4 Demographic and Economic Assumptions

This chapter outlines projections of the population and GDP, as well as the other economic assumptions used in the Statement.

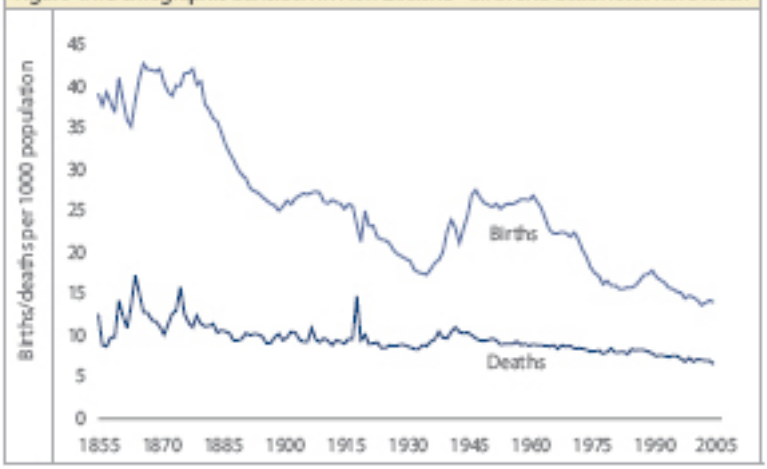
Who will populate New Zealand?

The starting point of the projections is to look at the issue of the size of the New Zealand population. Three things drive population: fertility (how many children are born), mortality (how many people die each year and, importantly, at what age) and migration (how many people leave and arrive in New Zealand).

Demographic change: the big picture

In common with many other OECD nations, New Zealand is experiencing a shift in the structure of the population.[23] The developed world (and increasingly the developing world) is in a transition from a high fertility/high mortality state to a low fertility/low mortality state. This is commonly referred to as "population ageing" and is the result of more people living into old age (defined here as 65 and older) and very old age (85 and older).

Figure 4.1: Demographic transition in New Zealand - birth and death rates have fallen



Source: Statistics New Zealand and the Long-term Data Series. Total crude birth and death rates. In the demographic charts and tables, most of the historical data points are averaged from around census years, such as 1996 or 2001. For clarity and consistency with other charts, we have moved the data to the nearest "rounded" year.

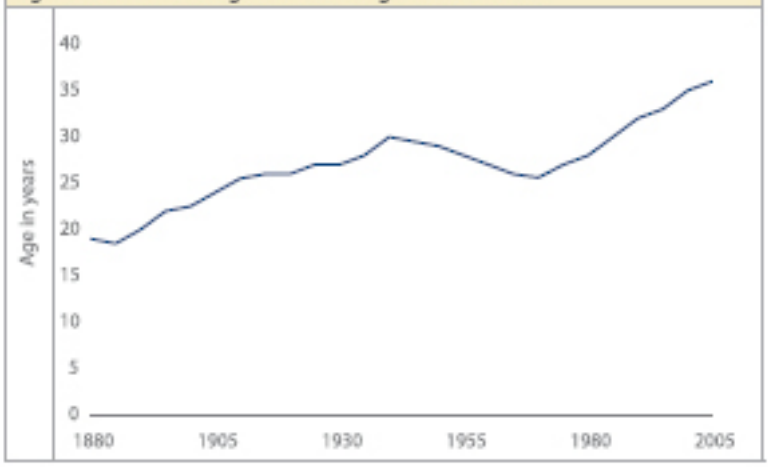
23 For a summary of the demographic transition, see Lee (2003).

This transition is not a demographic bump that will correct itself at some time in the future. In particular, it is not just the result of the post-Second World War baby boom. Rather, what has been driving this ageing of the population (Figure 4.1) is a demographic transition from the high fertility and high mortality rates of a century or more ago to the present and projected low fertility and low mortality rates. This is a permanent change in the age structure of the population; it will not reverse in the coming centuries, given the trends in demography.

The reduction in fertility is, of itself, likely to lead to a lower population (with no migration), while lower mortality has the opposite effect.

The combined effect is seen in the resulting median age of the population; this is the age that divides the population exactly in half. If you were 19 in 1880, half the New Zealand population would be older than you, and half younger. In 2005, the age of the median person had nearly doubled to 36.

Figure 4.2: The median age has been rising in New Zealand



Source: Statistics New Zealand

Assumptions for population projections

Statistics New Zealand, in the official National Population Projections published in December 2004, presents a range of different scenarios for fertility, mortality and net migration. They have produced nine separate projections. Of these nine, Statistics New Zealand considers that the mid-range projection (known as Series 5) is the most suitable for assessing future population changes. The Statement therefore uses Series 5 as the basis of our future demographic profile, but also illustrates the uncertainty around this series by use of alternative scenarios and probabilistic projections.

The Statement contains demographic and other projections for the entire New Zealand population and does not break out Māori as a separate group. There are several reasons for this. First, Statistics New Zealand's projections of sub-populations go out only to the early 2020s. Second, convergence between Māori and Pākehā is continuing in many aspects of life – labour markets, income support,

and intermarriage, to list but three. This is not to deny that disparities and differences exist between parts of New Zealand society, but only to suggest they are probably less important to the aggregate long-term picture than the similarities.

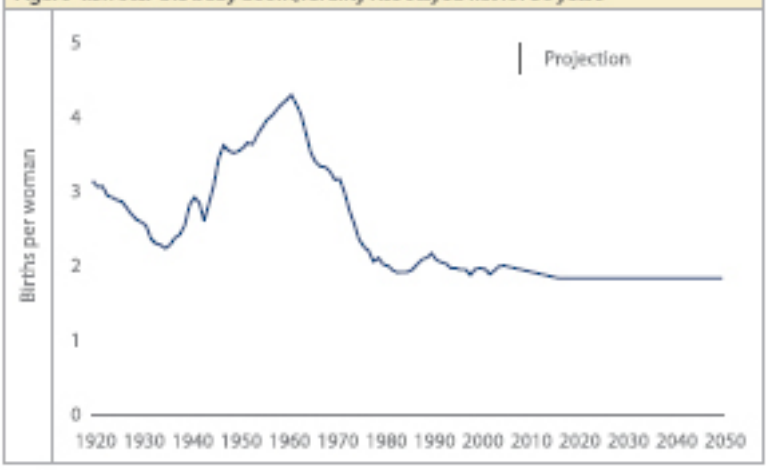
For further details, see Statistics New Zealand's report to the 2005 Hui Taumata (Māori Economic Development Conference).[24]

Fertility

The total fertility rate is assumed to fall in New Zealand from around 2 live births per woman now to 1.85 in 2016 and then remain constant. This is the level favoured by the United Nations in its long-term work for world population. The rate that replaces the population with zero net migration is around 2.1. This Statement's projections are therefore based on an assumption of a sub-replacement birth rate.

New Zealand's experience of fertility rates falling below replacement levels is not an isolated one. In some European countries, the total fertility rate has fallen, reaching 1.2 in Italy and 1.7 in the United Kingdom. Currently, 65 countries (with a combined population of over 2.8 billion people) have fertility rates at or below replacement levels (United Nations, 2005). The United Nations is predicting that the international trend towards sub-replacement fertility rates will continue.

Figure 4.3: After the baby boom, fertility has stayed flat for 30 years



Source: Total fertility rate from Statistics New Zealand, history and medium fertility assumption

Alternative fertility paths

Statistics New Zealand has produced projections based on two alternative assumptions of the future course of fertility: low fertility, where fertility falls more sharply to 1.60 in 2016, and high fertility, where fertility actually increases from the base-year rate (2004) of 2.01 to become 2.10 in 2016, before remaining constant.

24 Statistics New Zealand (2005).

The effect of the low fertility assumption, with nothing else changed, is to reduce the proportion of young New Zealanders in the population in 2050, and raise the proportion of people 65 and above compared with the base case. Overall population is smaller by 7% in 2050. Hence, there will be less demand for schooling, and greater pressures on pensions and health care for the elderly.

Using the high fertility assumption will result in the opposite: a larger population (by 7% in 2050), with a greater proportion of youth and smaller relative numbers of elderly.

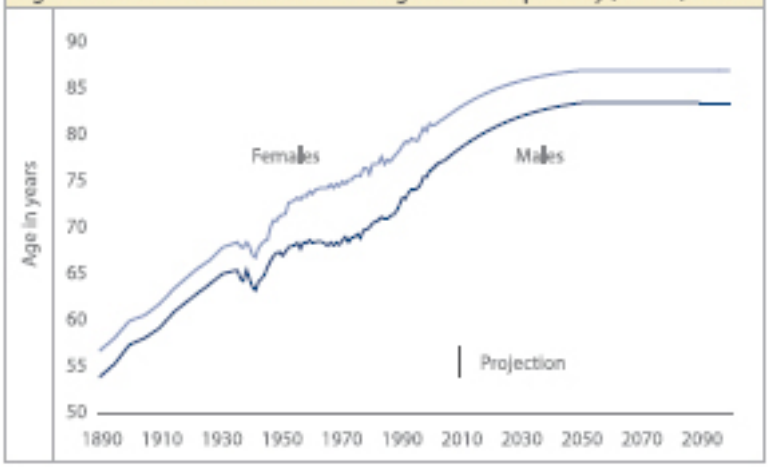
Mortality

Life expectancy at birth in a particular year is a way of summarising age-specific mortality rates in that year. This means that if mortality rates are falling, then life expectancy will be rising. Under Statistics New Zealand's medium assumptions, the median male life expectancy at birth rises from 76.3 years in 2000 to 83.5 years in 2050, while median female expected longevity grows from 81.1 years to 87.0. Overall, this means a gain of 1.3 years per decade, on average.

This rate of gain is slower than we have seen in the past half century (eg, female longevity grew by 9.8 years from 1950 to 2000 but is expected to grow by only 5.9 years in the next half century). For those aged 65 and 85, the assumed life expectancy gains are generally greater than the historical growth.

Figure 4.4 shows life expectancy at birth since 1890, while Table 4.1 includes life expectancy at birth as well as at different ages.

Figure 4.4: Statistics New Zealand assumes gains to life expectancy (at birth) slow



Source: Human Mortality Database, Statistics New Zealand medium mortality assumptions

Table 4.1: The median life expectancy at birth, at 65, at 85, in the stated year

Years	1900	1950	2000	2025	2050	1950 -2000	2000 -2025	2025 -2050	2000 -2050
Males	Age					Gain			
Birth	57.4	67.2	76.3	81.4	83.5	9.1	5.1	2.1	7.2
Age 65		12.8	16.7	20.2	21.8	3.9	3.5	1.6	5.1
Age 85		3.9	5.2	7.3	8.3	1.3	2.1	1.0	3.1
Females	Age					Gain			
Birth	60.0	71.3	81.1	85.3	87.0	9.8	4.2	1.7	5.9
Age 65		14.8	20.0	23.2	24.5	5.2	3.2	1.3	4.5
Age 85		4.2	6.5	8.5	9.4	2.3	2.0	0.9	2.9

Source: Life expectancy at birth from Statistics New Zealand, medium mortality assumption

Alternative mortality paths

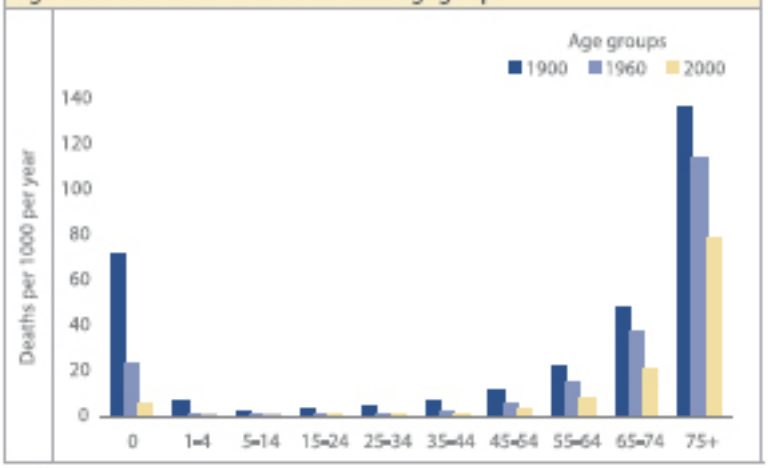
As with fertility, Statistics New Zealand has produced projections based on two alternative assumptions of the future course of mortality: high mortality, where life expectancy in 2050 is 81.0 and 85.0 for men and women respectively; and low mortality, where life expectancy is 86.0 and 89.0 for men and women respectively.

