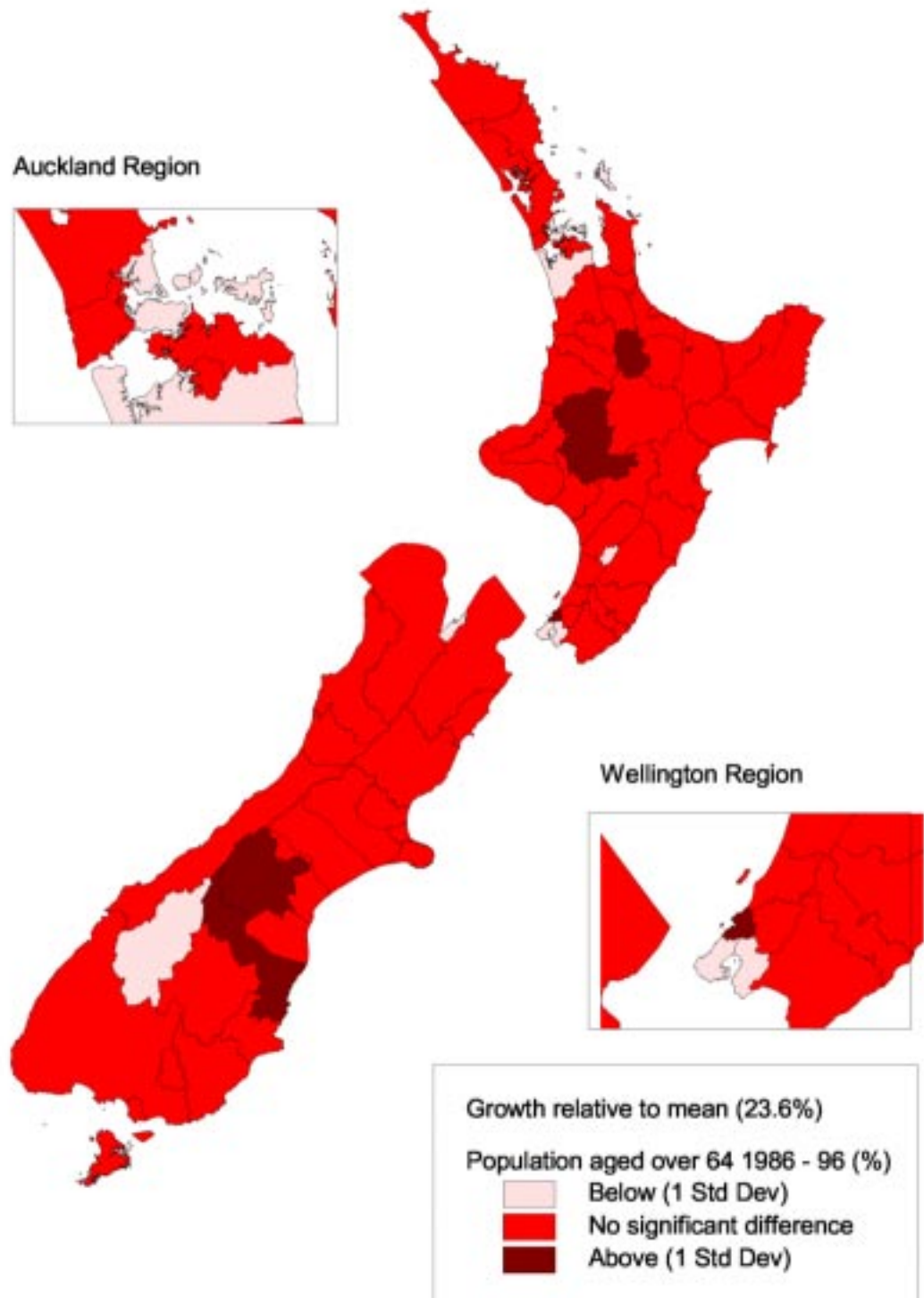
Map 5

Percentage of the Population Aged Over 64 (1996)



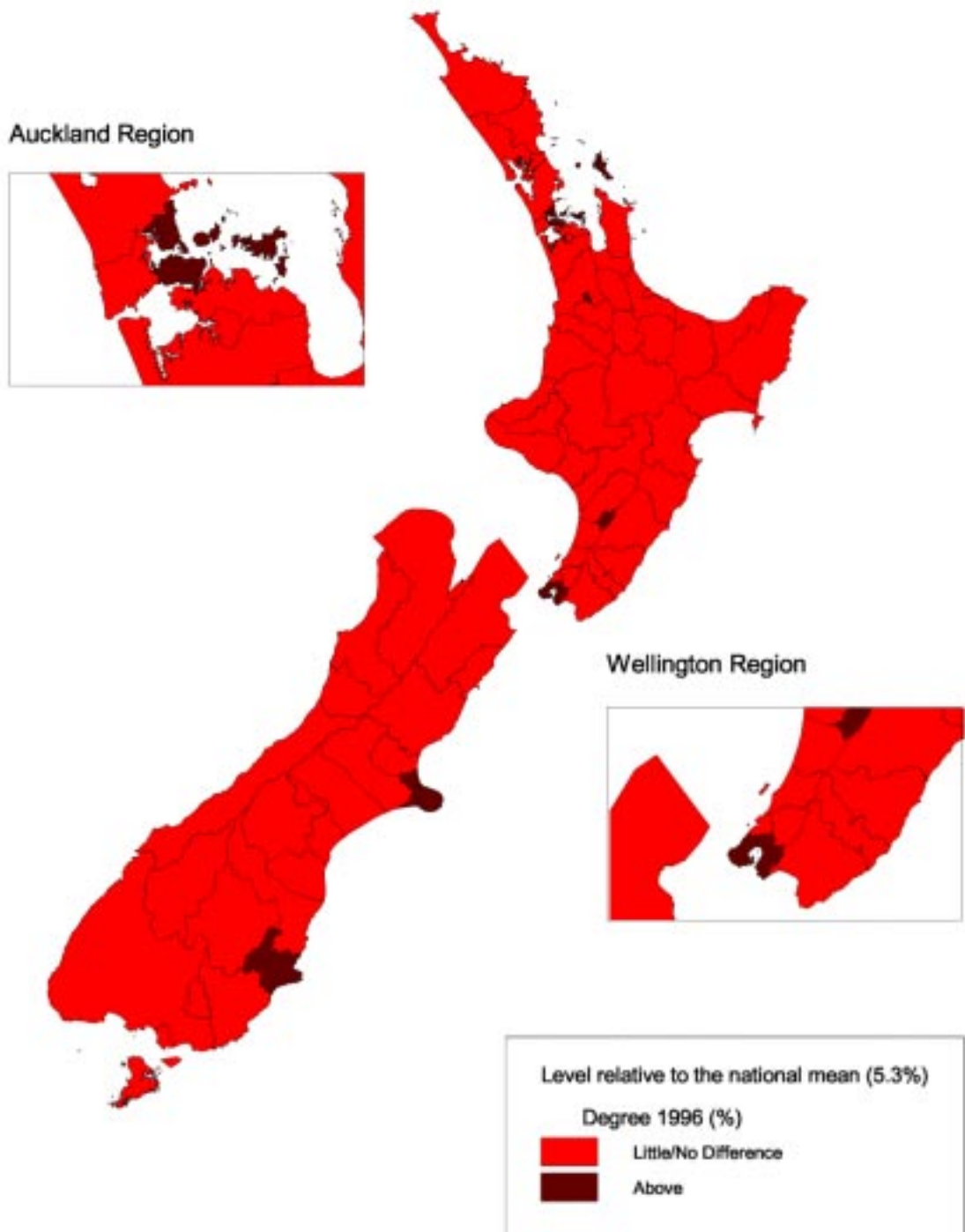
Map 6

Growth in the Share of Population Aged Over 64 (1986 to 1996)



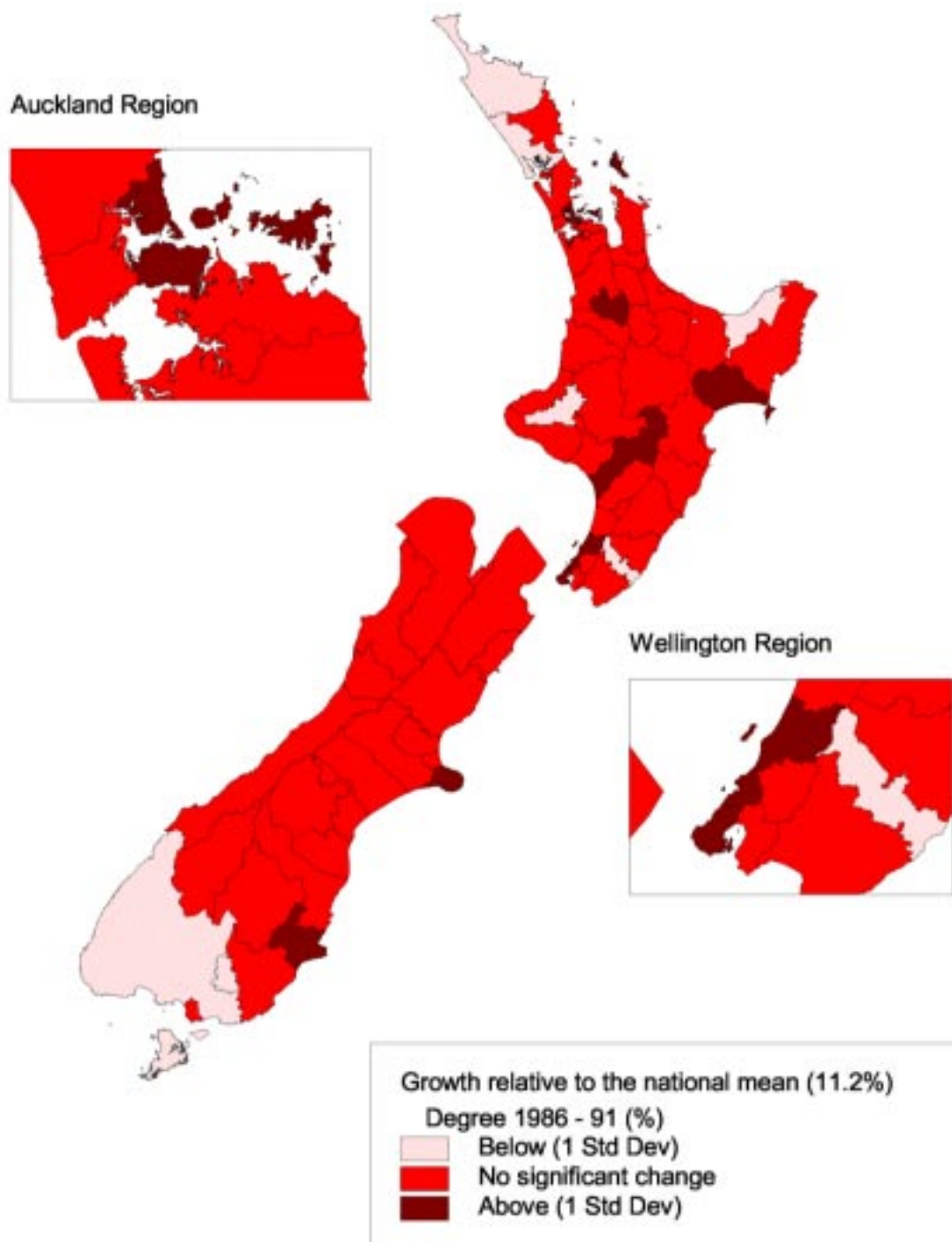
Map 7

Percentage of the Population Aged 15 and Over with a Degree Qualification (1996)



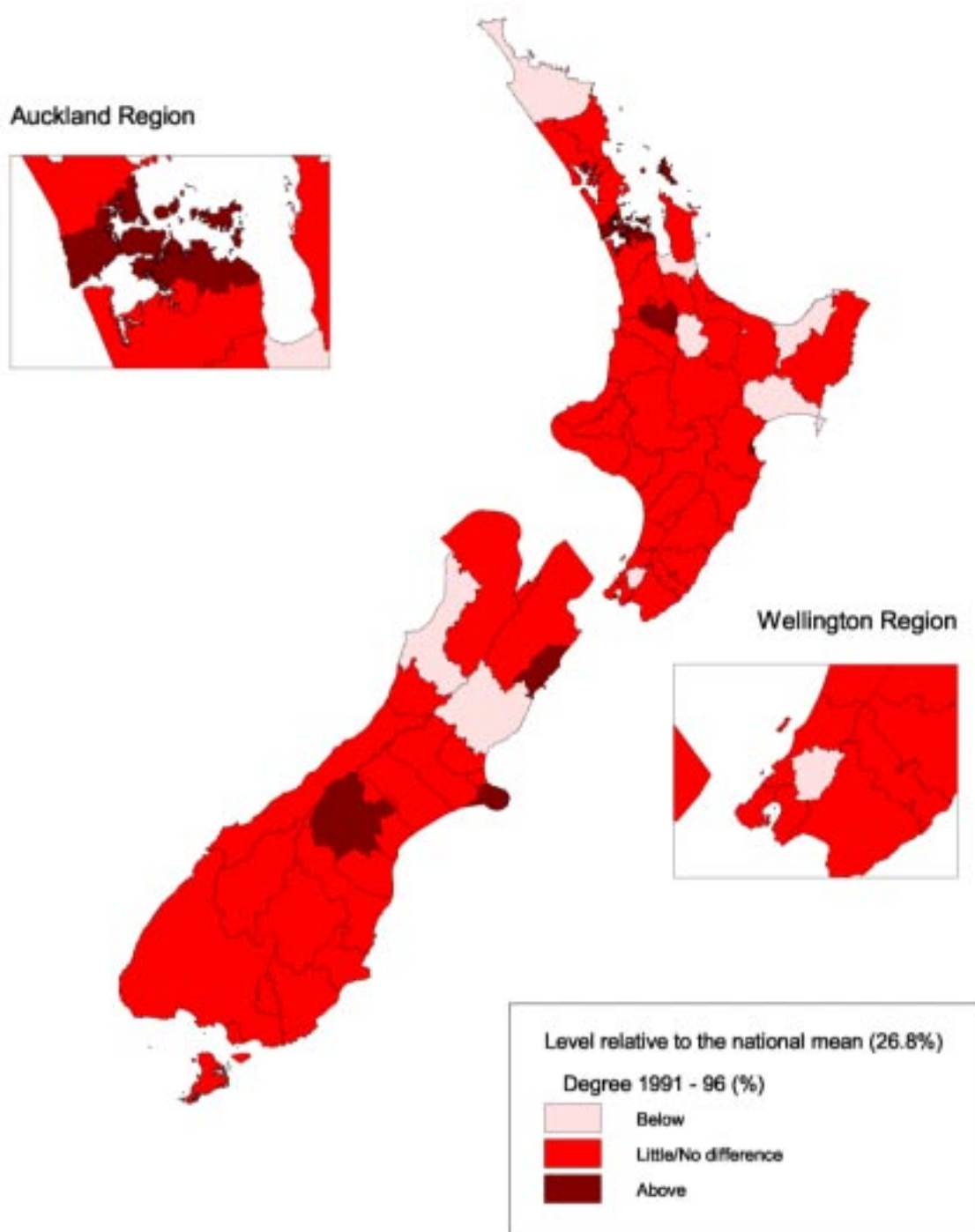
Map 8

Growth in the Share of Population Aged 15 and Over with a Degree Qualification (1986 to 1991)



