Long-term Fiscal Projections: Reassessing Assumptions, Testing New Perspectives

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New Zealand Treasury

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Abstract

Early in 2013, the New Zealand Treasury will publish the next long-term fiscal statement. The report will test fiscal sustainability over the next 40 years through a series of projections, capturing trends, risks and uncertainties flowing from population ageing and other drivers. It will also canvas a range of policy options to address sustainability, and their possible effects on living standards. The present paper lays out the modelling approach, the assumptions behind the projections, and the sensitivities around those assumptions. Early versions of this paper and two others on fiscal sustainability and on preliminary versions of the projections were presented at the NZAE Conference in June this year.

JEL CLASSIFICATION

JEL classification codes:

H00 – Public economics

H50 – National government expenditures and related policies

J00 – Labour and demographic economics

KEYWORDS

Key words: Public economics; government expenditure; labour economic; demographic economics

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1 Introduction

For the past 15 years or so, many countries around the world have examined the implications of current spending and revenue programmes (pensions, health, education, personal and corporate taxes, and so on) on the future fiscal position, given the expected demographic changes, likely trends for economic growth, and other drivers. The outcomes of these projections show the potential future effects of policy choices made by past and present governments. To change the possible longer-term fiscal position will require current and future governments to make further policy choices.

In New Zealand, the Treasury has produced long-term fiscal projections from the mid-1990s for one purpose or another. The Treasury has published formal statements of the possible future fiscal position twice before, in 2006 and 2009, as required by the Public Finance Act (under the 2004 amendment). The 2006 statement attracted relatively little attention. The second, incorporating the effects of a domestic recession and the 2008 global financial crisis, and resulting in a more dire picture, produced a wider debate about what choices could be made to prevent the projected debt position (New Zealand Treasury, 2006, 2009).

Picking up lessons from the first two statements, and from the 2010 Tax Working Group process, the Treasury has embarked on a wider and more open process to prepare the next statement. We have commissioned external experts to provide research on the evolution of the welfare state, on various policy settings and choices that could be made. Some are considering what could be learned from the past, both from programmes and policy-making processes that have had long-lasting results. Other important topics include fiscal sustainability, the evolution of the New Zealand welfare state from historians' and philosophers' perspectives, and approaches to intergenerational equity.

In addition to externally commissioned research, the Treasury has set up an external panel to challenge our work and provide suggestions on how to improve our analysis. A summary of the panel's deliberations will be made public after each of the four sessions between August and November. This will be followed in early December by a public conference hosted jointly by the Treasury and Victoria University Chair of Public Finance. The conference will incorporate our work and that of the external experts. Publication of the next Long-term Fiscal Statement will follow in March 2013.

Part of our work for the first panel session on 30 August 2012 is this paper, which re-assesses our modelling process and assumptions.

The paper is structured as follows. Section 2 explains at a high level what our projection model, the Long-Term Fiscal Model, does and doesn't do, dual ways of presenting projections, and how we will reflect uncertainty. Section 3 discusses the base demographic projection assumptions. This is followed by Section 4 explaining the choices behind the economic assumptions. Section 5 examines how base-case tax assumptions were arrived at, while Section 6 lays out the assumptions behind our spending projections for New Zealand Superannuation, welfare benefits, health and long-term care, education, and the rest.

Section 7 deals with assumptions needed to frame fiscal sustainability such as the long-term target debt ratio and how long to use current policy forecasts before moving to trend projections more based on historical averages. In Section 8, we discuss the sensitivity of the modelling to changes in the key demographic, economic and fiscal assumptions. Section 9 concludes.

The thinking in this paper draws on the paper on fiscal sustainability (Buckle and Cruickshank, 2012) and is incorporated in the paper on our economic and fiscal projections (Bell, 2012).

2 Long-term Fiscal Model primer and approaches to projections

"The goal of forecasting is not to predict the future but to tell you what you need to know to take meaningful action in the present." - Paul Saffo

"I don't try to describe the future. I try to prevent it." - Ray Bradbury

This section takes a high-level look at how the Treasury's spreadsheet-based Long-term Fiscal Model (LTFM) produces projections. Before embarking on that, we need to explain the language we use to describe two different approaches to looking at the future.

We use the term "forecasts" for predicting the results of the key interactions of the economy to produce a forecast of the business cycle over the near-term future. For example, a surge in exports lifts the demand for workers, driving down unemployment, and eventually wages and inflation rise, producing a monetary policy response to slow economic growth. We use the New Zealand Treasury Model (NZTM), a macro econometric model, with estimated coefficients capturing such behavioural linkages, to do the Budget Update macro forecasts (going out five years).

"Projections," on the other hand, involve relatively few interactions, few drivers, and relatively few assumptions; they more likely to follow smooth trends rather than the ebbs and flows of the business cycle. They can be used to show the effects of a change and answer a question: "What if this assumption was higher or lower?" Projections not an attempt to forecast the future in the way described above. They are a much more mechanical exercise. The two comments at the top of this section reflect the view that a projection has succeeded if it provokes a discussion leading to changes that avoids the projected outcome.

2.1 How the Long-term Fiscal Model works

The LTFM was developed in the mid-1990s to examine possible longer-term effects of current fiscal policy settings. Today the general idea is still the same: take the medium-term economic and fiscal forecasts from the NZTM as a starting point and then grow out these economic projections for several decades beyond that. Couple this with fiscal projections, using the last year of the fiscal forecasts as the launch point for projections of taxes, spending on government services, transfers, and changes to assets and liabilities.

The long-term fiscal team has weighed up the pros and cons of when it is best to switch from the forecasting methodology to projections: One approach is to go directly from history to projections, another to go to projections after the next expected election, and a third to wait the traditional five years before moving to projections. This discussion will be taken up in Section 7.

The model therefore uses a high-level macro background to project the government's financial accounts - financial performance (flows of revenue, spending including on the costs of servicing the existing debt and on government investment, for the core crown and wider total crown, including SOEs and Crown Entities), and the financial position (the balance sheet, assets and liabilities, including various measures of debt).

The macroeconomic forecasts (GDP, employment, interest and exchange rates, government spending and revenue) are produced by the NZTM. The macro modellers put in a set of assumptions describing the long-term trend behaviour of the NZ economy. The model then produces a quarterly track that describes a path from the end of actual outturns until it reaches the medium-term trend. The expenditure forecasts use estimates made by spending departments for the first year, based on budget tax and expenditure decisions, with total spending extended out by the operating allowances (unallocated new programme spending or tax changes) for the following years. Revenue forecasts are derived from the macroeconomic forecasts and some micro data from the Inland Revenue Department.

The economic projections (post-forecast) use Statistics New Zealand's population projection and participation rate assumptions to project the labour force (of those employed or unemployed and actively seeking work). The labour force projection is then combined with assumptions about the unemployment rate, average hours worked and the growth of average output per hour worked to arrive at a projection of real GDP. This is coupled with an assumption about inflation to produce a projection of nominal GDP. If the gap between the forecast of real GDP growth and potential (or trend) growth has not closed by the end of the forecast period, the first few years of the projection period are used to close the gap.

Projections for taxes on wages (source deductions) assume a gradual rise from the present depressed ratio to GDP to something close to the historical average over about five years into the projection period. After that, this tax grows with nominal GDP (in other words, we assume a fixed tax-to-GDP ratio). Corporate tax grows with GDP generally from the first projection year (although growth could be held back for a year or two, if businesses are still working through accessible losses). All other taxes (GST, excises and so on) grow with GDP in the projection period.

Government spending on services ("G" in the standard macro identity) is grown using costs by population (weighted by age and gender for the major health groupings) or just age (education) or just GDP (for many of the other functional spending areas), estimates of wage or other input price growth, public sector productivity growth, and inflation.

As for the transfers, spending on New Zealand Superannuation is grown by the projected growth of the average wage net of taxation and the numbers of people 65 years and older. The main social welfare transfers are grown by CPI inflation and the proportions of five-year age groups receiving each of the benefits (these remain fixed through the projection period). We assume that all supplementary benefits are grown from the end of the forecast base by inflation and numbers of people 15 years and older.

Revenue and spending (on goods and services and on transfers) produce estimates of projected primary balances. In the first projection year, the balance reduces the previous year's debt (if it's a surplus) and the finance cost of the resulting debt is added to current spending. The balance for that year is then added to the previous year's debt, producing a projection for the debt path.

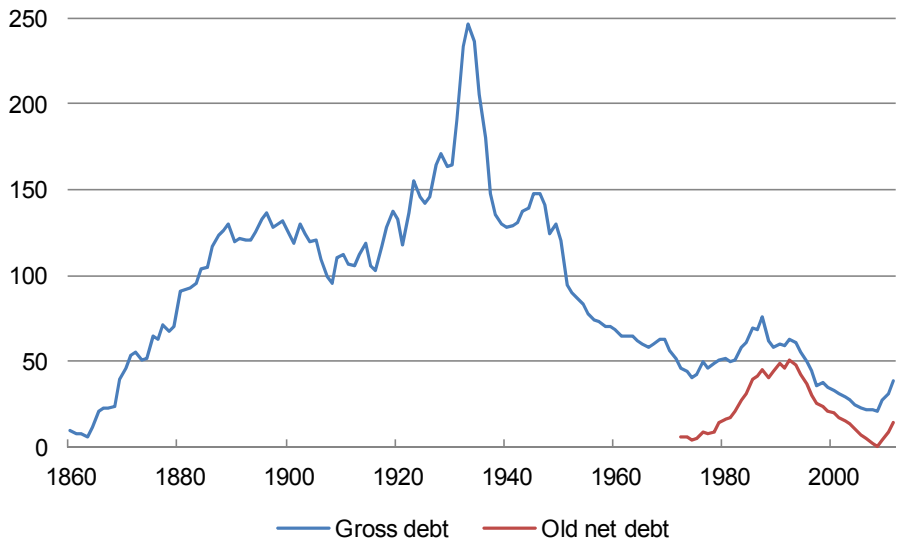
The new spending on capital is allocated to property, plant and equipment and then the stock is projected out using the growth of nominal GDP.

In summary, LTFM-based projections are not based on econometric modelling. Rather, they use plausible growth drivers, often drawing on current policy parameters or calibrations from history.

2.2 Two ways of presenting LTFM projections

For most of the period from the early 1990s to 2008, successive governments made their initial budgetary decisions with an eye on projected longer-term trends towards maintaining prudent debt levels, as formalised in the Fiscal Responsibility Act 1994 (and subsumed into the Public Finance Act in 2004). The result was that the ratio of debt to GDP fell through this period. So for nearly two decades, spending was generally constrained by governments keeping the debt ratio to "prudent" levels over the long term. What was "prudent" was announced in advance by successive governments.

Figure 1 – Core Crown debt, over the longer term (% of GDP)



Source: Statistics New Zealand, NZ Treasury.

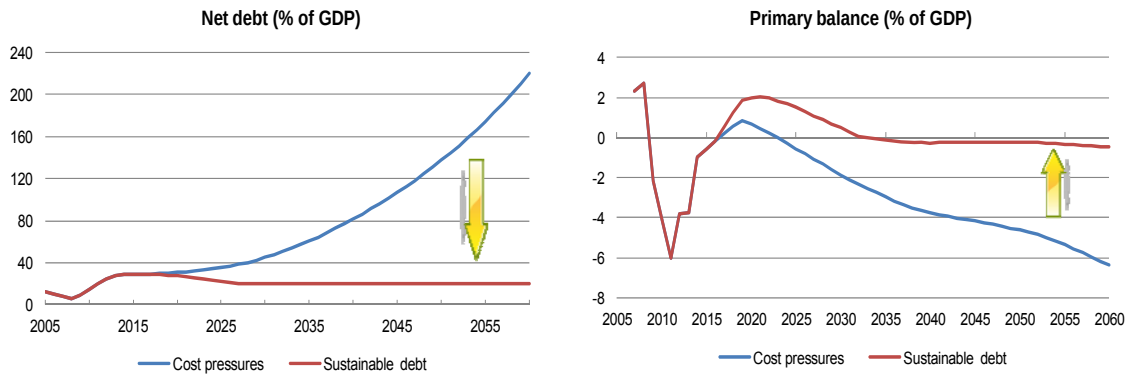
Note: This incorporates several different measures of debt. From 1972, this is gross sovereign-issued debt and the former core Crown net debt. Note this is IFRS-GAAP-consistent only from 1997 onwards.

In the first two reports on the long-term fiscal situation, growing fiscal pressures eventually produced a series of primary[1] deficits (it took a decade or two in the 2006 report, but happened immediately in 2009). These deficits fed into growing programme spending compounded by spending to finance the growing debt. So while this was the debt ratio picture in the two statements (reaching 106% of GDP in 2050 for the 2006 report and 223% for the 2009 report), long strings of deficits don't reflect the behaviour of governments between 1994 and 2008.

Allowing debt to grow with no corrective policy reaction assumes that future governments will abandon past "prudent" behaviour. As an alternative, we assume that future governments will manage their budget decisions so that net debt is maintained in the long run at around 20% of GDP (the current objective and the working assumption for these projections). To incorporate this in the modelling, we maintain the demographic and economic assumptions and the current fiscal settings, and set the model to solve for the change in the primary balance needed to reach and then maintain the debt limit. Bell (2012) shows that this requires a rise in tax or a reduction in spending (or a mix of the two) growing to around 5 percentage points of GDP in 2060.