There are two particular features of this increase in life expectancy.

First, there has been a substantial reduction in infant mortality. In 1900, for example, 8% of non-Māori children (born alive) would be expected to die before their first birthday. By 2003, this had fallen by a factor of almost 16 to 0.49%. Similar reductions have occurred at all ages up to 10.

Second, death rates have also reduced substantially during the middle stages of life. Although the reduction is not as dramatic as in the early years of life, it is still substantial: in the order of four to eight times lower in 2003 than in 1900.

Figure 4.5: Death rates have fallen across all age groups



Source: Statistics New Zealand

The combination of the lower death rates in early and middle age and little movement in the oldest age to which people live results in what demographers refer to as a "rectangularisation" of the survival chart: far more people survive into old age, and indeed into very old age, but the oldest age to which people are living is increasing at a slower rate (see Figure 8.3).

While mortality trends are clear, as yet we do not have full knowledge of what is causing this decline in death rates, what sorts of lives people are leading, especially in later life, and whether the trends of the recent past will continue or reverse. Chapter 6, which deals with health spending, contains an extended discussion of the drivers of mortality.

This Statement uses Statistics New Zealand's medium mortality assumption to drive the base-case projections. This may be on the conservative side (relatively low longevity outcomes) compared with some assumptions being used by other agencies in their long-term work.

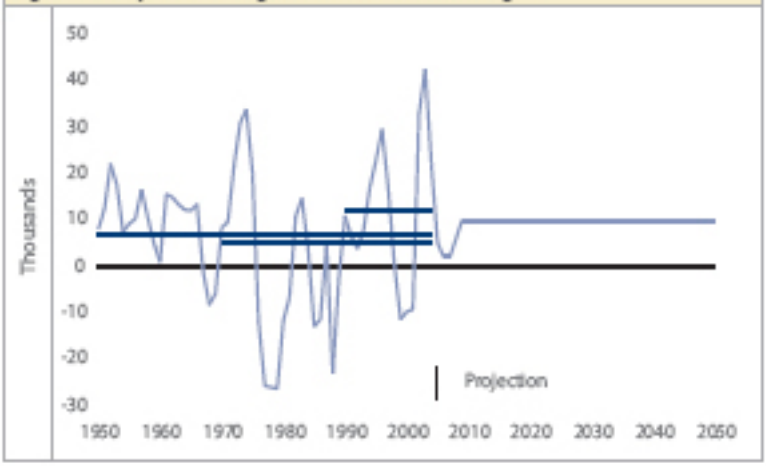
Statistics New Zealand's low mortality (higher longevity) assumption has a greater proportion of elderly, a relatively smaller labour force, and a larger population by 2050 (up by 2.3%). This is likely to place more pressure on the fiscal position.

An assumption of high mortality (lower life expectancy) will reverse these differences relative to the base case. The labour force would be proportionately larger, while the population in 2050 would be smaller.

Net migration

Finally, Statistics New Zealand assumes that median net migration settles at 10,000 from 2009 onwards (0.24% of the population in that year). Typically, we have a net inflow of people in their late teens and 30s and 40s, but a net outflow of people aged in their 20s. The horizontal lines in Figure 4.6 are the averages for the periods covered by the lines and show that this assumption is plausible, given recent trends.

Figure 4.6: Projected net migration follows recent averages



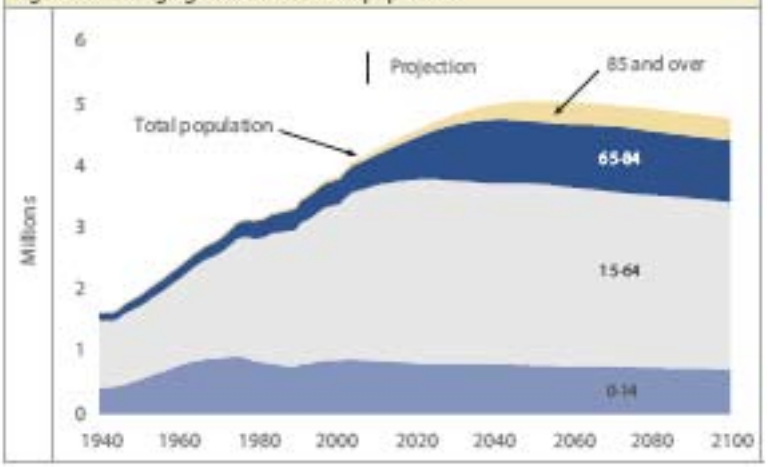
Source: Statistics New Zealand, annual net permanent and long-term migration

Resulting demographic projections

These assumptions produce projections of the changing shares in the total population of the young, those of the traditional working age,[25] the old and the very old. Total population is projected to reach 5 million in the mid-century and then to shrink back slowly.

The number of people over 65 is projected to grow almost three-fold, while those 85 and over will grow six-fold by 2050. Under this scenario, the working-age population grows until the mid-2020s and then contracts (it shrinks from 66% of total population now to 58% by 2050).

Figure 4.7: Changing shares in the total population



Source: Statistics New Zealand, history and Series 5 projection (static assumptions after 2050)

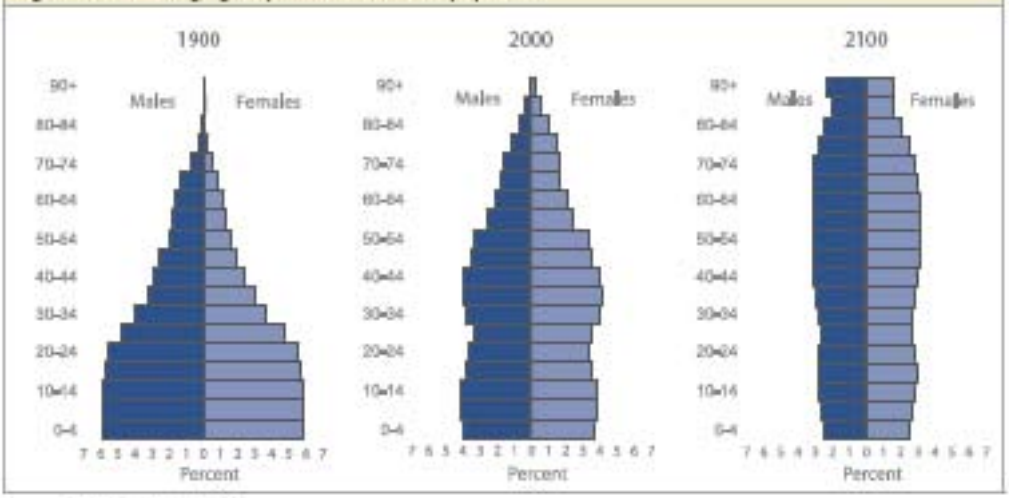
Another way of showing the changing structure of the population is to use population pyramids. The three snapshots below of New Zealand show a change from a population dominated by the young in 1900 (the pine tree), through to middle-aged spread in 2000, and then to a peg-shaped structure in 2100.

Another common way of looking at changing demographics is to chart the ratios of people in various age groups to the whole, or to another base group. Three ratios are of interest:

- the "old" ratio compares those aged 65 and above with the traditional working-age population of those aged 15 to 64
- the "young" ratio compares those under 15 with the working-age population
- adding young and old people together and comparing their numbers with the working-age population produces a "combined ratio."

25 The Statement uses "working age" as a convenient label for describing people aged between 15 and 64. There are people outside these limits who work and people inside who do not. The official definition of the working-age population (as used in the Household Labour Force Survey) is the civilian, non-institutionalised population 15 and older (no upper limit), and this definition is used to produce projections of the labour force.

Figure 4.8: The changing shape of New Zealand's population



Source: Statistics New Zealand

» The old-age ratio climbs from 0.18 now to 0.45 in 2050. Put another way, in 1900 there were 15 people of working age for every person over 65. Today, this has shifted to five people of working age for every person 65 and over, while by mid-century, there will be two.

The young ratio continues to fall slightly, before stabilising at around 0.27 in 2020. As a result, the combined ratio shows the same trend as the old ratio.

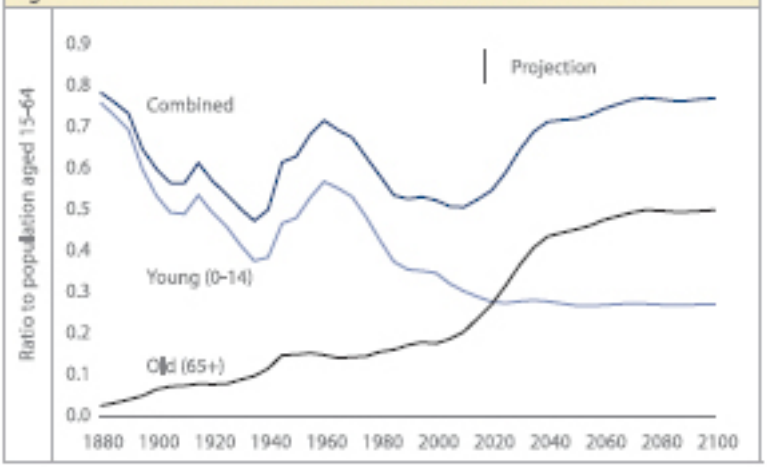
Figure 4.9 also shows that the demographic change is not a bulge but rather a structural change in the population. Unlike the earlier baby boom, the ageing boom (which is partly due to the earlier baby boom) will not be followed by an ageing bust, under these demographic projections.

Even with Statistics New Zealand's conservative assumption of fixed mortality rates after the mid-century, the old ratio continues to rise until the 2070s, when it stabilises around 0.5. Past trends suggest that life expectancy could continue to rise strongly after the 2030s and this would mean that the old ratio would be even higher.

New Zealand is around the OECD average for the projected increase in both the old ratio and the combined ratio. The old ratio in 2050 of nearly 0.5 means that New Zealand will have two people working to support the consumption of one retired, down from five now. In Japan, this ratio is currently one for one.

Some people tend to downplay the effect of ageing by pointing to the combined ratio, which was almost as high in 1960 (pushed up by the youth side) as it is likely to be in 2050 (pushed up by the elderly). The problem with this for the fiscal position is that the young are more likely to be supported privately by families and by relatively small amounts of public spending on schooling, while the elderly in the recent past have tended to use a far greater proportion of public resources.

Figure 4.9: Ratio of 65 and over to 15-64s doubles between 2000 and 2050



Source: Statistics New Zealand, history and Series 5 projection

Immigration might be seen as a way of maintaining a low old-age ratio. Doubling the number of net migrants from the assumed 10,000 to 20,000 each year from 2010 to 2050 results in the percentage of people aged 65 and over in the population falling from 26.2% to 24.7%. While the bulk of new immigrants are of working age, they too grow old and eventually make demands on public resources.

From another point of view, one way of keeping the aged ratio under 20% (where it is now) out to 2050 would require 300,000 net migrants per annum from 2020 onwards (4.9% of the population in 2020). In short, immigration is not a long-term solution to population ageing, although migration has many other positive features.

Capturing uncertainty with probabilistic projections

Statistics New Zealand and the Treasury are experimenting with probabilistic (or stochastic) modelling as a way of expressing the uncertainty that surrounds the demographic variables of fertility, life expectancy and migration.[26] Later Statements may extend this approach to some of the economic and fiscal variables used in the Long-Term Fiscal Model.

Probabilistic modelling typically uses historical information to calculate variability in the demographic data. It uses this variability to construct a probability distribution of outcomes. Probabilistic modelling randomly draws samples from probability distributions when projecting variables forward. This is repeated thousands of times to construct a plot showing the likelihood that certain scenarios will eventuate.