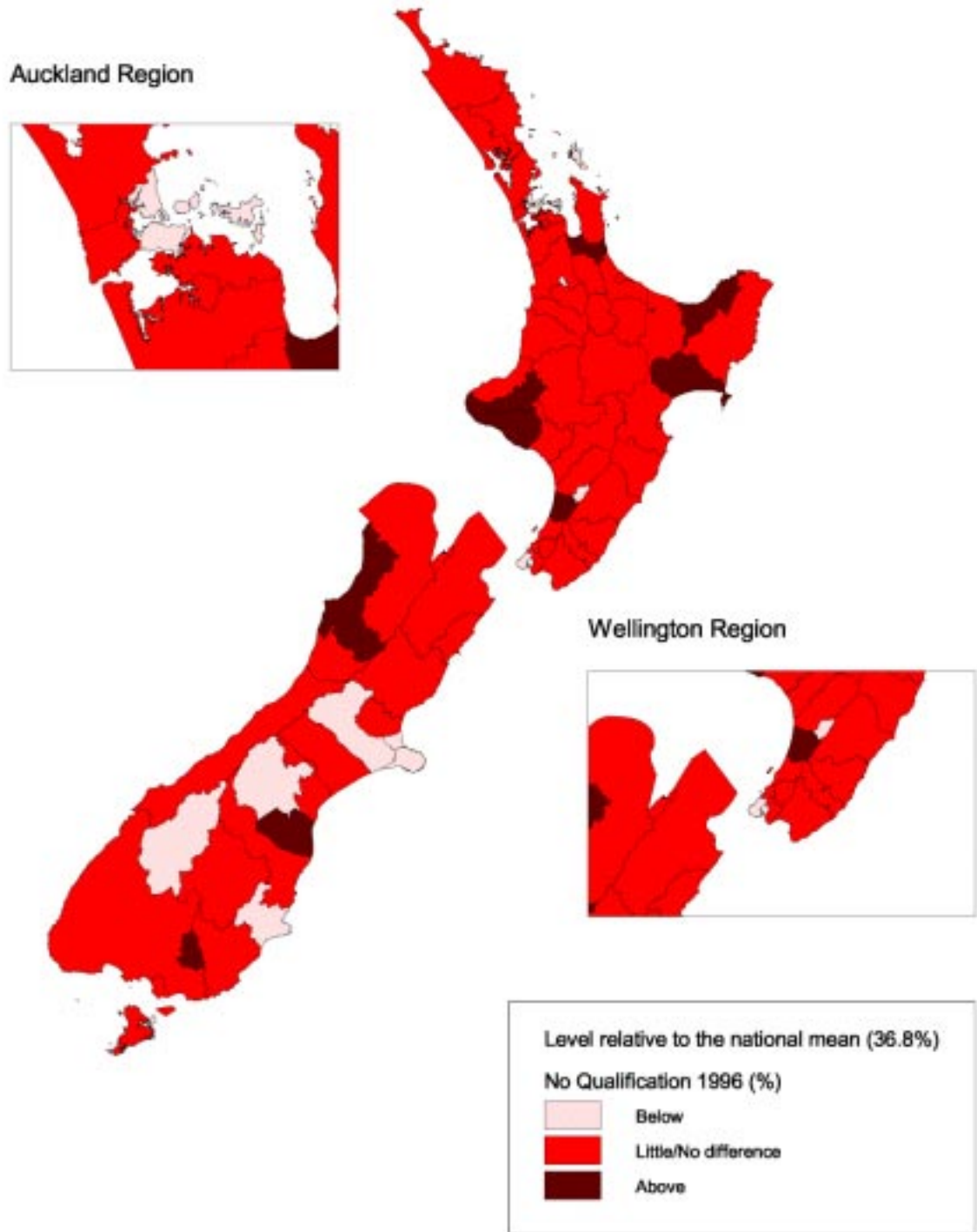
Map 9

Growth in the Share of Population Aged 15 and Over with a Degree Qualification (1991 to 1996)



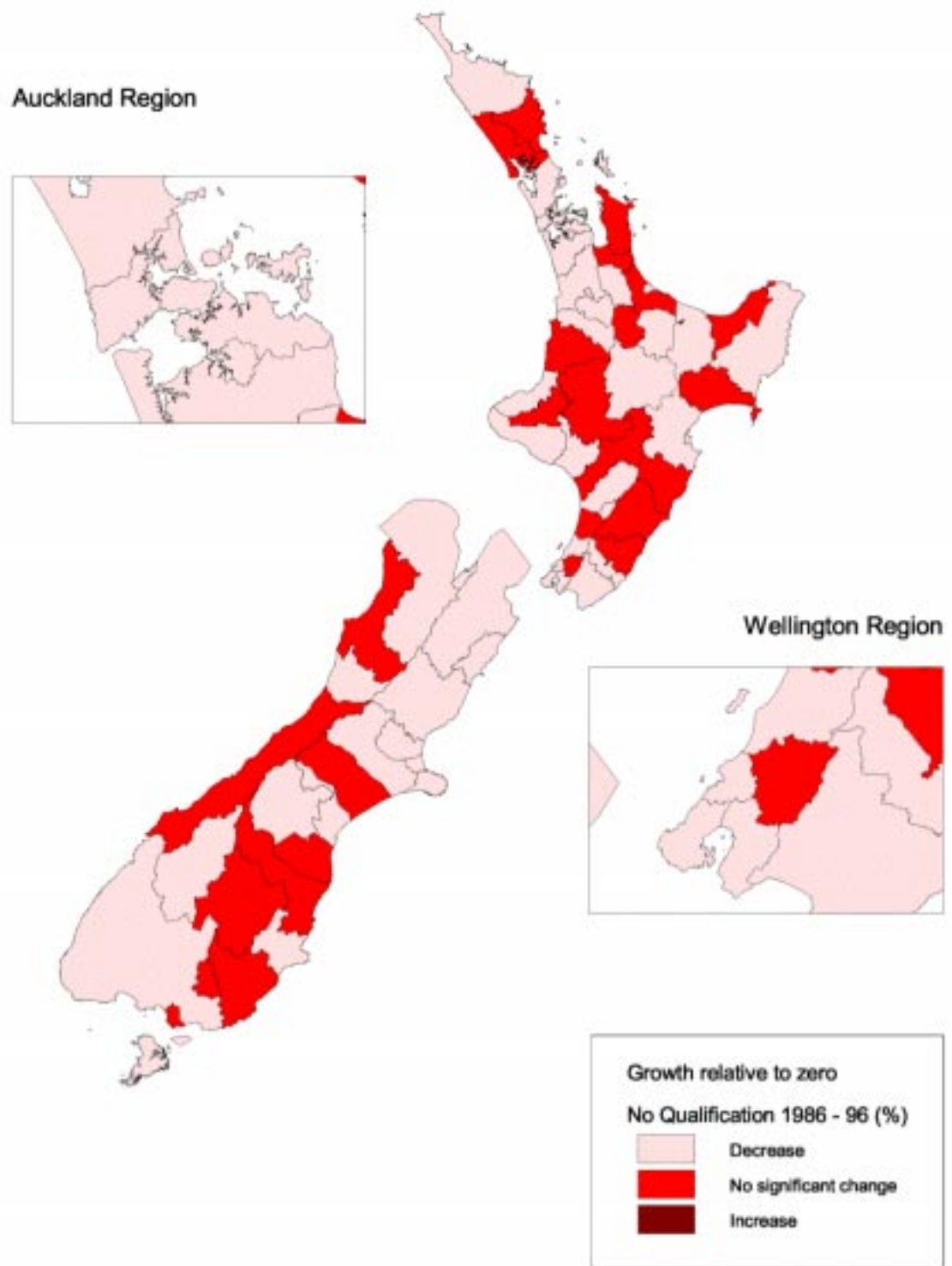
Map 10

Percentage of the population Aged 15 and Over with No Qualifications (1996)



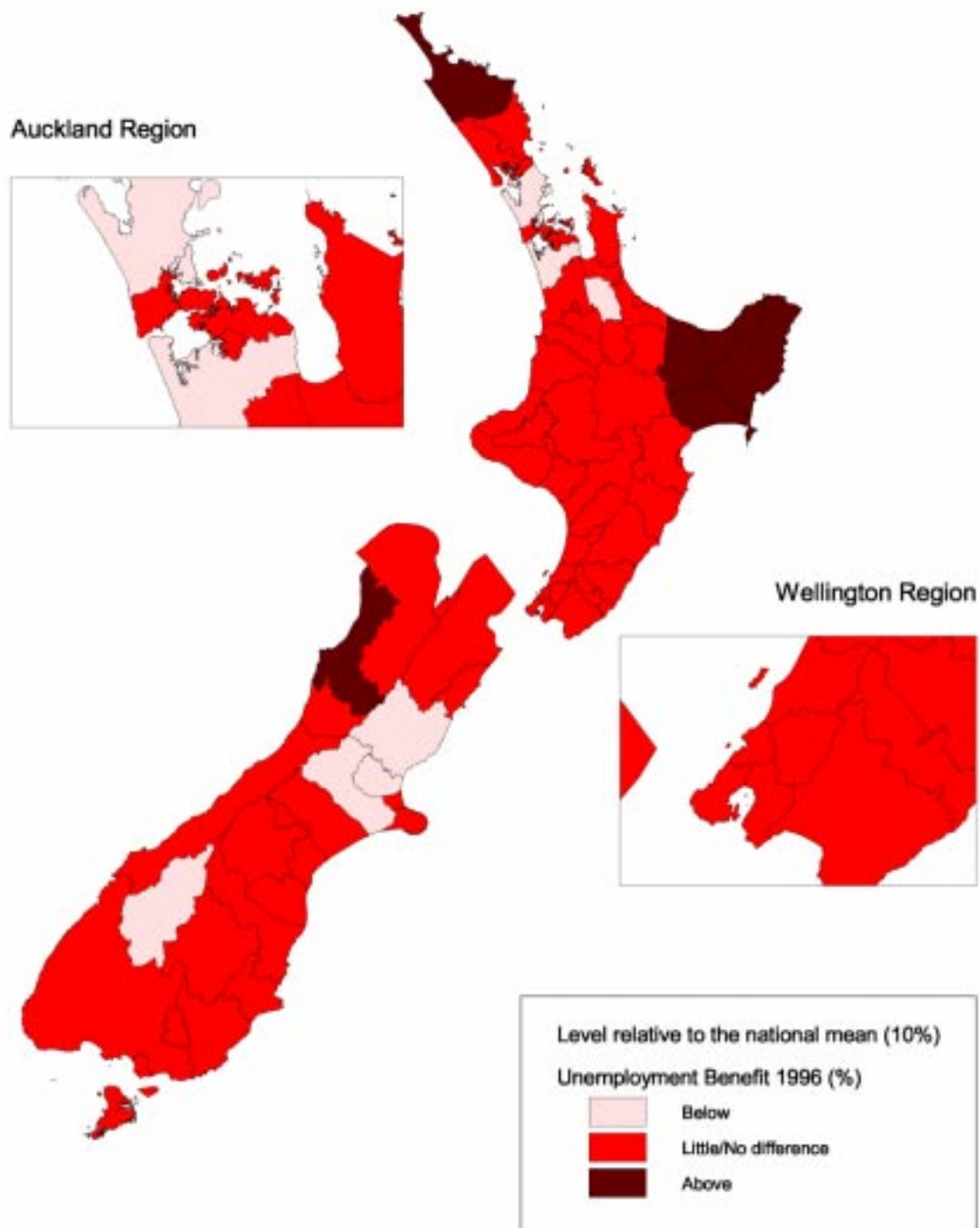
Map 11

Growth in the Share of Population Aged 15 and Over with No Qualifications (1986 to 1996)



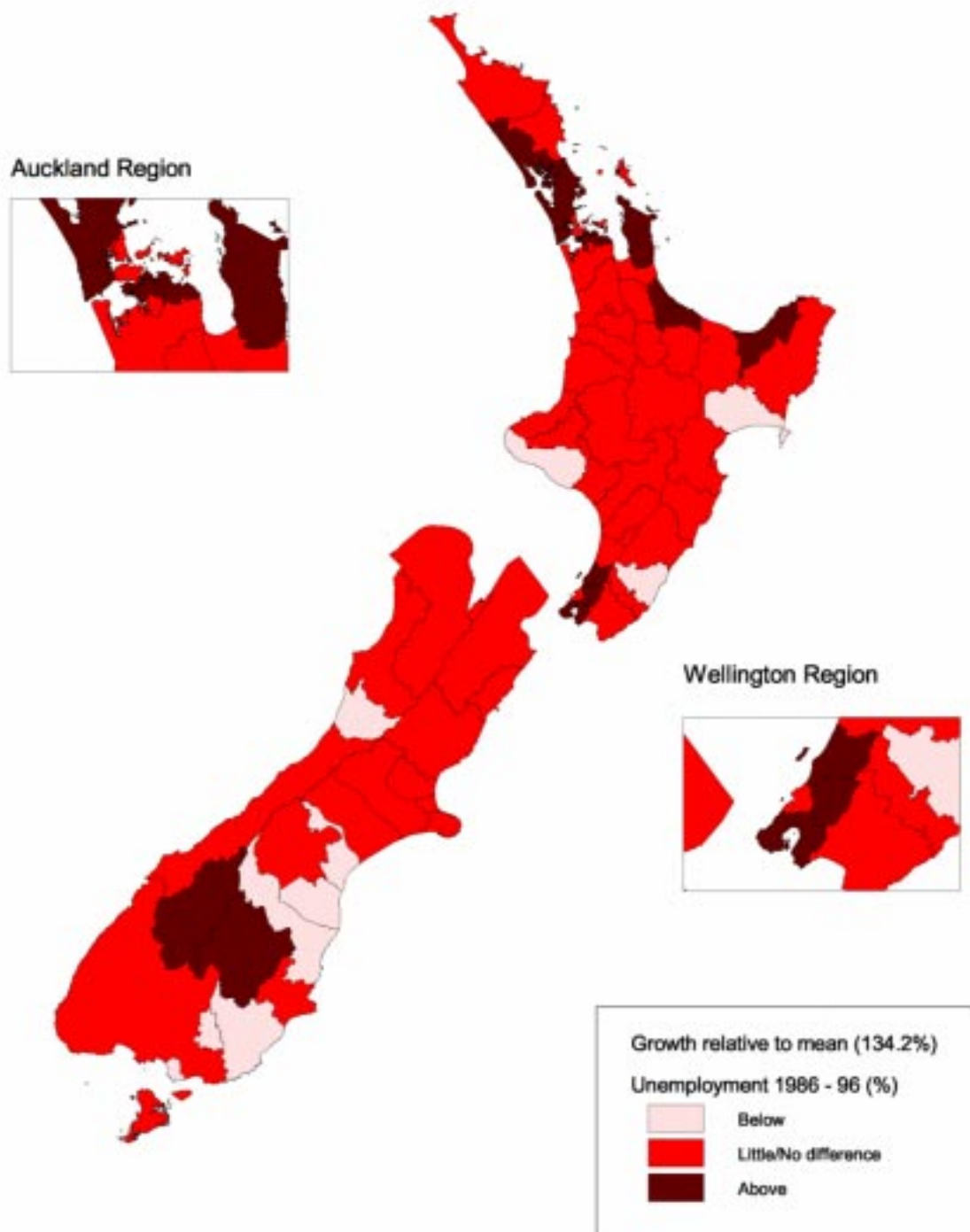
Map 12

Percentage of the Population Aged 15 to 64 who Receive Unemployment Benefit (1996)