So we have two ways of presenting the likely fiscal challenge future governments might face. In the past, we, and nearly every other country, have concentrated on the debt ratio as an indicator of the sustainability of current fiscal settings. We are calling this presentation the "cost pressures" scenario. This is very sensitive to the starting position. As noted above, New Zealand went from a projection of the 2050 (net) debt ratio of over 100% of GDP in the 2006 statement to over 220% three years later. What had changed? There were some spending policy changes and tax cuts, but the main change was the contracting economy in 2008 and the need to support people through the worst of the recession. In 2009, commentators tended to concentrate on the projected level of debt at the end of the projection, rather than on policy choices needed earlier on to stabilise the debt ratio and reduce financing costs (Bell and Rodway, 2012).

Figure 2 – A change in emphasis from stocks to flows (% of GDP)



Source: The Treasury (indicative)

For the 2013 statement, we have decided to shift the emphasis towards changes in the primary balance needed to control net debt as a share of GDP. The presentation using the assumed 20% debt anchor we are calling the "sustainable debt" scenario. The focus is then more directly on a stream of decisions around spending and taxation and these seem more

[1] A primary balance (surplus or deficit) is the government's fiscal balance (revenue less spending) excluding payments to finance debt and excluding interest income from financial assets.

real and amenable to change than frighteningly large piles of debt, although they in fact complement each other.

3 Demographics

We now turn to the assumptions behind the population projections. The population and labour force projections published by Statistics New Zealand in July and late August 2012 are different from past projections. Bascand (2012) presents background material on the approach to population and labour force projections, the assumptions and results, past accuracy, stochastic methods for quantifying uncertainty.

Population ageing shows up as a rise in the median age. This will also show up as changing proportions of the young and old to the "middle." The division points between these three groups are not entirely arbitrary. Around the world, 65 was often the age people received a pension. In our earlier days, 15 was the age many may have left school for work, perhaps on the family farm. Many statistics agencies have kept these division points for inter-country comparability, even through in many countries a sizeable proportion of people remain in education until their early 20s and many are continue in the labour force for a year or two past 65.

A move for the end of "youth" from 15 to 20, say, lifts the youth dependency ratio (youth over the middle group starting at 20) but keeps roughly the same shape. Changing the old to 67 and older and diving by a smaller middle (20-66) has a smaller effect and a very similar shaped ratio curve.

While these changes are important, we have decided to keep the 15/65 divisions for comparability internationally and with our earlier work.

3.1 New approach to quantifying uncertainty

In July, Statistics New Zealand released the 2011-base national population projections. The new projections have a greater emphasis on quantifying uncertainty. For the median projection, SNZ published percentiles (e.g., 5th, 10th, 25th, 50th, 75th, 90th and 95th) to give an indication of uncertainty. These uncertainty fans come from 2,000 stochastic projections, based on randomly sampled values of distributions of the major input assumptions derived from historical observed spreads. The 50th percentile (or median), for example, is an indication of where the actual value has a 50% chance of being higher than the projected value, and a 50% chance of being below the actual value.

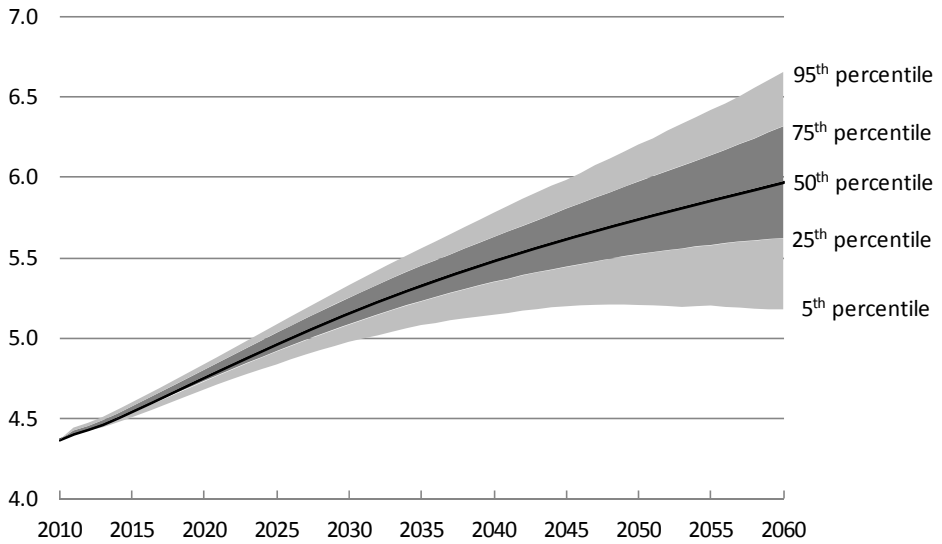
The background to this approach is contained in Dunstan (2011), building on his earlier work, and in Creedy and Scobie (2002), Leonova and McLellan (2005), and Wilson (2005), and others.

In the 2009-base releases, and earlier, SNZ illustrated demographic uncertainty by producing, for example, eight other "official" deterministic projections made up from different combinations high, medium and low assumptions for fertility, mortality and net migration.

Below is an illustration of uncertainty around the median projection of total population. This shows the 50th percentile value is 6 million in 2060 with the interquartile range (25th to 75th

percentile) of 5.6m to 6.3m. So half the stochastic projections have values for this ratio between these two values and half were outside this band. The 25th percentile means that a quarter of the stochastic projections lie below this line.

Figure 3 – Projected total population probability distribution (millions)



Source: Statistics New Zealand, July 2012

In reviewing the population projections behind our economic and fiscal modelling, it is important to be comfortable with the assumptions that determine the mid-range projection. This comfort could come from reviewing historic trends, the social and economic pressures that may be changing those trends and looking at what is happening in comparable countries.

Then, because we live in an uncertain world, we should not rely on a single projection as our only guide to future trends. Before the arrival of stochastic projections, we used the official alternative projections for conveying uncertainty. Because we are trying to illustrate the risks to the fiscal position, deciding which alternative projections to use depends on the relative costs of an under-projection and an over-projection. To warn about where growth of public spending, for example, on health or New Zealand Superannuation might go (both areas are affected by ageing), at present we could pick an alternative that has higher gains in life expectancy.

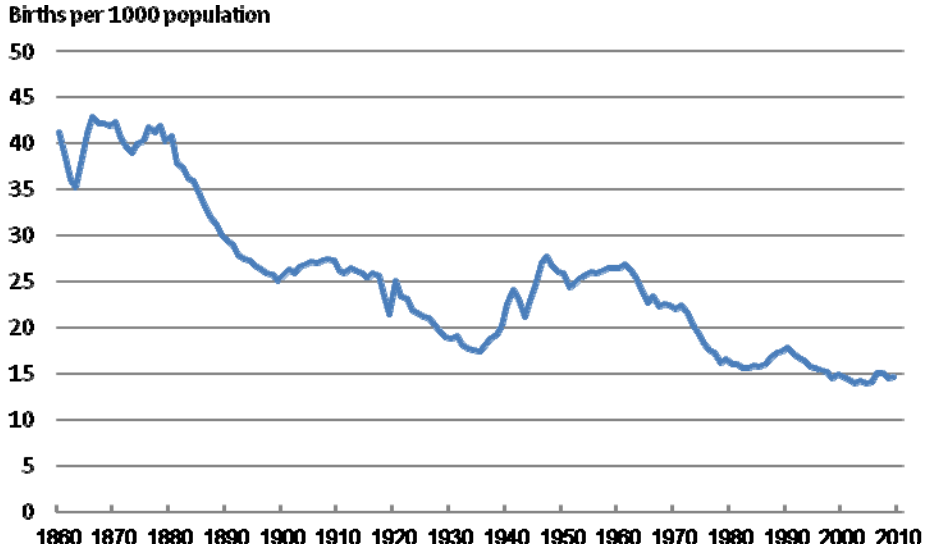
In the new stochastic world, this uncertainty is more quantified. That's a positive step forward. However, each statistic you look at, such as the old dependency ratio requires a calculation for each of the 2,000 runs and then a stacking in each year to calculate the percentiles. Working out how demographic uncertainty produces a probability distribution for the primary balance, for example, means running the stochastic projections through the LTFM and sorting the results, not a quick and easy task.

3.2 Fertility assumptions

One of the drivers of population ageing is a secular decline in average family size. The crude birth rate is the number of births per 1,000 people. Apart from a few wobbles now and then, the birth rate has generally fallen from around 40 births per 1,000 people 150 years ago to 15

per 1,000 now (put another way, from families averaging five to six children to families with two children). One of the largest of these wobbles was the rise in the birth rate after the Depression and the Second World War through to the late 1960s (the baby boom). Statistics New Zealand dates the baby boom from 1946 to 1965, although the birth rate was climbing from the mid-1930s and remained high until the 1970s.

Figure 4 – Birth rates have been generally falling through time



Source: Statistics New Zealand

Another measure of fertility is the sum of the age-specific fertility rates in a particular year. This summary measure is the "total fertility rate" (period measure for that year) and can be interpreted as the average number of live births that a woman would have during her life if she experienced the same age-specific fertility rates from that point onwards. It is a measure used by SNZ in making fertility assumptions in its projections.

We are not expecting that New Zealand will see another large baby boom in the future, because social and economic conditions have changed from those prevailing in the two decades after the Second World War. Contraception is more reliable, women are participating more in tertiary education and in the labour market, and are having their children later in life than they did a decade or two ago. All these factors have led to a lower fertility rate.

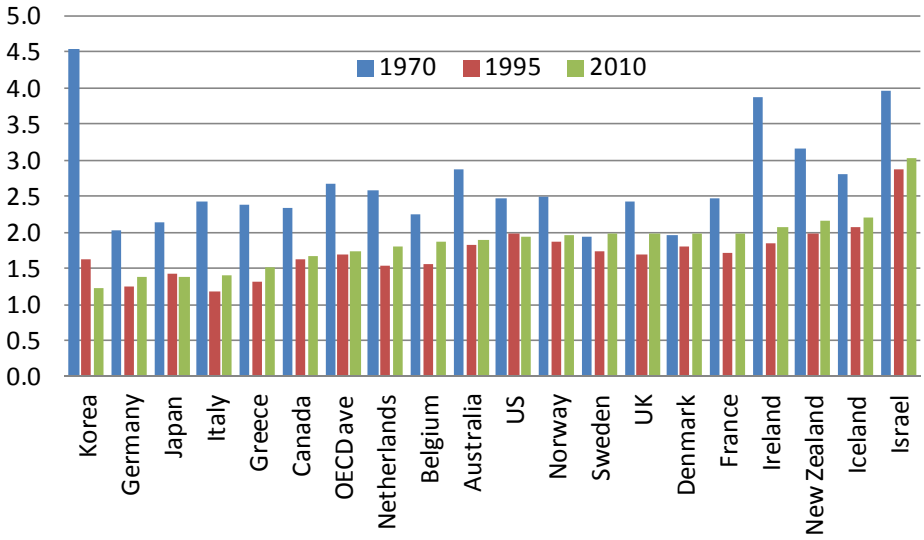
At this stage, it is not clear that the higher fertility rates of Māori and Pasifika groups are converging towards Pākehā rates. From 2002 to 2009, Māori births were a growing percentage of the total and the average age for Māori childbirth could be rising.[2]

SNZ's medium assumption in the August 2012 population projection update is that the fertility rate will gradually settle back a little from where we are now (at around the replacement rate of 2.1 babies per woman) and then stay at the long-term assumption rate of 1.9 from 2032 onwards. This assumption is based on an analysis of the NZ period and cohort fertility rates, rates of childlessness, and ethnic fertility patterns, as well as international comparisons. It is

[2] In 2006, fertility rate for the total population was 2.05 babies per woman (2.14 in 2009). For Māori, it was 2.7 (2.8 in 2009); Pasifika, 2.95; Asian, 1.52 and European, 1.92. A rising average age for Māori births could indicate greater participation in the labour market or tertiary education and could indicate a fall in the fertility rate and birth numbers (Te Puni Kōkori, 2011).

also close to the fertility rates we have seen since 1977 (1.9-2.2). The current New Zealand fertility rate and the long-term assumption were both near the top of the OECD in 2010.

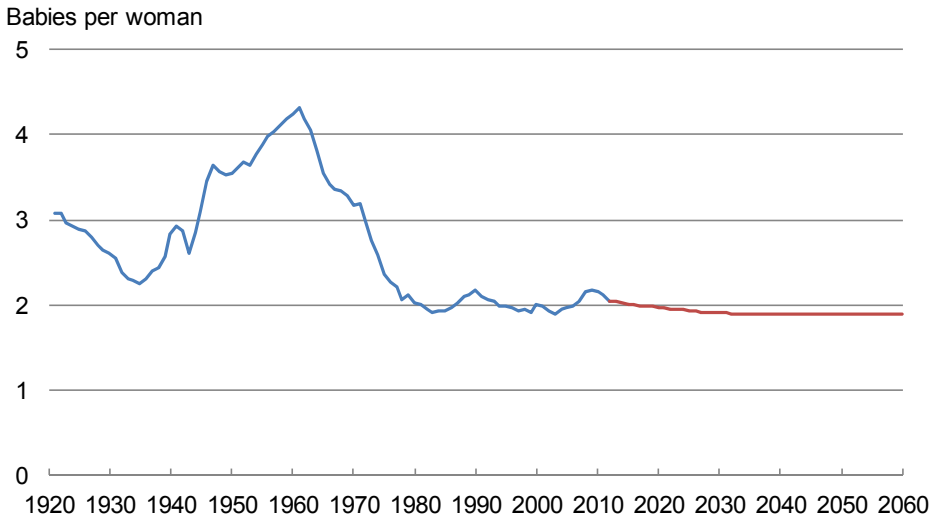
Figure 5 – TFR for selected OECD countries (1970, 1995, 2010)



Source: OECD (2011), OECD Family Database, ranked by 2010 values

The long-term rate of 1.9 babies per woman has been our assumption since the 2009 statement. At this point, it seems a plausible central assumption. Upside risk occurs if non-European groups do not converge as fast as it is assumed in the background (but this has some advantages for the fiscal position). Downside risk occurs if Māori and Pasifika converge quickly to European and Asian fertility rates.[3] This would have the opposite effects on public spending.