Extending probabilistic modelling to fiscal and economic variables provides an additional tool to help judge how much policy adjustment might be necessary to provide a high degree of confidence that fiscal sustainability will be achieved. It would also allow policy makers to identify and gauge the key sources of uncertainty that matter at different points in the future for particular fiscal variables. Finally, it would enable policy makers to evaluate how different policies perform in the context of uncertainty, but would require explicit assumptions to be made about the nature and size of uncertainty around each policy area.[27]

This box describes the results of modelling the uncertainty in the assumptions about fertility rates, mortality, net migration, the sex ratio at birth, and in the base-year (2004) numbers. The probabilistic projections are based on Statistics New Zealand's Series 5 deterministic projection as the median. We are not modelling uncertainty in this median projection.

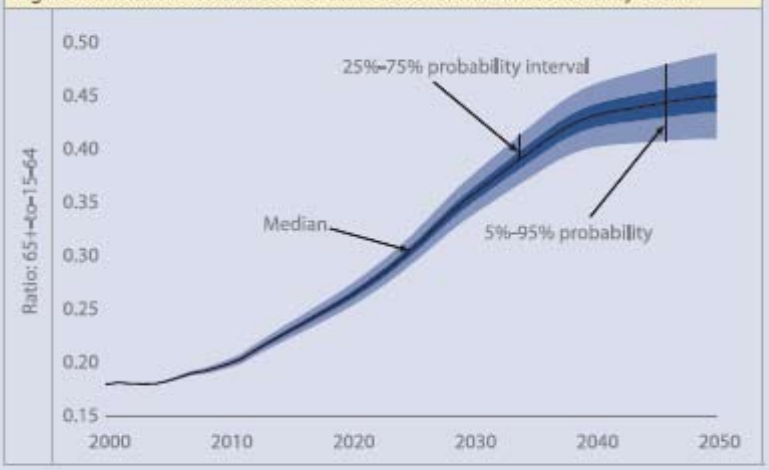
In Figure 4.10, the black line is the median projection of the aged ratio, the dark shaded area indicates the 25% to 75% probability interval, and the total shaded area the 5% to 95% probability interval. Notice that uncertainty about the aged ratio increases significantly only after 20 to 25 years. This is because for the next two decades uncertainty around mortality is mainly associated with people whose births have already happened. After that, uncertainty around the aged ratio increases significantly as there is uncertainty about the births as well as the deaths of people.

The main conclusion we can take from this work is we can say with reasonable confidence that the aged ratio will double.

26 Dunstan and Speirs (2005).

27 Bryant (2003), Lee (2004), Heller (2002), and Lee, Anderson and Tuljapurkar (2003.)

Figure 4.10: Ratio of 65 and over to those 15 to 64 will almost certainly double



Source: Statistics New Zealand, indicative Series 5 probabilistic projections

What will people be doing?

The Long-Term Fiscal Model builds projections of real GDP growth from the end of the latest macroeconomic forecast by using the size of the working-age population, labour participation rates, and assumptions about long-run unemployment and labour productivity growth. Thus, GDP is equal to:

working-age population (15+)	Population: The total number of people available for work
multiplied by	
participation rates x (1 – unemployment rate) x average hours worked	Participation: The number actually working and how much they work
multiplied by	
GDP per hour worked	Productivity: How much each person produces each hour that she or he works

Participation

Once the working-age population (in the larger sense of people 15 or above) has been calculated, the next step in constructing the projection of GDP is to calculate participation rates.

The pattern of labour force participation has been changing in New Zealand since at least the Second World War.[28] This means that it is necessary to take a view on whether there will be further changes in this pattern over time.

28 See Hurnard (2005), Callister (2005) and Johnston (2005).

Women's participation rates have been rising since the Second World War, and women aged 25 to 54 have had a greater level of participation than their predecessors.[29]

While New Zealand does not have an obligatory retirement age, labour market participation at present drops from 60% or so for people aged 60 to 64 to 13% or so for those over 65 (both of these have risen over the past 20 years, particularly for females, because of the lift in the age of eligibility for superannuation in the 1990s).

Over the past half century, participation rates of young men and women have been falling, reflecting greater enrolment in tertiary education. Over the prime working ages (25 to 54), male participation fell as men were displaced by structural change. Through this period, prime-aged female participation rose as women moved into new areas of work, adapted to change, worked longer before having children, or decided to remain childless.

Long-Term Fiscal Model projections of labour force participation rates have divided the population into five-year age cohorts from 15 to 19 years through to 65 and older. In the past, the Long-Term Fiscal Model has taken a two-stage approach to projecting labour force participation rates. First, the model has allowed rates for each cohort to adjust over the first four years of the projections. Then the rate arrived at in the final year is held constant for the remainder of the projection period (about 35 years).

This Statement adopts the cohort method of projecting participation rates.[30] This is based on the observation that a person's labour market behaviour through life has more in common with people born at around the same time as them (their birth cohort) than with people in the same age group through time; for example, women in their 30s are participating more than their mothers in general were at that age.

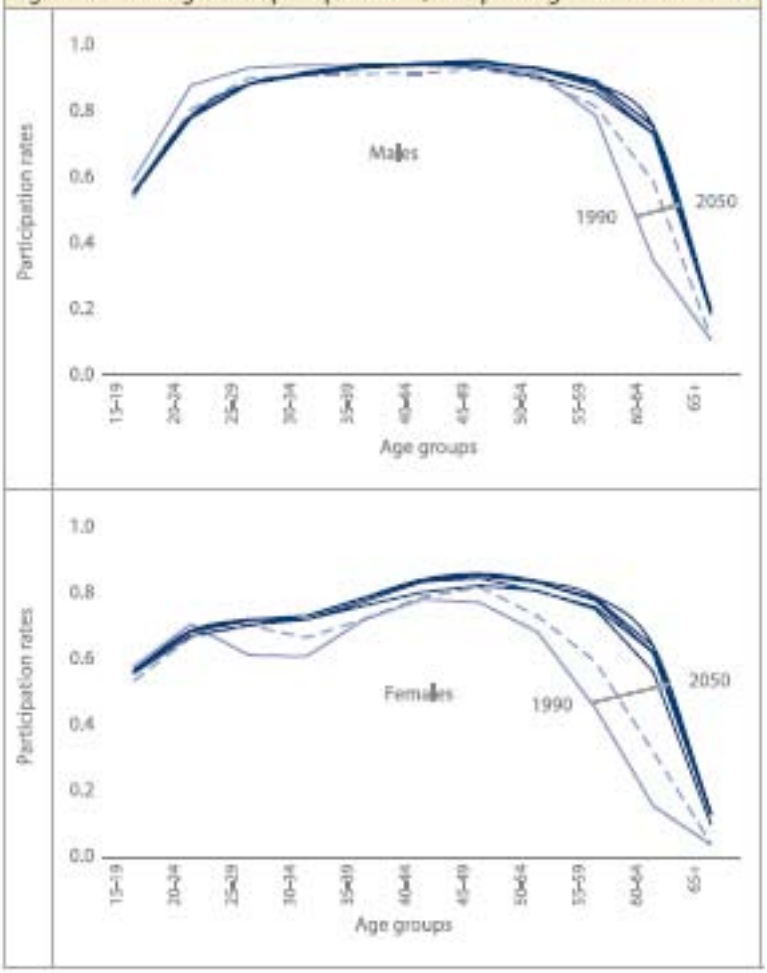
The technique bases the future participation rate for any particular cohort in any five-year period on the actual experience of the previous cohort. For example, the 60- to 64-year cohort in 2005 to 2009 uses historical participation-rate data for the 55 to 59 cohort in 2000 to 2004 to estimate labour-force entry and exit probabilities and applies these probabilities to determine the appropriate rates for 2005 to 2009. Into the far future, this process continues to use participation rates in one period to project participation rates in the next.

For many age groups, this produces a rising profile further into the projection period than the previous method. As a result, the Long-Term Fiscal Model now projects slightly higher levels of GDP growth and higher revenue growth over the projection period, which improves both the expected financial performance and financial position of the Crown.

29 This is based on participation rates derived from the census - see Hurnard (2005).

30 For further details of this method, see Burniaux et al (2005) and Productivity Commission (2005).

Figure 4.11: Prime-age female participation rises, while prime-age male labour is stable



Source: The Treasury

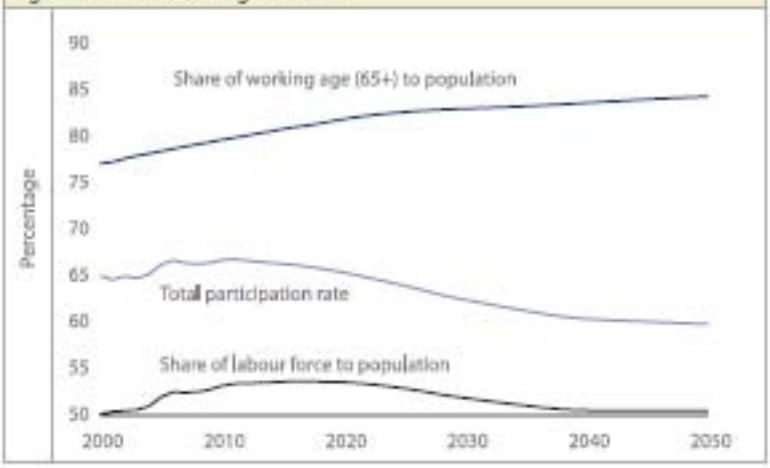
The aggregate participation rate falls from 68% now to 60% by mid-century. The labour force grows to mid-century and then begins to decline. Even though participation of the open-ended 65-plus cohort is expected to rise, aggregate participation falls, as a greater proportion of people spills into the older age groups, where participation is lower.

Before 1980, female employment rates were inversely correlated with fertility. In the 1990s, this flipped: high female employment became correlated with high fertility, signalling a change in women's preferences (Jaumotte, 2004). So the same policies that support fertility will now support employment.

Alternative participation scenarios

New Zealand's labour force participation rates are high relative to the OECD average. Even so, there is scope for increasing participation, particularly among young women and sickness or invalid

Figure 4.12: Labour force growth stalls



Source: The Treasury

beneficiaries. A previous Treasury study[31] calculated the effect on GDP of hypothetical increases in employment from increased participation, taking into account the differences in productivity between new and existing workers. The results suggest that increasing the labour force participation of women aged 25-34 to the average, adjusted for paid maternity leave, of the top five OECD nations increases employment by 28,800, making GDP 1% higher than it actually was in the baseline year of 2001. Raising participation overall to the average of the top five OECD countries increases employment by 142,600 and generates an increase of 5.1% in GDP.

Employment and unemployment

The Budget economic forecast assumes that, by 2010, the trend unemployment rate is 4.5% of the labour force and this is assumed to remain constant throughout the projection period. Along with this, hours worked per employee are also assumed not to change after 2010.

Productivity

Empirical estimates suggest that productivity rises with age before declining after middle age.[32] This could mean that ageing could produce a (small) decline in average productivity, with the effects of a greater proportion of older workers being largely offset by relatively fewer younger ones. The present modelling, however, assumes that average labour productivity (real output per hour worked) grows by 1.5% annually for everyone over the projection period. This reflects the median growth in the output per hour worked between 1980 and 2003.

Labour productivity growth (which is assumed to equal the real wage growth in the Long-Term Fiscal Model) of 1.5% a year means that by mid-century, real incomes will have doubled.

31 Bryant, Jacobsen, Bell and Garrett (2004).

32 Productivity Commission (2005).

Chapter 11 examines the effects on the fiscal position of changing this productivity assumption.

Inflation and bond rates

The final major assumptions in the modelling are that annual inflation over the projection period is 2%, the middle of the present Reserve Bank target range, and that the real government 10-year bond rate is 4%.