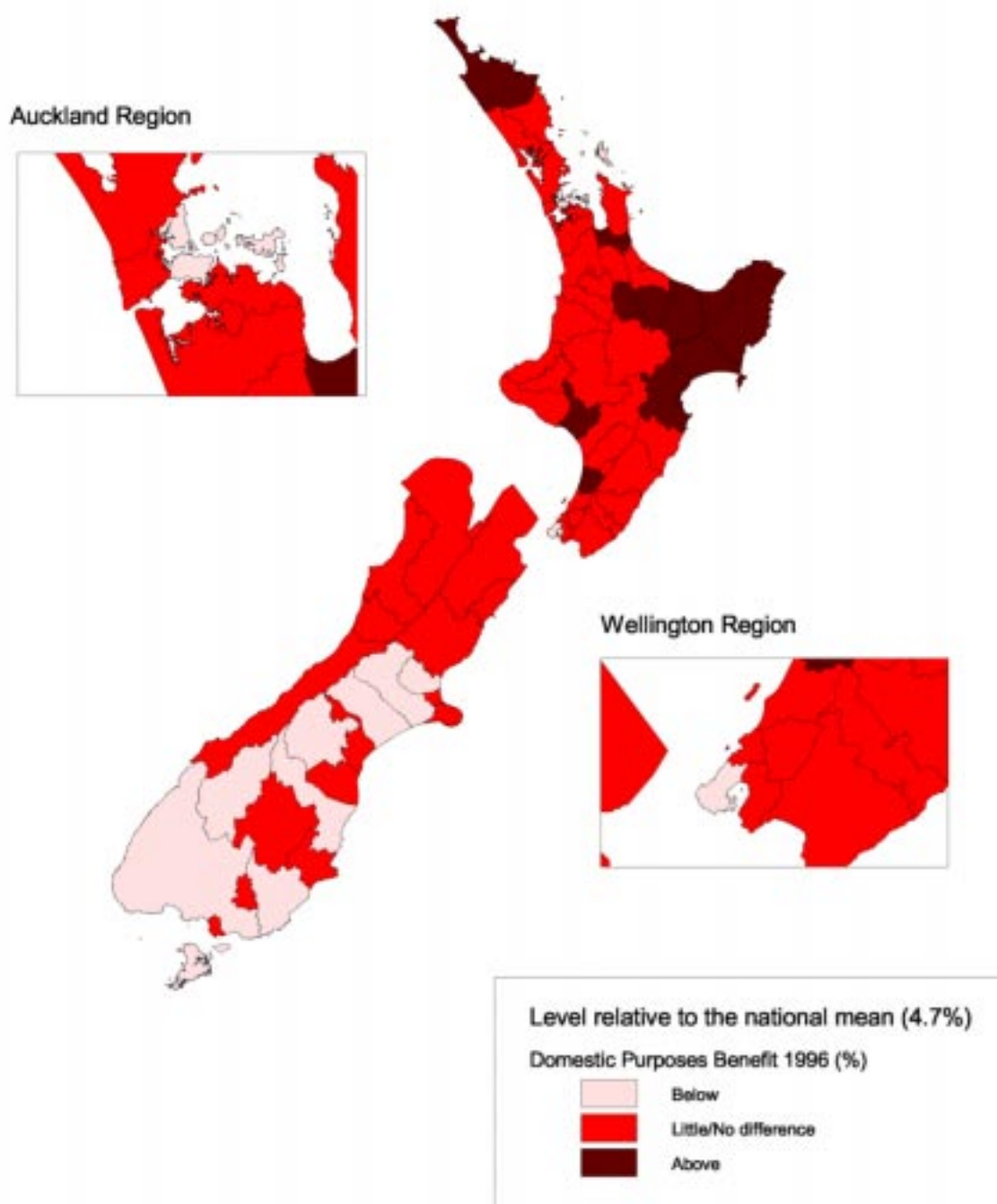
Map 13

Growth in the Share of Population Aged 15 to 64
who Receive Unemployment Benefit (1986 to 1996)



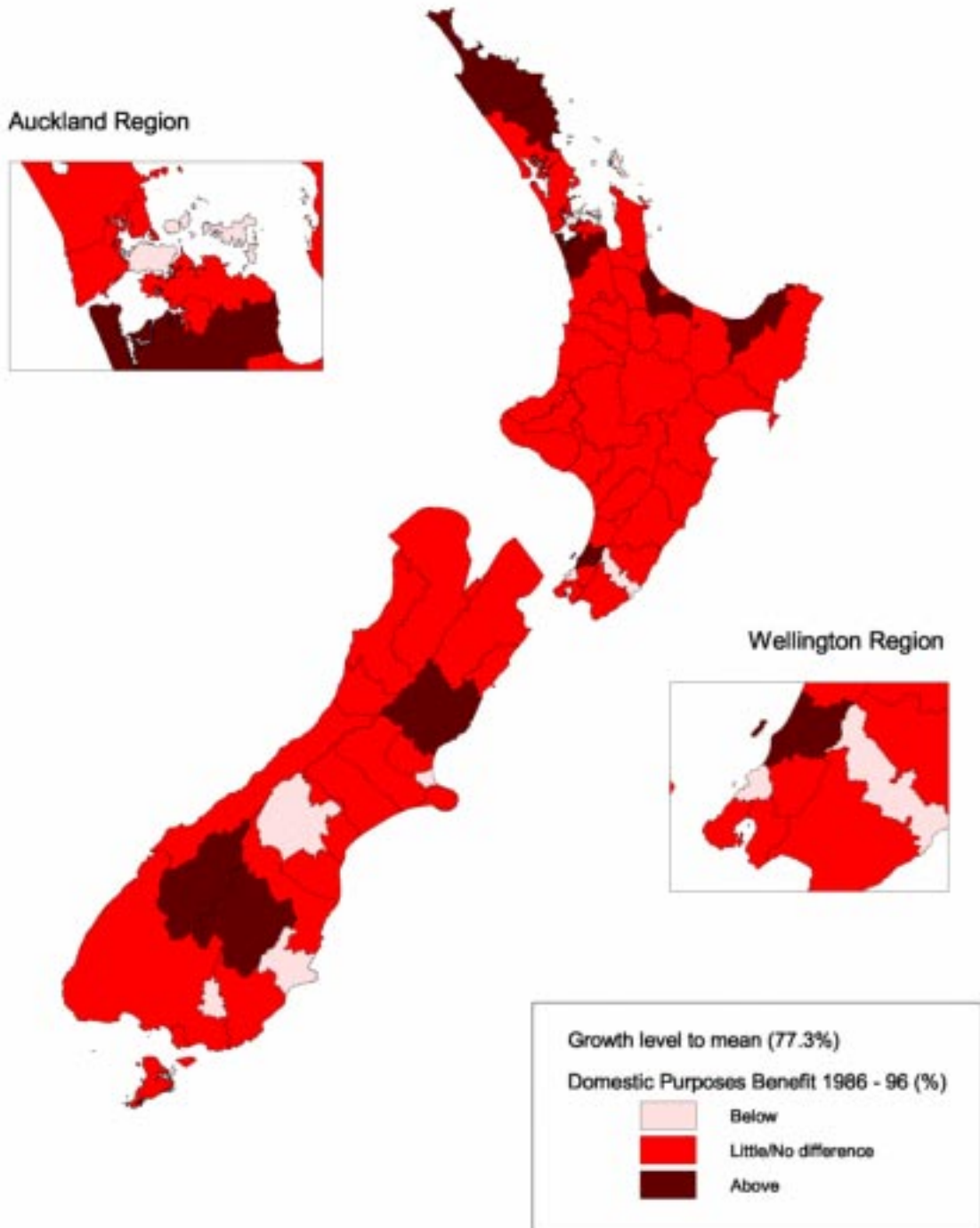
Map 14

Percentage of the Population Aged 15 to 64 who Receive Domestic Purpose Benefit (1996)



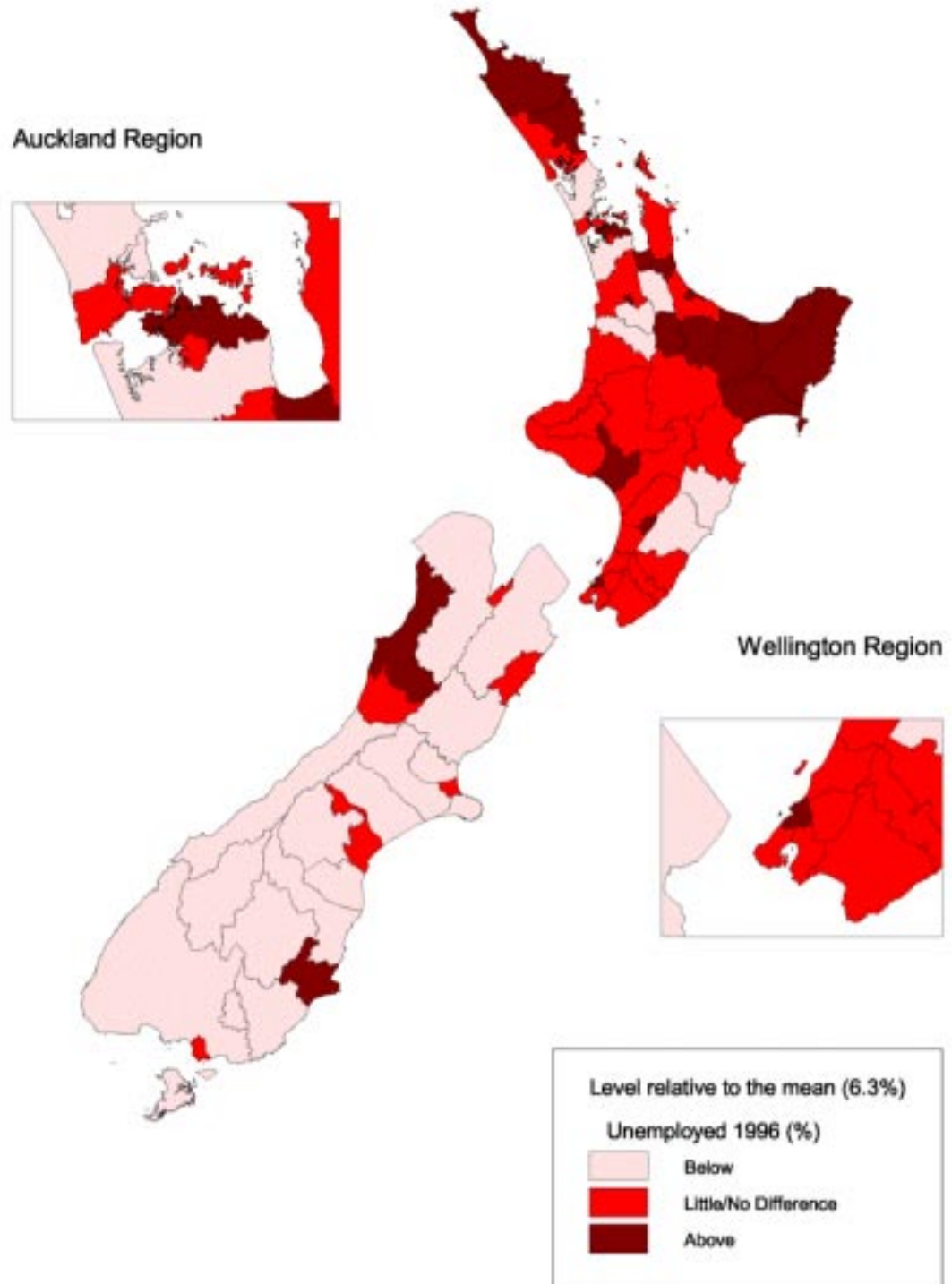
Map 15

Growth in the Share of Population Aged 15 to 64
who Receive Domestic Purpose Benefit (1986 to 1996)



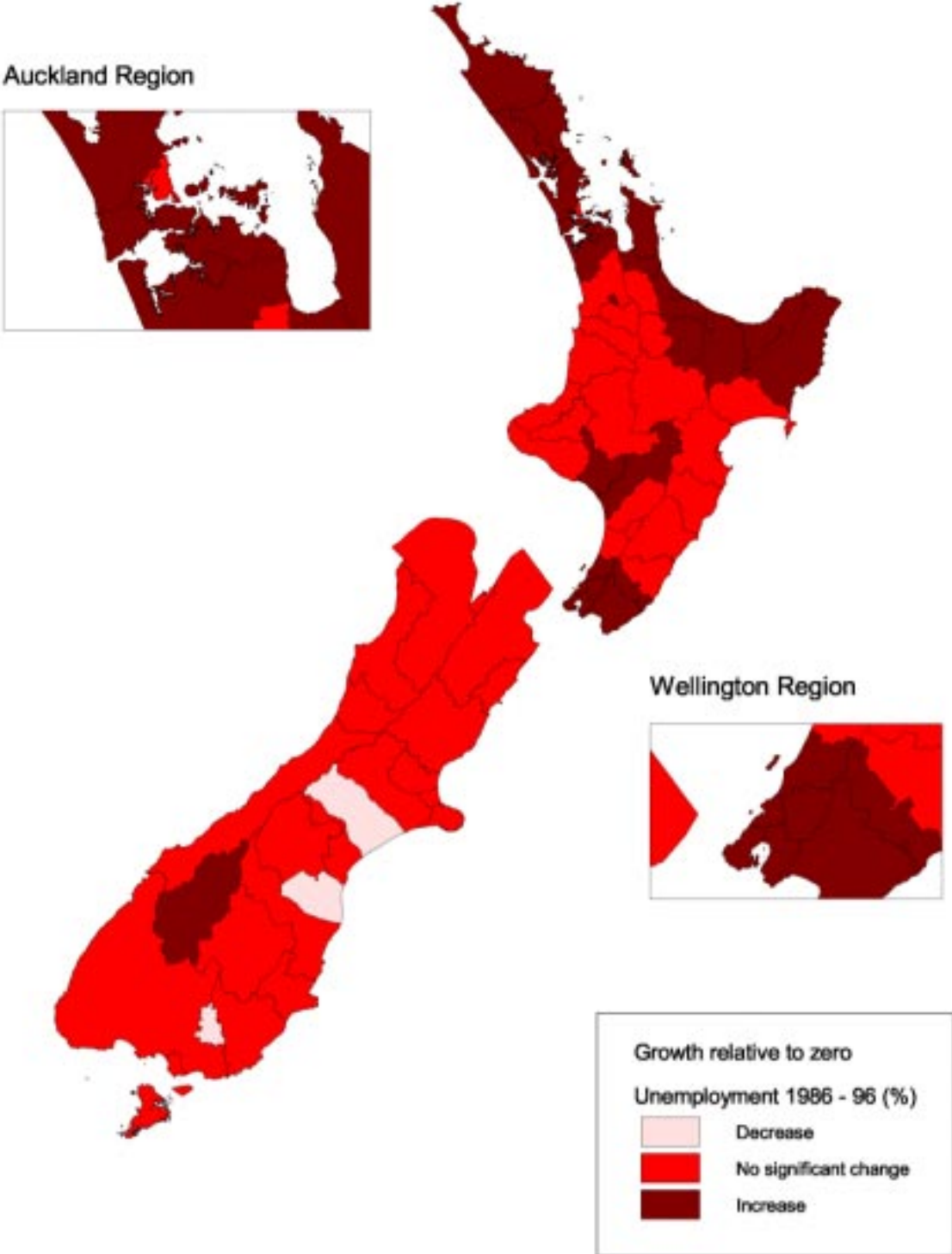
Map 16

Percentage of the Labour Force who are Unemployed and Actively Seeking Work (1996)



