The Ageing of the New Zealand Population, 1881-2051

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Abstract

The paper reviews data on long-term changes in the age structure of the New Zealand population. It sets out trends and projections for the age structure of the national population, and for associated measures of dependency. It describes the influences on age structure of fertility, mortality, and migration. Disaggregated results on age structure are presented, including ethnic differentials, regional variations, and fluctuations within narrowly-defined age groups. Comparisons are made with other OECD countries. Uncertainty, the likelihood of continued life expectancy gains, and life expectancy and health at older ages are discussed.

JEL CLASSIFICATION
J11 - Demographic Trends and Forecasts
J14 - Economics of the Elderly

KEYWORDS
Population Ageing
New Zealand
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The Ageing of the New Zealand Population, 1881-2051

1 Introduction

The New Zealand population is undergoing a long-term transition from a "pre-industrial" age structure in which the vast majority of people are young to "post-industrial" age structure in which young and old age groups are more evenly balanced. This paper presents some empirical data on these age-structural changes. Some of these data will be familiar to anyone concerned with population ageing in New Zealand. Other data, such the results for long-run trends, international comparisons, and prospects for continued mortality decline, may not be.

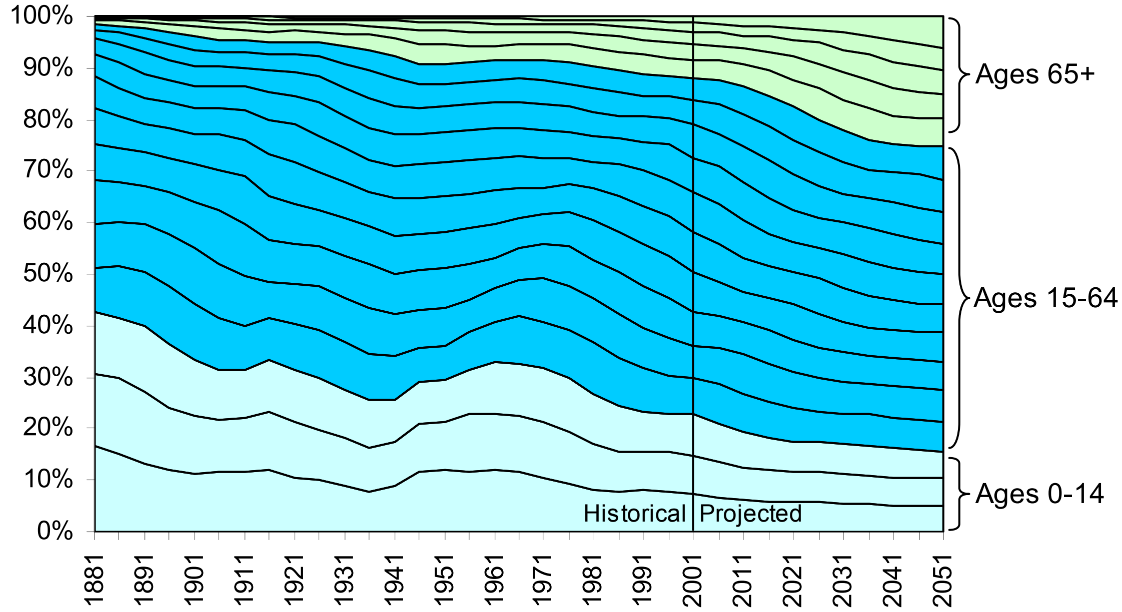
Section 2 of the paper reviews long-term national trends for age structure, including trends in dependency ratios. Section 3 looks at the changes in fertility, mortality, and migration that have been driving the age-structural trends. Section 4 presents disaggregated results for different ethnic groups, regions, and narrowly-defined age groups. Section 5 compares dependency ratios in New Zealand with those of other OECD countries. Section 6 looks at uncertainty and population projections. Section 7 discusses the likelihood of continued gains in life expectancy, and Section 8 looks at life expectancy and health at older ages. The final section draws together the main findings from the paper.

2 Historical and projected trends in age structure

Census data allow long-run trends in age structure to be measured with a reasonable degree of accuracy. Figure 1 presents these trends, along with results from Statistics New Zealand's "preferred" projection series for the period 2001-2051 (Series 4). (Summaries of the data graphed in Figure 1 are given in Appendix Table 1.)

The most prominent feature of the historical and projected data is the increase in the proportion of the population in the older age groups at the expense of the proportion in the younger age groups—that is, population ageing. The downward trend in the share of the younger age groups was, nevertheless, reversed from the beginning of the baby boom in the 1940s to its peak in the 1960s. The proportion in the older age groups is set to increase sharply in coming decades as the baby boom cohorts reach their 60s.

Figure 1 – Historical and projected age structure for the New Zealand population



Source – 1881-1976 Census data cited in Bloomfield (Bloomfield 1984: II.5, II.6, II.23); 1981-2051 Census data and Series 4 projections accessed from Statistics New Zealand website www.stats.govt.nz on 8 July 2003.

Notes – Maori are excluded until 1951. However, the Maori population was only a few percent of the national population between 1881 and 1951, and the exclusion of Maori does not greatly affect the shape of the distribution. Results for 1931 were obtained by interpolating between the 1926 and 1936 Censuses; results for 1941 were obtained by interpolating between the 1936 and 1945 Censuses; and results for 1946 were obtained by interpolating between the 1945 and 1951 Censuses.

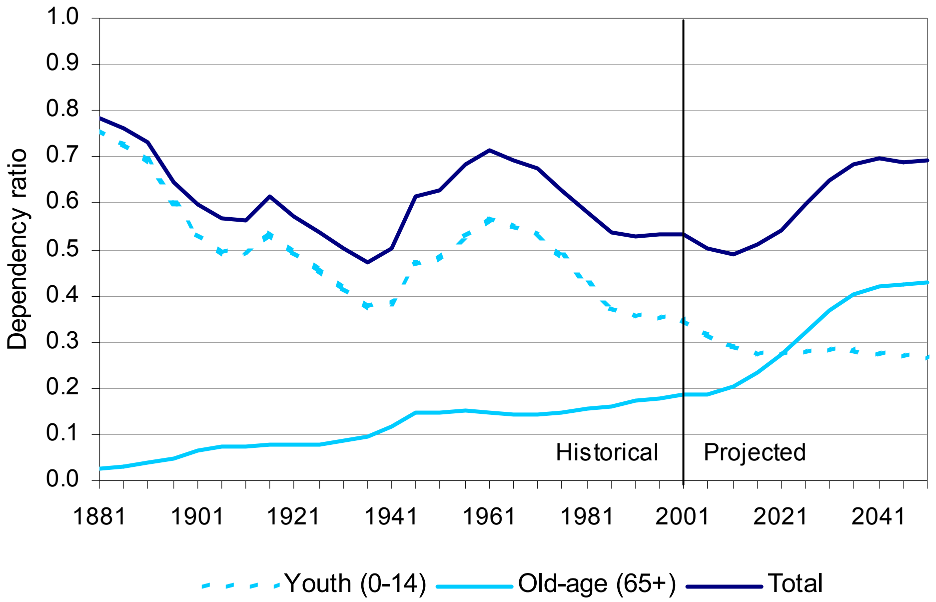
Is this change to an older age structure permanent, or just a transitory effect of the ageing of the baby boom cohorts? Long-term trends in age structure are driven by long-term trends in fertility and mortality rates, so the permanency of the age structure depends on the permanence of low fertility and mortality rates. Rises in either cannot be ruled out, but most researchers argue that low fertility and mortality are an integral part of “modern” economic and social life.

Changes in the age structure lead to changes in the balance between dependants and working-age people. Figure 2 shows three indices that attempt to measure changes in the balance. The youth dependency ratio is the population aged 0-14 divided by the population aged 15-64, and the old-age dependency ratio is the equivalent measure for the population aged 65 and over. The total dependency ratio is the sum of the young and old-age dependency ratios.

Youth dependency has fallen sharply since 1881, except during the baby boom, and is expected to continue falling. Old-age dependency has risen, and is expected to continue rising. The declines in youth dependency have been offset by rises in old-age dependency. The net effect has been that total dependency has fluctuated rather than showing a consistent trend upward or downwards. The average level for the total dependency ratio over the whole period 1881-2051 is 0.61. The current level is 0.52; under the projection shown, the total dependency ratio will not return to its average level until the early 2020s.

All three indices can be criticised. It can be argued, for instance, that a majority of people are now “dependent” until age 20, or even age 25, rather than age 15. There are also conceptual problems with simply adding together indices of youth dependency and old-age dependency, since the two types of dependency may have different economic and social implications. A response to these concerns is that all summary indices are necessarily imperfect and incomplete, but that some, including the three dependency ratios shown here, are nevertheless illuminating.