Resulting GDP projections

In growth terms, nominal GDP in any one year (Y_t) grows as follows from 2010 onwards:

$$Y_t = Y_{t-1} \times (1+g) \times (1+p) \times (1+i),$$

where

Y_{t-1} = GDP in the previous year,

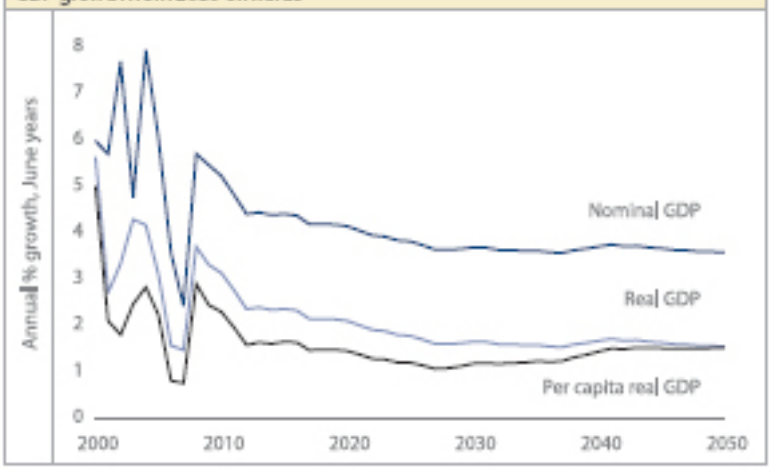
g = growth of labour force,

p = labour productivity growth, and

i = the inflation rate.

In other words, growth of nominal GDP is roughly the sum of the labour force growth, labour productivity growth and the inflation rate. This formula implicitly assumes that the employment rate and average weekly hours worked are constant after 2010.

Figure 4.13: Ageing reduces population and economic growth, but not per capita GDP growth from 2030 onwards



Source: Statistics New Zealand and Treasury projections

Table 4.2: Summary of key economic assumptions from 2010

Variable	Value
Labour productivity growth	1.5%
Inflation	2.0%
10-year real government bond rate	4.0%
Unemployment rate	4.5%
Average hours per week	38.4 hours

Combined with these assumptions, the demographic projections translate into slower labour force growth and real economic growth lowering from about a 3.2% annual average over the past decade to a 1.6% average through the 2040s. Real per capita growth is closer to labour productivity growth, but it falls below this when population growth is larger than labour force growth from 2020 onwards.

5 Taxes and Other Revenue

This chapter discusses the financing of government expenditure.

The tax system

Total tax revenue in any one year is the product of the tax base and the rate at which taxes are levied on that base. In New Zealand, the main taxes are: GST, which is levied at a constant ("flat") rate on virtually all consumption that takes place within the country; an income tax, which in turn is composed of a company tax, levied at a flat rate of 33%; and personal tax, which is levied using a progressive rate structure. In addition, the government levies excises on petroleum products (a fixed dollar amount per unit), tobacco products (fixed levy rate per kilo of tobacco) and alcoholic beverages (fixed levies per litre of alcohol, with different rates applying to beer, wine and spirits). Other sources of tax revenue include some tariffs on imports, road-user charges and some stamp duties.

For many taxes, the base is simply projected to grow in line with GDP, since this is either explicitly (eg, with income tax and GST) or implicitly (in the case of excises on petroleum products) the tax base. Tax rates are assumed constant.

In the case of the personal tax system, however, the progressive nature of the rate scale adds a complication.

Under the current rate scale, marginal rates of tax increase with income. There is currently a four-step scale (three main statutory rates of 19.5%, 33% and 39%, plus a low-income earner rebate that reduces the effective rate on incomes below $9,500 to 15%). Traditionally, the thresholds at which the different rates apply have been fixed in nominal terms, giving rise to "fiscal drag." This occurs when increases in nominal incomes result in people moving up the income tax scale, lifting their average tax rate.

Given the assumption discussed in the previous chapter that wages grow on average at 1.5% a year above increases in prices, nominal wages will increase significantly over the projection period: by 2050, the average nominal wage (QES) will rise from the current level of around $42,900 to over $200,000. After adjusting for inflation, this average wage will be over $84,000 per annum in 2050 when expressed in today's dollars. Keeping the current rate scale in place would mean people on the average wage paying tax at the top marginal tax rate. The average tax rate on this average wage would increase from 21% to 35%.

Traditionally, New Zealand governments have addressed fiscal drag by adjusting the tax scale in an ad hoc manner. In the 2005 Budget, the Government announced the introduction of an automatic system of adjusting the tax thresholds for price inflation.[33] This change has yet to be legislated.

Interaction between fiscal drag and the New Zealand Superannuation Fund

A further issue that needs to be addressed is the interaction between contributions by the government to the New Zealand Superannuation Fund and the personal rate scale.

This interaction between the tax scale and the contribution to the Fund involve a series of steps, the implications of which are not always obvious.

Under the New Zealand Superannuation and Retirement Incomes Act, the annual contributions to the New Zealand Superannuation Fund are directly related to the dollar amount of superannuation expected to be paid in the future. That dollar amount is, in turn, directly related to after-tax income, via the operation of the indexation formula in the legislation. The indexation formula says that benefits are adjusted annually by movements in the CPI, but must remain within a band of 65% to 72.5% of the average after-tax wage.[34]

The after-tax part of this formula is important. It requires the Treasury, when advising on the amount of contributions to the Fund, to form a view of the rate of tax to be paid by a person earning the average wage in each of the next 40 years.

This leads back to the issue of fiscal drag.

In operating the mechanism for calculating the contributions to the New Zealand Superannuation Fund, the Treasury has to date assumed that there is no fiscal drag and that the thresholds in the personal tax scale have been increased in line with movements in wages.[35] As noted above, this is a strong assumption, but one that is justified given the structure of New Zealand Superannuation.

Tax revenue projections

For these reasons, and for modelling simplicity, previous studies of the long-term fiscal position in New Zealand (and studies undertaken by other governments) have tended to assume that the tax-to-GDP ratio remains constant through the projection period. This tradition is continued in this Statement, with the bottom-up projections in this chapter assuming a constant ratio (see Figure 5.1). This assumption is relaxed in some of the top-down projections discussed in Chapter 11.

The impact of varying the fiscal drag assumption is also discussed below. Using the announced three-yearly price indexation of the tax thresholds means that the effects of fiscal drag would be reduced, but not eliminated.

33 The details of the policy are that once every three years, starting in 2008, the various thresholds in the personal tax scale would be increased by the cumulative increase in the CPI over the previous three years.

34 The confidence and supply agreement between the Labour Party and the New Zealand First Party requires the floor of the band to be 66% during the current term of Parliament.

35 The recent strong growth in employment has had this effect: the number of people on benefits has fallen and the number of people in employment has increased markedly.
Fiscal drag also occurs if the distribution of earnings changes. That is, if the number of people earning higher incomes increases, then the tax-to-GDP ratio will increase even if the personal tax scales are indexed to wages.

Assuming a constant tax-to-GDP ratio is a strong assumption. It means that the effect of demographic change and other policy changes are left only on the spending side, when governments do have the option to increase taxes to finance increases in spending. But to go further and impose the precise mechanism by which the ratio is held constant may seem to be especially prescriptive.

Modelling approach

The projections of tax revenue break the tax system into three components:

- source deduction of benefits and New Zealand Superannuation
- source deductions of other income from employment
- all other taxes.

Source deductions on benefits is projected as follows:

$$T^b_t = T^b_{t-1} \times (1+\beta)$$

where T_t = tax and β = growth of benefit payments, including New Zealand Superannuation.

Benefits here include New Zealand Superannuation, Unemployment Benefit, Domestic Purposes Benefit, Invalids Benefit and Sickness Benefit.

Source deductions on all other income sources is:

$$T^o_t = T^o_{t-1} \times (1+ g),$$

where g = growth of nominal GDP.

Total source deductions is the sum of these two:

$$T_t = T^b_t + T^o_t.$$

All other tax types (such as corporate tax and GST) are modelled as follows:

$$T_t = T_{t-1} \times (1+ g),$$

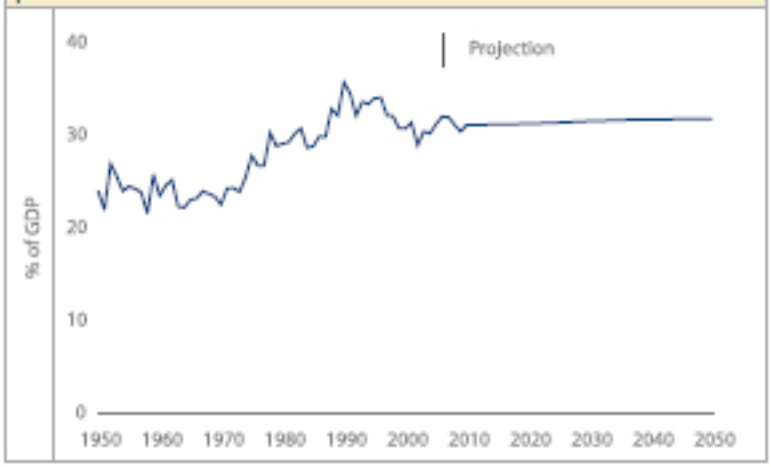
where g = growth of nominal GDP. In other words, the tax-to-GDP ratio for all taxes other than source deductions on benefits remains constant from 2011 onwards.

The revenue-to-GDP ratio does move up slightly through the projection period, because of taxation on the growing payout for New Zealand Superannuation (and other benefits).

Sensitivity to assumption changes

Because of the structure of Treasury's Long-Term Fiscal Model, it is not possible simply to alter the tax scales, because taxes are estimated at too high a level of aggregation. It is possible, however, to use proxies to get an impression of the size of the effect of assuming no fiscal drag on the fiscal position.

Figure 5.1: Tax revenue as a share of GDP rises only slightly through the projection period

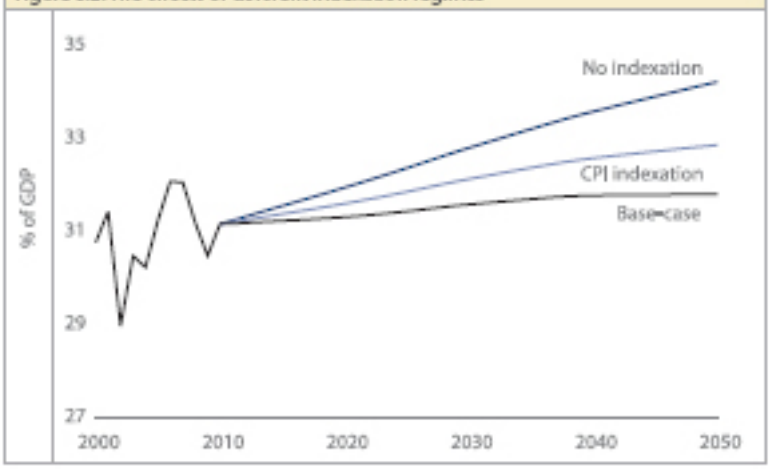


Sensitivity to assumption changes

These scenarios use tax elasticities to illustrate the effects of different tax scales. The first scenario (full fiscal drag) assumes an elasticity of personal taxes to income of 1.3; a 1.0% increase in incomes results in a 1.3% increase in taxes.[36] This estimate comes from taking the incomes from a sample of taxpayers and working out each one's tax liability based on today's personal income tax scale. All incomes are then raised by 1% and the tax liabilities recalculated using the same scale (ie, no indexation). The result is a 1.3% increase in personal tax. All other taxes are assumed to have an elasticity of 1.0 (a 1.0% increase in income increases tax revenue by 1.0%).

Under this fiscal drag scenario, the tax-to-GDP ratio is 2.4 percentage points higher than in the base case.