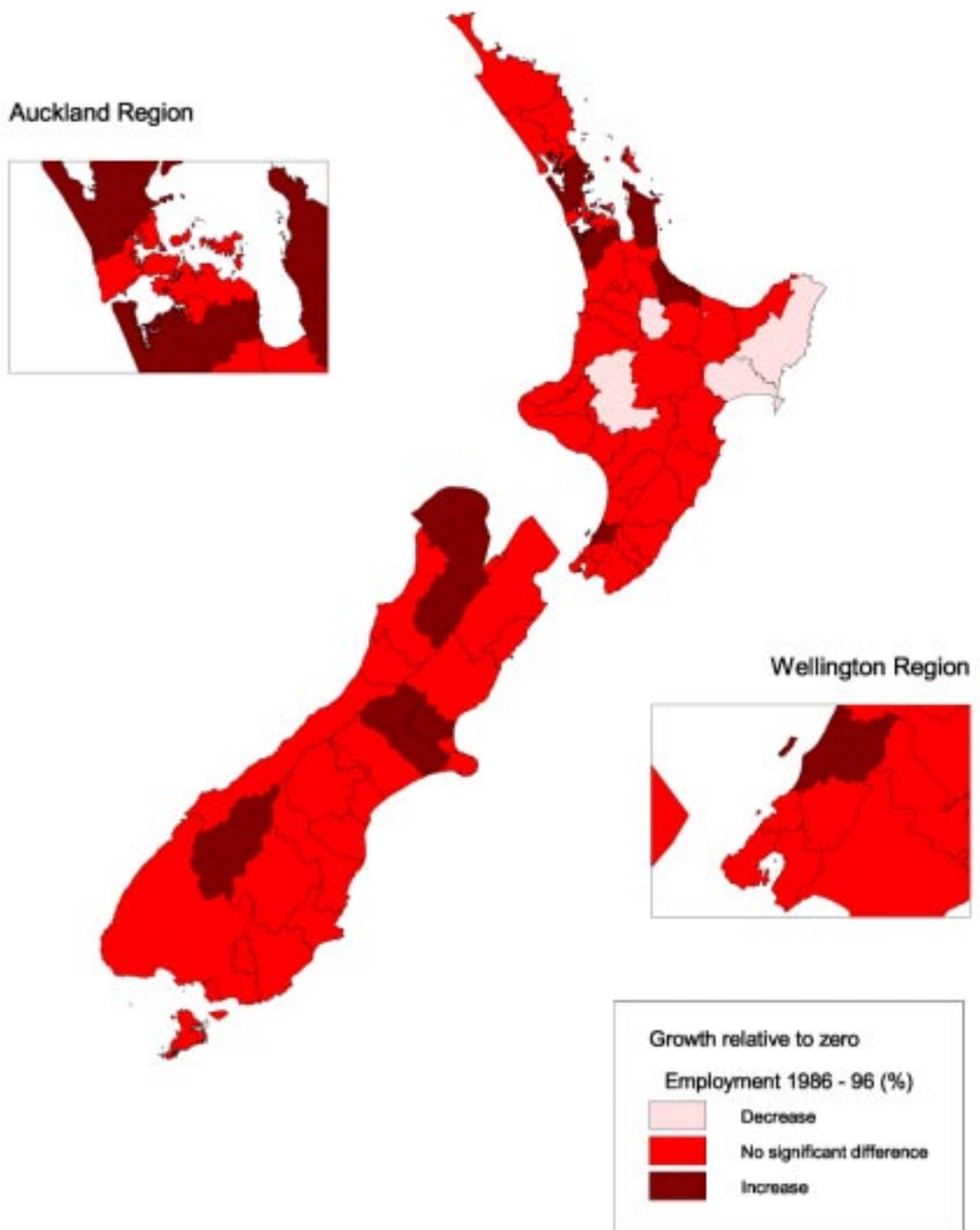
Map 17

Growth in the Labour Force of those Unemployed (1986 to 1996)



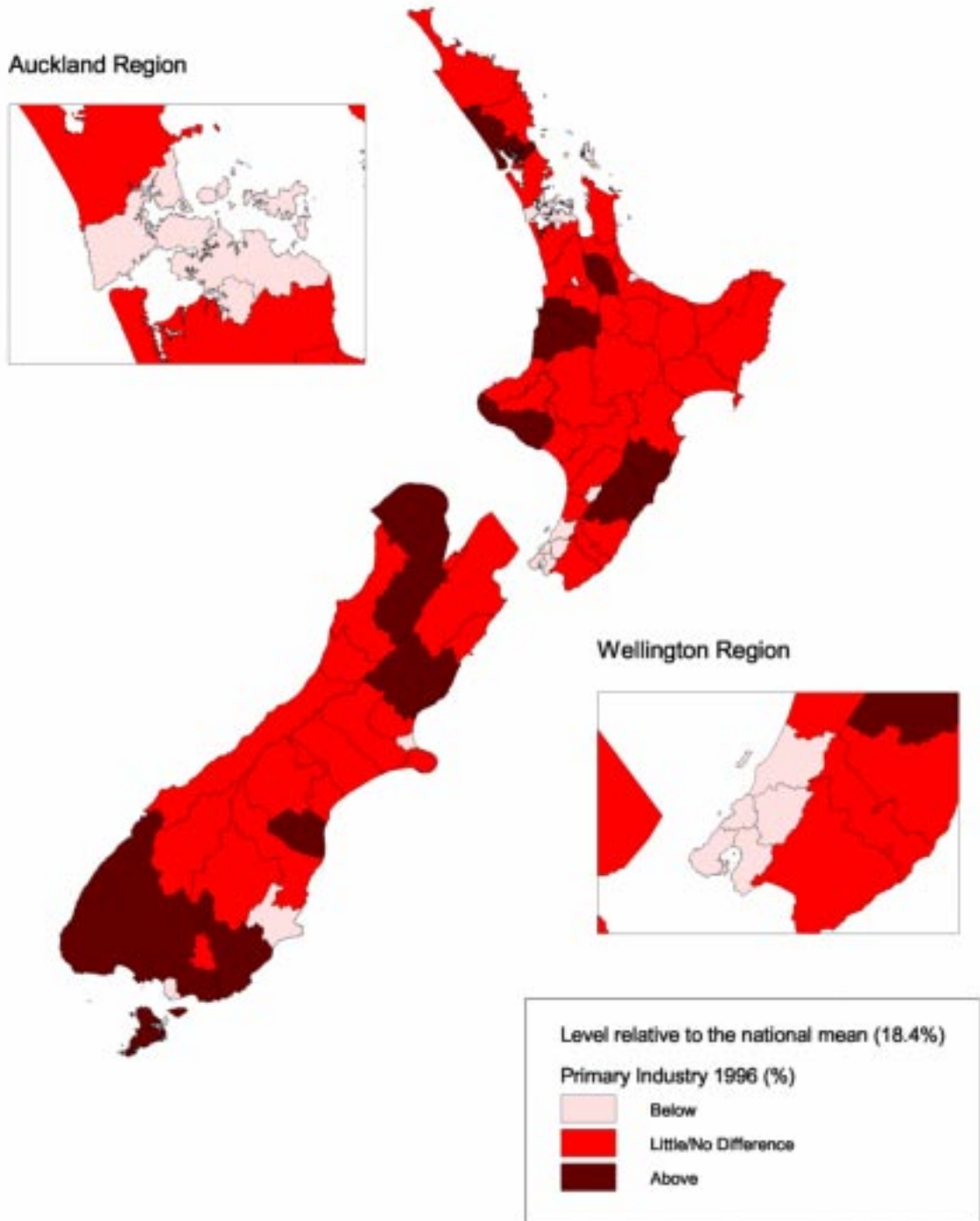
Map 18

Growth in the Labour Force of Full and Part Time Workers (1986 to 1996)



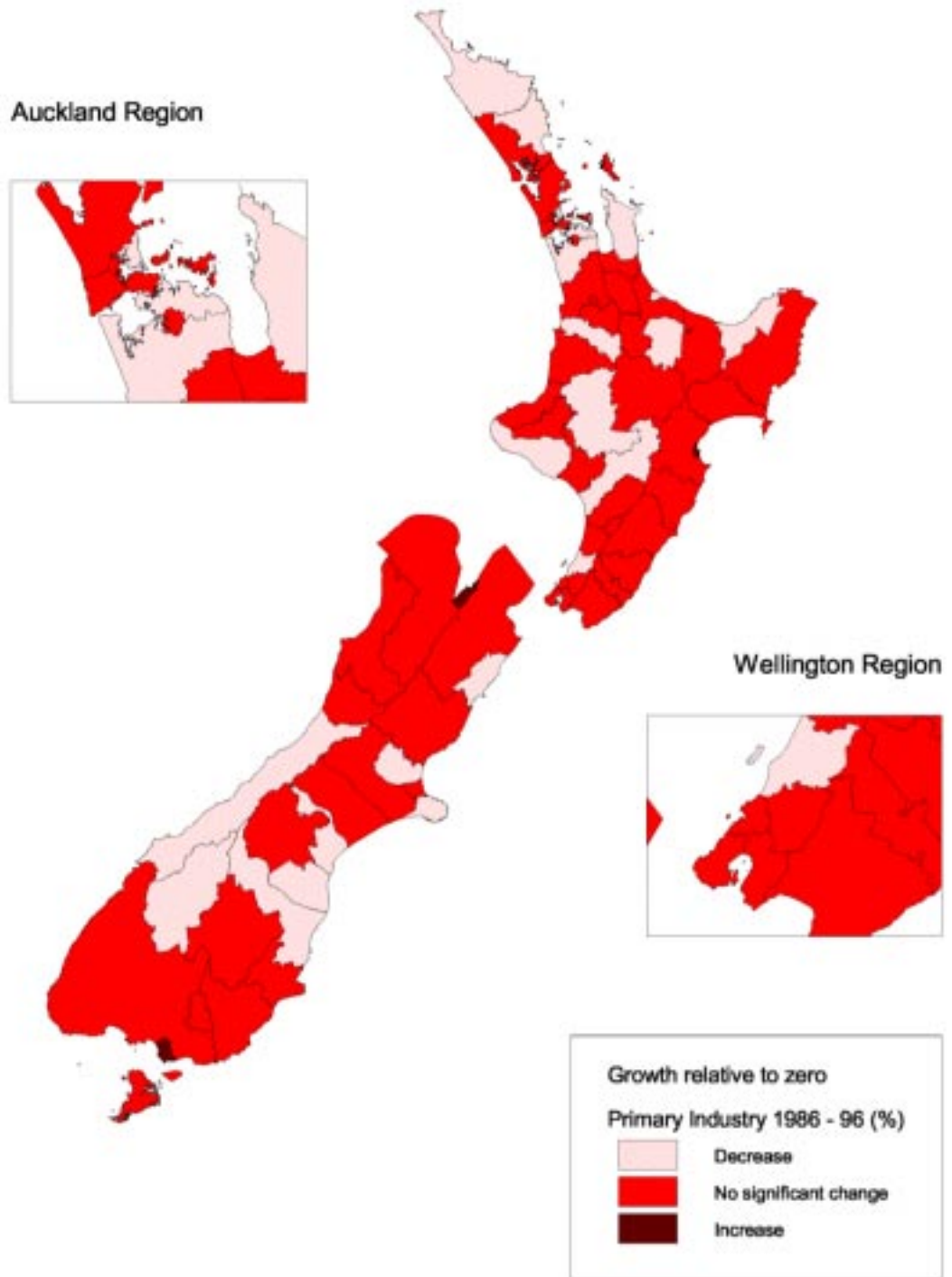
Map 19

Percentage of the Population Aged 15 and Over who Work within a Primary Industry (1996)



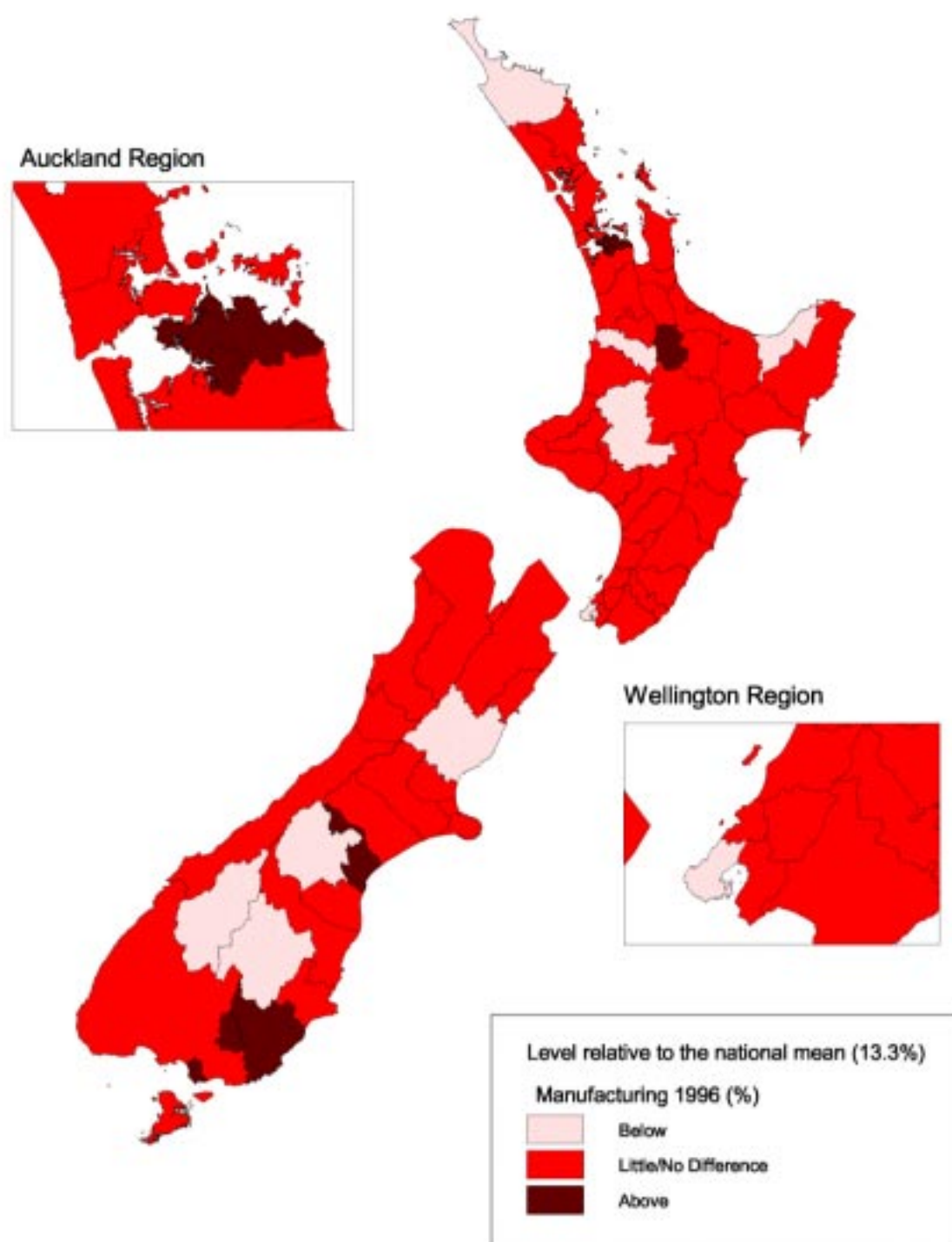
Map 20

Growth in the Share of Population Aged 15 and Over within Primary Industry (1986 to 1996)