Figure 6 – New Zealand's period total fertility rate, 1921-2060

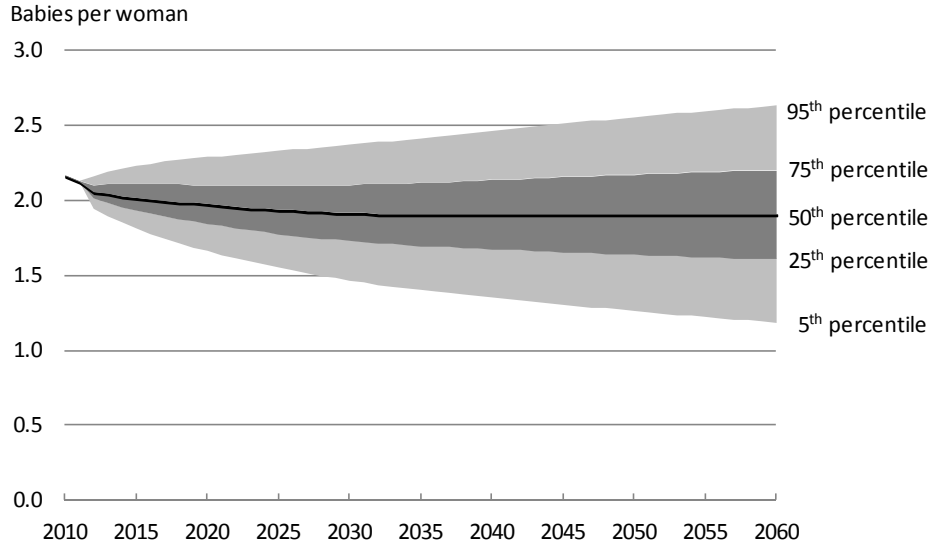


Source: Statistics New Zealand, history and median assumption (red)

[3] Although there are many more factors that could affect future fertility rates other than ethnic composition. Moreover, convergence of ethnic fertility patterns is not a necessary requirement for the mid-range assumption.

The figure below shows the probability distribution around the median assumption for fertility in the 2011-base population projection. This uses random sampling from a normal distribution with a standard deviation derived from the history of fertility between 1977 and 2009 and shifted so that the 1.9 fertility case is at the 50th percentile.

Figure 7 – Uncertainty around the median assumption for period total fertility rate



Source: Statistics New Zealand, July 2012

3.3 Mortality (life expectancy) assumptions

Life expectancy is an area we should test carefully in setting assumptions for our long-term fiscal projections. Life expectancy assumptions have generally been progressively lifted internationally as recorded increases have been sustained.

Another tendency in setting these assumptions has been to slow down gains in life expectancy when looking ahead.[4]

Recently, the IMF (2012) warned that governments and managers of private funds are likely to be underestimating the life expectancy of ageing populations, a risk that could further threaten their fiscal positions and increase risks to financial and fiscal stability.[5] The IMF analysis showed that if individuals lived three years longer than expected, which was in line with under-estimations in the past, the already large costs of ageing to governments could increase by another 50%. Longevity risk affects financial stability by threatening fiscal sustainability and weakening private sector balance sheets, adding to existing vulnerabilities in the current environment.

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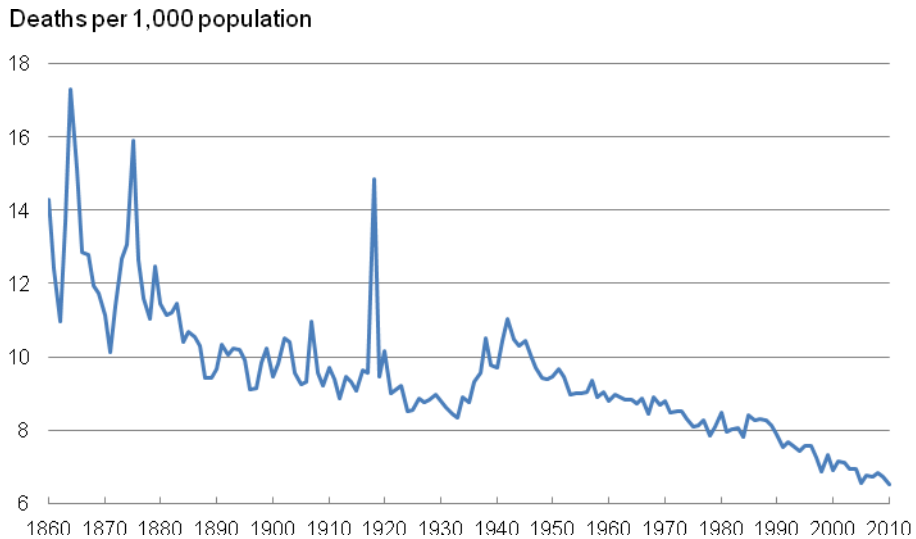
[4] Oeppen and Vaupel (2002) found a linear relationship through time for the growth in the highest life expectancy around the world. Despite this pattern, demographers continued to announce limits to life expectancy which would be surpassed within a few years. US demographer Tuljapurkar (2005a, b) has analysed the burden of disease and potential health innovations from nanotechnology and believes that average life expectancy in the US in 2050 could reach 100 years.

[5] These messages were repeated in June 2012 by the Financial Services Council: they say Statistics New Zealand's medium life expectancy assumptions are too low and that taxes will need to go up to cover NZS costs (Financial Services Council, 2012).

The crude death rate in New Zealand (deaths per 1,000 mean population) has been trending downwards for the past 150 years, apart from wars (and their consequences) and epidemics (e.g., the Spanish influenza epidemic is evident in the sharp spike in 1918).

Figure 8 – Death rates have been generally falling through time



Source: Statistics New Zealand

Age-specific mortality rates in a particular year are converted into a summary measure called life expectancy at birth for that period via life table calculations. Life expectancy at birth can be interpreted as the average number of years that a person could expect to live if he/she experienced the age-specific mortality rates prevalent in a particular year (period measure) throughout her life. It does not, therefore, include the effect of any future decline in age-specific mortality rates. If rates continue to fall through life, as we have generally seen since the mid-1940s, that person is likely to live longer (this is captured by the cohort measure of life expectancy). A person wanting to get an idea of how long a person might live on average (perhaps for planning how much to save for retirement) should look at the cohort measure of life expectancy, rather than the snapshot, period measure.

Table 1 – How long might I live?

Life expectancy at birth, period and cohort measures

Age in years		1900	1950	2000
Males	Period	57.4	67.2	76.3
	Cohort	58.2	77.3	88.6
Females	Period	59.9	71.3	81.1
	Cohort	63.1	82.0	91.6

Source: Statistics New Zealand http://www.stats.govt.nz/browse_for_stats/health/life_expectancy/how-long-will-I-live.aspx, updated September 2011.

Note: "Period" refers to the year in which the mortality rates are converted into life expectancy. "Cohort" refers to the year of birth and the calculation takes changes in age-

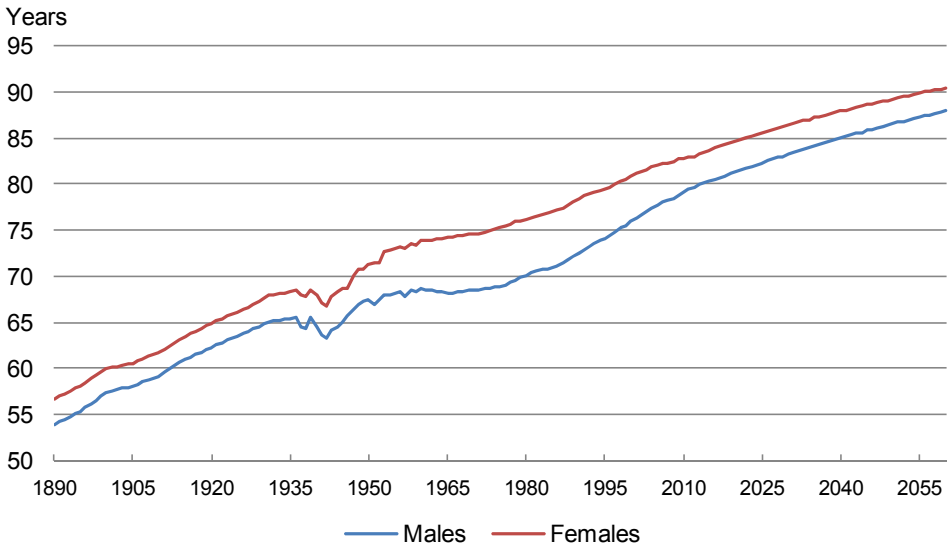
specific mortality rates from year to year into account. The period values for 1900 are non-Maori.

Compared with New Zealanders born in 1900 (non-Maori), those born in 2000 can expect on average to live an additional 25 years. Since 1950, life expectancy at birth (period measure) has risen by about 23 months (1.95 years, averaging males and females) each decade. There is uncertainty about how far and fast mortality rates will continue to fall.

These trends towards longer lives on average are a result of drier and warmer homes, cities without horse manure dust in the air, clean water and communal sewage disposal, public health campaigns for immunisation and against smoking, healthier lifestyles and food, and better medical care and technology. Improvements in life expectancy resulted first from reductions in infant mortality and maternal deaths and later from people living to older ages. What has not changed much over this period is the age of the oldest people. We are seeing more people surviving to older ages.

In the median 2011-base projection, SNZ assumes mortality rates will continue falling and so life expectancy (the period measure) will continue rising, but at a slower growth rate (1.6 years or 19 months per decade) to reach 88.1 years for men and 90.5 years for females in 2061.[6] This is higher than in the 2009 medium assumption (closer to the old high life expectancy - or low mortality - scenario) and seems more in line with life expectancy assumed in comparable countries.

Figure 9 – Rising life expectancy at birth



Source: Statistics New Zealand, Human Mortality Database

Notes: 1) The base year for the projections is 2011.
2) There is a break in 1952 when for the first time Māori life expectancy was included in the national data.

The very high life expectancy projection assumes life expectancy at birth increases at a similar annual rate as between the 1975–77 and 2005–07 complete period life tables (by

[6] This reflects the non-linear relationship between age-specific death rates and life expectancy combined with the fact that death rates are relatively low at younger ages so further reductions cannot generate the same life expectancy gains that we've had in the past. These 2061 assumptions contrast with the 2009-base projections where the two assumptions for that year were 85.6 and 88.7 years.

0.31 and 0.23 years of life for males and females, respectively), reaching 95 years for both males and females in 2061. This is an average growth of 2.7 years per decade from 2012 onwards.

Māori life expectancy has increased substantially from 1950 to 2007: for males it rose by 30% and for females by 34% (the New Zealand total changes were 16% for males and 15% for females over this period). However, Māori life expectancy in 2005-07 stayed lower than the total by 7.6 years for males and by 7.1 for females). More are surviving to older ages (TPK, 2011, p28). Only 52% on Māori males born in 1950 could expect to reach 60; by 2005-07, this proportion had reached almost 80%. For Māori females, the proportions were 53% in 1950 and 87% in 2005-07. The proportions for the total population in 2005-07 were 90% for males and 93% for females.

The OECD's estimate of life expectancy for New Zealand females was 82.7 years in 2009 putting the country about half way down the OECD. For males, life expectancy was 78.8 years in 2009, ranked 8th in the OECD.

Risks on the downside are no further convergence in average life expectancy between Māori-Pasifika and Europeans (genetics, socioeconomic backgrounds and health access could be drivers of this), and a faster-than-expected rise in obesity and diabetes, or similar health conditions, across all population groups.

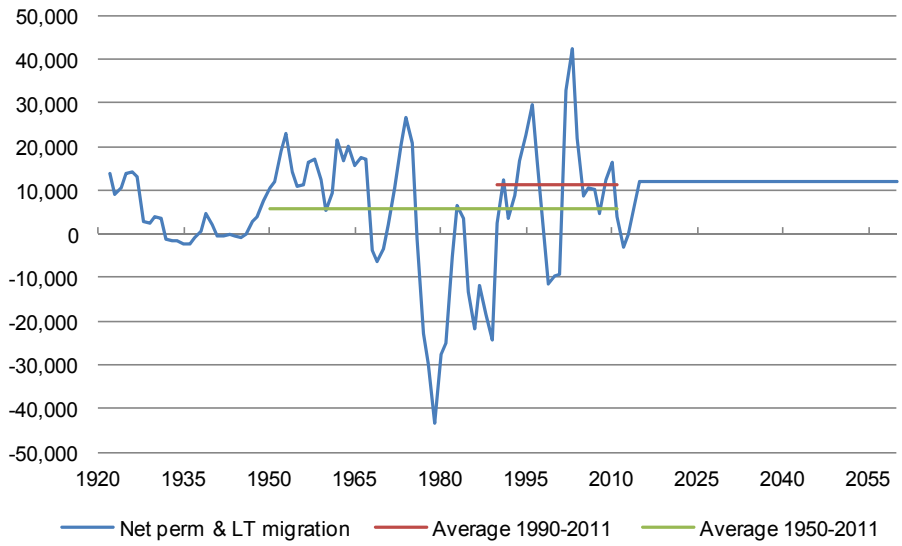
3.4 Net migration assumptions

The other key variable used in producing population projections is net migration. This has moved erratically up and down over the past half century, because of policy changes, the relative economic growth differences between New Zealand and the source and destination countries, and on the numbers of Kiwis leaving for their "overseas experience," returning Kiwis and the reunification of families of former migrants.