Figure 5.2: The effects of different indexation regimes



Source: The Treasury

36 An elasticity of 1.3 is used in Treasury short-term forecasts of personal tax revenue as a proxy for fiscal drag.

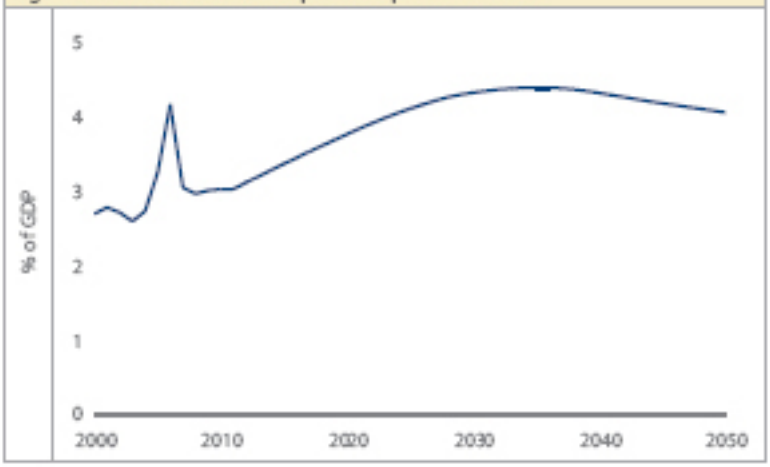
The second scenario shows the impact of adjusting the brackets in the personal tax scale from 2011 onwards by the assumed rate of inflation: 2% a year. The tax elasticity estimated in this case is 1.14 for personal income, which, when weighted up with the flat taxes, gives a total tax elasticity of 1.06. The result is a tax-to-GDP ratio between the no-indexation ratio (full fiscal drag) and the largely flat ratio. In 2050, the tax-to-GDP ratio for the inflation-indexed case is 1.1 percentage points higher than the base case.

Non-tax revenue

On the non-tax side, the Government also earns revenue from its commercial and other operations. Some examples are the profits from state-owned enterprises, the investment income of funds operated by Crown entities such as the Accident Compensation Corporation and the Earthquake Commission, and income on its foreign reserves.

Increasingly, the largest source of income for the Crown is the earnings of the New Zealand Superannuation Fund. While these earnings are retained in the Fund and will be used for the purpose of paying future New Zealand Superannuation benefits, they are, legally, the income of the Crown and so are included in the Crown's accounts.

Figure 5.3: Non-tax revenue is expected to peak in the 2030s

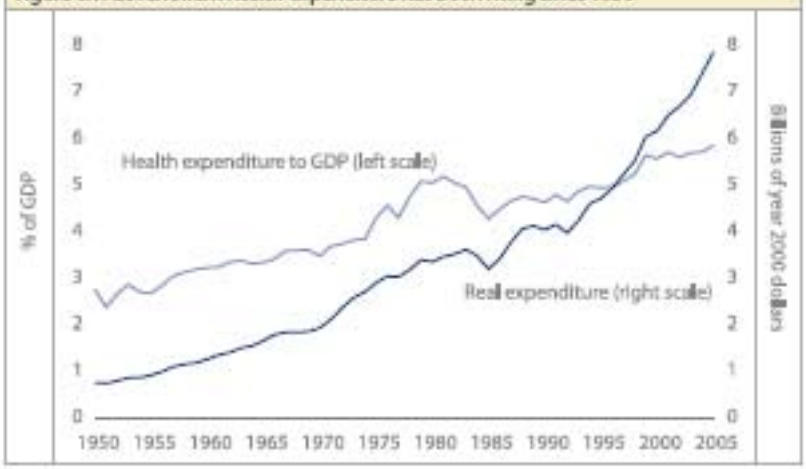


Source: The Treasury

6 Health

Health care is a major component of government spending in New Zealand and has been rising both in real terms and as a proportion of GDP for a long time. Average per capita real growth in health spending from 1950 to the present has been 3% and has accelerated to over 4% from the early 1990s.

Figure 6.1: Government health expenditure has been rising since 1950



Source: The Treasury[37]

This chapter discusses what has been driving health spending decisions in the recent past, presents a base-case projection for future spending and discusses alternative scenarios for different modelling assumptions.

The future health status of the population

An understanding of the future course of the health status of the population is key to modelling future health spending.

As discussed in Chapter 4 on demographic and economic assumptions, the structure of the New Zealand population is changing. The key issue is how this change will affect health spending.

37 Preparing a long-term data series for health spending presents definitional issues. It is not clear whether the data use the same bundle of goods and services since 1950. We are confident, however, that the data presented here do, at a high level, accurately reflect the trend in spending over the past 50 years.

In any particular year, health-care costs in OECD countries increase with age. In addition, the developed and developing worlds are undergoing population ageing. These two facts have led many to conclude that population ageing will inexorably lead to large and rapid increases in health expenditure.

Richardson and Robertson (1999), however, caution that drawing simple conclusions like this might not be a secure basis for policy development:

> . . . it is not necessarily true that future costs will be dominated by ageing and it is possible—as a matter of logic—that ageing per se may have no effect. The existence of a cross-sectional distribution of health costs . . . does not imply that over time aggregate health costs will be determined by the age composition of the population and the costs per age cohort . . . . The belief that there is a fixed medical need for each cohort of the population and that there is a well defined set of services required to meet these needs has been labeled by Evans (1984) as the "naive medical model." The deterministic view that health expenditures are defined fairly precisely by technical factors is simply wrong.

Indeed, international research has led to some uncertainty about the link between population ageing and health expenditure.[38] Econometric studies have produced mixed findings on the relationship between changes in countries' population age structure and changes in their health expenditure.

Kotlikoff and Hagist (2005) studied the growth of health spending in 10 OECD countries from 1970 to 2002. While total health spending has increased 2.5 times faster than GDP over this period in the countries studied, most of this has been due to increases in "benefit growth" (where "benefit" is defined here as health expenditures per person at a given age). They note:

> Had there been no benefit growth, healthcare spending would still have grown because of demographics, specifically changes in the age composition of healthcare beneficiaries and increases in the total number of beneficiaries. But with no benefit growth, healthcare spending in our 10 countries would have grown, on average, only one fifth as fast.[39]

More fundamentally, the focus on age structure may be misplaced, because underlying health status, rather than age, may be the real determinant of the demand for health care. More technically, it is "time-until-death" that determines the cost of health care, not age itself. Miller (2001) studied the pattern of annual spending by Medicare, the United States Government's health programme for the elderly. He showed that the average annual Medicare cost of 95-year-old Americans who were nine years from death was $2,100. In contrast, the average cost of Medicare for a 75-year-old in the last year of life was $13,500.

38 See O'Connell (1996).

39 Kotlikoff and Hagist (2005), p. 1.

Moreover, the relationship between age and health status varies over time. This point is important. In many countries, what it means to be "old" is changing. Not only are we seeing many more people survive into old and very old age, we are seeing many more active, healthy old people. While the evidence available is still inconclusive, researchers have developed ideas that suggest that gains in longevity will translate into lower health-care costs in the future.

Theories of the future course of mortality and morbidity

There are many different theories and a consensus is yet to emerge about where mortality and morbidity are headed. Oeppen and Vaupel (2002, p. 1030) note:

> Mortality improvements result from the intricate interplay of advances in income, salubrity, nutrition, education, sanitation, and medicine, with the mix varying over age, period, cohort, place and disease.

Like many countries' official population projections, those for New Zealand assume that the recent trends in mortality reduction will eventually taper off.[40]

There are, however, studies in the literature that question whether this will be the case. Oeppen and Vaupel, for example, are at the optimistic end. They predict no decline in the rate of increase in life expectancy for the future, with a continuation of a rate of increase of about 2.4 years per decade. This would see life expectancy at birth reach 97.5 years by the middle of the 21st century and 109 years by 2100.

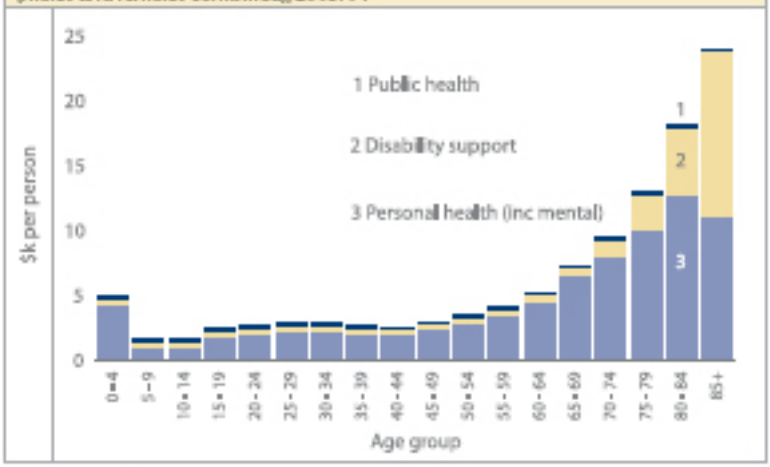
Booth and Tickle (2003), in a study undertaken for the Australian Productivity Commission's work on the economics of population ageing in Australia, have produced projections of life expectancy that are in excess of the official estimates of the Australian Bureau of Statistics (ABS). They estimate female life expectancy at birth in 2027 in Australia to be 88.1 years, compared with an ABS projection of 85.4 years.

There are also pessimists. Olshansky et al (2005) are critical of those studies that predict life expectancy on the basis of extrapolating the past. They prefer an approach that relies on trends in health and mortality that can be observed in the *current* adult population, which they suggest will lead demographers to revise *downwards* their estimates of life expectancy at birth.

Lee (2003) cites two separate stages to the decline in mortality. The first stage, starting in around 1800 in Europe, involved reductions in contagious diseases and infectious diseases spread by air or water. Personal hygiene improved (boosted by increases in income), as the germ theory of disease became more widely accepted. Improvements in nutrition were also helpful. The developed world has probably already experienced most of the potential decreases in mortality due to reductions in infectious diseases and improved nutrition. Cutler, Deaton and Lleras-Muney (2006) reach similar conclusions.

40 The results presented here are for Statistics New Zealand's preferred projection series, which has "medium" assumptions around fertility, mortality and migration. For details of other series, see Statistics New Zealand (2005).

Figure 6.2: Annual government health expenditure by age and service group (males and females combined), 2003/04



Source: Ministry of Health

Figure 6.2 shows the relationship between age and average government health expenditure per person in New Zealand in the financial year 2003/04. Public health covers areas such as health protection, health promotion and disease control. Disability support services include items such as home support, residential care, and equipment, while personal health includes primary, secondary and tertiary medical care.

Per capita expenditure on personal health and disability support services increased with age in 2004, though the most pronounced increases occur with disability support services. For people aged 85 and over, 61% of health expenditure in 2004 was accounted for by disability support services.

Why does health expenditure increase with age? International research suggests that people in poor health need more health care than people in good health, and that the prevalence of poor health, particularly chronic disease and associated disability, rises with age.

Studies in the United States and Canada have found that, on average, people who are about to die make greater use of health services than those who are not. So "distance to death" can predict health expenditure better than "distance from birth" (age, in other words). The link between distance from death and expenditure is especially strong for acute care (Lubitz and Riley, 1993; McGrail, Green, Barer, Evans, Hertman and Normand, 2000; Miller, 2001; Yang, Norton and Stearns, 2003).

An increase in life expectancy means that there has been a change in the health status of the population. There is an unsettled debate in the literature on what is happening, and what is likely to happen in the future, to health status. The first bar in Figure 6.3 represents a life before the increase in life expectancy. There are three broad possibilities for changes in health status, which are illustrated in

a stylised form in the lower three bars. In each case, they take as given an increase in life expectancy: people are, on average, living longer. The question they seek to answer is whether those extra years of life are, to put it crudely, lived in "good" or "bad" health.[41]

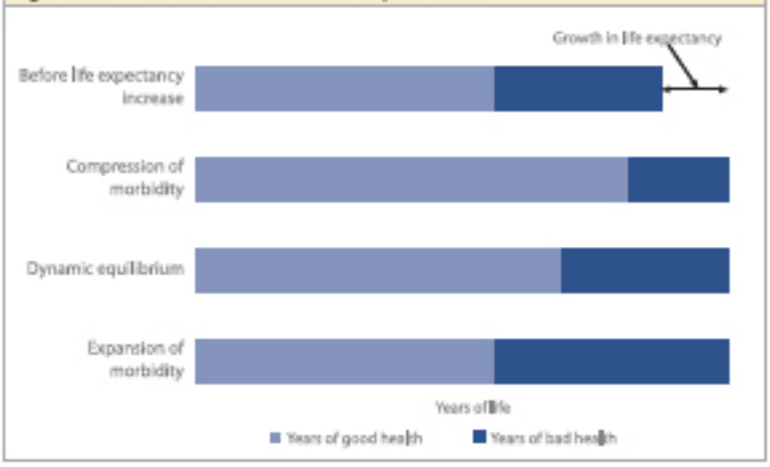
The first, and most optimistic, scenario is that health is improving across the board. This is known as a "compression of morbidity": people both live longer and have fewer years of bad health.