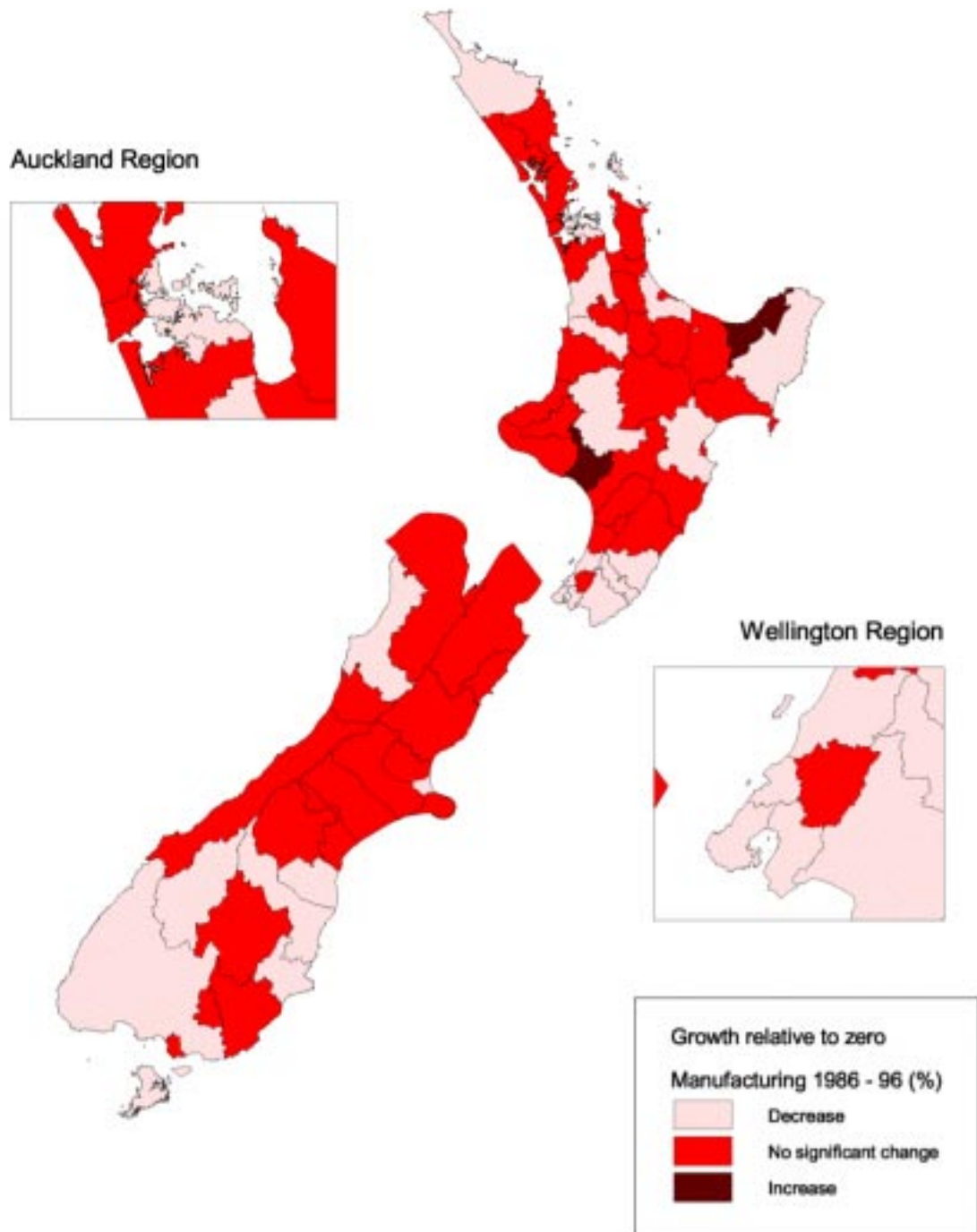
Map 21

Percentage of the Population Aged 15 and Over who Work within Manufacturing (1996)



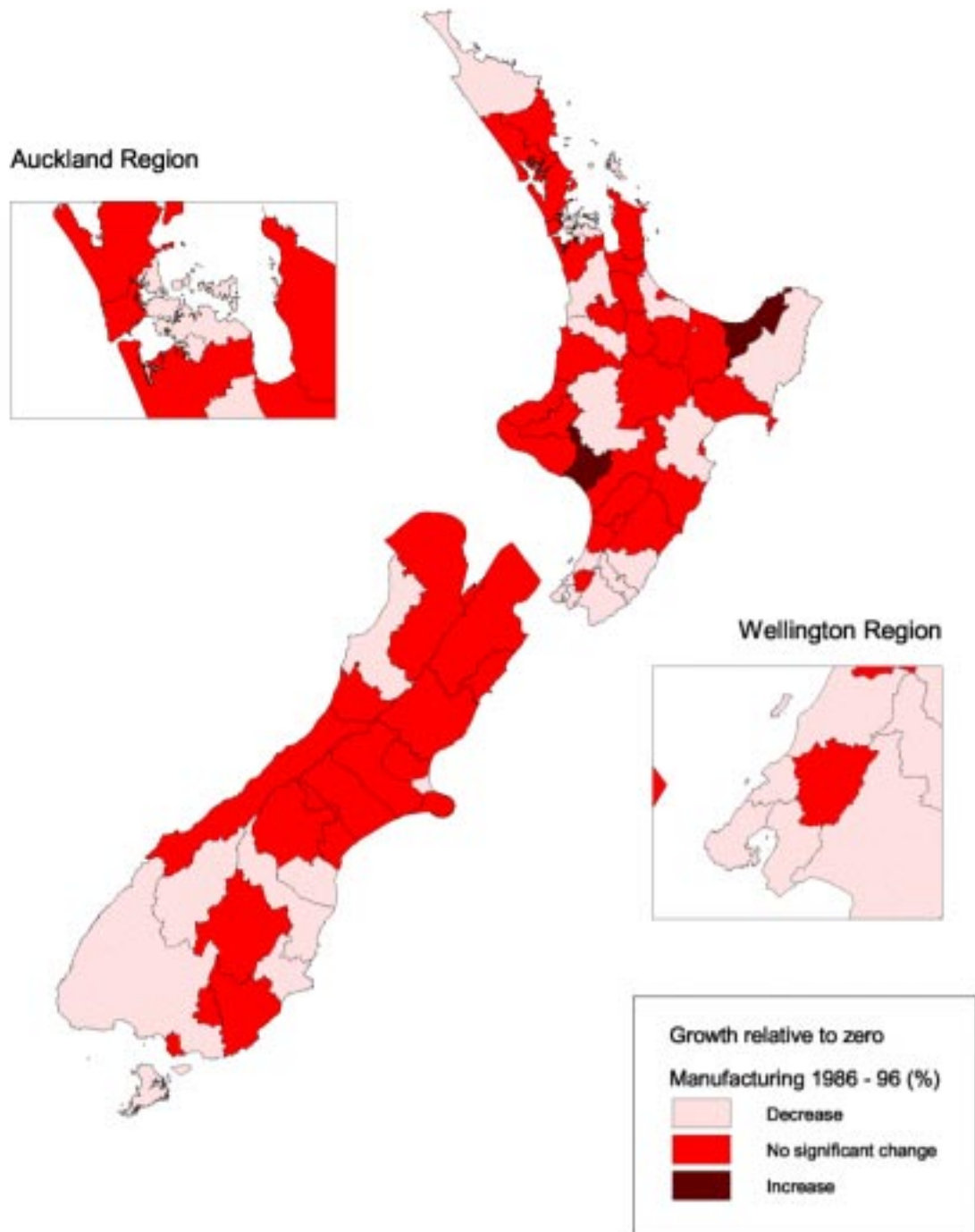
Map 22

Growth in the Share of Population Aged 15 and Over within Manufacturing (1986 to 1996)



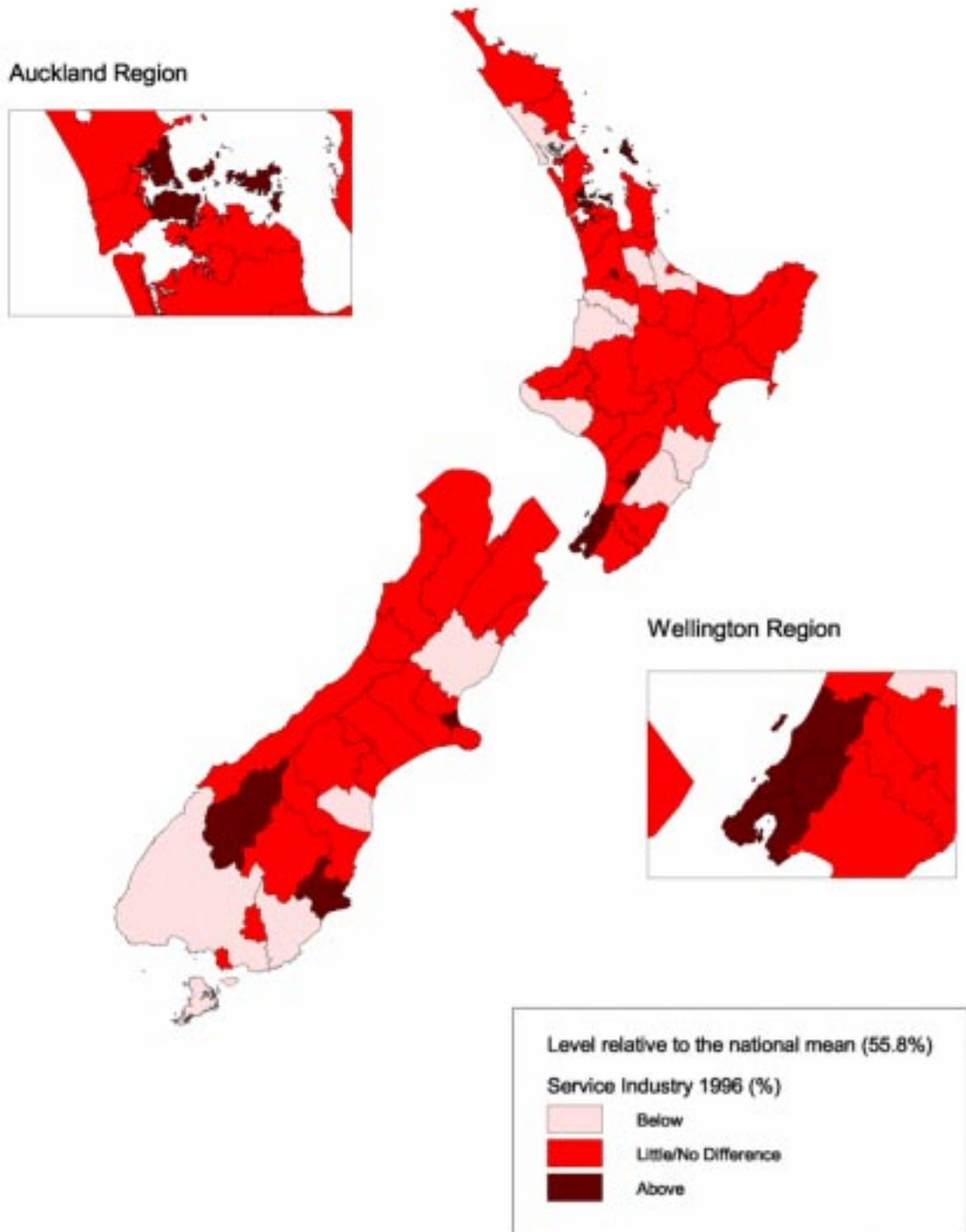
Map 22

Growth in the Share of Population Aged 15 and Over within Manufacturing (1986 to 1996)



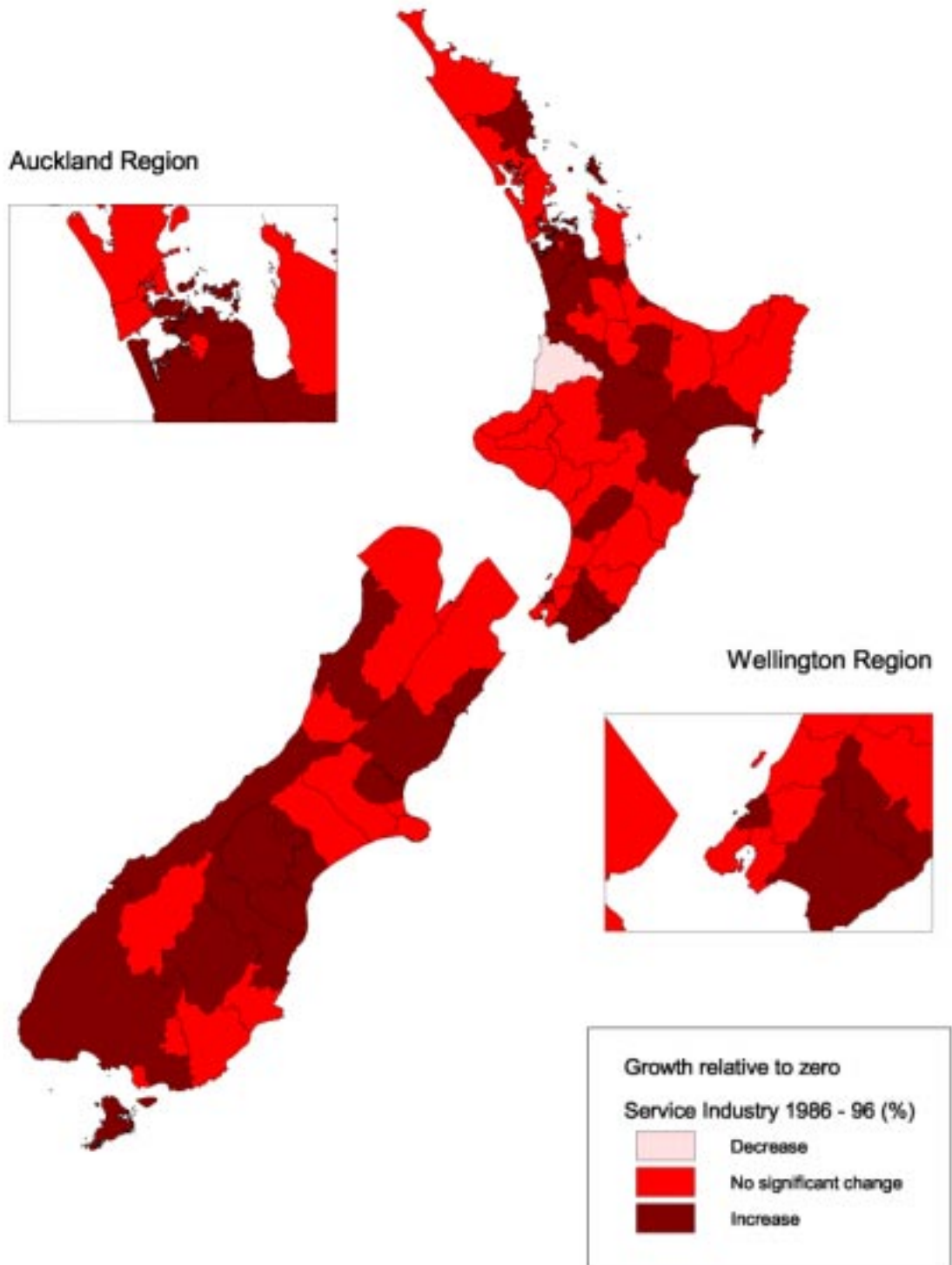
Map 23

Percentage of the Population Aged 15 or Over who Work in the Service Industry (1996)