Assumptions about levels of net migration do not have a major bearing on the ageing of the New Zealand population, as there are relatively small numbers with few older people migrating. If anything, higher net migration tends to reduce slightly the effects of ageing over the long term. For example, SNZ's medium fertility and mortality series (2009-base) with zero net migrants has a ratio of people 65 and older to 15-64 in 2060 of 0.47, compared with 5,000 net migrants (0.44), 10,000 (0.43) and 15,000 (0.42). Similar slight differences hold for the median age indicator of population ageing. So holding fertility and mortality as in Series 5, but decreasing the numbers of net migrants ages the population a little.

The median assumption of 12,000 net migrants each year is a little higher than the average from 1990 and double the 60-year average. The economic slowdown after the GFC, along with the Christchurch earthquakes, may have changed the near term.

Figure 10– Net migration, 1950-2060 (median, 2011-base)



Source: Statistics New Zealand, *Demographic Trends: 2011* and July 2012 update

As more of our traditional source countries face greater pressures from ageing, we are likely to see greater competition for immigrants, and inducements for Kiwis to migrate. Hence, we are likely to find it is harder to attract, or hold onto, 12,000 net migrants. Any lower numbers occurring over a long period means greater pressure on government spending and taxation from a population that is ageing faster than the 2011-base median scenario.

3.5 Role of the baby boom

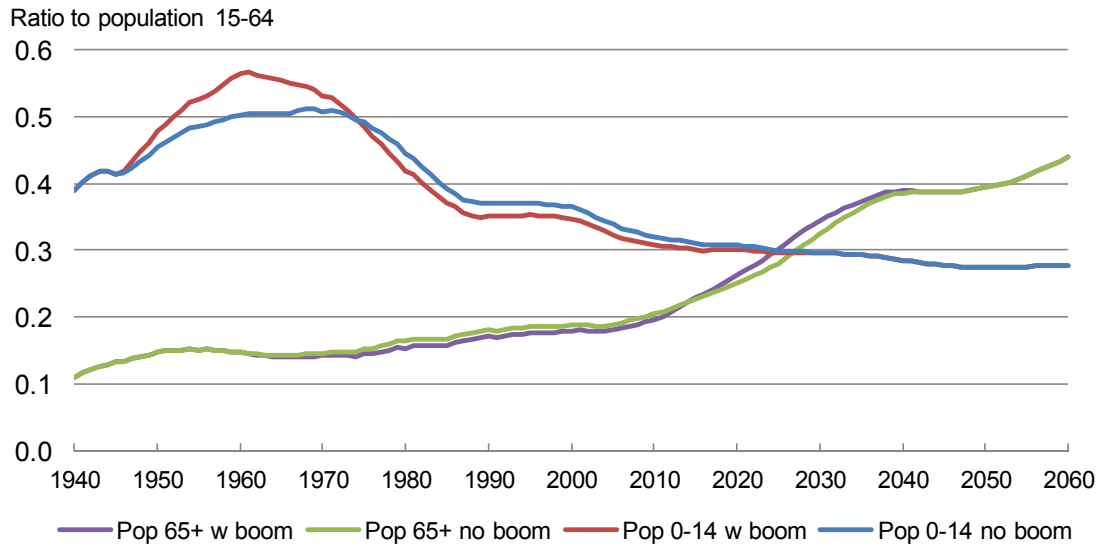
One reason people do not appreciate the permanency of the change in the population structure is that they think it is all a "baby boomer" story. In the two decades after World War II, fertility was high, with a peak at twice the average number of births per woman as is the case now. And life expectancy is much higher today.

Even without the post-WWII baby boom, our population would still be ageing as a result of the fall in the fertility rate and the trends towards lengthening lives over the past century. Over the last 50 years, the baby boom held back the rise in the median age and in the next three decades or so, the baby boom will lift the proportion of the population over 65. By the mid-century, when most of the post-WWII baby boomers will have died, the population will have an older age structure than it had at any time in the past.

Figure 11 illustrates this using the ratios of the young (0-14 years) and old (65 years and older) to the core working age population aged from 15 to 64 years. The figure shows the historic and projected ratios and endeavours to illustrate what these ratios would be like if the fertility rate had not increased and the baby boom had not occurred during the immediate post-war years. This has the effect of smoothing out the number of births between 1945 and 1965. Taking the top off the baby boom shows up as the gap between the red and blue lines (young dependency ratios) and removes some of the 65-year-old survivors from 2012 onwards (gap between the green and purple lines). The important point is that from 2050 or so onwards, when the bulk of the baby boomers have died, the aged dependency ratio is still twice as large as it is now.

The biggest contributors to New Zealand's ageing population are our past low fertility and mortality rates. The baby boom made the population a little younger in the last half of the 20th century and a little older in the first half of the 20st.

Figure 11 – Effect of removing the 1946-1965 baby boom on dependency ratios



Source: The Treasury, Statistics New Zealand, median projections (2011-base)

3.6 Demographic assumptions: conclusions

Here are our high-level comments about the three main assumptions:

- At present, the median fertility assumption of 1.9 in the long run seems balanced between risks. SNZ continues to assume this in the 2011-base projections.
- Statistics New Zealand's 2012 projection is closer to the 2009 high life expectancy case. The 2011-base assumptions have lifted life expectancy all the way out to 2061, where the gap with the 2009-base assumption is 2.5 years for males and 1.8 years for females. This better reflects the longer-term fiscal risks we are likely to be facing (IMF, 2012).
- The present median migration assumption of 12,000 is probably fairly balanced, but it does have some risks on the downside from increased competition for people from other countries facing similar ageing pressures. This reflects the fact that permanent and long-term migrants was not picking up people who stay here longer than visitors do and could well be counted among the longer-stay residents.

4 Economics

The assumptions needed to produce projections of GDP are outlined here. These include an average of weekly hours worked, labour productivity growth, labour participation, unemployment rate, inflation rate (used for general price growth), the government five-year bond rate. Drawing on the recent work by Gardiner *et al.* (2012), we indicate how population ageing might affect these assumptions through time.

4.1 Unemployment rate

This is the long-run unemployment rate for which inflation remains steady. It is estimated in the NZTM at 4.5% and applies in the LTFM from 2019 onwards.

4.2 Average hours worked

The assumption of average weekly hours paid in the long run is based on an average paid hours paid over the past decade and a half. For the forecast, average hours paid is scaled up to hours worked by using a recent ratio of the two. This puts the long-run hours worked per week at 33.2 hours. Gardiner *et al.* have estimated that the ageing population alone could reduce average hours from 33.2 to 32.4 hours by 2060.

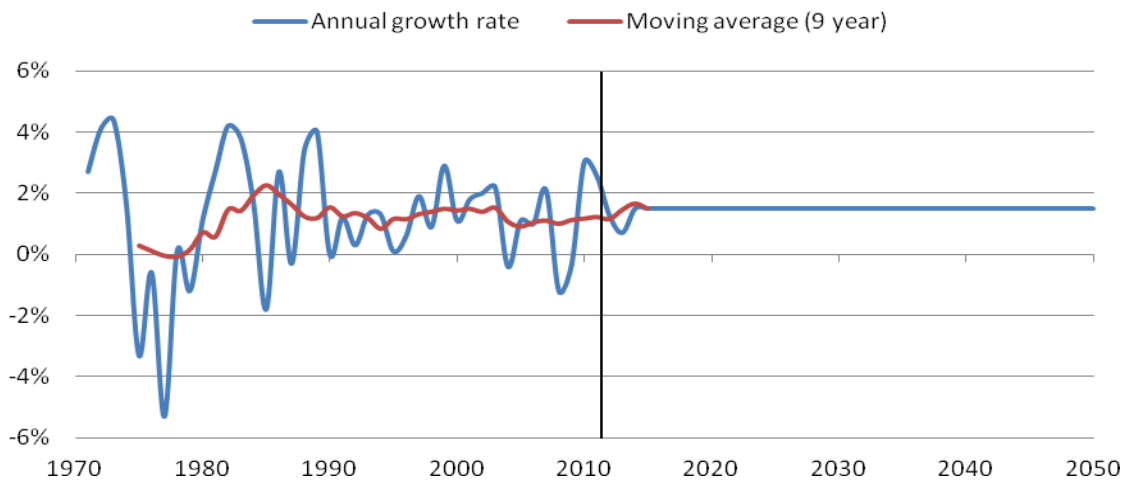
4.3 Productivity growth assumption

We intend to keep the 1.5% annual growth used in both the 2006 and 2009 statements. This is broadly in line with smoothed productivity growth over the past two decades. The DiMaio and Carroll (2012) papers presented at the first external panel session look back over New Zealand's growth record of the past 40 years and at what might drive growth over the next 40. They suggest that growth of between 1.5% and 2% on average is possible. On the other hand, some are arguing that the GFC shock may have produced a step change down in productivity growth around the world. We intend to continue with 1.5% in the model.

Because of the 80% pass-through of real wage growth assumed in the model for a large part of government expenditure and that this productivity growth is a key factor in GDP growth, much of the effect of this assumption, but not all, is washed out in the total tax and expenditure ratios to GDP.

Using the proxy of average wages by age and gender groups, Gardiner *et al*. show that the assumed labour productivity growth would fall through time to about 1.45% in 2060. They conclude that the relatively small reduction in labour productivity growth from 1.5% reflects that the increase in the proportion of people 65 and older is offset by the decline in youth and a marginal increase in the proportion of prime age adults into the higher relatively productivity age groups.

Figure 12 – Labour productivity growth in history and long-term assumption



Source: Statistics New Zealand, Treasury

4.4 Participation assumptions

Significant changes have occurred in labour participation rates over recent years. The rates have typically fallen among the younger age groups, associated with increased tertiary participation rates. Male labour participation rates up to age 50 have fallen, while most female rates have been rising (Figure 13).

The 2012 labour-force projections use the same approach as the underlying median demographic projection: a deterministic median projection based on the central demographic projection with percentiles of various statistics around this to reflect historically based uncertainty in demographic and participation rate assumptions. The labour force consists of people aged 15 years and over who regularly work for one or more hours per week for financial gain, or work without pay in a family business, or are unemployed and actively seeking part-time or full-time work.

Dividing these numbers by the median population projection gives a measure of "median" participation for each age and gender group.

The August 2012 median projection assumes:

- fertility, mortality, and migration – as outlined in the 2011-base national population projections (see above)
- labour force participation – the average working life (to age 80 years) increases to 49.4 years for males and 43.4 years for females. In 2006, the base average working life (to age 80 years) was 45.5 years for males and 37.0 years for females.

The labour force projections are based on census data (the latest census is still 2006). Between the 2010 update (Series 5M) and the 2012 median update, SNZ increased the aggregate labour force by 286,000 people in 2061.

Population ageing will tend to lower aggregate participation through time. This is because participation rates of older groups tend to be lower than those of younger groups. So as

people join the older groups in relatively greater numbers, the aggregate rate will tend to fall. This is one factor, among several, likely to slow GDP growth in the future.

The labour force projection is a key input to our GDP projections. This is the only use the labour force participation rates are put to in the LTFM. So just the aggregate labour force is used and used to grow out the aggregate five-year forecast of the labour force from the New Zealand Treasury Model.

GDP in the projection period comes from:

$$Y_t = Y_{t-1}\frac{LF_t(1-UR_t)}{LF_{t-1}(1-UR_{t-1})}\left(\frac{HW_t}{HW_{t-1}}\right)\left(\frac{LP_t}{LP_{t-1}}\right)$$

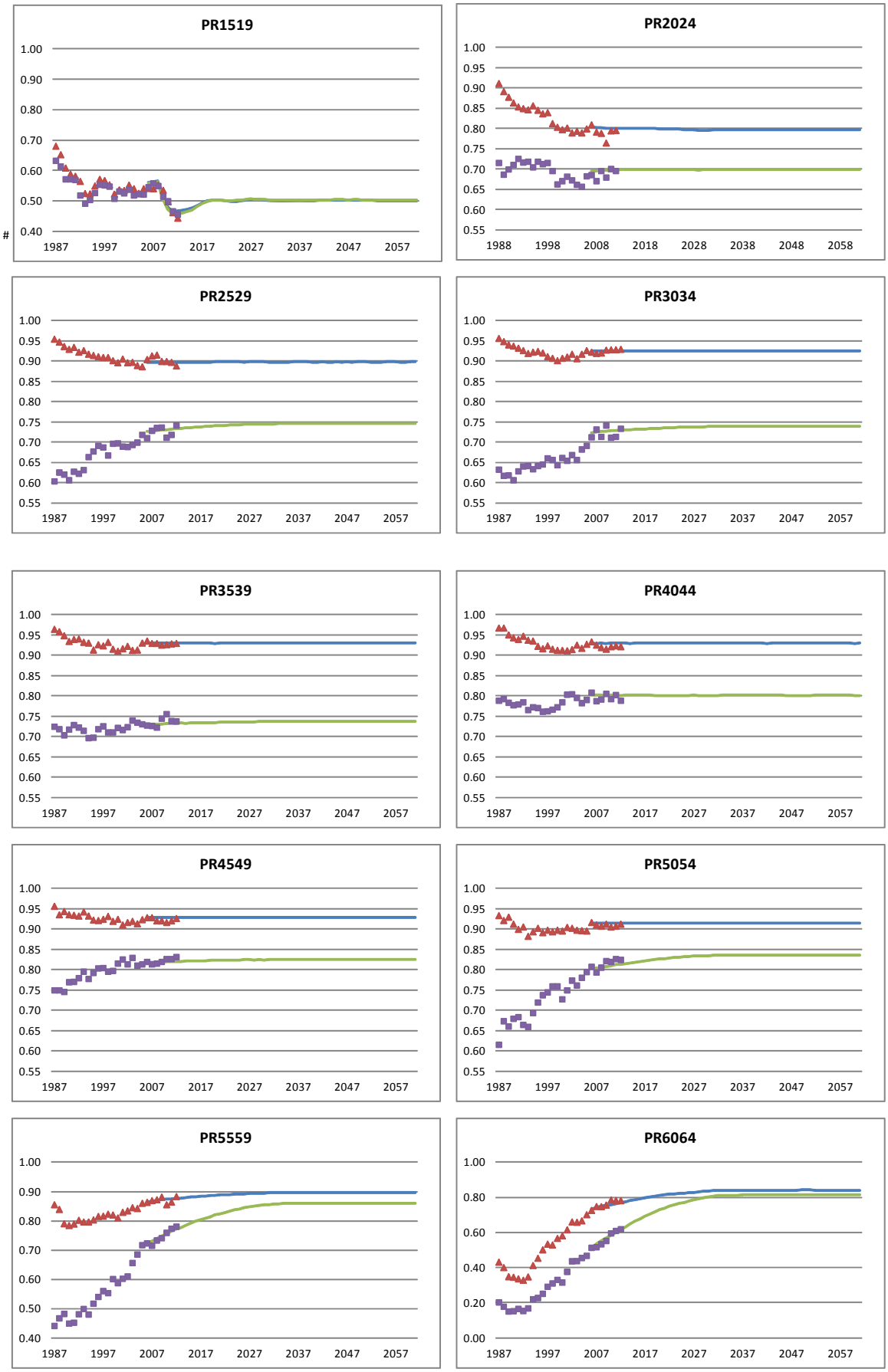
and $$N_t = N_{t-1}\frac{Y_t}{Y_{t-1}}\left(\frac{P_t}{P_{t-1}}\right)$$