The second is a "dynamic equilibrium" (also known as "healthy ageing"): the absolute period of bad health stays the same, but falls in relative terms as the absolute period of good health increases.

The final and most pessimistic scenario is known as an "expansion of morbidity": the absolute period of good health stays the same, with all the increased years of life expectancy being in poor health. A severe expansion of morbidity would see the absolute period of good health reducing.

It is difficult to predict the net effect of medical progress on age-specific disability rates. Some new technologies have led to increased disability rates. The standard example is coronary care, which has reduced the case fatality of heart attack, but in so doing has created an "epidemic" of heart failure.

Figure 6.3: Possible future health states in years of life



Source: The Treasury

Other technologies, however, such as drugs to reduce hypertension (the major risk factor for stroke), have helped reduce disability rates. Similarly, it is difficult to predict the net effect on disability of conflicting population health trends such as increasing obesity and declining smoking rates. The only way to resolve the uncertainty is to look at longitudinal data on disability.

41 Figure 6.3 divides a person's life neatly into discrete periods of good and bad health. For many people, this is clearly not the case.

New Zealand evidence on disability trends

There have been two recent studies of trends in disability in New Zealand.

Graham et al (2004) use data from two observations, one in 1981 and the other in 1996, to evaluate the evidence for the three theories of health change. They find that the "dynamic equilibrium" scenario provides the best fit to the New Zealand data.

Tobias et al (2004) use data from two surveys of disability conducted in 1996 and 2001, after each census, to test for trends in health status. They find mixed evidence. Their method divides expected life into four discrete periods:

- disability-free life expectancy
- disability not requiring assistance (level 1 disability)
- disability requiring non-daily assistance (level 2 disability)
- disability requiring daily assistance (level 3 disability).

Over the five years between the two censuses, life expectancy at birth for males increased by 1.9 years, to 76.3 years; while for females, the increase was 1.5 years, to 81.1 years.

Table 6.1 breaks down the increase in expected life into the four stages. The results are different for males and females. For males, the vast bulk of the increase can be expected to be spent in the state of highest disability. This supports an "expansion of morbidity" theory. For women, however, there is actually a decline in the period spent in the highest level of disability, with increases in disability-free years as well as periods of moderate disability.

Table 6.1: Decomposition of increase in life expectancy

	Males	Females
Total	1.9	1.5
Disability-free	0.1	0.4
Level 1	0.0	0.6
Level 2	0.0	0.8
Level 3	1.8	-0.3

International evidence

Bryant, Teasdale et al (2004) report on a systematic review of international longitudinal studies.[42] Census data from Australia appear to imply that disability rates have risen. The highest-quality studies, covering the longest periods, however, have been conducted in the United States. These studies all suggest that disability rates have declined significantly.

42 Appendix 3 of Bryant, Teasdale et al (2004).

Robine and Michel (2004) suggest that population-wide studies might be masking some significant trends through time and in sub-groups of societies. They tentatively suggest that a four-stage process can explain the apparently inconclusive evidence, as follows:

1 an initial increase in survival rates of sick people, leading to an expansion of morbidity

2 control of the progression of chronic diseases, which produces a "dynamic equilibrium" between a fall in mortality and an increase in disability

3 an improvement in the health status and behaviours of new cohorts of older people, which produces a compression of morbidity

4 the eventual emergence of very old and frail populations, which would be represented as a new expansion of morbidity.

Synthesis

Putting these competing theories and the data from New Zealand and overseas together is not an easy task. The forces at work are complex and not completely understood.

From these studies, it is reasonable to assume that, in the future, the incidence of disability will decline as the population ages, meaning that people will be living longer and healthier lives.

Modelling the future

Modelling the future course of health spending is a challenge. In contrast to the case of New Zealand Superannuation, there is not a single parameter-driven scheme in place. Rather, there is a complex set of policies, which are usually described as "the public health system."

The Government currently funds large amounts of health care provided by private suppliers (examples include: doctors visits subsidised via the Primary Health Organisation system; pharmaceuticals subsidised via the Pharmaceuticals Benefits Schedule operated by Pharmac; treatment of personal injury from accidents reimbursed - sometimes partly, sometimes completely - by the Accident Compensation Corporation scheme). It also supplies heath-care services in kind (principally through the hospitals operated by District Health Boards).

The total quantum of health spending is thus the result of a myriad of individual purchase decisions made by successive governments about what to fund and what to provide.

The model

For the purpose of developing the projections of future spending, it is assumed that the broad features of the existing health system will remain in place and that governments will continue to make purchase decisions much as they have in the past.

Under this approach, the result is that government decisions are driven by a combination of demography, cost and policy decisions. The model does not, however, separate out completely the effects of each of these three elements.

The modelling choices made draw on historical patterns and the potential demographic and non-demographic drivers of health spending in the future. The most likely settings of the modelling parameters are used in the base case. The base case is used in Chapter 11 as part of projections of the overall long-term fiscal position. The present chapter also presents a range of other scenarios to illustrate the effects of different drivers on the projections.

All health spending service groups, except disability services, grow as follows:

$$E_t = E_{t-1} \times (1+cw_t) \times (1+g)^{\varepsilon} \times (1+r_t),$$

where:

E = health spending,

cw = growth of $\sum_a$cost weights$_a$ x population group$_a$ (summing over age and gender groups, a),

ε = income elasticity of demand for health services,

g = nominal GDP growth (as a proxy for income), and

r = a residual growth factor.

In other words, growth in spending on health is the sum of population growth and the growth effects of ageing and health status, and the growth of demand, plus an additional growth factor (capturing relative price changes and the costs of new technologies).

This equation differs from the standard Long-Term Fiscal Model equation in that it has the residual growth term and it tracks nominal GDP growth. The major growth differences between the Long-Term Fiscal Model modelling and the present approach are in the residual growth factor and the fact that the cost profiles vary in time and depend on whether the recipient of health-care services is in the last year of life or not (is a "decedent" or a survivor).

For disability support services, following Bryant, Teasdale, et al, the incidence of disability decreases over time, roughly in line with longevity gains (falling by 0.5% a year). The provision of informal care is also related to labour participation of 50- to 64-year-old women to capture choices between provision of care and a job in the labour market: as more older women find paid work, the less likely they will be able to support disabled relatives and the greater will be the demand for formal care provided by the State.

Growth for disability support services is modelled as follows:

$$E_t = E_{t-1} \times (1+cw_t) \times (1+p) \times (1+g)^{\varepsilon} \times (1+r_t) \times (1+h_t),$$

where:

E = public spending on disability support services,

cw = growth of the fixed cost weights times the age and gender groups,

p = the rate at which the incidence of disability is falling,

g = growth of nominal GDP,

r = growth of the residual, and

h = growth in the participation of the 50 to 64 age group.

Data

The expenditure covered here is government health spending, which makes up about 80% of total spending on health. OECD studies of government health spending differentiate between health care and long-term care. Health care is the provision of medical goods and services to the whole population. Long-term care is the provision of goods and services to the elderly, including both medical and non-medical care, such as accommodation and food.

In New Zealand, health care and long-term care are both largely funded through Vote Health (with some funding from the Ministries of Social Development and Education) and it is therefore difficult to differentiate between them. The model does not attempt to break out a separate category of long-term care.

For historical data, a single series of current-dollar spending on Vote Health is sutured together from a number of different accounting regimes. The Ministry of Health provided 2003/04 spending profiles by five-year age groups for four categories of spending: personal health (67% of the total, covering primary, secondary and tertiary care), disability support services (24%, consisting of home support, residential care and equipment) and two final small categories, mental health (7%) and public health (2%, covering health-promotion campaigns).

Parameters of the model

Making projections of health spending requires parameters for:

- cost weights
- income elasticity of demand for health services, and
- the residual growth factor.

Nominal GDP growth is produced in the modelling of the future of the economy (see Chapter 4).

Projecting disability support services requires additional parameters relating to the incidence of disability, plus projections of the future size of various population sub-groups (which are derived from the general population projections discussed in Chapter 3).

Historical data are used to derive a number of these parameters. Several assumptions are made to analyse the drivers of real per capita health spending over the period 1950 to 2005:

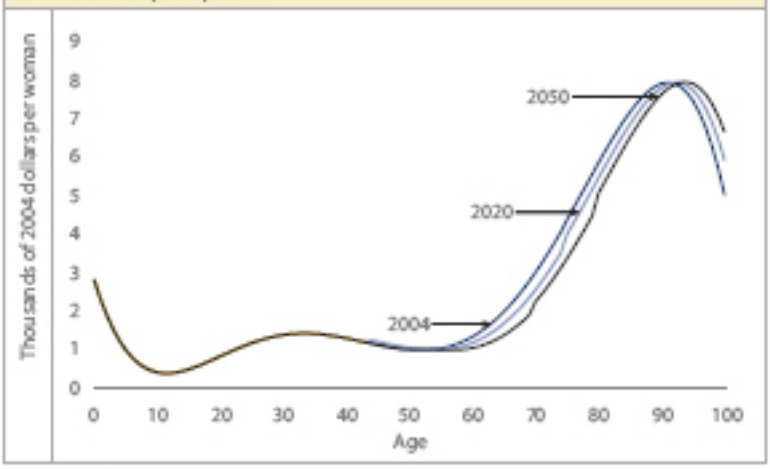
- the proportions of spending in the cost profiles (of the four categories added together), such as those in Figure 6.2, have remained the same over the past five decades (we have no data indicating how these might have changed through the decades)
- aggregate health spending covers roughly the same bundle of services throughout this period (admittedly this is unlikely, as, for example, disability support spending moved from Social Development to Health in the 1990s)
- the CPI is an appropriate deflator for aggregate health spending over this period
- real growth in health spending is the sum of growth due to changes in the mix of ages, rising demand (modelled by GDP) and a residual (which might be capturing the effects of relative price movements, technology, and input costs such as wages of health workers).

Running historical demographic changes through the fixed-cost age profile suggests per capita annual growth arising simply from changes in the age-mix has been around 0.2 to 0.5% a year through the period, a relatively minor contributor to the growth of real per capita health costs since the 1950s (3.0%). (This growth analysis is highly dependent on the deflator and the period covered. It is also in mild conflict with the assumption that health status is changing over the next four decades.)

Estimates in the literature of the income elasticity of demand for public health services range from 0.9 to 1.2 and centre on 1.0. Estimates of the income demand for health care depend on the level of analysis. The larger the group studied (region, country, group of countries), the higher the estimates of the income elasticity in the literature. An elasticity of 1.0 means that average growth of per capita demand for health services is the same as nominal GDP per capita (a measure of aggregate income). Using New Zealand data for the period 1950 to 2005 produced an estimate of 1.16.

Based on history, the average annual residual growth factor over the past 50 years is just over 1% when the income elasticity is set at 1.0, or 0.9% when income elasticity is equal to 1.16. Note that in the early-to-mid 1980s, real health spending contracted, forcing the residual growth to be negative. For the projection period, an income elasticity of 1.0 is assumed for the base case, but a scenario for 1.16 is also presented. Note that a higher estimate for the income elasticity requires a smaller estimate for the residual.