Figure 2 – Historical and projected dependency ratios



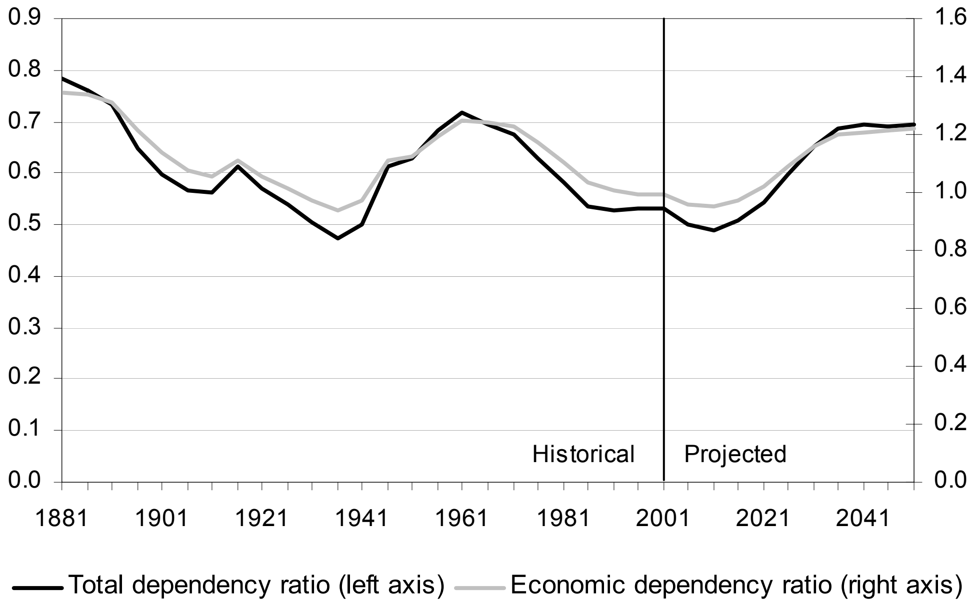
Source – Calculated from the following data: 1881-1976 Census data cited in (Bloomfield 1984: II.5, II.6, II.23); 1981-2051 Census data and Series 4 projections accessed from Statistics New Zealand website www.stats.govt.nz on 8 July 2003.

Notes – The youth dependency ratio is the population aged 0-14 divided by the population aged 15-64; the old-age dependency ratio is the population aged 65 and over divided by the population aged 15-64; the total dependency ratio is the sum of the young and old-age dependency ratios.It is instructive to examine changes in summary measures of population structure.

It is also reassuring that alternative measures of dependency are highly correlated. One alternative measure is the "economic" dependency ratio, the population in the labour force divided by the population not in the labour force[1]. Figure 3 shows the total dependency ratio and 'economic' dependency ratio for the period 1881-2051. Though not identical, the two series clearly convey much the same message.

[1] In these calculations, the population in the labour force is calculated using fixed age-sex-specific participation rates, and changing population distributions. Let a_i be the labour force participation rate of age-sex group i (which is held fixed) and let p_{it} be the proportion of the total population in age-sex group i in year t. The economic dependency ratio equals $l_t / (1-l_t)$ where $l_t = \Sigma a_i p_{it}$.

Figure 3 – Total and "economic" dependency ratios



Note – The 'economic' dependency ratio is defined as the population in the labour force divided by the population not in the labour force, where the population in the labour force is calculated using fixed age-specific participation rates (in this case the rates for the first quarter of 2003), and changing proportions each age group.

Source – Population distribution calculated from the following data: 1881-1976 Census data cited in (Bloomfield 1984: II.5, II.6, II.23); 1981-2051 Census data and Series 4 projections accessed from Statistics New Zealand website www.stats.govt.nz on 8 July 2003. Age-specific labour force participation rates obtained from the Household Labour Force Survey, First Quarter 2003.

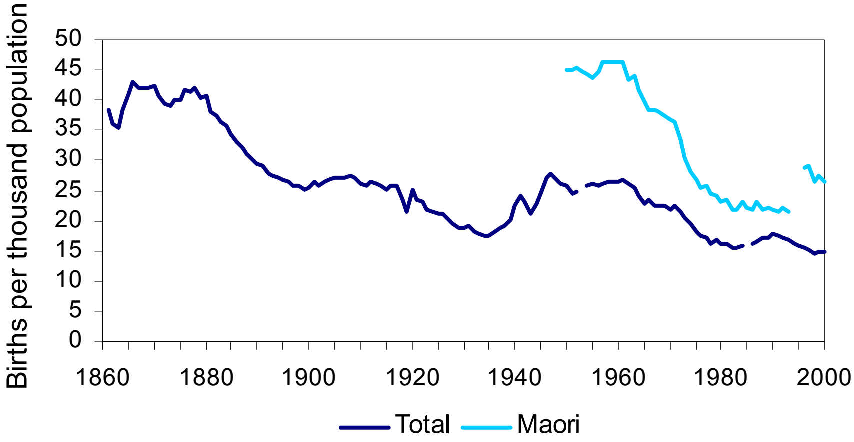
3 Proximate determinants of changes in age structure

People enter or leave a population through birth, death, and migration. The age structure of a population is thus an outcome of trends in fertility, mortality, and migration rates.

3.1 Fertility

The birth rate for the total New Zealand population has been drifting downwards since the 1880s, with an interruption during the baby boom of the 1940s, 1950s, and 1960s (Figure 4). In the long run, fertility decline leads to a lower ratio of young people to old people, and hence an "older" age structure.

Figure 4 – Births per thousand population, 1860-2000



Source – 1860-1994 (Thorns and Sedgwick 1997: Table 2.4); 1995-2000 (Statistics New Zealand 2001a: Table 2.08)

Note – Before 1 September 1995, the ethnicity of birth was determined by the 'degree-of-blood' of the child; from that date is was determined by self-identification of the mother. The apparent increase in Maori fertility during the 1990s is probably an artefact of this change.

However, the short-run effects of a fertility decline differ from the long-run effects. A fertility decline leads immediately to an fall in youth dependency, but the rise in old age dependency does not occur until until the large pre-decline cohorts reach old age. During the intervening period the total dependency ratio is temporarily below trend: there is a temporary reduction in the number of dependents per working-age person. This reduction in dependency can give the economy a transitory boost, and has been referred to as a "demographic bonus" (Bloom and Williamson 1998).

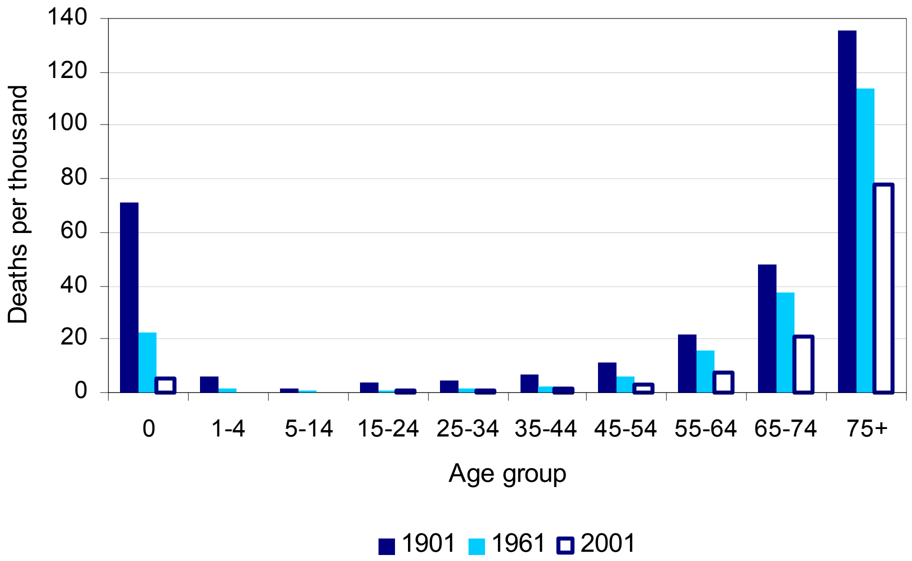
The short-run effects on the age structure of the decline in fertility after the early 1960s are clearly visible in Figure 2. Youth dependency declined immediately, but the effects on old-age dependency have still not appeared; in the intervening period, total dependency has been reduced.