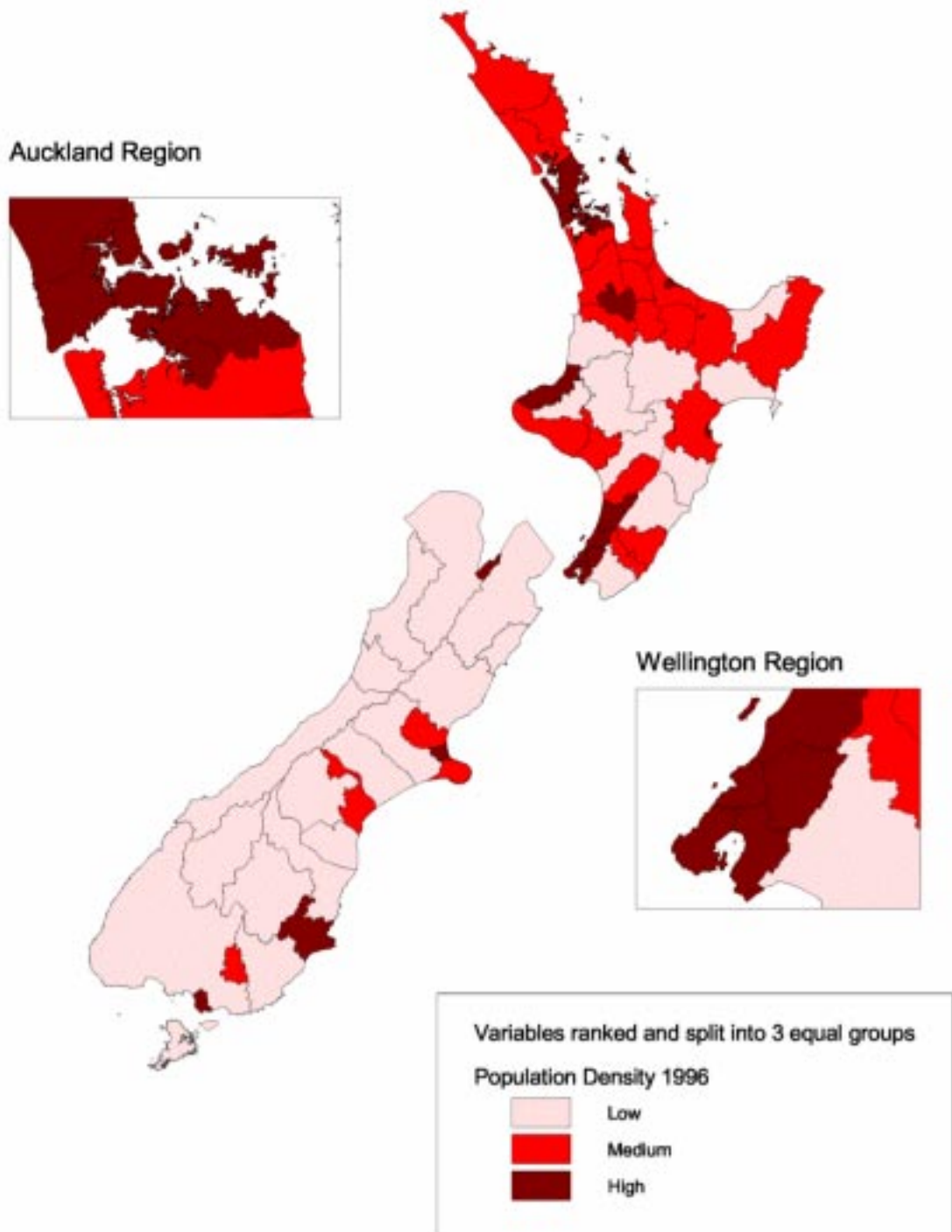
Map 24

Growth in the Share of Population Aged 15 and Over within the Service Industry (1986 to 1996)



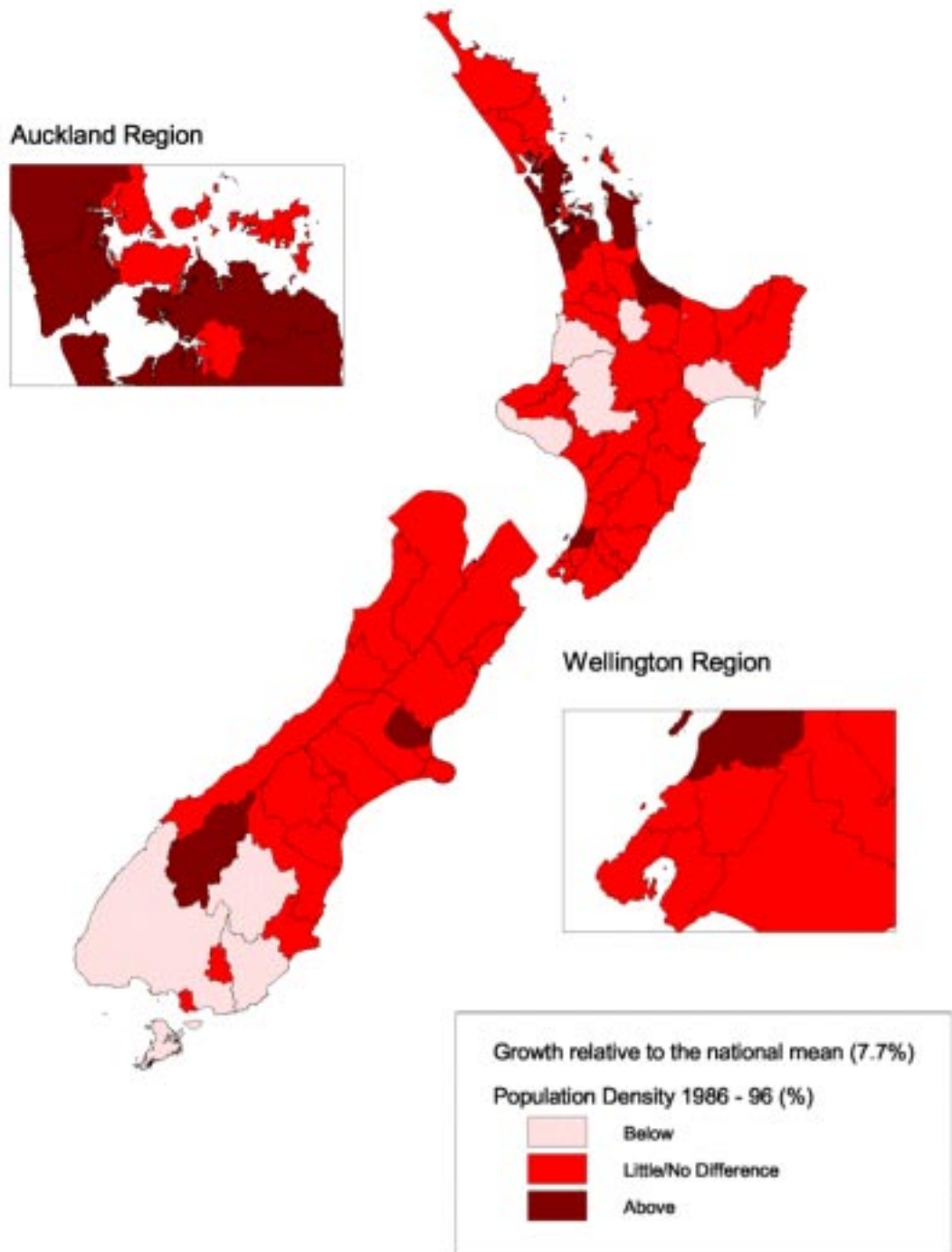
Map 26

Population Density 1996 (per square km)

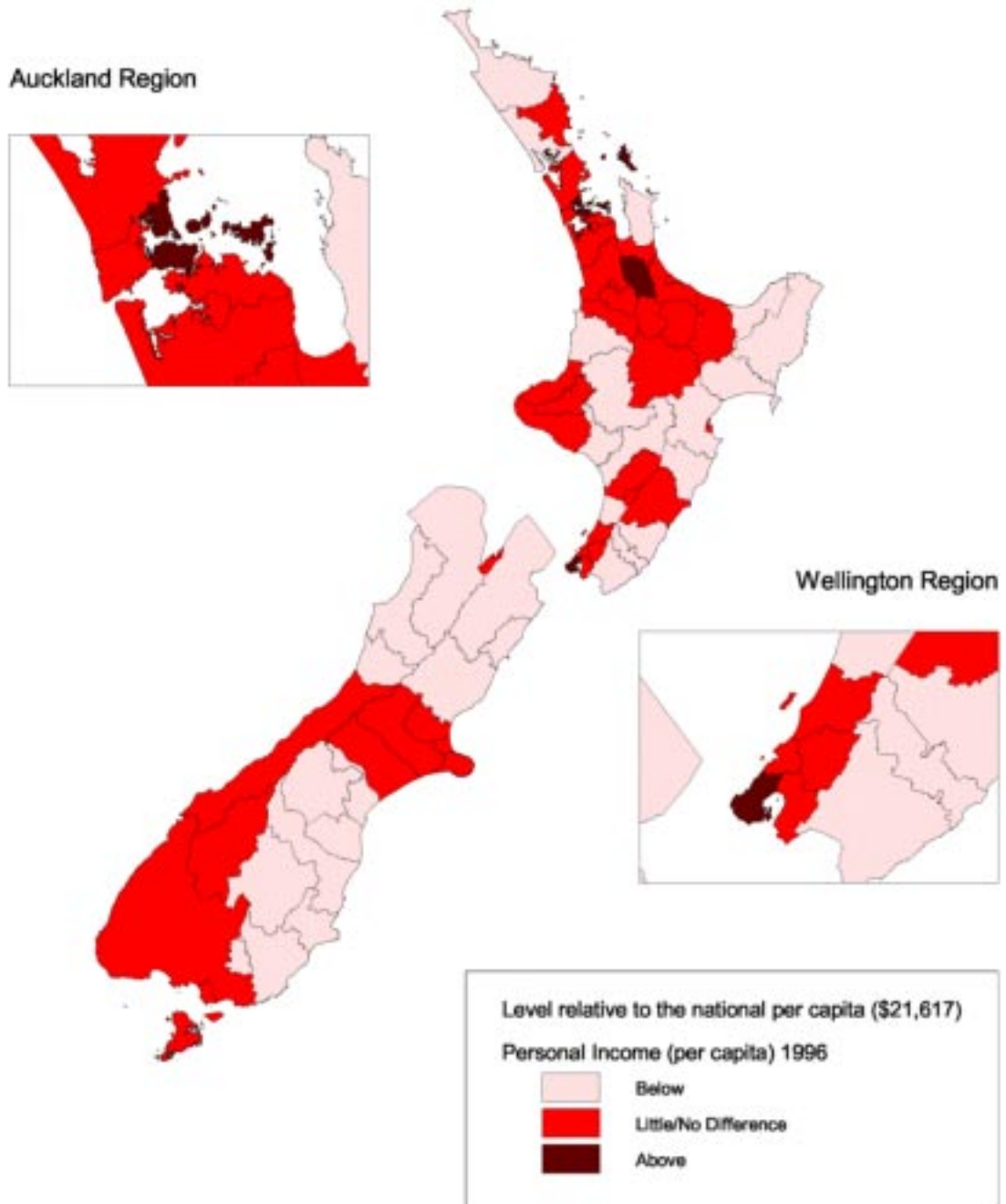


Map 27

Growth in Population Density (1986 - 1996)

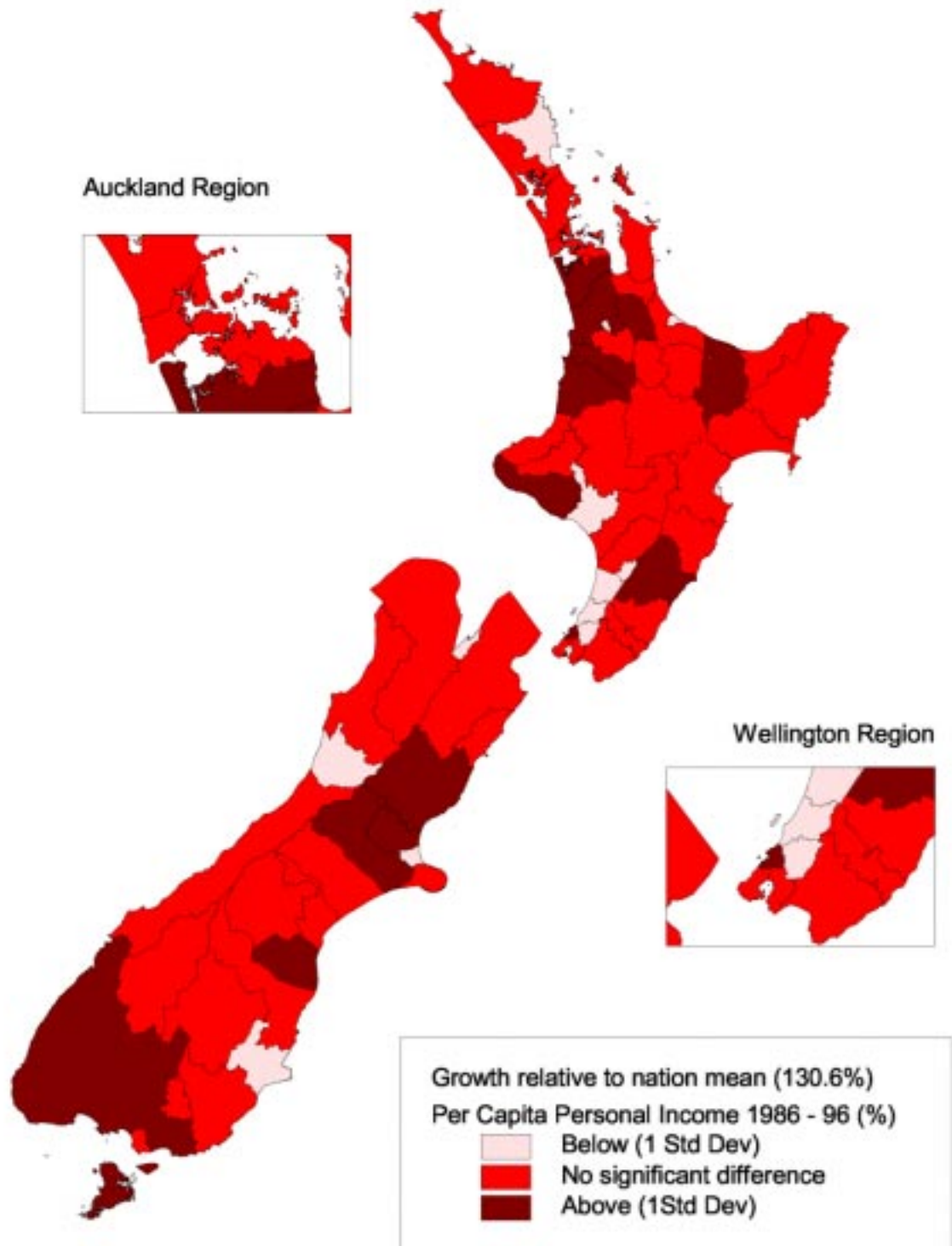


Map 28
Per Capita Personal Income for Population Aged 15 and Over (1996)