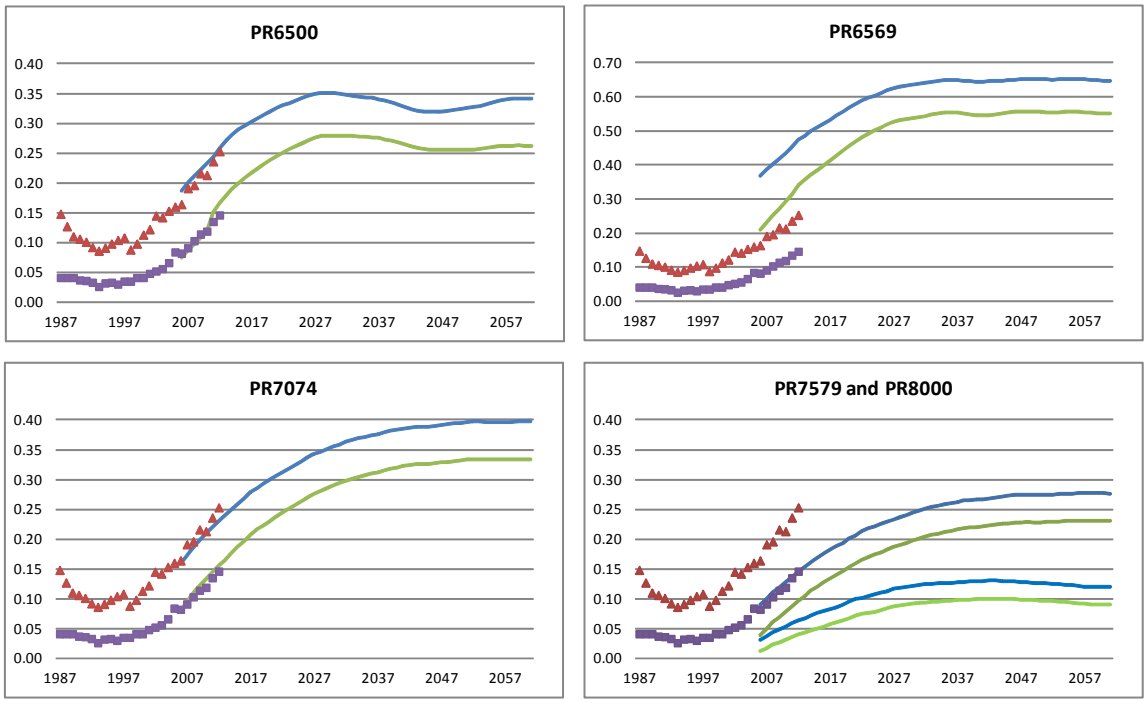
where Y_t (N_t) is real (nominal) GDP in year *t,* LF_t the aggregate labour force, UR_t the unemployment rate, HW_t average hours worked, LP_t labour productivity, and P_t the price level. This means that growth of real GDP equals growth in the number employed plus growth in the average hours worked and the growth in average real output produced per hour worked. Then nominal GDP growth is the growth of real GDP plus the growth in prices.

In the 2012 projection of the labour force, by 2016, about the time when the LTFM projection begins, SNZ tends to flatten the single-year-of-age participation rates of the workers aged under 50 (see Figure 13). For some age groups, this is justified – they are high and stable anyway - but in other cases, this breaks rising trends. For example, without the recent effects of the recession, the participation rates for women aged 25-29 rose strongly through history (as shown by the quarterly HLFS) and then the census-based projected rates rise for a few years and then stop rising.

Changes this time include higher participation by women aged 50 and older (which level out at about 2035), and by men aged 65 and above. In fact, from about 2020, between and quarter and a third of people aged 65 and older are expected to be in the labour force.

Figure 13 – Grouped-labour force participation: HLFS (to 2012), NLFP (August 2012)





Source: Statistics New Zealand

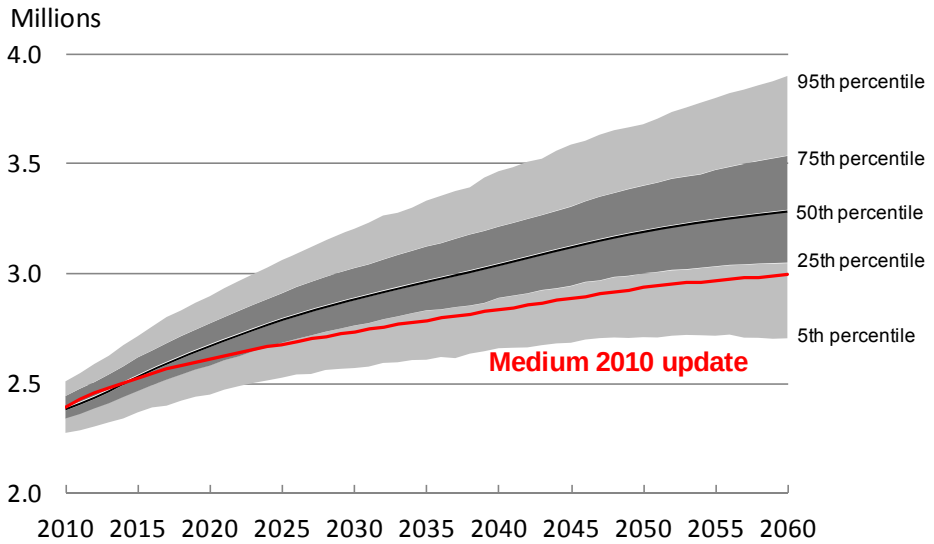
Notes: 1) Red triangles: Males; Purple squares: Females (HLFS)

2) Blue line: Males; Green lines: Females (National Labour Force Projections, Based on 2006 Census, released August 2012)

3) For PR6500 and the 65 and older five-year age groups, the HLFS triangles and squares refer to the open-ended, 65 and older group.

The labour force 2012 update projection has the 2010 aggregate Series 5M (medium) below the 25th percentile from 2020 onwards. The result is that the aggregate labour force projection has lifted by some 290,000 people in 2060. This means that the new projection for GDP (and tax revenue) is higher than under the former projection.

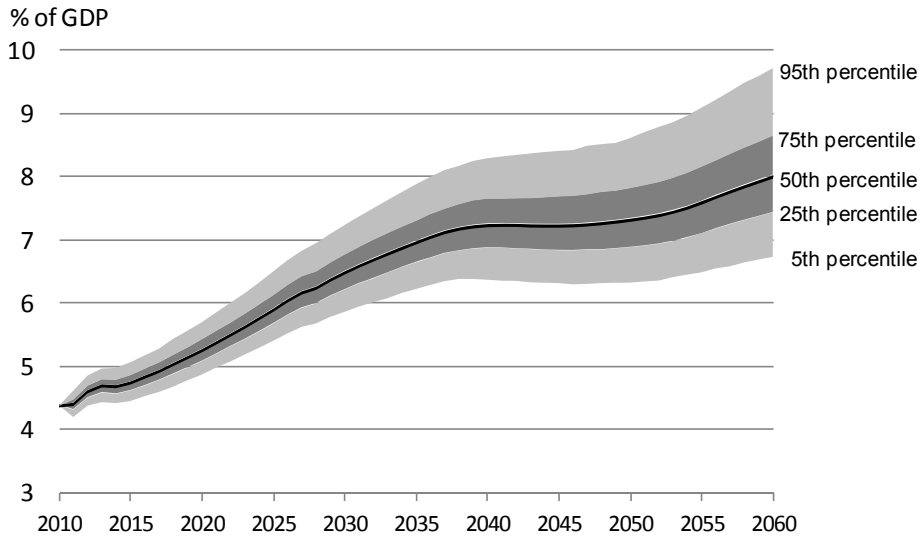
Figure 14 – Probability distribution of the median labour force projection



Source: Statistics New Zealand, NLFP (2006-base), August 2012 update

The single-year-of-age breakout is useful in showing possible effects of changing the NZS eligibility age on participation and hence on GDP. For example, the stochastic population and labour force projections enable us to produce a fan of uncertainties (percentiles around the mid-range projection) for the cost of NZS as a proportion of GDP. This says the median (50th percentile) rises to 8% in 2060. It is "most likely" (in the sense of lying in the interquartile range) the value will be between 8.6% and 7.4% in that year. Finally note that that this ratio is more likely to lie above the median than below.

Figure 15 – Probability distribution of NZS spending ratio to GDP



Source: Statistics New Zealand, Treasury

4.5 Inflation

For all the longer-term projection work, we have used a CPI inflation assumption of 2%. This was not based on history, but is used simply because it is the centre of the Reserve Bank's policy band: keep CPI inflation between 1% and 3%.

This is different from the inflation assumption used by the Treasury accountants in their long-term work, for example, to calculate returns to funds. They use an assumption of 2.5% average inflation which is closer to an historical average for net-present-value calculations.

4.6 Interest rates

The 5-year government bond rate assumed for NZTM is 4% real or 6% nominal. This is adopted as the long-term interest rate for calculating the financial costs of borrowing on government bonds. Treasury accountants have come to a different position on interest rates. They believe interest-rate reductions in the international financial markets (now 50-basis points lower than they were before the GFC) are structural and are assuming a 5-year-bond rate over the long term of 5.5%.

In the preliminary projections, we assume the bond rate moves up gradually to 5.5% in 2021, remains at this level until 2026 and then climbs to its peak 6% in 2031.

5 Revenue

For this and the following section, we outline the fiscal assumptions for the cost pressures scenario, where we try to capture something like current policy or past practice for projected revenue types, and spending on public services and transfers, against a background of relative constraint. The cost pressures all show up in the debt track.

Three bundles of taxation are covered in the model: source deductions (tax on wages withheld at source), corporate taxes (net of refunds), and the rest (dominated by GST). In the longer run, these are targeted at a historically derived share of GDP (allowing for recent tax rate changes). This requires a rise in core crown tax from the present 26.7% of GDP to 29% in 2030.

Because tax revenue is below historical averages as a result of the GFC, projections for taxes on wages (source deductions) assume a gradual rise from the present depressed ratio to GDP to something close to the historical average (11.2% of GDP) over about five years into the projection period. After that, this tax grows with nominal GDP (in other words, we assume a fixed tax-to-GDP ratio). Corporate tax grows with GDP generally from the first projection year (although growth could be held back for a year or two, if businesses are still working through accessible losses). All other taxes (GST, excises and so on) grow with GDP in the projection period.

For the total crown basis, corporate taxes net of refunds are adjusted to a historically justified 4.5% of GDP soon into the projection period. The adjustment might be delayed if we believe there is a large stock of accessible tax losses which would delay the growth of corporate tax for a year or two. The rest of taxes (GST, excises, tax on entrepreneurial income, withholding taxes on interest income and dividends and so on) move quickly to 13% of GDP in the projection period, matching an historical average.

Our later work (not finished at the time of writing this paper) will illustrate various options and trade-offs in changing various spending or tax policies to achieve various net debt to GDP targets, and take into account the effects of ageing on tax bases, while meeting other objectives in distribution or maintain growth or supporting the environment.

6 Expenditure

For the 2009 statement (Bell, *et al.*, 2010), we derived a growth formula for spending on public services that drew on inflation, the growth of real input costs, and demographic and non-demographic volume factors, for what we are now calling the cost pressures scenario. The trend growth parameters were derived from history or current policy settings, and from the underlying demographic projections. Many of the spending lines in the core Crown expense tables (for example, 2012 Budget, pp123-125) are modelled separately in the LTFM.

Annual price growth of public services (health, long-term care, education, law and order) is composed of inflation (π_t = 2.0%), real input price growth (w_t = 1.2%, or 0.8 of labour productivity growth 1.5%), and average public sector productivity growth (a_t = 0.3%). Annual growth in the quantity of services is composed of demographically-driven growth (d_t which depends on each spending sector because different age groups are drivers each with different cost weights) and non-demographic volume growth (p_t, again sector-dependent).