Fertility trends for the total population disguise quite different trends among Maori. As Figure 4 shows, Maori fertility rates did not begin declining until the 1960s, 80 years later than the population as a whole. The apparent increase in fertility during the 1990s is probably just an artefact of definitions used. Before 1 September 1995, the ethnicity of a birth was determined by the "degree-of-blood" of the child; from 1 September it was determined by self-identified status of the mother. Section 4.1 discusses how the contrasting birth rates are reflected in contrasting age structures.

3.2 Mortality

Death rates fell across all age groups during the twentieth century, as Figure 5 shows. Over the period 1901-1961, infant mortality declined substantially, while old-age mortality declined more modestly; after 1961 infant mortality continued to fall, but the largest absolute declines were among old people. Because they were concentrated especially among young people, the early mortality declines actually acted to *reduce* the average age of the population. They reduced it directly, by raising the number of surviving children, and indirectly, by raising the proportion of people surviving to the reproductive ages and having children themselves. Later mortality declines, in contrast, increased the average age of the population. They raised the number of surviving older people, with little effect on the number of births, since the proportion of people surviving to the reproductive changes was already very high (Preston, Heuveline and Guillot 2001: 159-60).

Figure 5 – Deaths per thousand population, by age-group, 1901, 1961, and 2001



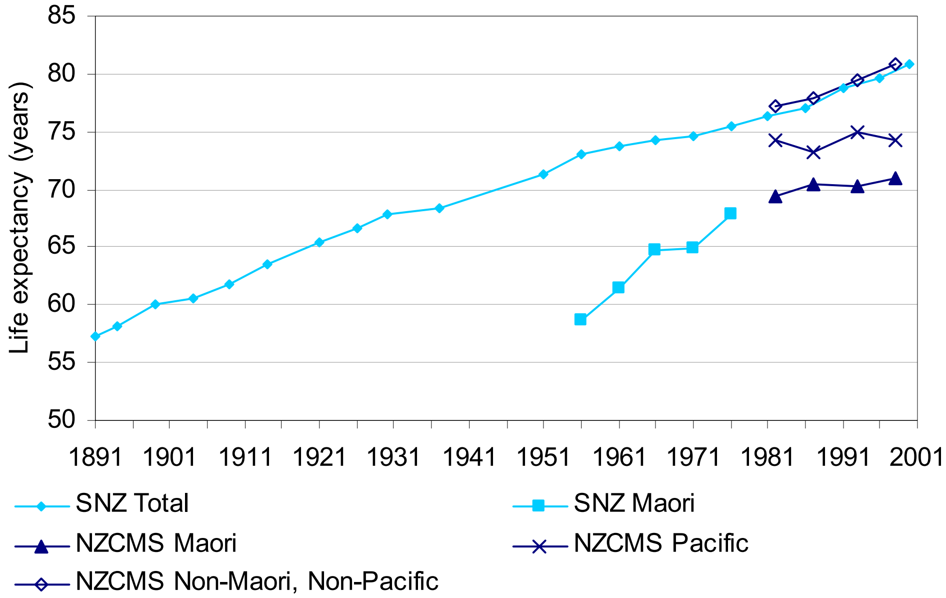
Note – 1901 estimates do not include Maori. All estimates are for males and females combined.

Source – Statistics New Zealand (2002b: Table 5.15)

Mortality trends, like fertility trends, have been different for Maori than for the population as a whole. Figure 6 shows some representative life expectancy data. The "SNZ" series are official Statistics New Zealand estimates. The "NZCMS" series are from a recent publication of the New Zealand Cohort Mortality Study. These series correct for the fact that the ethnicity of Maori and Pacific people was often not recorded on death certificates during the 1980s and 1990s, leading to an underestimate of mortality among these groups[2]. As is apparent, Maori female life expectancy was much lower than total female life expectancy in the mid-1950s, but improved much faster over the next 25 years, reducing the difference considerably. From the early 1980s to the late 1990s, Maori female life expectancy improved little, while total female life expectancy improved sharply, so that the difference again widened. A similar pattern occurred with males (Figure 14). Life expectancies for Pacific people appear to be higher than for Maori, but lower than for the population as a whole. As will be seen in Section 4.1, the lower life expectancies reinforce the effects of the higher birth rates, to give Maori and Pacific Peoples younger age structures than other New Zealanders.

[2] The estimates shown define as "Maori" anyone who included "Maori" among the one or more ethnicities they reported on their census forms; the estimates define as "Pacific" anyone who included "Pacific" among the ethnicities they reported, but did not include "Maori". Another series was calculated in the New Zealand Cohort Mortality Study, defining people as "Maori" only if they reported Maori as their sole ethnicity, and defining people as "Pacific" only if they reported Pacific as their sole identity. Estimated life expectancies for Maori and Pacific people in these series were lower than in the "prioritised" series shown here.

Figure 6 – Life expectancy at birth, females



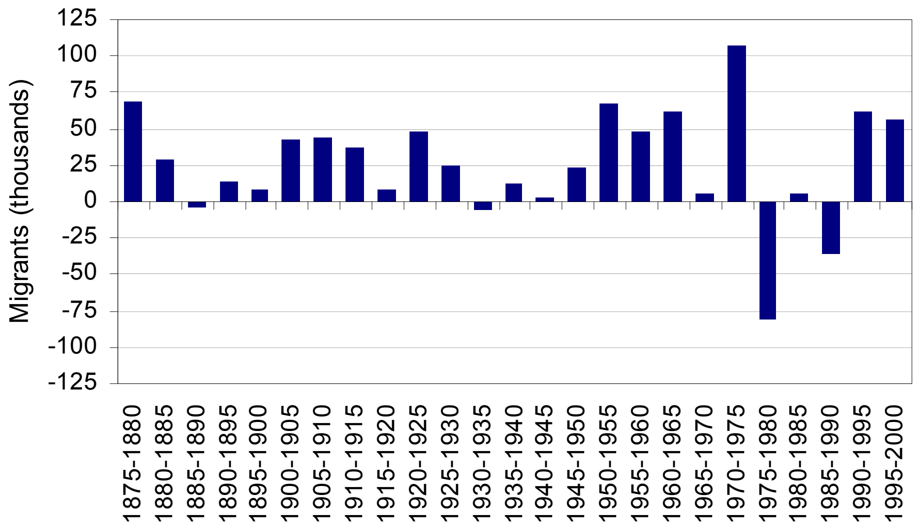
Sources – SNZ Total and Maori: Statistics New Zealand (2000: 102) and Statistics New Zealand (2002a: Table 4.10); NZCMS Maori, Pacific, and Non-Maori Non-Pacific: Ajwani *et al.* (2003: Appendix Table 24).

Note – NZCMS refers to "New Zealand Cohort Mortality Study". The figure shows the 'prioritised' NZCMS series. Data for males are shown in the Appendix.

3.3 Migration

During the 1990s, levels of net migration into New Zealand were comparable to those following World War II, in contrast to the dramatic outflows of the early 1970s and 1980s (Figure 7). Immigration regulations have long favoured young working-age migrants (Statistics New Zealand 2002b:). In-migration does in fact peaks around these age groups, though, as Figure 8 shows, so does out-migration.

Figure 7 – Net migration to New Zealand (thousands)

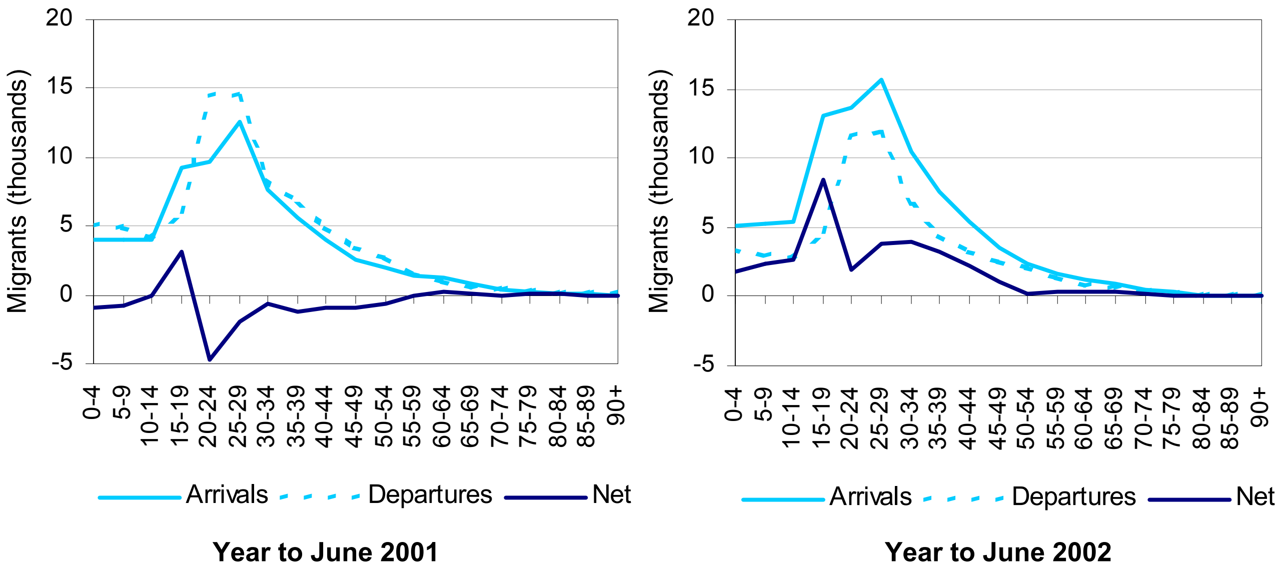


Source – (Statistics New Zealand 2002b: Table 5.16)

Note – These estimates are for total migration, and do not distinguish between "permanent and long-term" and "short-term" migrants.