Figure 6.4: dynamic equilibrium in the personal health category: cost profiles for women in 2004, 2020, 2050



Source: The Treasury, based on Ministry of Health costs by 5-year age group

Table 6.2: Decomposition of historical real per capita health spending

Average real annual growth to 2005 from	1950	1960	1970	1980	1985	1990	1995	2000
Total health	3.0	2.9	3.0	2.4	3.5	3.7	4.1	3.7
Pure age effect	0.2	0.3	0.4	0.5	0.5	0.4	0.4	0.4
Age-adjusted growth	2.7	2.6	2.6	1.9	3.0	3.3	3.7	3.3
Income elasticity = 1.0								
Income effect	1.5	1.6	1.5	1.8	1.8	2.6	2.3	2.6
Residual	1.2	1.1	1.1	0.1	1.2	0.7	1.4	0.7
Income elasticity = 1.16								
Income effect	1.8	1.8	1.7	2.1	2.1	3.0	2.7	3.0
Residual	0.9	0.8	0.9	-0.2	0.9	0.3	1.0	0.3

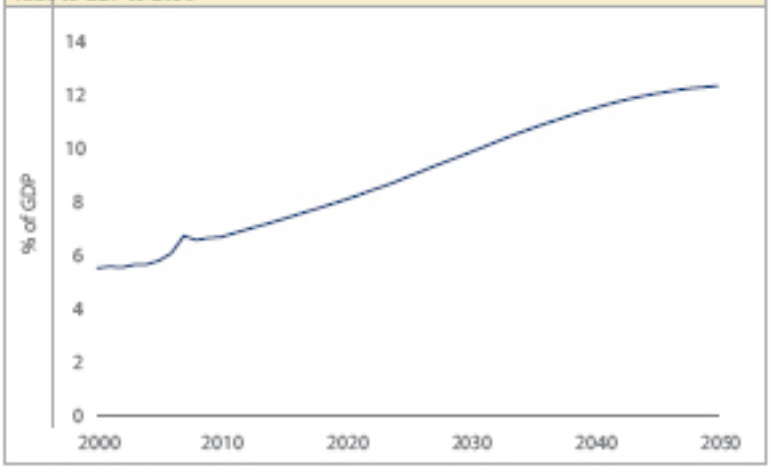
Source: The Treasury

The dynamic equilibrium hypothesis is assumed to hold in the projection period so that longevity gains are translated into further years of good health. The life expectancy of a 65-year-old woman in 2050, for example, is almost five years more than it was in 2000 and so the health costs of that person are assumed the same as a 60-year-old in 2000. The historical 5-year-age cost profiles curves are interpolated into single years and then shifted to the right to simulate this dynamic equilibrium.

In addition, the personal health cost curves are separated into the death-related costs incurred in the last year of life and the costs of the survivors. For each age group, the proportion of those dying to those surviving is falling and this dampens health spending each year. Under these two assumptions (healthy ageing and death-related costs), the projected fall in mortality (rise in longevity) will tend to lessen the impact of ageing on public health spending.

The base-case projection assumes that the income elasticity of demand is 1, and the residual growth decreases from the historical average of 1 over the past 40 years to 0 in 2050 under the assumption of unspecified cost containment through the period.

Figure 6.5: The base-case track for core health spending shows a doubling of the ratio to GDP to 2050



Source: The Treasury

The base-case results

The base case models total health expenditure using demographic changes, projections of healthy ageing and falling disability prevalence, distance to death, demand growth (unit elasticity), and an historically derived but diminishing residual growth factor. This residual captures changes in relative prices, technology, and so on, while the assumption of a gradual reduction represents unspecified cost containment through time.

For this projection, the average annual real per capita growth between 2005 and 2050 is around 3%, much as it was in the previous half century. The contribution to this from the changing age-mix (moderated by changing health status) is about 0.8% on average (with fixed weights, this growth is 0.9%). So ageing effects are larger in the projection period than in history, but they are not dominant. In fact, if the assumed income and residual growth effects are omitted, demographic and health status by themselves serve to lower the proportion of health spending to GDP by more than 3 percentage points.

The bulk of the growth in spending, therefore, comes from cost and coverage growth. This produces a rise in the ratio of spending to GDP of 6.6 percentage points between 2005 and 2050 and average nominal growth of 5.8%.

Alternative scenarios

Compared with superannuation, where spending depends on the number of people 65 and older and the average payment amount (growing by a preset rate), the health system is clearly not parametric. This makes modelling future public health spending a difficult proposition; the drivers of spending growth are uncertain and even when plausible parameters are selected, there is the normal

uncertainty about their projected growth rates. This section therefore looks at various scenarios with different settings of the proposed parameters.

This section lays out six alternatives to the base case. The first four show the effects of varying modelling assumptions in our base model, while the last two come from different models.

Full-cost pressure

The full-cost pressure scenario has the residual growth factor remaining constant over the whole projection period to 2050. This would happen if there were no cost-containment measures that were assumed in the base case. Health spending has grown faster than GDP over most of the past 50 years. A small part of this is due to ageing, but most is due to demand pressures and the rest is taken up with the residual.

If these extra cost pressures are not contained, this scenario suggests a higher track for health spending than the base case by 2.8 percentage points of GDP in 2050, 9.4 percentage points higher than the ratio is now.

High elasticity

In the base case, the income elasticity of demand is set at 1.0, based on overseas studies. An estimate for New Zealand is 1.16 and this is used in the second scenario (with the residual, accordingly, lower at 0.9, tapering to 0 in 2050).

The intuition behind this scenario is that New Zealanders see medical services as a "superior good" (to use the economic jargon) and demand relatively more of them as they become wealthier through time.

Stronger demand effects make this the highest-cost scenario, with the ratio to GDP in 2050 almost 10 percentage points higher than in 2005 and more than 3 percentage points more than in the base case.

Fixed-cost profiles

The base case scenario includes an element of improved health status. The third scenario examines the impact of this improvement on the projections of personal health care (as opposed to disability support services, which are covered by the next scenario). The scenario does this by keeping the personal health cost profiles and disability prevalence fixed for each age group. This captures the features of an "expansion of morbidity" (people live longer in the future, but with today's incidence of morbidity).

Compared with the base case, this scenario shows the effects of generally poorer health outcomes and indicates that health spending could grow faster than the healthy ageing base case, with a gap opening up of 1 percentage point by 2050. This scenario has health spending as a GDP share rising by 7.6 percentage points by 2050 above the present ratio.

Disability incidence unchanging

The fourth scenario isolates the effects of unchanged disability incidence on the disability support component of health spending. This reverses the base case assumption that, as a society, changes in lifestyles, earlier and potentially cheaper medical interventions and so on will reduce the rate of disability through time.

If this does not happen, then health spending increases by a half percentage point of GDP by 2050 above the base case (and by 7.2 percentage points of GDP compared with now).

Health status

The final scenario is built on the health-status modelling undertaken by the Treasury and the Ministry of Health,[43] where costs of each age and gender group depend on the numbers of people in the last year of life or not, and on the numbers disabled or not. Another difference from the base case is an assumed steady reduction in mortality (rise in life expectancy), while the base case modelling assumes a deceleration in longevity gains.

Underlying costs grow by the average seen over the past half century (but less than that seen over the past decade). As a share of GDP, health spending reaches 12% in 2050, a rise of 6.4 percentage points from the ratio now. This scenario has a similar end point to the base case, but a steadier journey in getting there.

Low-cost growth

The fifth alternative simply models the impact of the changing population structure on health spending.

In this scenario, cost profiles do not shift to the right for each age group but, in effect, move upwards with the growth of labour productivity (or the nominal wage). This assumes an expansion of morbidity, but allows only cost rises due to increases in labour costs, and not to technology or demand produced by rising incomes. This is a common approach, where no allowance is made for changes in the health status of the population: we live longer, but in poorer health.

While keeping health status constant has been used in Long-Term Fiscal Modelling in New Zealand and other countries in the past, the underlying premise - that health status is invariant - does not have much support in overseas research or work done here in New Zealand.

In the low-cost scenario, health spending as a share of GDP rises to about 10% (down on the base case by 2.7 percentage points) by 2050, up from 5.8% in 2005. The average nominal spending growth between 2005 and 2050 is 5.1%, compared with the base case's 5.8%.

43 Bryant, Teasdale, et al (2004) has the modelling details.

The results of the scenarios compared

The results of the six scenarios, and the base case, are presented in Table 6.3 and Figure 6.6.

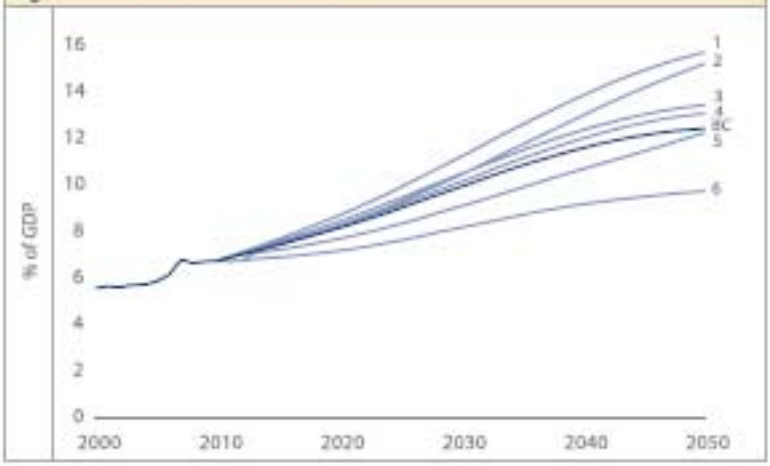
One striking feature of the scenarios is that they all see health expenditure increasing as a proportion of GDP. The differences are in the rate of growth and its trajectory. This is, in part, a product of the modelling technique used. Health spending in New Zealand (and the industrial world) has been increasing steadily in the past and the model of future spending is based, in part, on the historical trend.

There are, however, reasons to think that this approach might be reasonable. It is difficult to see why New Zealanders would want to spend less of our national income on health care as income increases.

While there is some evidence to support the notion that continued improvements in life expectancy will translate into lower health spending, via improvements in health status, the proportion of the population in old age and very old age is set to increase markedly over the next 50 years and it would be surprising if this did not, at least to some extent, lead to increased spending, given the relationship between age and health expenditure we see today.

Finally, the history of medicine has been one of substantial increases in the range of procedures and treatments available (coverage) and their cost. Again, it is difficult to see why this trend might suddenly come to an end.

Figure 6.6: A theme and six variations



Source: The Treasury. The scenarios are numbered as in the above table and BC = base case

Table 6.3: Decade results of base-case and alternative scenarios

Scenario (% of GDP)	2005	2010	2020	2030	2040	2050
Base case	5.8	6.7	8.1	9.9	11.6	12.4
Difference from base (pp of GDP)						
1 High elasticity	0.0	0.0	0.5	1.3	2.3	3.3
2 Full-cost pressure	0.0	0.0	0.1	0.5	1.4	2.8
3 Fixed-cost profiles	0.0	0.0	0.3	0.5	0.8	1.0
4 Disability incidence unchanging	0.0	0.0	0.1	0.2	0.4	0.6
5 Health status	0.0	0.0	-0.5	-0.8	-0.9	-0.2
6 Low-cost growth	0.0	0.0	-1.0	-1.8	-2.4	-2.7

Policy lessons from these projections

As just discussed, the largest driver of spending above GDP growth is the residual growth factor, which can be thought of as a proxy for decisions around the "cost and coverage" of the public health system.

As a result, the greatest impact on future spending patterns is likely to come from a focus on non-demographic factors. In the short term, particular challenges are around:

- continuing to seek ongoing improvements in the performance of the health system and in the quality of services; that is, continually looking for ways to get better value for money
- managing the adoption of new technology (linking the demand for newer, more complex technology to evidence about its impact on health outcomes and the trade-offs involved)
- the coverage of, and access to, services; and, in particular, seeking better health outcomes through earlier and simpler interventions.

The longer-term debate should focus on the relationship between health outcomes and health spending (at the macro level), and the relationship between the quality and cost of health services (at the micro level). There is no simple relationship between total spending and health outcomes; more does not necessarily mean better (the United States is the prime example, where a high-cost health system has not produced superior health outcomes). There is some evidence that a lower-cost health system can, with smart use of resources and a focus on quality, deliver optimal health outcomes.

7 Education

Public spending on education since the Second World War has been primarily occupied first in educating the baby boomers and building schools in which to teach them and, later, in catering for the growing participation of people of pre- and post-school age in our education system.