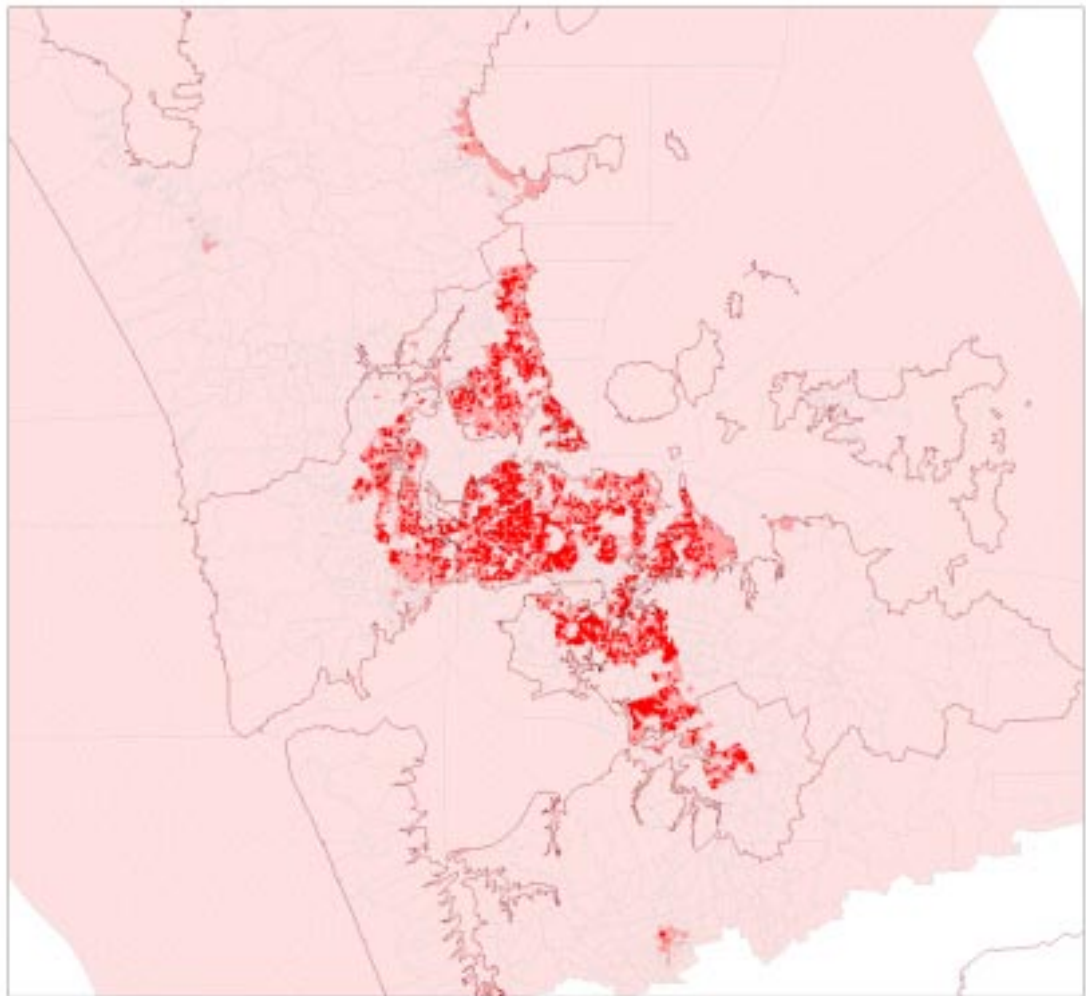
Map 29

Growth in the Per Capita Personal Income for Population Aged 15 and Over (1986 to 1996)