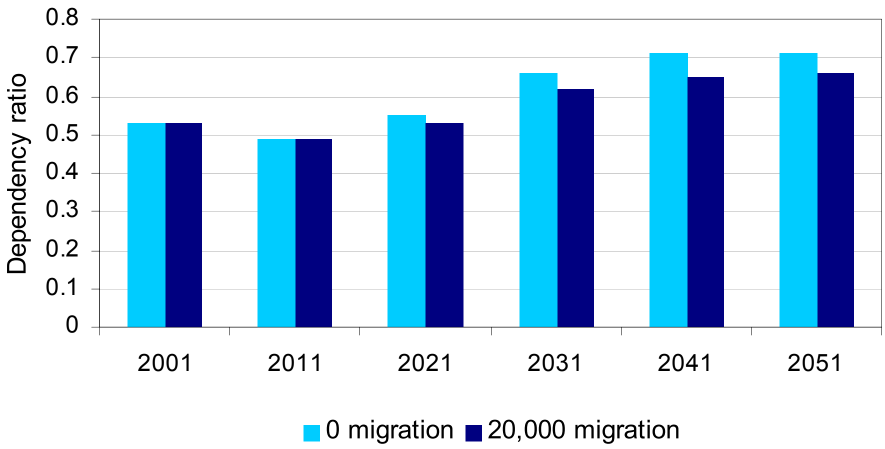
Higher levels of in-migration tend to increase the proportional share of the working ages and reduce the dependency ratio. However, the magnitude of these increases is typically less than intuition would suggest. Despite the peaks around the young working ages, many migrants belong to older age groups. Even those in-migrants who are young when they arrive grow old themselves, and have children, thus contributing towards the number of dependants.

Figure 8 – Permanent and long-term migration by age, 2001 and 2002



Source – Statistics New Zealand (2002a: Table 5.4)

Figure 9 – Statistics New Zealand 2001-base projections for the total dependency ratio, with varying migration assumptions



Source – Data accessed from Statistics New Zealand website www.stats.govt.nz in July 2003

Note – Both projection series assume "medium" fertility and "medium" mortality; the "0 migration" series assumes net migration of 0 per annum, and the "20,000 migration" series assumes net annual migration of 20,000.

The most satisfactory way to analyse these processes would be to set up a simulation that, for instance, distinguished between students and longer-term migrants, distinguished New Zealand citizens from non-citizens, and allowed migrants to have different fertility rates from non-migrants. This is not currently possible, given available data. Some insights can, nevertheless be gained by comparing results from conventional projection series based on varying assumptions about migration.

Figure 9 compares results from two of Statistics New Zealand's 2001-base projection series. The two series both use the medium' fertility and 'medium' mortality assumptions. The first series uses Statistics New Zealand's '0 migration' assumption, which is the assumption with the lowest long-term level for net migration. Under this assumption, in-migration exactly matches out-migration after a short adjustment period—though for the population as a whole, and not for every age group. The second series uses Statistics New Zealand's "20,000 migration" assumption, which is the assumption with the highest long-term level for net migration. Under this assumption, in-migration eventually exceeds out-migration by 20,000 per year. Over 50 years, a difference of 20,000 per year adds up to 1 million extra migrants, a substantial number. As can be seen in Figure 9, dependency ratios are indeed lower under the "20,000 migration" scenario. The reduction is not, however, large: 0.65 dependants per working-age person by 2051 rather than 0.71. The effect on population size *is* large. The population in 2051 would be 5.8 million under the "20,000 migration" assumption and only 4.4 million under the "0 migration" assumption (the difference is greater than 1 million mainly because of births to migrants.)

Similar exercises have produced similar results in other countries (United Nations 2000, Young 1988). It seems to be a general rule that migration has a much larger impact on population size than it does on population age structure.

4 Disaggregated measures

Section 3 has already alluded to the need to disaggregate in order to identify contrasts in the demographic situations of different ethnic groups. Disaggregating by geographical region and by narrow age group also reveals some important differences.

4.1 Ethnicity

Fertility rates for the "European", "Maori", "Pacific" and "Asian" ethnic groups are shown in Table 1. In Table 1, as in the rest of this section, the ethnic groups used for the estimates are not mutually exclusive: for instance, people who identified themselves as both "European" and "Maori" on their census forms are included in both estimates. Nor are the groups exhaustive: Statistics New Zealand also has a catch-all "Other" category, whose results are not shown here. Maori and Pacific Peoples have significantly higher fertility than Europeans and Asians. These differences are long-standing (see, for instance, Figure 4.) Maori and Pacific Peoples have significantly lower life expectancies than Europeans and Asians[3]. Migration patterns also differ: the "Asian" ethnic group, for instance, has very high migration rates in the young adult ages.

3 See, for instance, Figure 5 and the documentation accompanying Statistics New Zealand's 2001-base ethnic population projections available from the Statistics New Zealand website www.stats.govt.nz.

Table 1 – Total fertility rates, by ethnic group, 2001

Ethnic group	Total fertility rate
European	1.76
Maori	2.55
Pacific	2.95
Asian	1.65
Overall	1.97

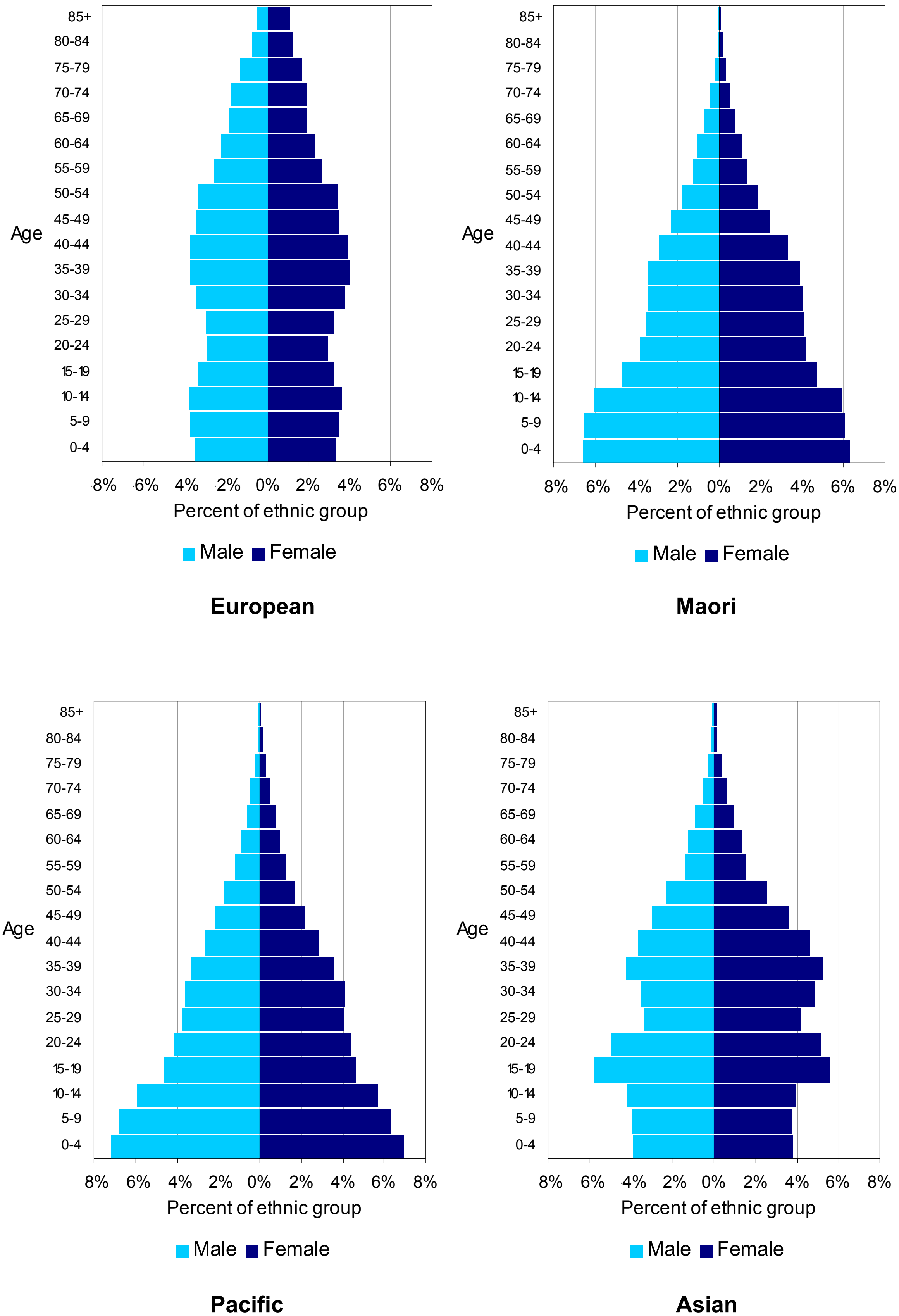
Source – Obtained from the documentation accompanying Statistics New Zealand's 2001-base ethnic population projections. Accessed from the Statistics New Zealand website www.stats.govt.nz in July 2003.