The non-demographic volume growth parameter is the residual growth in past expenditure that is not attributable to other drivers, and is derived from trends for the particular sector.

The equation below outlines the framework for modelling a single sector of public service expenditure growth in year *t*, g_t (Bell, *et al.*, 2010, p.82):

$$1 + g_t = (1 + \pi_t)(1 + w_t)\left(\frac{1}{1 + a_t}\right)(1 + d_t)(1 + p_t).$$

In other words, expenditure growth equals price growth (the *π, w* and *a* terms) times quantity growth (the *d* and *p* terms). In a simple, first-order, linearised form (with the higher-order terms omitted), this becomes:

$$g_t \approx \pi_t + w_t - a_t + d_t + p_t$$

In contrast, the expenditure growth of demand-driven transfers (NZS, unemployment benefit, accommodation supplement are examples) is modelled more simply as

$$1 + g_t = (1 + \pi_t)(1 + d_t)$$

where g_t is the growth of expenditure in year *t*, π_t is the growth of transfer indexation (typically CPI inflation or nominal wage growth), and d_t is the growth of the recipient population. Linearised, this becomes:

$$g_t \approx \pi_t + d_t.$$

6.1 Health

Public health is probably one of the most complicated of the public service sectors to model. What we spend as a country for public health is the result of layers of decisions stretching back for decades. As such, it lacks the simple parametric structure of a (near) universal programme like New Zealand Superannuation.

The Ministry of Health provides us with cost weights which allow us to break health spending into five functional categories. Spending amounted to $13.8 billion in 2011 (a fifth of all non-interest spending):

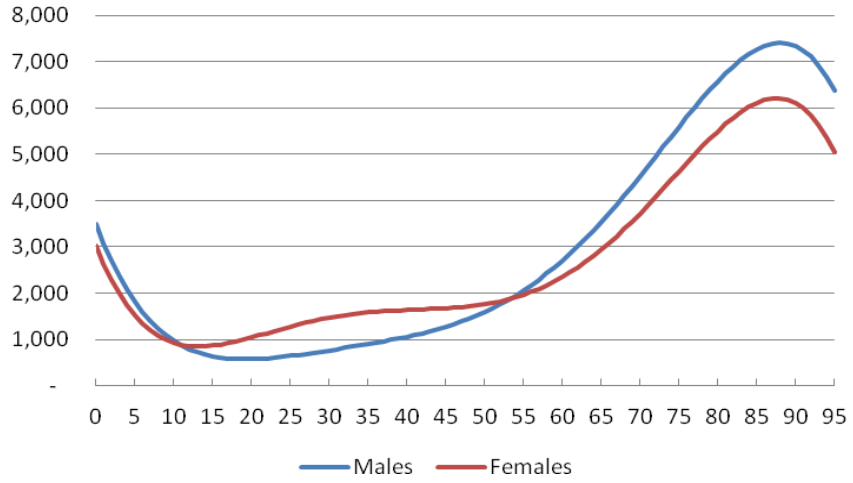
- Personal health (public costs of GP visits, public hospital stays, public funding of drugs), making up 68% of total core crown spending on public health
- Mental health, 10%
- Health of older people, 10%
- Disability support services for those 64 and younger, 8%, and
- Public health (preventative health services), 4%.

Each of these has its own per capita costs by age group and gender for 2010. These cost weights are multiplied by the appropriate demographic group and then used to calculate category population cost growth d_t which varies by year, gender and category.

While the evidence for "healthy ageing" (compression of morbidity) is not always unequivocal and may depend on disease types, we have attempted to model this for personal health spending by shifting out the cost weight curves to reflect the rising longevity (which is now largely occurring in the older age groups). So if life expectancy of a 65-year-old increases by four years in 2060 compared with 2010, we would assume the average spending in real terms for a 65-year-old in 2060 is equivalent to that of a 61-year-old now. This aligns with the approach taken by the OECD in its public health modelling (OECD, 2006).

The health of older people is a proxy for long-term care. The cost curve for this in 2010 has ever-rising growth with age.

Figure 16 – Cost weights for personal health spending, by age and sex ($2010)



Source: Based on Ministry of Health data (2010), smoothed by the Treasury

Parkyn and Ball (2012) have revisited the growth assumption of non-demographic volumes, pushing up the cost curves. In 2009, we estimated this growth at 0.8% as an average across all government public services (Bell, *et al.,* 2010). This has been re-estimated just for the public health sector as 1.5%, equal to the Treasury's assumption for long-term annual growth in economy wide labour productivity. This means that the long-term non-demographic cost growth is now 2.4%, which is 0.9% from the relative price effect ($w_t - a_t$ = 1.2% - 0.3% = 0.9%) plus the 1.5%. The relative price effect is an example of Baumol's cost disease. This contrasts with the assumption of 1.7% in the 2009 report. By decomposing New Zealand's public health growth rates between 1981 and 2002, the average is 2.5%, close to the new estimate.

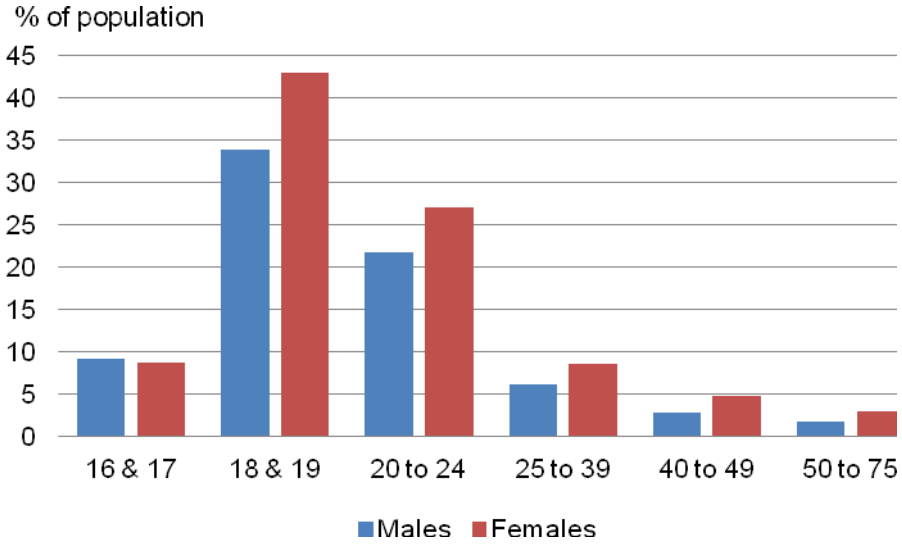
6.2 Education

Education expenditure in the LTFM is modelled by four levels: early childhood, primary, secondary, tertiary, and by tertiary student allowances, student-loan write-offs and Ministry of Education expenses and other expenses.

We have taken current participation rates by age for each of these levels. The data for domestic tertiary equivalent full-time (EFT) students is graphed below. The bulk of tertiary EFT students come from the 18-24 group, although older age groups are also keen on tertiary. In 2010 about a third of males aged 18-19 were in tertiary (on an EFT student basis),

while almost half of females of those ages were participating. These numbers have risen since 2008 (boosted by a tighter job market since the start of the recession).

Figure 17 – Tertiary participation by domestic EFTS by age group and gender



Source: Ministry of Education

Note: These are calendar-year averages from 2003 to 2010

These average proportions are applied to the population projections to provide an estimate of the tertiary EFT-student numbers through time. A similar participation rate weighting process is used for the early childhood and compulsory sectors (primary and secondary).

Parkyn and Ball (2012) re-estimated the non-demographic volume growth for the public education system. Over the last 50 years, education spending has risen at around the same rate as health spending (around 3% real per capita). This has outstripped GDP growth, with the result that spending as a share of GDP has increased from around 2% of GDP in 1950 to 6% of GDP by 2011.

The baby boom added to education pressures in the 1950s and 1960s, but this has been in reverse since. After accounting for these pure demographic effects, Parkyn and Ball suggest that non-demographic education costs have increased at the rate of around 3% per annum over history. In 2009, we assumed the growth of the non-demographic volume as 0.8% across the board. This time, looking at education spending on its own, we feel 1% growth is a better estimate, which when coupled with the relative price factor (0.9%) gives the non-demographic part of nominal education growth as 1.9% per annum.

6.3 New Zealand Superannuation

New Zealand Superannuation is a pension scheme paid out of current taxation to people from their 65th birthday, provided they satisfy a residency test.[7] The payment is set at 66% of the net average wage for a couple. A person who lives with others (uncoupled) or who lives

[7] To be eligible for NZS, a person must be a New Zealand citizen or permanent resident, and have been a resident and present in New Zealand for not less than 10 years since the age of 20, of which five years or more must be since the age of 50.

alone is paid at higher rates than half of the couple rate. On each 1 April, the payment made to a couple is adjusted upwards by the CPI inflation rate for the year from the December quarter to the prior December quarter with the proviso that the result must lie between 65% and 73.5% of the net average wage. Without tax changes and real wage growth, this means that before long, Superannuation payments increase with the growth rate of the net wage (this is the assumption prevailing in the projection period).

As outlined at the start of this section, these parameters make modelling NZS aggregate spending relatively simple. From the last year in the forecast, we grow out the amount by the growth rate of the numbers of people 65 and older and by the growth rate of the net average wage. This implicitly assumes that the proportions of people who are paid different amounts depending on living style (coupled, single alone or single in shared accommodation) and the proportion of people 65 and older claiming NZS remain constant.

6.4 Welfare

Welfare spending is going to be a tricky area to project as we are in the midst of changing the welfare system. Some of these changes may not have been enacted by the time the long-term fiscal report is finished next March. For now, we are using our set of assumptions for the main four benefits from the 2012 Budget. We apply recent age breakdowns by males and females for those receiving the domestic purposes benefit, the invalid's benefit and the sickness benefit, combined with the population projection to provide a projection of numbers of people on these benefits. The growth rate of numbers on the unemployment benefit is derived from the growth of unemployment derived from the labour force projection and the unemployment rate.

Finny (2012) surveyed New Zealand legislation and historical practice and it seems that these four main benefits have been indexed by CPI inflation from the early 1970s. This means that relative to the average wage or payments of Superannuation, the amounts paid in these benefits will grow smaller. Finny also found that to address this in some other countries' long-term projections the indexation assumption for welfare benefits is eventually boosted from inflation to something closer to wage indexation (examples are Canada, UK and some EU members).

To summarise, we assume the recent proportions on DPB, SB and IB in the population will hold into the future and that the payments will be inflation-indexed. This means that these benefits will fall as a proportion of the average wage and that the aggregate spending on these benefits will fall relative to GDP. Through time, the sustainability of this setting is likely to come under increasing political pressure.

As for the supplementary benefits (such as accommodation supplement, disability allowance, family tax credit, and other minor benefits), we assume these grow with inflation and the "target" population. Implicit in this is the assumption that there is an unchanged proportion of the target population that will receive the benefit in the future. For the accommodation supplement, disability allowance and minor supplementary benefits, the target population is all those 15 and older. The family support target population is people 18 and under.

The challenge for us is the sustainability of inflation indexing for these benefits. Some people could remain on the invalid's benefit for a large proportion of their lives and this assumption will lead to a rise in (relative) poverty.

6.5 Law and order

The cost weighting for the corrections part of this area of spending is concentrated on males in their 20s (allowing for rapidly decreasing numbers at older ages). We assume that 50% of the spending in this area is on imprisonment, while 25% is on home and other detention. For the more untargeted parts of the sector we assume that the population driver is everyone 15 and older. Overall, the other growth parameters follow the generic pattern described at the start of Section 6.

6.6 Others

The other non-finance spending – defence, transport and communications, economic and industrial services, primary services, heritage and culture, housing and community development, core government – are assumed to follow the growth patterns outlined above: public services productivity growth 0.3% a year, non-demographic volume growth 0.8% with demographic growth following that of the adult population.

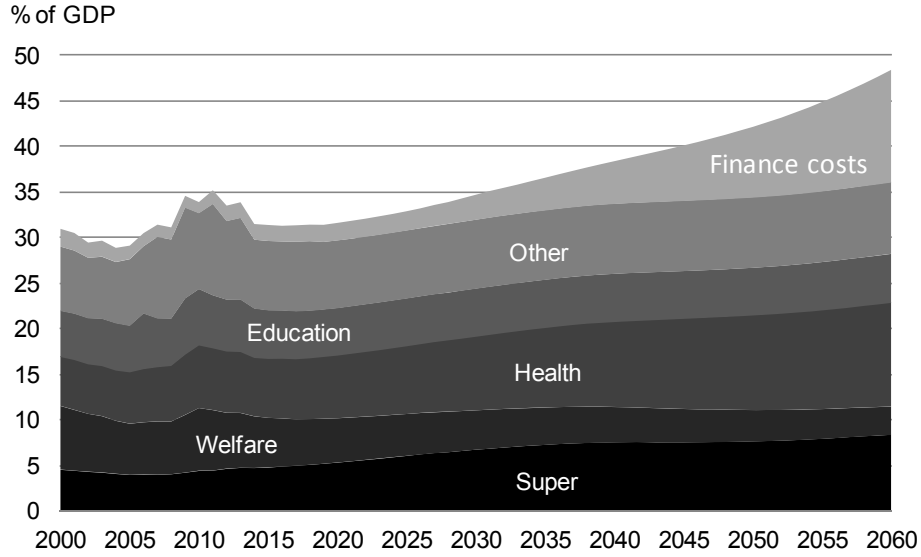
6.7 Fiscal assumptions: conclusions

Below is a chart showing where our base fiscal (and demographic and economic) assumptions lead us for expenditure. These are the cost pressures projections where no debt constraint is applied.