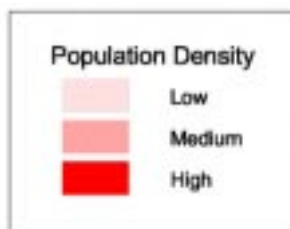


Map 30

Auckland Region Population Density at MB Level 1996

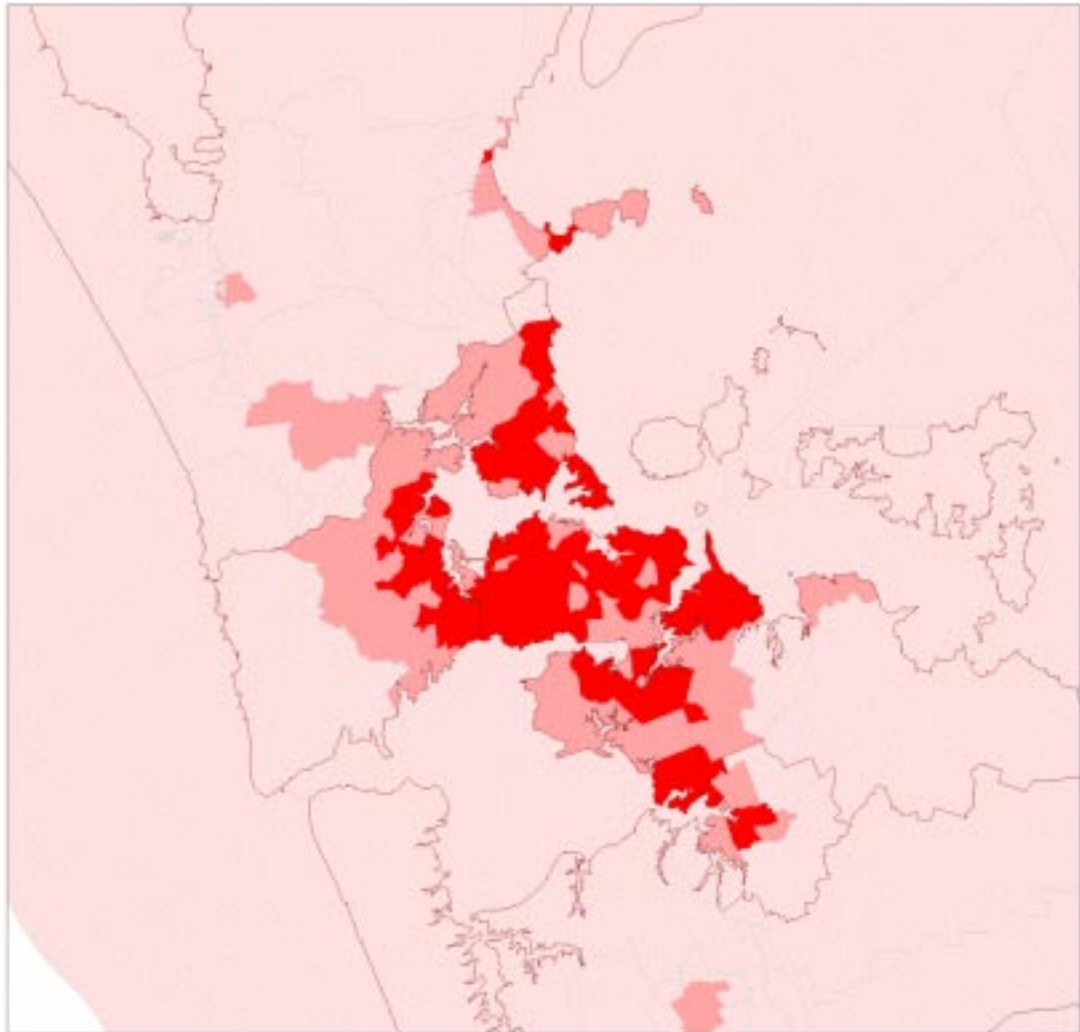


10 0 10 Kilometers

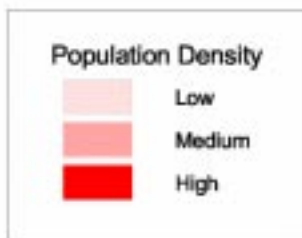


Map 31

Auckland Region Population Density at AU Level 1996

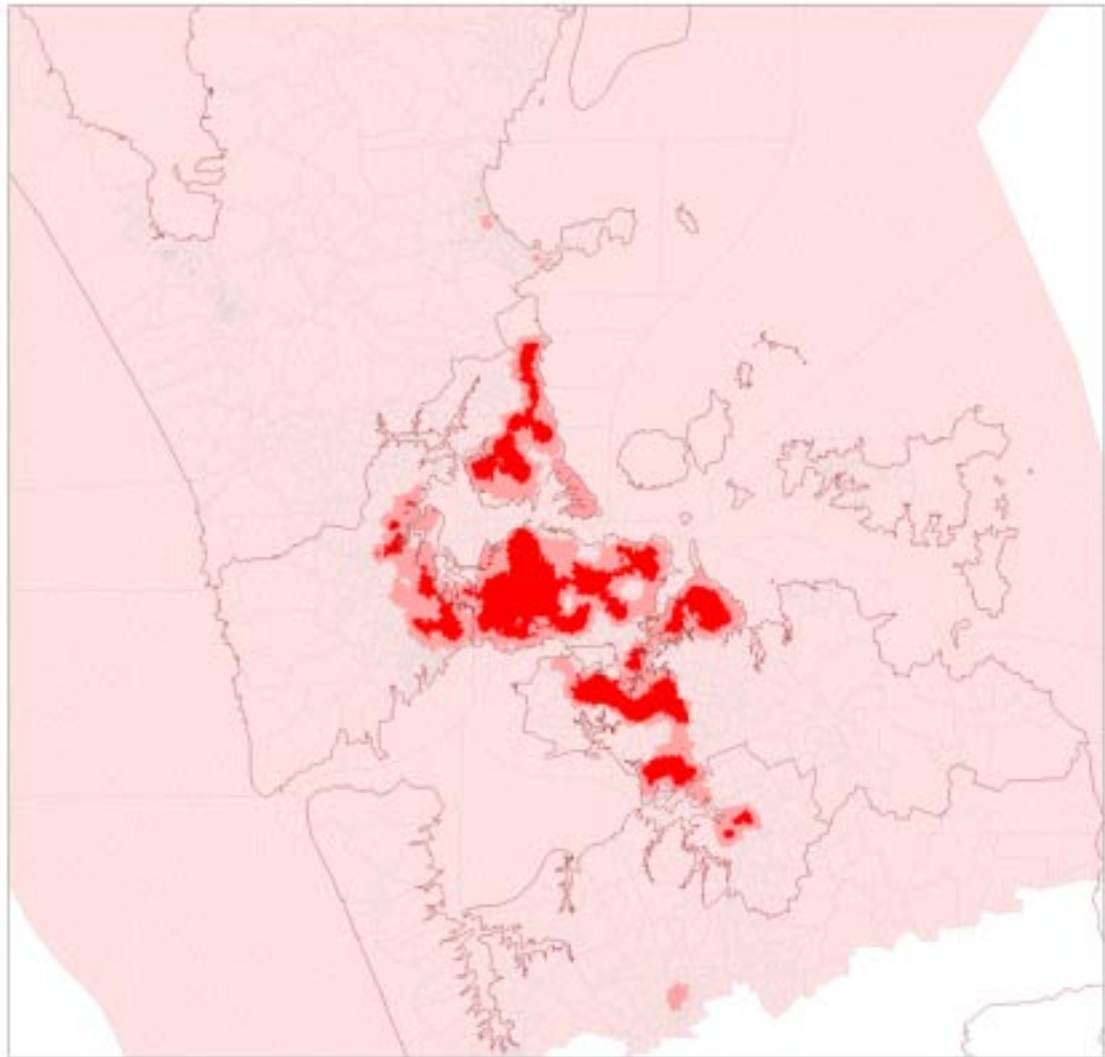


10 0 10 Kilometers

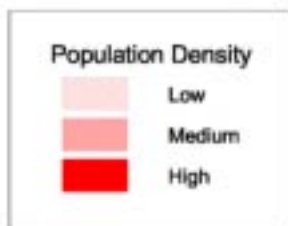


Map 32

Auckland Region
Population Density at 1km Radius 1996

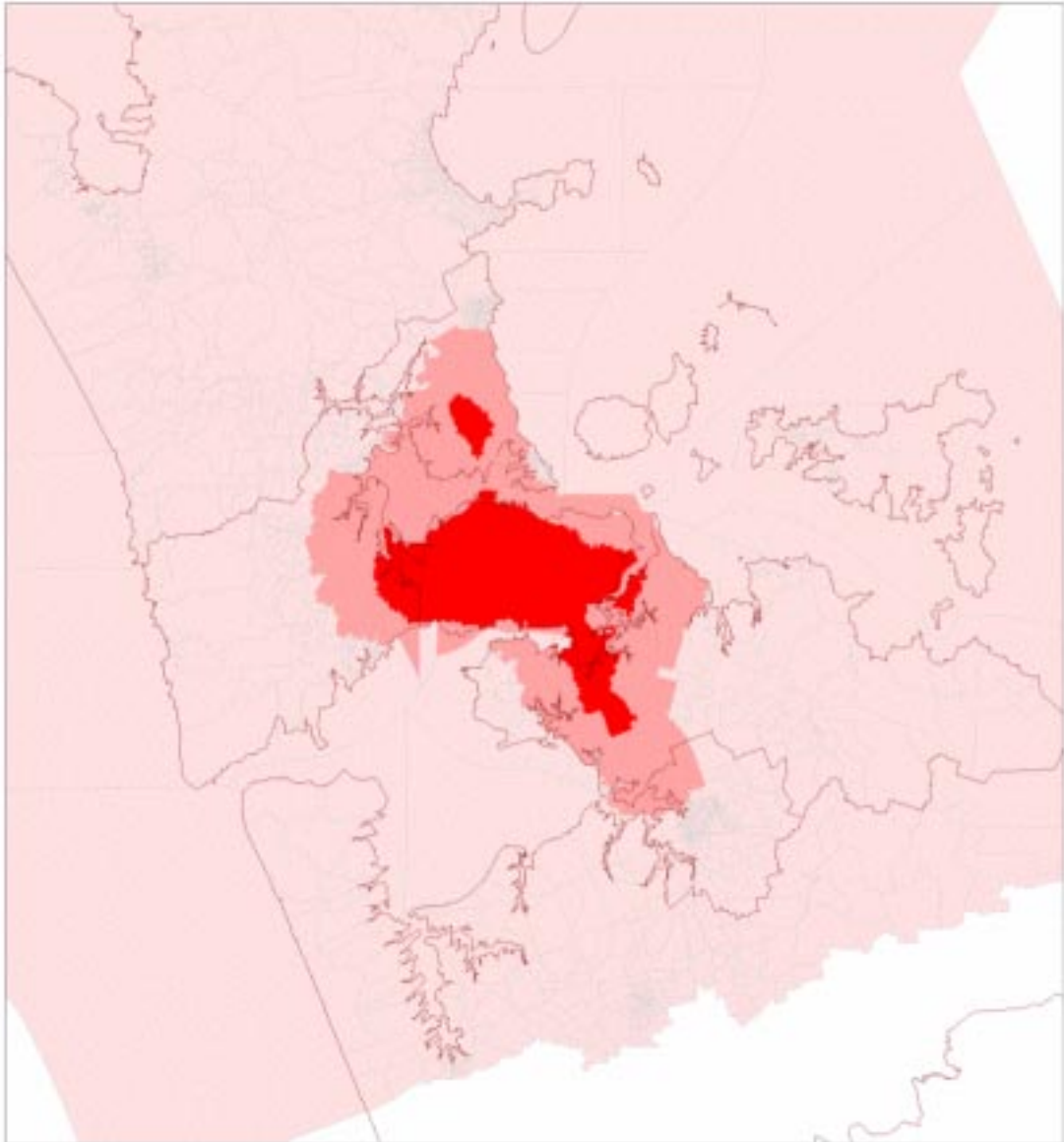


10 0 10 Kilometers

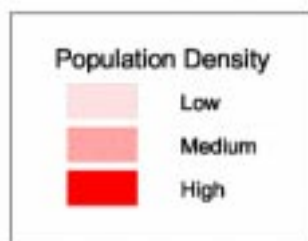


Map 33

Auckland Region Population Density at 5km Radius 1996

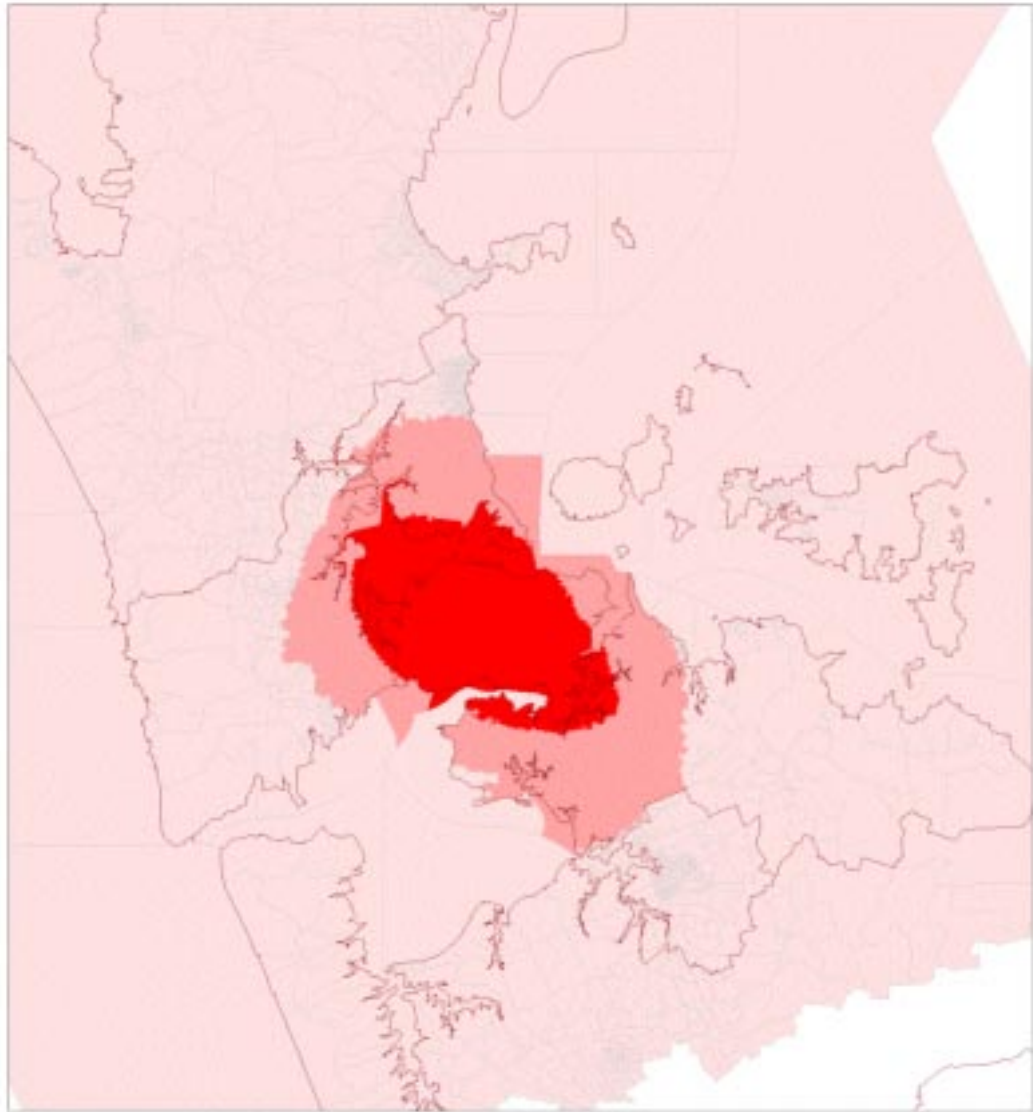


10 0 10 Kilometers

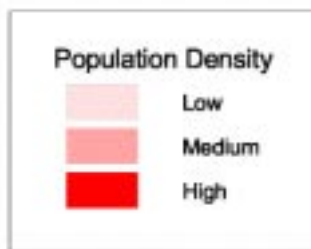


Map 34

Auckland Region Population Density at 10km Radius 1996

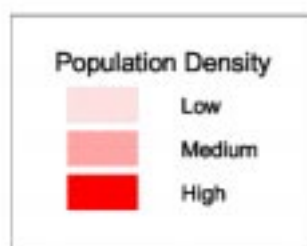
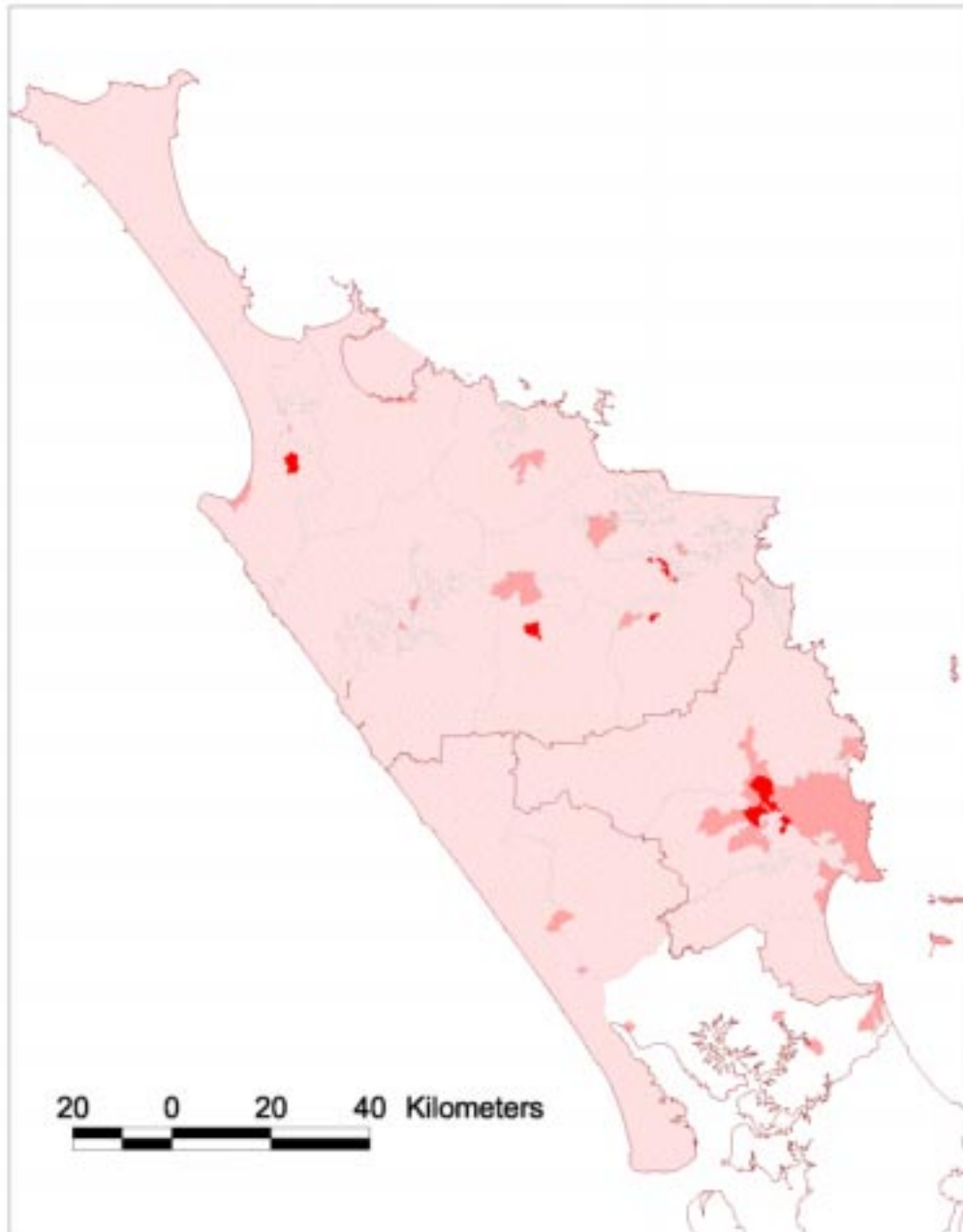


10 0 10 Kilometers



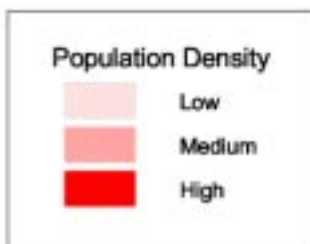
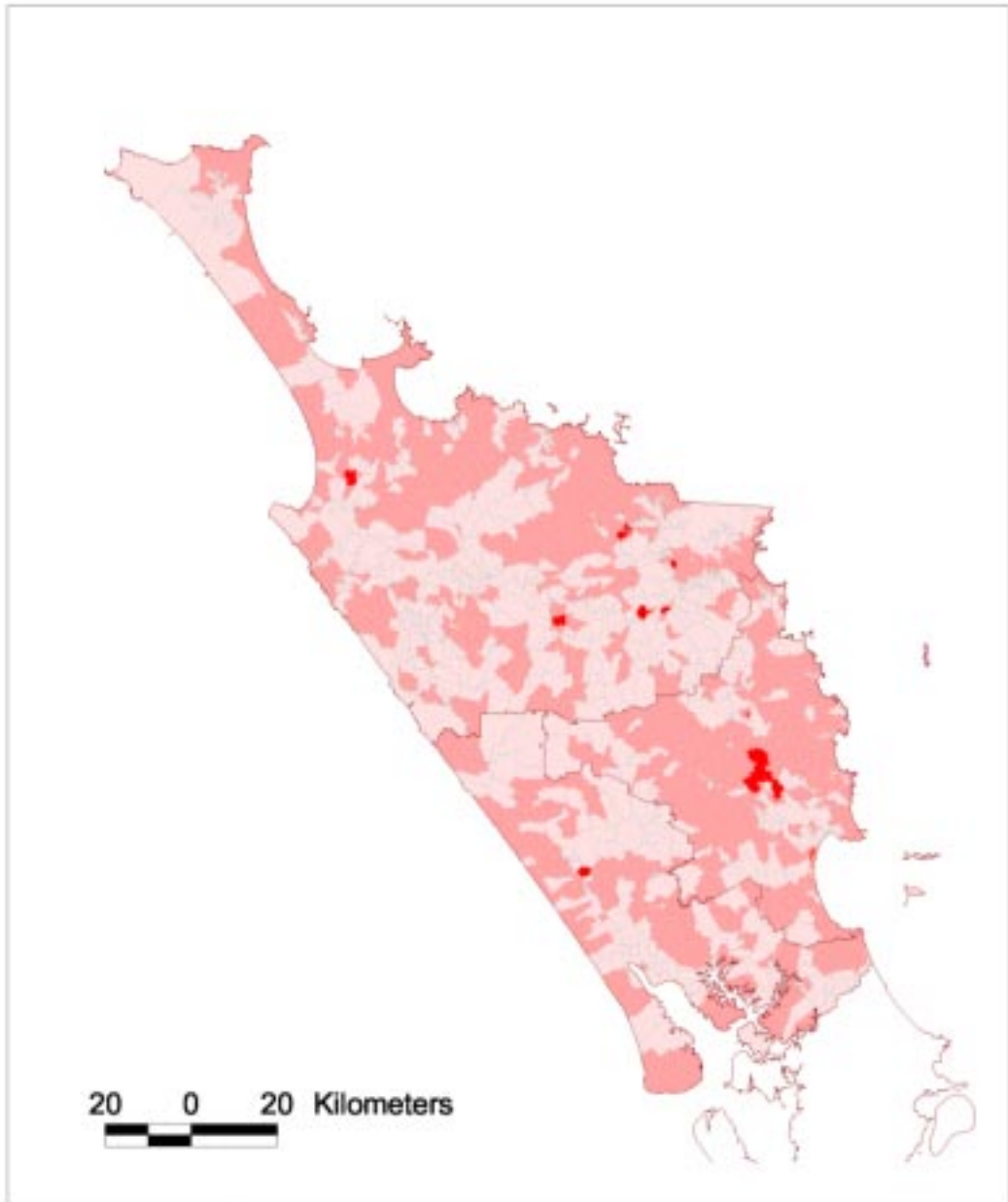
Map 35

Northland Region Population Density at AU 1996



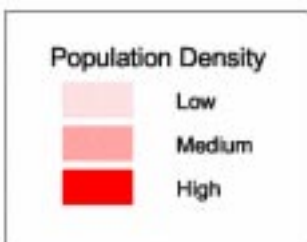
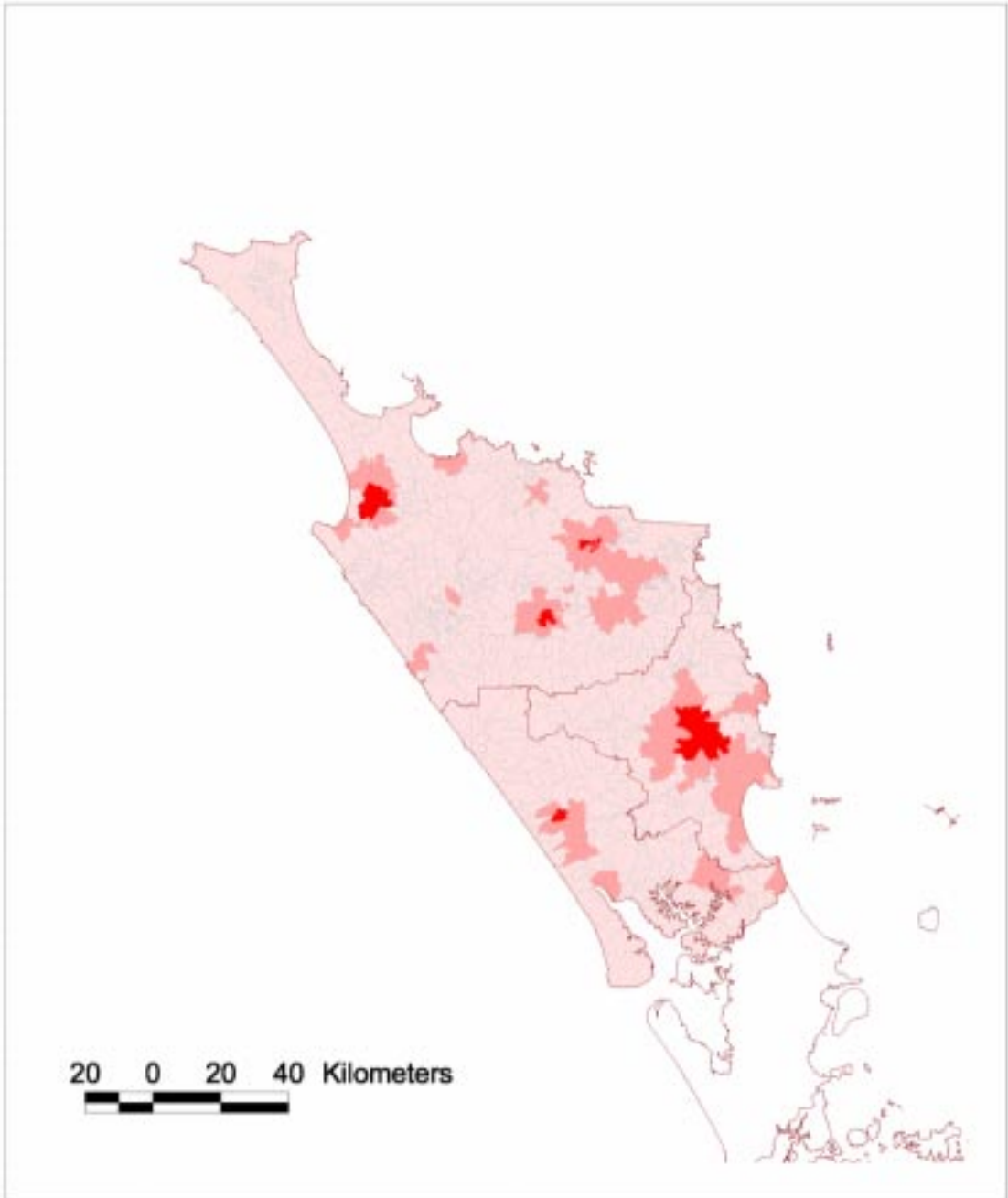
Map 36

Northland Region
Population Density at 1km Radius 1996



Map 37

Northland Region Population Density at 5km Radius 1996



Map 38

Northland Region
Population Density at 10km 1996