Notes – The total fertility rate is the number of births the average woman would have over her lifetime if prevailing age-specific fertility rates were to be maintained indefinitely. The ethnic groups are not mutually exclusive: for instance, a person who identified themselves as both "European" and "Maori" would be included in both estimates.

Figure 10 shows age-sex pyramids. The width of each horizontal bar in the pyramid indicates the proportion of the ethnic group in that age-sex category. The wide bases of the Maori and Pacific pyramids imply that the Maori and Pacific populations are relatively young. The bulge in the European pyramid between ages 30 and 54 is formed by the baby boom cohorts; the bulge about 30 years below this is formed by the baby boomers' children. The bulge in the Asian pyramid at ages 15-24 is formed by students.

Differences in the age structures of ethnic groups mean they are affected differently by age-specific social trends. Rises or falls in youth employment, for instance are have a disproportional impact on Maori and Pacific Peoples. Conversely, changes in superannuation arrangements have a disproportional impact on Europeans. The population-level differences visible in Figure 10 also have family level counterparts. Elderly Maori and Pacific Peoples, for instance, have more children whom they can draw on for support than do elderly Asians and Europeans (Statistics New Zealand 2001b: Table 8).

Figure 10 – Age-sex pyramids, by ethnicity, 2001



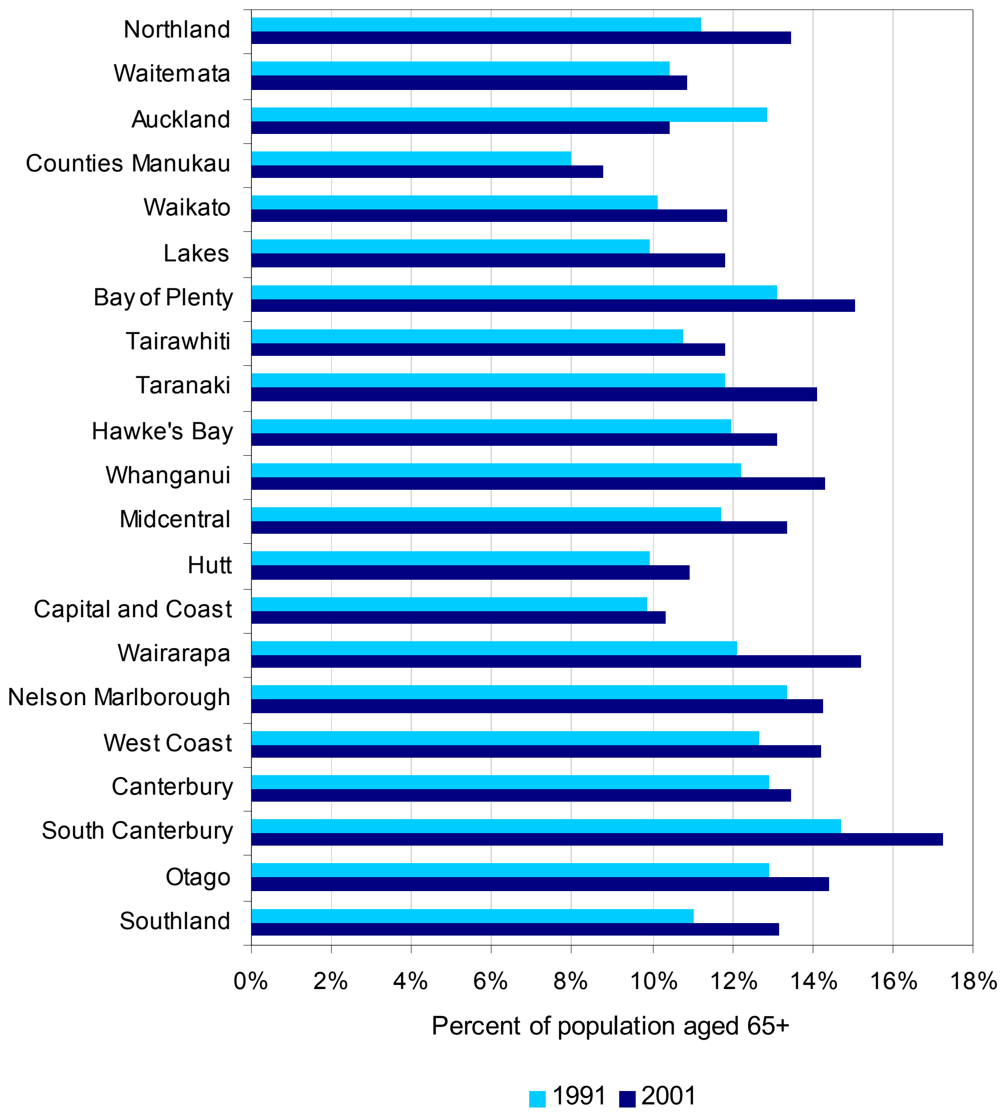
Source – Calculated from 2001 Census data downloaded from Statistics New Zealand website www.stats.govt.nz in July 2003

Note – The categories are not mutually exclusive: for instance, a person who chooses both European and Maori ethnicities is included in both categories.

4.2 Region

Age structures vary across geographical areas, in line with variations in ethnicity, job prospects, desirability as a retirement destination, and so forth (Lepina 2000, Stephenson 2002). Figure 11 shows some illustrative data, based on the areas served by District Health Boards. Note that these areas differ not only in levels of population ageing but also in rates of change. Between 1991 and 2001, for instance, the proportion of the Wairarapa population aged 65 and over increased by 3.1 percentage points, while in Auckland it *decreased* by 2.4 percentage points (due, presumably, to migration). These data illustrate the importance of local priority-setting and of funding formulas that take into account differences in age structure.

Figure 11 – Percent of population aged 65 and over, by District Health Board, 1991 and 2001

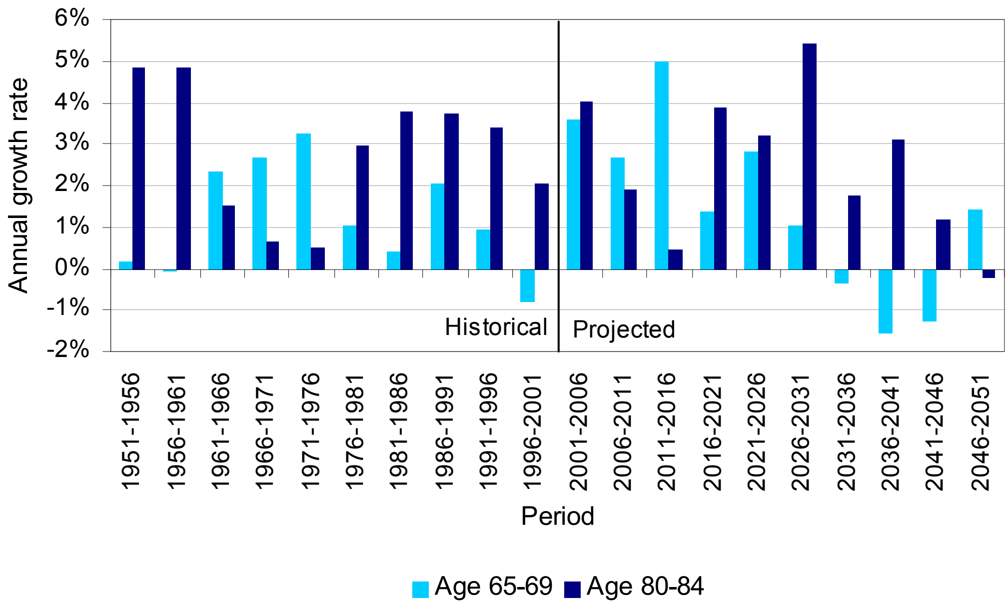


Source – 1991 and 2001 Census data, obtained from the Statistics New Zealand website www.stats.govt.nz in July 2003.