Over the next 50 years, with demography still an important driver, declining proportions of young in the population could mean that the quality of the education system could be maintained, while at the same time resources could be freed up to help pay for the growing demand from health and superannuation. Whether there will be such a fiscal dividend from education is far from certain.

This chapter looks at some of the past drivers of education spending and touches on the issues facing the major components of each sub-sector. It then outlines the approach taken to modelling future spending by sectoral level and the sensitivity of the results to some of the risks.

Over the past half century, public spending on education has grown two-and-a-half times as a share of GDP (Figure 7.1). Annual growth has averaged 10.9% a year (4.5% real growth a year), about 1.7 percentage points faster than nominal GDP growth over this period.[44] Over the past decade, when the data are more clearly operating, rather than capital expenditure, total education spending has grown by an average of 6.2% a year.

Figure 7.1 also shows that forces in addition to demography have been driving the growth in public spending on education as a share of GDP since the 1970s.

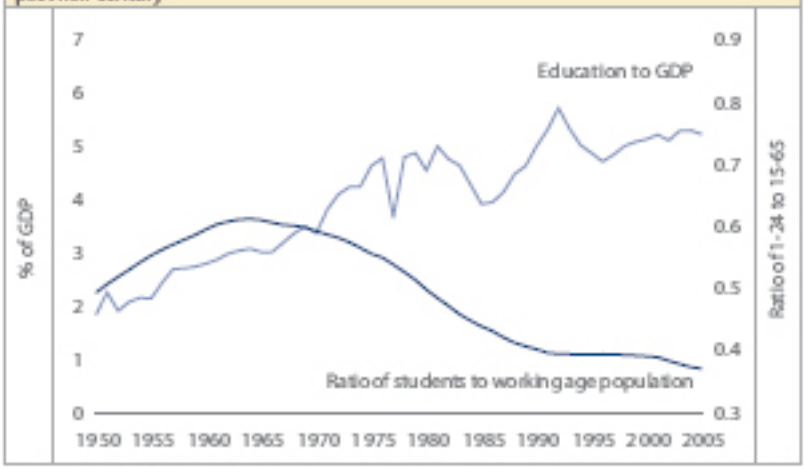
At present, spending on primary and secondary schooling takes about half of the public spending on education, while tertiary has about a third.

Looking ahead, demography is likely to change the shape of the education sector. Figure 7.2 shows the prime catchment ages for the different parts of the sector.

Student numbers depend on present enrolment rates and their evolution in the projection period. The number in the early childhood education pool is expected to fall by 11% between 2005 and 2050, primary by 10%, and secondary by 9%, while tertiary returns to 2005 levels after the early 1990s baby blips have completed their studies.

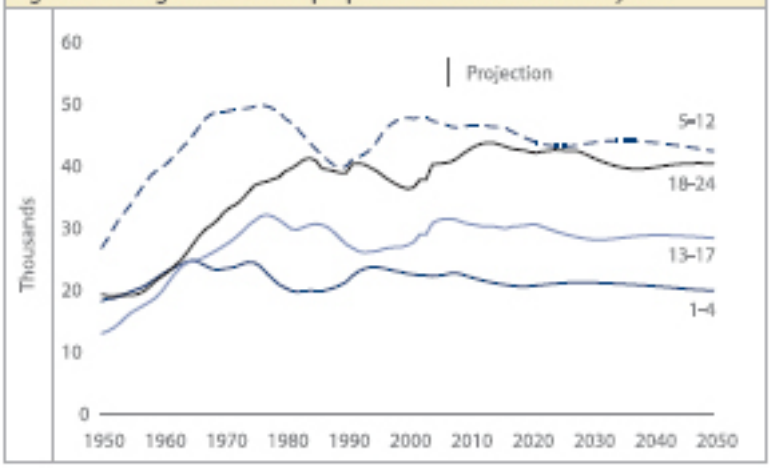
44 The box in Chapter 1 about data quality is particularly pertinent here; data before 1994 may also include capital costs of building those post-war schools.

Figure 7.1: Public spending on education has more than doubled its share of GDP in the past half century



Source: Statistics New Zealand

Figure 7.2: Change in numbers of people in sectors over the next 50 years



Source: Statistics New Zealand Series 5 projection

On pure demographic grounds, spending for education services will fall over the projection period, provided costs per student stay constant (which means, in practice, teachers' pay moving in line with that of the rest of the workforce).

Other factors are, however, at play. In the short-to-medium term, the public education sector is likely to see a continuation of the trends of the recent past. Some of the issues are:

» schools built after the Second World War are now fully depreciated and the sector is facing large capital costs to replace them

» population movements mean that schools are now not always in the areas where families are. Recent experience is that it is difficult for resources to be shifted completely to where the children are

- there could be shifts in the boundary between public and private schooling, placing greater pressures on the fiscal position
- the number of students going on to tertiary education has stopped growing, perhaps because of the strong labour market
- the median age of students has risen because of growing attendance by people over 40. While these numbers are as yet small in the overall picture, they may become more significant with the ageing of the population and rising demands for moving in and out of education throughout life
- the need to improve productivity performance could place greater demand on the public sector for job-related training.

Drivers of the future and modelling assumptions

Basically, for each education sector, future public spending is just the expected cost per student times the projected number of students. More specifically, the general form for modelling each sector is:

Spending = [teachers' average wage*(teacher/student)]*[enrolment rate*population for sector].

The assumption here is that labour costs are the only, or the dominant, driver – or are a fixed proportion of total costs. In fact, labour costs make up about 80% of the operating expenses in schools. Hence, more accurately, for each education sector:

Spending = (total spending/teachers' labour costs)*average wage*(teacher/student)* enrolment rate*population for sector.

If, in the base case, the proportion of total costs to labour is assumed to be fixed and the student-teacher and enrolment ratios are fixed (including the mix of full-time and part-time tertiary students), then in growth terms:

New spending = old spending*(new wage/old wage)*(new population for sector/old population for sector).

Based on this, a simple modelling approach is used to project forward all levels of education (with a slight variation in tertiary), using the growth of the age-group base, inflation and a real per student growth factor of 1.5% each year based on the real wage of teachers. This wage is assumed to grow at the same rate as for the whole economy and be equal to productivity growth.

$$E_t = E_{t-1} \times (1+i) \times (1+w) \times (1+d),$$

where

E = expenditure,

i = the inflation rate,

w = real wage growth, and

d = growth of the appropriate age group.

Here the appropriate sectoral age groups are 1 to 4 for early childhood education, 5 to 17 for primary and secondary (largely the compulsory sector) and 18 to 29 for tertiary. (The tertiary age group has been expanded to the late 20s because a growing proportion of tertiary attendance is being drawn from those older than the traditional prime catchment ages of 18 to 24.) As noted above, these groupings tend to reduce in size over the next half century. The base modelling assumes that enrolment rates from each of these age groups remain as they are now. Sensitivity scenarios later examine the effect of changing this assumption.

Tertiary spending has an extra growth driver. In this case, E is tertiary spending (plus student loan write-offs) and the extra growth driver is the growth of $(1 - part_{18\text{-}29})$, where $part_{18\text{-}29}$ is the participation rate of the 18-to-29-year olds. For those aged 16 and older, working is an alternative to attendance in upper secondary and tertiary education and so rising demand from the labour market will reduce enrolment.

The student loan scheme is assumed to continue.

Figure 7.3: Projected education spending falls as a share of GDP

Source: The Treasury. The spike in 2006 is the write-off of student loans

Risks to these projections

These projections depend on the demographic projections, the risks to which are outlined in Chapter 4.

The spending per student could rise faster than the assumed labour productivity growth (wage per worker) and that would limit any gains released from the public education sector. Enrolment rates might rise, rather than remain where they are at present. More and more tertiary students could come from those middle-aged and older.

The requirement for stronger aggregate productivity growth may put on pressure for more technical training, publicly funded rather than funded privately by firms.

Rising wealth may increase the demand for life-long learning and produce an ageing of the tertiary student population.

Sensitivity tests

This section looks at three scenarios.

Rising enrolment

The first scenario tests the sensitivity of the modelling to student numbers by assuming higher enrolment in each sector. Recent European Commission modelling of long-term education spending is used as the basis of the calculations.[45]

The schools enrolment rate is assumed to rise gradually so that, by 2050, it is 6 percentage points higher and tertiary, 9 points higher, than in 2011.[46] With no guidance from EC modelling, the early childhood education enrolment rate is rather arbitrarily assumed to rise 10 percentage points by 2050.

These changes lift the spending-to-GDP ratio by 0.3 percentage points by 2030 and double that by 2050. The effect is that while spending still falls, the reduction is much smaller than in the base case.

Rising enrolment and older attendance in tertiary

Over the period from 1999 to 2003, the areas of greatest growth in tertiary attendance have been in those 40 and older (from a low base and more as part-time students). This scenario therefore applies the rising tertiary enrolment assumptions in the first scenario to people aged 18 to 64. This change lifts the spending-to-GDP ratio by 0.2 percentage points above the previous case in 2050 and 0.8 points above the base case.

Lower student/teacher ratios in schools

The second scenario looks at the effect of changing student/teacher ratios on spending.

This could be thought of a modelling an increase in the quality of the public education system (even though the evidence on the link between educational outcomes and student/teacher ratios is far from clear).[47]

45 Montanino, Przywara and Young (2004), p 17.

46 The enrolment increase in schools is lower because compulsory education means that enrolment rates are high already. The increase here is in the post-compulsory school enrolments.

47 See, for example, Michael A. Boozer and Tim Maloney, "The Effects of Class Size on the Long-Run Growth in Reading Abilities and Early Adult Outcomes in the Christchurch Health and Development Study," Treasury Working Paper, 01/14.

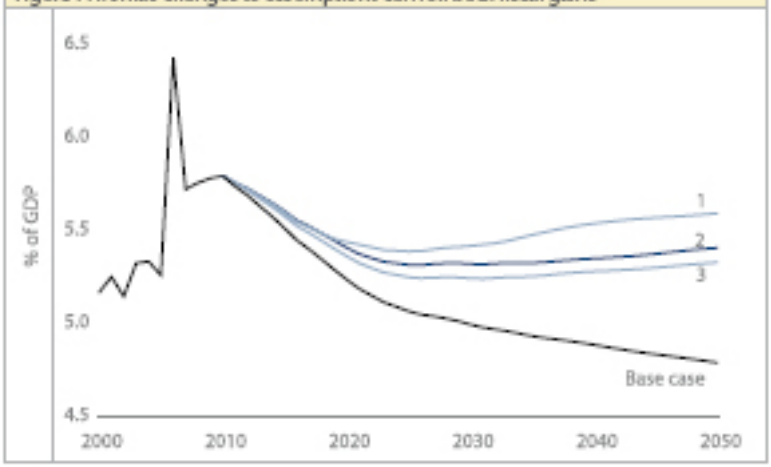
The scenario lowers the student-teacher ratio gradually in primary and secondary schools so that by 2050 it is 20% lower than it is now. This reduction is somewhat arbitrary and is equivalent to decreasing the average class size by four students by 2050.

The result is a similar increase in spending to that in the enrolment scenario.

Table 7 .1: Results of allowing changes to modelling ratios

Scenarios (% of GDP)	2005	2010	2020	2030	2040	2050
Base case	5.14	5.79	5.23	4.99	4.88	4.78
Difference from base (pp of GDP)						
1. Rising enrolment, larger tertiary pool	0.00	0.00	0.20	0.42	0.65	0.80
2. Rising enrolment	0.00	0.00	0.17	0.33	0.46	0.62
3. Falling student-teacher ratios	0.00	0.00	0.13	0.25	0.40	0.54

Figure 7.4: Small changes to assumptions can roll back fiscal gains



Source: The Treasury

Conclusion

The base case shows that demographic change could produce a reduction in the GDP share spent on education over the next half century. However, the scenarios in this chapter show that even small changes in some of the parameters can reduce potential savings.

With a decreasing proportion of the population in the work force and an increasing dependent population (especially those over 65), there is an open question about whether education will be primarily driven by demography.