Under these assumptions, NZ Superannuation grows faster than nominal GDP, driven in the projection period by population ageing and nominal wage growth. On the other hand, spending on welfare transfers shrinks as a proportion of GDP, as the main driver is the assumed CPI growth. The two added together roughly hold their share of GDP. Health grows faster than GDP, ending up at about 11.5% of GDP, a 5 percentage-point rise. Education holds its own against GDP, as do all the other spending categories as a group.

So allowing the bottom-up drivers free rein results in primary spending rising from 29.6% of GDP in 2015 (the start of the projections) to 36% in 2060. The climbing deficit requires higher financing costs, which feed back into higher spending a larger deficits (behind this is the assumption of holding tax at a fixed proportion of GDP after the first few years of the projection.

Figure 18 – Resulting spending shares of GDP



Source: The Treasury LTFM

7 Fiscal framing

The fiscal responsibility provisions of the Public Finance Act can also be viewed as an explicit contract, both state-to-state and state-to-citizens. It was a response to shocks (such as Britain going into the Common Market and the 1970s' oil price shocks), unaffordable policies (such as Think Big, or supplementary minimum prices for sheep meat) and the inevitable consequence: huge external indebtedness and lower living standards. These fiscal provisions reflected a resolve never to be so exposed and vulnerable again. That was the reason the focus turned to debt as the fiscal anchor and successive governments concentrated on generating surpluses and paying off debt over the last quarter century.

Why would the next 25 years be any different? By simple extrapolations of existing policy, the Treasury's past long-term projections implicitly assumed governments would enter a new reckless phase, without recognising the overarching policy constraint of first the Fiscal Responsibility Act and now the Public Finance Act. No modern government would be elected on a platform of running deficits and accumulating more and more debt outside a crisis.

The beauty of the PFA as an explicit contract is the openness and transparency it provides to citizens on the performance of governments against this contract. At the same time, it reflects a liberal democratic approach and provides governments with discretion within this constraint. It doesn't prescribe (or proscribe) different philosophical approaches to policy – as long as they can be afforded and don't create unsustainable obligations for the state in the future. So all of this supports the use of net debt as our budget constraint in our long-term fiscal modelling (rather than "exploding debt" graphs).

7.1.1 Level of debt constraint

We have taken a net debt constraint of 20% of GDP as our working assumption. Successive governments have managed debt down to this level in either gross or net terms for most of

the past decade and a half (Figure 2 in Buckle and Cruickshank, 2012). The current government is aiming to return the level of net debt to no higher than 20% of GDP by 2020.

Our constrained debt projection, therefore, shows the effects of long-term net debt constraint levels of 20% of GDP on the projected deficit in 2060. In the sensitivity testing section of this paper, we also consider tighter and looser constraints of 0%, 10% and 30% of GDP to illustrate what is needed to reach each of these rather than 20%. A strong case could be made that, given New Zealand's history of shocks – economic, financial, environmental – a lower net debt anchor (meaning a larger buffer against shocks) is likely to be prudent. Fookes (2011) models the effects of shocks on the fiscal position using severe scenario analysis. In our final report, we intend to retain the 20% long-term anchor, but will point out the effects of a lower level of net debt.

The final report will also show the effects of a GFC-type shock in, say, 2020 and how long it might take to wind net debt back to around 20% of GDP.

7.1.2 Forecast-projection transition timing

In past statements, we have used the full five years of the forecast (plus some occasional extensions, for example, to close the output gap) before starting the projections – amounting to more than one term of government. So we have three options for starting points for the projections:

Cold start from the end of history

This involves starting the projections from the last official macro and fiscal outturns and meshing the fiscal projections in as best we can. This tells us something about the sustainability of the current fiscal position and of the demographic, economic and fiscal growth assumptions. It has the advantage of not relying on the fiscal plans of any current or future government. With no forecast at the front, we would avoid the confusion that arises about the difference between forecasts and projections and would considerably simplify the modelling. Current policy and assumptions also become clearer to state (macro projection parameters become single, fixed numbers for all future years, for example).

Start from the end of the latest five-year forecast

This is what we have done in the past. It has the advantage of having more time to close any fiscal gap. On the other hand, it depends on what could be a current government's optimistic fiscal forecasts at improving the fiscal position early on without any committed and detailed policy programme for actually doing this.

Start from around the end of the current parliamentary term

This represents a position between 1 and 2 above. This is the end of a current government's mandate for its fiscal strategy.

We have decided on the third option and the projections will start at the end of the current term, making the year to 30 June 2015 the first year of the projections of public services expenditure. Projections in the other areas of spending and revenue begin after the five forecast years.

8 Sensitivity of projections to assumptions

This section lays out how a variation in an assumption might change the projections from where they head with the central assumptions outlined above. These alternative scenarios provide no indication of how likely these changes might be vis-à-vis the central assumptions (unlike the stochastic projections for population and the labour force that Statistics New Zealand has introduced this year). They give an idea of size and direction of change reflecting the long-term fiscal modelling assumptions. Here we compare the effects of assumption changes on the base-case cost pressures scenario (apart from sensitivity testing of the target net debt assumption which uses the sustainable debt scenario).

8.1 Sensitivity to demographic assumptions

In addition to the various fans around the median population projection, Statistics NZ has provided a set of alternative (deterministic) scenarios. These usefully illustrate the directional effects of changes from the median assumptions.

A population with a higher fertility rate of 2.5 compared with 1.9 (both attained in the early 2030s) will produce a younger population and a larger labour force. This is unlikely to happen as it is above the 95th percentile until about 2045 (see Figure 7). Something like this might happen, for example, if Māori and Pasifika birth rates do not converge to European levels. In this scenario, the median age in 2061 is 37.7 years compared with the base population projection's 44 years. This leads to higher expenditure over this horizon, a lower primary balance and a rise in net debt.

Higher life expectancy at birth so that in 2061 it is 95 rather than the 89 years of the median scenario produces higher expenditure, a larger primary deficit and 25% more net debt in the last decade. About half of the rise in total expenditure to GDP over the base-case ratio comes from increases in health and NZS spending.

The base-case assumes 12,000 net migrants from 2015. Assuming no net migrants produces an older population, that starts to shrink in the last decade (as Japan is doing now), a lower level of GDP and hence less revenue. That coupled with higher spending produces a larger primary deficit and a higher level of net debt. A future where net migrants are more restricted is possible if ageing populations around the world produce fierce competition for migrants.

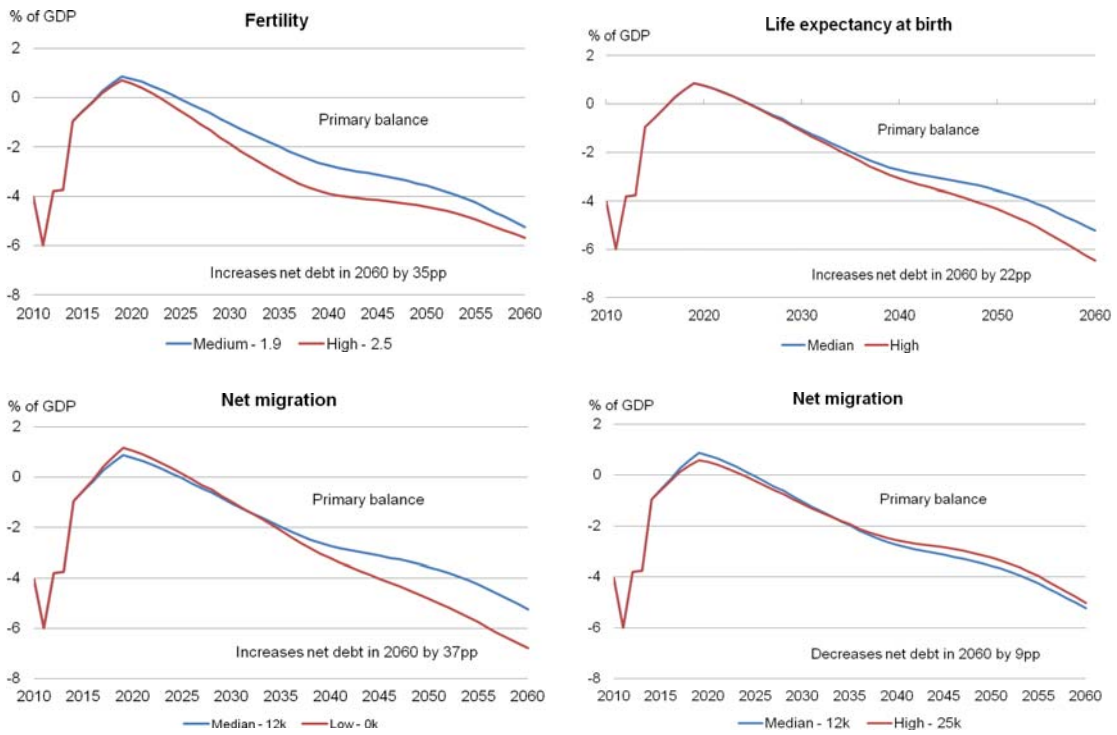
Finally, assuming twice as many migrants each year (who are younger on average than the resident population) lowers the median age, lifts GDP and revenue, lowers the ratio of expenditure to GDP, the lowers the primary deficit. So over the 50-year projection horizon, having more migrants helps the long-term fiscal position, but only a little, and the effect diminishes through time. Bear in mind, though, we have only occasionally seen more than 20,000 net migrants a year over the past half century.

Table 2 – Effects of changes to fertility, life expectancy and migration (core crown)

Alternative less base-case projection	2025	2035	2045	2060
Higher fertility (rising to 2.5)				
Expenditure	0.6	1.7	2.3	2.3
Revenue	0.0	0.0	-0.1	-0.2
Primary balance	-0.5	-1.1	-1.0	-0.5
Net debt	2.5	11.6	23.7	35.3
Higher life expectancy (95 in 2061)				
Expenditure	0.0	0.2	0.8	2.4
Revenue	0.0	0.0	0.0	0.0
Primary balance	0.0	-0.2	-0.5	-1.2
Net debt	0.0	1.0	4.9	21.7
Zero net migration				
Expenditure	-0.2	0.1	1.2	3.7
Revenue	0.0	0.1	0.2	0.3
Primary balance	0.2	-0.1	-0.9	-1.6
Net debt	-1.9	-1.9	5.1	36.7
Higher net migration (25,000)				
Expenditure	0.2	0.0	-0.4	-0.8
Revenue	0.0	-0.1	-0.1	-0.2
Primary balance	-0.2	0.0	0.3	0.2
Net debt	1.8	2.1	-0.6	-8.8

Source: The Treasury, Long-term Fiscal Model. These are differences in percentage points of nominal GDP.

Figure 19 – Effects of demographic assumption changes on primary balance



Source: The Treasury LTFM

8.2 Sensitivity to economic assumptions

This time, we look at changes in two key economic drivers in the model: economy-wide labour productivity growth, and labour participation rates.

The long-run productivity growth rate affects the cost side of the production of public services through wage growth (we assume Baumol cost-disease, and pressures in some sectors from international labour markets). If economy-wide productivity growth is only 1% rather than the base 1.5%, then with other things unchanged, GDP will be smaller, as will revenue. Expenditure as a share of GDP is higher, producing a higher primary deficit and a higher level of net debt as a share of GDP (higher by 60 percentage points of GDP in 2060). On the other hand, higher overall productivity growth of 2% a year produces a similar effect, but with roughly opposite signs.

Table 3 – Effects of changes to productivity and participation (core crown)

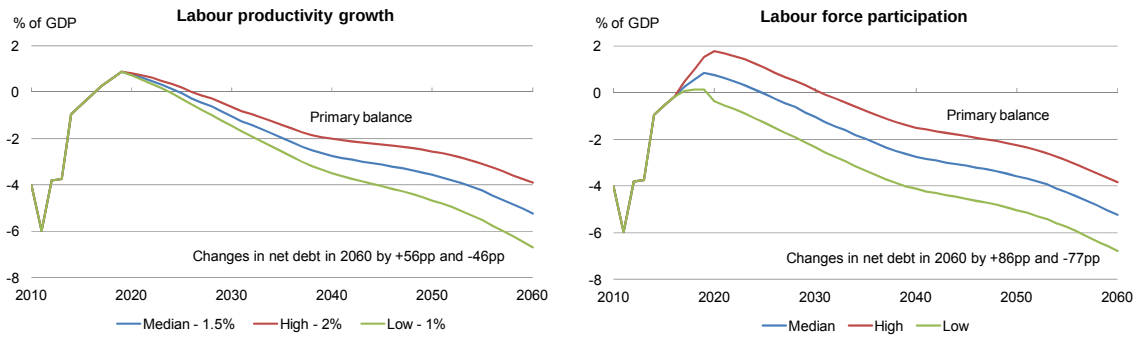
Alternative less base-case projection	2025	2035	2045	2060
Lower productivity growth (1% pa)				
Expenditure	0.4	1.1	2.1	4.7
Revenue	0.1	0.2	0.3	0.4
Primary balance	-0.2	-0.6	-0.9	-1.4
Net debt	1.5	7.6	19.8	55.8
Higher productivity growth (2% pa)				
Expenditure	-0.3	-1.0	-1.9	-4.0
Revenue	-0.1	-0.2	-0.2	-0.3
Primary balance	0.2	0.6	0.9	1.3
Net debt	-1.5	-7.0	-17.3	-45.9
Lower labour participation rates (old L)				
Expenditure	1.7	2.7	3.9	6.3
Revenue	0.0	0.0	0.0	0.0
Primary balance	-1.2	-1.3	-1.4	-1.6
Net debt	9.1	24.6	44.5	85.7
Higher labour participation rates (old H)				
Expenditure	-1.5	-2.4	-3.5	-5.7
Revenue	0.0	0.0	0.0	0.0
Primary balance	1.1	1.2	1.3	1.4
Net debt	-8.3	-22.2	-40.2	-77.1

Source: The Treasury, Long-term Fiscal Model. These are differences in percentage points of nominal GDP.