4.3 Narrow age groups

Broad changes to the overall shape of the age distribution such as population ageing, or the movement of the baby boom cohorts through the age distribution, are slow and systematic. These gradual transformations can, however, occur simultaneously with rapid, erratic changes within narrowly-defined age groups (Pool 2001). Figure 12, for example, shows historical and projected growth rates for the age groups 65-69 and 80-84. These growth rates vary enormously from one five-year period to the next: between the periods 1956-1961 and 1961-1966, for instance, the growth rate for the 80-84 age group fell from 4.8% per annum to 1.5%. These "disordered cohort flows" arise when sudden or mutually reinforcing changes in birth rates, death rates, or migration rates result in one cohort being substantially bigger or smaller than its predecessors (Pool 2001, Preston *et al* 2001: 180-4).

Figure 12 – Annual growth rates for the age groups 65-69 and 80-84



The extent to which aggregate levels of a particular variable are affected by disordered cohort flows depends on the age profile of the variable. If age-specific rates for the variable are markedly different in the age groups experiencing the disordered cohort flows than they are in other age groups, then the effect of the disordered cohort flows is particularly large. The classic example is schooling. Enrolment rates for primary school, for instance, are high in the age group 5-9 and low elsewhere: a sharp increase in the size of the 5-9 age group therefore implies a sharp increase in the number of primary school students. Similarly, if admittance to rest homes becomes increasingly concentrated in the oldest age groups, then sudden changes in the size of these age groups could create large gaps between capacity and demand.

5 International comparisons

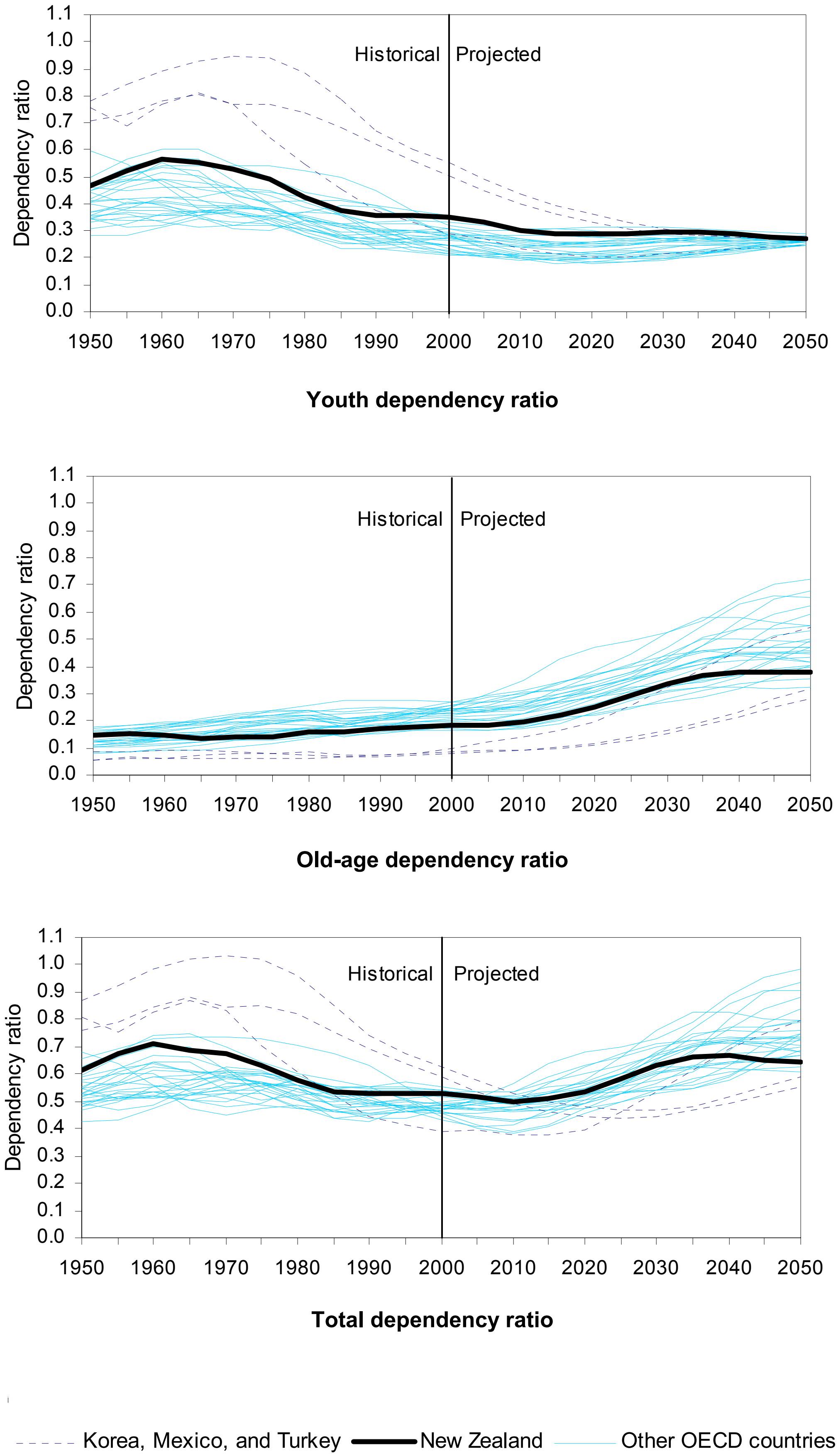
New Zealand's fertility rates have been relatively high by OECD standards, leaving New Zealand with a relatively young age structure (Bryant 2003b). Figure 13 illustrates New Zealand's position within the OECD using United Nations Population Division projections for all 30 OECD countries.

Youth dependency has been higher in New Zealand than in most OECD countries, and is projected to remain so. The only two countries with substantially higher youth dependency at present are Turkey and Mexico, both of which are relatively poor and under-developed. Korea began the 1950s poor and under-developed, but has experienced such rapid development, and such an extreme fertility decline, that its youth dependency ratio is now lower than New Zealand's and is projected to remain lower.

Old-age dependency has been lower in New Zealand than in most other countries, and is projected to remain so. The only countries with substantially lower old-age dependency are again Korea, Mexico, and Turkey, though the UN projects that Korea will overtake New Zealand in coming decades.

The net effect of New Zealand's high youth dependency and low old-age dependency has, for past decades, been relatively high total dependency. If the UN projections are borne out, however, total dependency will rise more slowly in New Zealand than elsewhere over coming decades. New Zealand will move from near the top of the international distribution for total dependency ratios to near the bottom. Concern at dependency burdens created by population ageing thus needs to be tempered by the realization that any adverse effects of ageing *per se* are likely to be felt more strongly in other OECD countries than they are here. At the same time, however, it must be acknowledged that fiscal and economic effects of population ageing depend also on many non-demographic factors, such the financing arrangements for government pension schemes, or the incentives for labour force participation.

Figure 13 – Dependency ratios of OECD countries



Source – Calculated from data from the United Nations Population Division's online database *World Population Prospects: The 2002 Revision* at http://esa.un.org/unpp/

6 Population projections and uncertainty

Demographic trends are much easier to predict than most social and economic trends. Aided by the fact that all the relevant people have now been born, demographers can, for instance, say something sensible about the number of 60 year olds who are likely to be living in New Zealand in 2061. Few other economic or social forecasts about the year 2061 contain much substance. Moreover, for many purposes, it is legitimate to ignore the demographic uncertainty that is present. If all that is required is an order of magnitude, or if demographic influences are not the focus of attention, then a single demographic projection is often enough.

In some cases, however, it is helpful to test the extent to which the results of a policy model are sensitive to demographic uncertainty. Economic forecasters, for instance, might want to take the possibility of adverse demographic trends into account. Statistical agencies, including Statistics New Zealand, respond to this need by publishing a set of alternative projections, based on different combinations of fertility, mortality, and migration assumptions, as shown in Table 2. By comparing results from different series, users can obtain some feeling for the magnitude and influence of demographic uncertainty, as was done in Section 3.3 for migration.

Table 2 – Projection variants published by Statistics New Zealand

Series	Fertility assumption	Mortality assumption	Migration assumption
1	Low	Medium	5,000
2	Medium	High	5,000
3	Medium	Medium	0
4	Medium	Medium	5,000
5	Medium	Medium	10,000
6	Medium	Medium	20,000
7	Medium	Low	5,000
8	High	Medium	5,000

The standard projection variants approach is simple, inexpensive, and transparent. It does, nevertheless, have some problems. For reasons explained in Bryant (2003a), sets of population projection variants tend to understate the extent to which uncertainty about fertility rates creates uncertainty about future age structure. Demonstrations that "demography makes little difference" to projected fiscal or economic outcomes therefore needed to be treated sceptically.

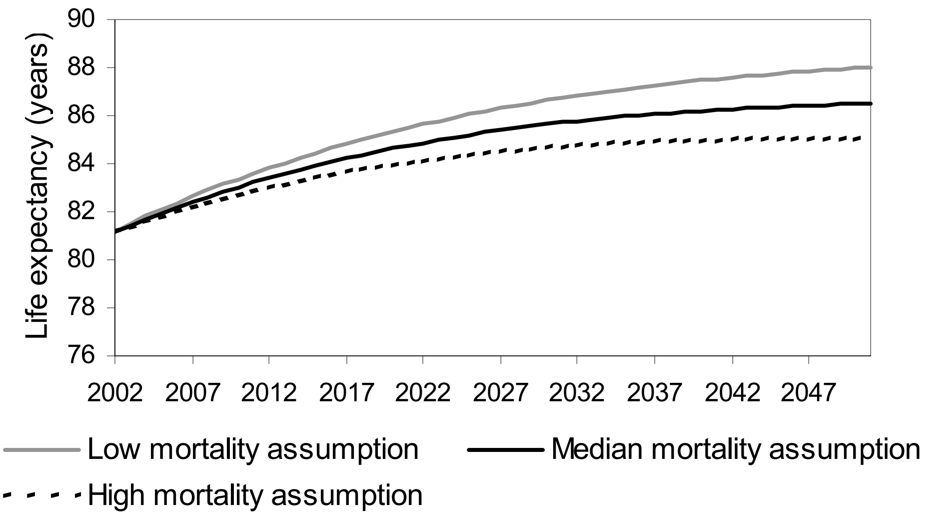
Probabilistic population projections, which yield probability distributions for future demographic outcomes, can be used to overcome these limitations. Wilson and Bell (2003) are in the process of constructing probabilistic projections for Australia and New Zealand. Preliminary results suggest, for instance, that there is a 95% probability that the median age of the New Zealand population will fall between 40 years and 51 years in 2051 (it is currently 26 years) (Wilson 2003: Figure 13).

7 Prospects for continued gains in life expectancy

Whatever method is used to model uncertainty, all population projection methods require assumptions about underlying trends. In the absence of convincing arguments to the contrary, most statistical agencies and academic demographers assume that fertility will decline slightly in OECD countries such as New Zealand where it is currently high, and will increase slightly in countries such as Italy or Japan where it is currently very low. Similarly, "preferred" or "median" migration assumptions are usually based on some slightly modified version of the status quo[4]. Assumptions about mortality trends are, however, subject to much greater debate.

On one side of the debate are those who place a high weight on medical arguments and intuitions about plausible ceilings for human life expectancy. Influential advocates for this position are, for instance, Fries (1980) and Olshansky, Carnes, and Cassel (1990). Statistical agencies have traditionally accepted these views, and have based population projections on mortality assumptions that entail a slowing or complete halt in life expectancy improvements during the projection period. Statistics New Zealand follows this approach, as illustrated by Figure 14.

Figure 14 – Assumptions about female mortality rates used by Statistics New Zealand in 2001-base population projections



Source – Customised tabulations from Statistics New Zealand

On the other side of the debate are demographers and statisticians who argue for a continuation of historical trends. The most striking demonstration of the persistence of these trends is the series for "best practice" life expectancy assembled by Oeppen and Vaupel (2002: 1030). Best practice life expectancy is the level achieved by the lowest-mortality population in the world. It has been increasing by 2.43 years per decade for women and 2.22 years per decade for men, for a full 160 years, with extraordinary regularity, and no sign whatsoever of a slow-down. (Fitting straight lines to the graphs

4 For some examples of fertility and mortality assumptions, see the following: Statistics New Zealand at www.stats.govt.nz; the United Nations Population Division at http://esa.un.org/unpp/; Lee and Tuljapurkar (1994); and Lutz, Sanderson and Scherbov (Lutz, Sanderson and Scherbov 2001).

gives an R-squared of 0.992 for women and 0.980 for men.) Individual countries do move towards or away from the best-practice level, but over the last 40 or so years, there has been a tendency for industrialised countries to converge towards it. Cross-country variance in life expectancy has fallen substantially (Oeppen and Vaupel 2002: Supplementary Material, White 2002: Table 3).

Proponents of the argument for a continuation of historical trends point to the repeated breaching of putative biological limits to life expectancy. A striking example was the claim, made by prominent American scientist Louis Dublin in 1928, that the upper limit to life expectancy was 64.75 years; unknown to him, non-Maori New Zealand females had breached this limit 7 years earlier. A more recent example was the claim by Olshansky *et al*. (1990) that life expectancy at age 50 could not exceed 35 years; Japanese women surpassed this figure six years after the claim was made (Oeppen and Vaupel 2002: 1030).

Table 3 – Life expectancy at birth in 2051

	Female	Male
2001 life expectancy + improvement of 2 years per decade	91.0	86.1
Statistics New Zealand's median mortality assumption	86.5	82.5
Statistics New Zealand's low mortality assumption	88.0	84.5

Source – Information on mortality assumptions obtained from the documentation for the *National Population Projections (2001(base) - 2051)* accessed from the Statistics New Zealand website www.stats.govt.nz in July 2003.

Assuming continued gains at something like historical rates leads to large divergences from conventional life expectancy assumptions by the end of the projection period. Table 3 provides an illustrative example. Males and females are both assumed to experience gains in life expectancy at the rate of 2 years per decade. Under this assumption, New Zealand women would have a life expectancy of 91.0 years in 2051, and New Zealand men a life expectancy of 86.1 years. Neither figure is implausible: Japanese women currently have a life expectancy of 85 years. However, as Table 3 shows, Statistics New Zealand's median mortality assumption and low mortality (ie high life expectancy) assumption both entail significantly lower life expectancies.

Table 4 – Statistics New Zealand projection results for 2051

Projection series	Total population in 2051 (thousands)	Population aged 90 and over in 2051 (thousands)
Medium fertility; **high mortality**; net migration of 5,000	4,721	109
Medium fertility; **low mortality**; net migration of 5,000	4,891	169
Difference between low mortality and high mortality series	4%	55%

Source – Calculated from Statistics New Zealand (2002a: Table 8.2)

When life expectancy is already high, further gains only lead to a small proportional increase in the size of the total population. They do, however, lead to large increases in the size of the oldest age groups. Table 4 illustrates this effect, by comparing results from two Statistics New Zealand population projections that differ only in the mortality assumptions. The total population is only 4% larger in 2051 under the low mortality assumption, but population aged 90 and over is 55% larger. The oldest age groups are of special interest for fiscal projections because of their very high health costs. Ministry of Health data indicate, for instance, that government health expenditures per woman aged

65-69 are approximately $3 thousand per year, while expenditures per woman aged 95 and over are $25 thousand per year.

Unfortunately, choosing which historical trend to extrapolate into the future is not straightforward. Different results are obtained for New Zealand, for instance, if male and female life expectancies are modelled separately or jointly, or if the trend is estimated from all available data or from data since World War II. Oeppen and Vaupel (2002) and White (2002) suggest that national projections could have two components: a projection of an international trend, and a projection of the individual country's divergence from this trend. Lee and Carter (1992) advocate projections that extrapolate trends in logged age-specific mortality rates.

None of these approaches is clearly superior to all the others. They are all likely, however, to yield projected age structures with significantly more older people than is currently expected.