We have used the 2010 high and low bracketing around the medium labour force projection to look at the effects of high and low participation around the 2012 median projection. The LTFM translates this census based LF projection into an HLFS-based projection. In 2060 this means the high and low versions differ from the median projection by 165,000 people.

Lower participation potentially means more people require support and this shows up as higher expenditure. This has little effect on the ratio of tax to GDP as that is largely held as a constant ratio. The result is a larger deficit and significantly higher debt (about 50% larger than the base-case in 2060. The higher participation case is more or less a mirror image of this.

Figure 20 – Effects of economic assumption changes on primary balance



Source: The Treasury LTFM

8.3 Sensitivity to fiscal assumptions

This section looks at the effects on fiscal aggregates of changes to a public health non-demographic volume growth parameter (the "p" factor), productivity growth of public services, the level of the operating balance at the start of the projections, and the long-term target debt level.

As mentioned in Section 5.1 on health modelling, we have revisited some of the growth parameters in that sector. In the 2009 statement, we assumed a non-demographic volume growth of 0.8%pa across all public services (non-transfer) spending. This time we have reconsidered this and have set the health parameter at 1.5% which is closer to the history of public health spending. Here we show the effect in maintaining the 2009 0.8% setting.

The lower-growth setting reduces the ratio of health spending in 2060 by more than 3 percentage points. These feed through to lower primary balances (see Table 5).

The next pair of alternative scenarios shows the effects of lower (0%) and higher (0.6%) productivity growth of public services; 0.3% remains the base setting. Lower productivity growth means the costs of producing the desired quantity of services are greater, leading to a growing primary deficit and a larger wedge of net debt (as a ratio of GDP). The higher productivity case mirrors this on the other side.

The next pair shows the sensitivity on long-term fiscal aggregates of the starting point of the projection. This is modelled by adjusting expenditure up or down by 1 percentage point of GDP in the starting year of the projection. If the 2015 operating balance were 1pp of GDP lower, then net debt in 2060 would be around 70pp of GDP higher than in the basecase, illustrating the compounding effects of interest on rising debt. The lower starting point has the opposite effect. The long-term projections are sensitive to the starting point.

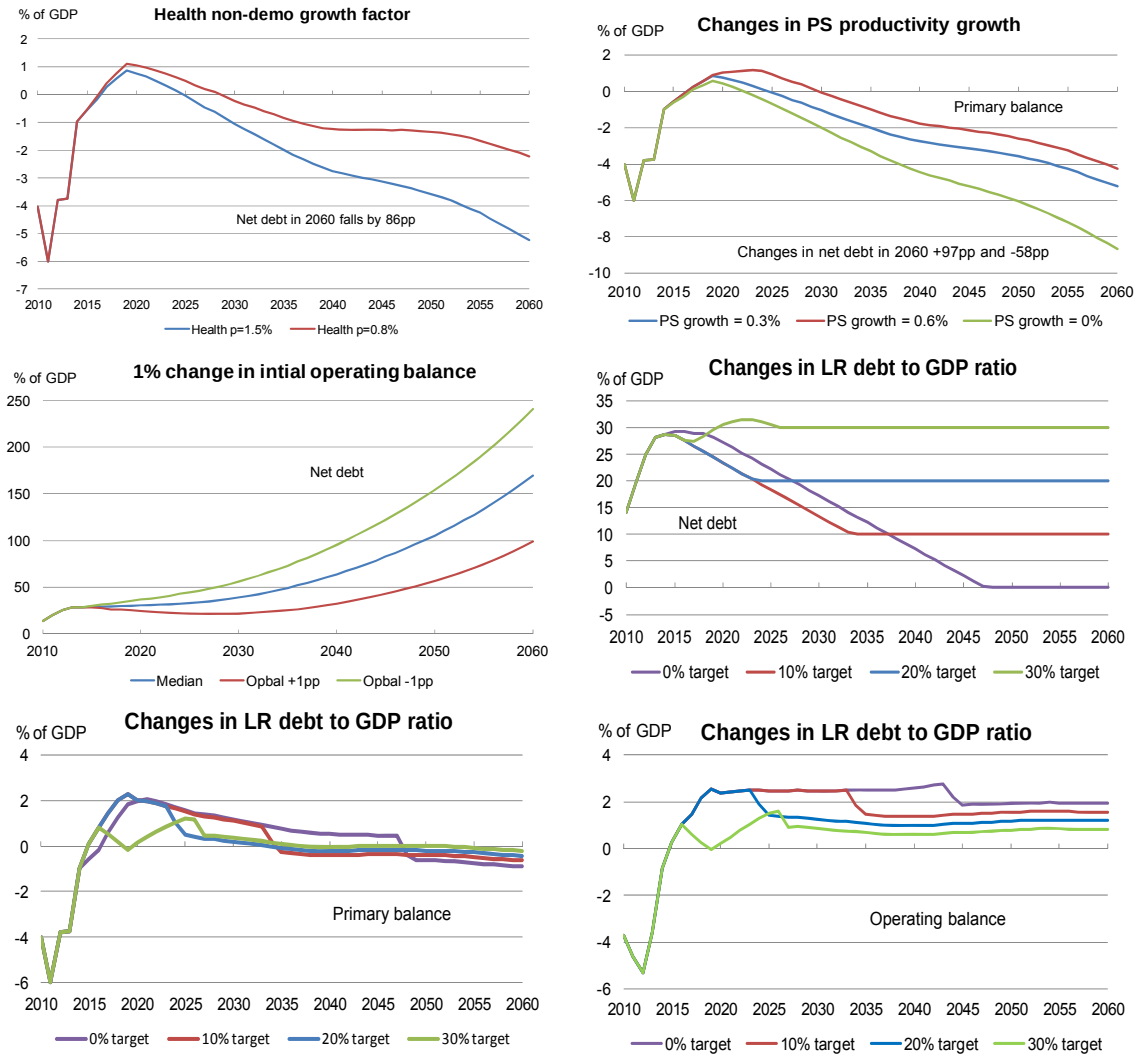
The final examples show the effect of managing net debt to different ratios of GDP in the long term. The base-case sustainable debt scenario has a long-term net debt target of 20% of GDP (that's the current fiscal strategy setting). Tighter (looser) debt targets of 0%, 10% (or 30%) of GDP are modelled here as reductions (increases) in spending. These results are not symmetric around the 20% case: For a 30% target, only a small amount of fiscal consolidation is required to reach the target, while it takes a couple of decades of hard slog to reach the 10% (or the 0%) target.

Table 4 – Effects of changes to fiscal settings (core crown)

Alternative less base-case projection	2025	2035	2045	2060
Lower non-demographic volume growth for health spending (0.8% pa)				
Expenditure	-0.7	-1.8	-3.6	-7.7
Revenue	0.0	0.0	0.0	0.0
Primary balance	0.5	1.2	1.9	3.0
Net debt	-3.3	-13.1	-32.4	-86.0
Lower public services productivity growth (0.0%)				
Expenditure	0.8	2.1	4.0	8.7
Revenue	0.0	0.0	0.0	0.0
Primary balance	-0.6	-1.3	-2.1	-3.4
Net debt	3.8	15.1	36.8	97.1
Higher public services productivity growth (0.6%)				
Expenditure	-0.2	-0.8	-1.6	-3.2
Revenue	1.0	1.0	1.0	1.0
Primary balance	1.0	1.0	1.0	1.0
Net debt	-4.4	-15.9	-30.0	-57.9
Lower starting operating balance (down 1pp of GDP in 2015)				
Expenditure	1.5	2.3	3.2	5.0
Revenue	0.0	0.0	0.0	0.0
Primary balance	-1.0	-1.0	-1.0	-1.0
Net debt	11.3	23.9	39.6	70.9
Lower long-term net debt target (10% of GDP) - sustainable debt scenario				
Expenditure	-1.0	-0.4	-0.4	-0.4
Revenue	0.0	0.0	0.0	0.0
Primary balance	1.0	-0.2	-0.2	-0.2
Net debt	-1.6	-10.0	-10.0	-10.0
Even lower long-term net debt target (0% of GDP) - sustainable debt scenario				
Expenditure	-0.9	-1.2	-1.6	-0.7
Revenue	0.0	0.1	0.1	0.1
Primary balance	1.1	0.8	0.7	-0.5
Net debt	2.2	-7.8	-17.8	-20.0
Higher long-term net debt target (30% of GDP) - sustainable debt scenario				
Expenditure	-0.1	0.4	0.4	0.4
Revenue	0.0	0.0	0.0	0.0
Primary balance	0.7	0.2	0.2	0.2
Net debt	10.6	10.0	10.0	10.0

Source: The Treasury, Long-term Fiscal Model. These are differences in percentage points of nominal GDP against the base cost pressures scenario, except for the last three which show changes from the sustainable debt scenario

Figure 21 – Effects of fiscal assumption changes on fiscal aggregates



Source: The Treasury LTFM

These sensitivity tests also provide some guidance about where policy solutions to our long-term fiscal challenge might not lie (at least for the degree of changes and the horizon considered here). Higher fertility and migration produce relatively small changes in the fiscal aggregates (although they may have positive effects on the macroeconomy). Likewise, if we all worked longer or more productivity, that would help, but wouldn't solve the fiscal challenge.

Finally, the modelling shows the lower the net debt target, the longer it takes to get there (no surprise there, given we have assumed a constant rate of consolidation for each). These results just reflect what the balances have to be to achieve the long-term debt target. Under these assumptions, to reduce net debt to 0% of GDP requires an extended period of operating surpluses in excess of 2%. To put this in context, in the buoyant years of 1994-2008, various measures of operating surplus (largely at the total crown level) averaged about 2.5% of GDP.

9 Conclusion

The Public Finance Act requires the Treasury to be transparent about assumptions used in making long-term fiscal projections. This paper summarises where we have got to in the demographic, economic, revenue, expenditure and framing assumptions.

These will undoubtedly change as we move through the next six months. We generally use Statistics New Zealand's demographic and labour force projections and these have being recast as stochastic projections. The assumptions around these have changed – chiefly in lower mortality (longer lives) and higher participation than in the previous releases.

We have revisited our economic and fiscal modelling and the assumptions behind the longer-term projections. We now acknowledge more explicitly the policy decision-making over the past 20 years have generally been taken to constrain debt and that looking ahead some kind of constraint should also apply even in the cost pressures scenario.

Key to our fiscal projections is how we treat the cost pressures projection of health spending. Most spending areas outside health and NZS grow by less than GDP. So the major drivers of the long-term fiscal projections come down to Super, health and taxes. Yes, the others play a role in sustainability of the fiscal position, but most of the action is with the big three. We have allowed for healthy ageing, resulting in lower public health costs for older people in future. We need to do more thinking about disability services and how close this is to long-term care spending other countries report separately.

The final set of assumptions has to do with the role of debt constraint, where to shift to projections, and sensitivity assumptions around when and how much a repeat of the GFC would set back the sustainability of the long-term fiscal position.

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Appendix

Appendix Table 1 – Summary of key assumptions as at 30 August 2012

Demography	2009	Now
Base case	Series 5 2009(base)	50th percentile 2011(base)
Fertility	Falls to 1.9 babies per woman	The same but takes a decade longer to reach 1.9
Period life expectancy	Rises to 85.6 years (M), 88.7 years (F) in 2061	Rises to 88.1 years (M), 90.5 years (F) in 2061
Net migration	Reaches 10,000 shortly into the projection	Reaches 12,000 shortly into the projection
Economy	**2009**	**Now**
Productivity growth	1.5% from 2014	1.5% from 2020
Participation	Series 5 medium 2010(base) Overall part rate in 2061: 63%	50th percentile 2006(base) Overall part rate in 2061: 65%
Average weekly hours worked	35 hours	33.2 hours
Inflation rate	2% mid-band	2% mid-band
Long bond rate	Holding at 6% through projection	Rising to 5.5% in the 2020s rising to 6% from 2030s
Fiscal	**2009**	**Now**
Revenue (largely tax)	Long term ratio 28% of GDP	Long term ratio 29% of GDP
Expenditure - *Public services* *(growth set by operating allowances in forecast period)*		
	Public sector productivity of 0.3% a year	Public sector productivity of 0.3% a year unchanged
	Real growth of 1.2% (80% of wage growth - 1.5% - passes through)	Real growth of 1.2% unchanged (80% of wage growth - 1.5% - passes through)
Health	Real per person growth rates 0.8% Price adjusted growth 1.7% Static cost curves	Real per person growth increased to 1.5% Price adjusted growth is now 2.4% Healthy ageing assumed (curves move out with life expectancy gains)
Education	Real per person growth rates 0.8% Price adjusted growth 1.7%	Real per person growth rates 1% Price adjusted growth 1.9%
Others	Real per person growth rates 0.8%	Real per person growth rates 0.8%
Expenditure - *Transfers* *(growth is demand-driven)*		
Superannuation (NZS)	Indexed by nominal wage growth	Indexed by nominal wage growth
UB, DPB, IB, SB, and other welfare	Indexed by inflation	Indexed by inflation
Expenditure - *Debt-financing costs*		
	End of year debt*new year's bond rate	End of year debt*new year's bond rate
End of current fiscal strategy period		
First year of projections	After 5 years (2014)	After 3 years (2015) only for public services; Rest follow five years of forecast