8 Life expectancy at age 65

Having reached age 65, how much longer can the average person expect to live? Table 5 shows estimates for 1911, 1961, and 2001. The numbers shown are "cohort" life expectancies, as opposed to the conventional "period" life expectancies. Cohort life expectancies allow for the fact that mortality rates continue to change after the reference date; period life expectancies assume that mortality rates remained fixed at their original level. The estimates for 2001 in Table 5 are based on Statistics New Zealand's median mortality assumption. If, as the previous section argues, the median assumption is somewhat pessimistic, then actual life expectancy at 65 in 2001 was higher than these estimates suggest.

Table 5 – Cohort life expectancy at age 65

	Non-Maori		Total population
Year	1911	1961	2001
Males	12.6	12.9	18.2
Females	13.8	16.6	21.9

Sources – 1911 and 1961 estimates from Cheung (1999 : Appendix Table 9) 2001 estimates calculated from data on the median mortality assumption for 2001-base projections, presented in customised tabulations from Statistics New Zealand

Life expectancy at age 65 increased far more quickly between 1961 and 2001 than between 1911 and 1961, particularly for men. Reductions in mortality rates have become increasingly concentrated in the older age groups. Some writers have argued that these improvements in mortality rates have not been matched by improvements in health status (Fries 1980). As part of an on-going study of health expenditures, a team from the Ministry of Health and Treasury has conducted a review of the international literature on trends in health status. The review was confined to studies using longitudinal survey data. The conclusion of the review was that, within each age group, health status probably has been improving over the long run. Seventy-year-olds now, for instance, tend to be healthier than seventy-year-olds 20 years ago.

9 Conclusion

The basic demography of population ageing in New Zealand is well known. The proportion of the population in older age groups is increasing, which will raise old-age and total dependency ratios over coming decades. Some aspects of population ageing are, however, less well known.

Commentaries on population ageing often overlook the fact that ongoing increases in total dependency ratios can be seen as returning New Zealand to a long-run average. It is often assumed that high rates of in-migration could reverse these trends; such assumptions are, however, incorrect.

As always, national averages obscure substantial heterogeneity. Because of a history of higher fertility and higher mortality, Maori and Pacific peoples have young population structures quite different from the New Zealand population as a whole. The extent and rapidity of population ageing also varies sharply between geographical regions within New Zealand. Moreover, although statistics on broad age groups show a slow and inexorable movement towards an older age structure, the growth rates of narrowly-defined age groups often change rapidly and erratically. Internationally, too, there is heterogeneity. Because of its relatively high fertility rates, the New Zealand population is ageing and more slowly than many other OECD countries

Current Statistics New Zealand projections, like those of most national statistical agencies, can somewhat understate uncertainty about future demographic trajectories. In particular, they may understate the potential for continued gains in life expectancy.

The policy significance of the broad structural transition towards an older population is well recognised. However, the nuances and complexities also have practical implications. They affect, for instance, immigration policy, optimal funding arrangements, the fairness of inter-generational and inter-regional transfers, appropriate levels of reserve capacity for welfare services, New Zealand's relative economic prospects, and the plausibility of fiscal and economic projections.

10 Appendix - Supplementary data

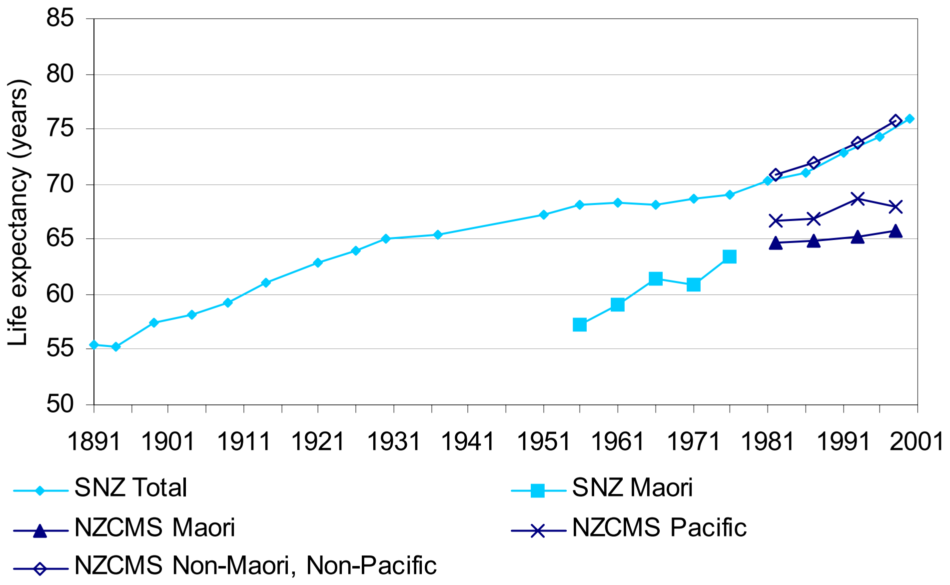
Table 6 – Historical and projected age distribution of the New Zealand population

	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80+	Total	Population (millions)
1881	31%	21%	17%	14%	11%	5%	2%	1%	0%	100%	0.490
1886	30%	22%	16%	13%	11%	6%	2%	1%	0%	100%	0.579
1891	27%	23%	17%	12%	10%	7%	3%	1%	0%	100%	0.627
1896	24%	24%	18%	12%	9%	7%	4%	1%	0%	100%	0.703
1901	22%	22%	20%	13%	9%	7%	5%	2%	0%	100%	0.773
1906	22%	20%	21%	15%	9%	6%	5%	2%	0%	100%	0.889
1911	22%	18%	20%	16%	10%	7%	4%	2%	0%	100%	1.008
1916	23%	18%	15%	17%	12%	7%	5%	2%	1%	100%	1.099
1921	21%	19%	16%	16%	13%	8%	5%	2%	1%	100%	1.219
1926	20%	19%	16%	14%	14%	9%	5%	2%	1%	100%	1.344
1936	16%	18%	17%	14%	12%	11%	7%	3%	1%	100%	1.491
1945	21%	15%	15%	14%	12%	9%	8%	4%	1%	100%	1.604
1951	21%	15%	15%	14%	12%	9%	8%	4%	1%	100%	1.939
1956	23%	16%	13%	14%	12%	9%	7%	4%	1%	100%	2.174
1961	23%	18%	12%	13%	12%	10%	7%	4%	2%	100%	2.415
1966	23%	19%	13%	12%	11%	10%	7%	4%	2%	100%	2.677
1971	21%	20%	15%	11%	11%	10%	7%	4%	2%	100%	2.863
1976	19%	20%	16%	12%	10%	9%	7%	4%	2%	100%	3.129
1981	17%	19%	16%	14%	10%	10%	8%	5%	2%	100%	3.143
1986	15%	18%	17%	15%	11%	9%	8%	5%	2%	100%	3.263
1991	16%	16%	16%	15%	13%	9%	8%	5%	2%	100%	3.374
1996	16%	15%	15%	16%	14%	10%	7%	5%	3%	100%	3.618
2001	15%	15%	13%	15%	14%	11%	8%	6%	3%	100%	3.737
2006	14%	15%	13%	14%	15%	12%	8%	5%	3%	100%	4.109
2011	12%	14%	14%	13%	15%	13%	10%	6%	4%	100%	4.248
2016	12%	13%	14%	12%	13%	14%	11%	6%	4%	100%	4.379
2021	12%	12%	13%	13%	12%	14%	12%	8%	5%	100%	4.506
2026	12%	12%	12%	13%	12%	13%	12%	9%	5%	100%	4.622
2031	11%	12%	12%	13%	13%	11%	12%	10%	6%	100%	4.714
2036	11%	12%	11%	12%	13%	11%	12%	11%	8%	100%	4.776
2041	11%	12%	11%	11%	13%	12%	11%	11%	9%	100%	4.807
2046	10%	11%	12%	11%	12%	13%	11%	10%	10%	100%	4.814
2051	10%	11%	12%	11%	12%	13%	12%	9%	10%	100%	4.806

Source – 1881-1976 Census data cited in (Bloomfield 1984: II.5, II.6, II.23); 1981-2051 Census data and Series 4 projections accessed from Statistics New Zealand website www.stats.govt.nz on 8 July 2003.

Note – Maori are excluded until 1951.

Figure 15 – Life expectancy, males



Sources – SNZ Total and Maori: Statistics New Zealand (2000: 102) and Statistics New Zealand (2002a: Table 4.10); NZCMS Maori, Pacific, and Non-Maori Non-Pacific: Ajwani *et al*. (2003: Appendix Table 24).

Note – NZCMS refers to "New Zealand Cohort Mortality Study". The figure shows the 'prioritised' NZCMS series.

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