Social Expenditure in New Zealand: Stochastic Projections

John Creedy and Kathleen Makale

WORKING PAPER 07/2013
June 2013

Working Papers in Public Finance

VICTORIA
UNIVERSITY OF WELLINGTON
TE WHARE WĀNANGA
O TE ŪPOKO O TE IKA A MĀUI

Chair in Public Finance
Victoria Business School

The Working Papers in Public Finance series is published by the Victoria Business School to disseminate initial research on public finance topics, from economists, accountants, finance, law and tax specialists, to a wider audience. Any opinions and views expressed in these papers are those of the author(s). They should not be attributed to Victoria University of Wellington or the sponsors of the Chair in Public Finance.

Further enquiries to:
The Administrator
Chair in Public Finance
Victoria University of Wellington
PO Box 600
Wellington 6041
New Zealand

Phone: +64-4-463-9656
Email: cpf-info@vuw.ac.nz

Papers in the series can be downloaded from the following website:
http://www.victoria.ac.nz/cpf/working-papers

Social Expenditure in New Zealand: Stochastic Projections

John Creedy and Kathleen Makale[1]

Abstract

This paper presents stochastic projections for 13 categories of social spending in New Zealand over the period 2011-2061. These projections are based on detailed demographic estimates covering fertility, migration and mortality disaggregated by single year of age and gender. Distributional parameters are incorporated for all of the major variables, and are used to build up probabilistic projections for social expenditure as a share of GDP using simulation methods, following Creedy and Scobie (2005). Emphasis is placed on the considerable uncertainty involved in projecting future expenditure levels.

JEL CLASSIFICATION

E61: Fiscal policy
H50: Government Expenditures
J11: Demographic Trends and Forecasts

KEYWORDS

Population, projections, stochastic simulation, social expenditure, fiscal costs, New Zealand

---

[1] New Zealand Treasury and Victoria University of Wellington. The views expressed in this paper are those of the authors and do not necessarily reflect the views of the New Zealand Treasury. We are grateful to Christopher Ball, John Bryant and Nicola Kirkup for comments on an earlier version of this paper.

1 Introduction

The aim of this paper is to produce stochastic projections of social expenditure in New Zealand over the fifty-year period 2011 to 2061. By their very nature, expenditure projections cannot possibly provide accurate information about future levels. A very large range of parameters are held fixed or are assumed to change according to simple trends over the projection period. In considering the question of, 'what if recent trends were to continue and there were no endogenous policy changes?', such projections can at best provide an indication of the kind of stresses that could arise. There will inevitably be responses to those changes, including 'general equilibrium' types of response arising, for example, from changes in wage rates resulting from labour market pressures. While they cannot therefore be treated as forecasts, projections can stimulate and inform further analyses, considering for example whether market responses may be expected to mitigate or exacerbate the anticipated pressures.

Particular concern has been expressed regarding the consequences of the demographic transition in progress in New Zealand as in many industrialised countries. This involves the ageing of the baby-boom generations and, more importantly, continued reductions in fertility and especially mortality, with the latter producing the phenomenon of the 'ageing of the aged'. The fact that most types of social expenditure are age related makes this category of government expenditure a particularly important area of investigation. Of course, the present transition is merely one stage in earlier extensive demographic transitions experienced by developed economies. Furthermore, there have been very large changes in tax and expenditure ratios that have been quite independent of demographic changes.[2]

In view of the uncertainty that is inevitably involved in making projections, it is important to provide some indication of the potential range of values which could arise. Indeed, in considering possible policy action, and in particular the timing of such intervention (which may include tax smoothing in anticipation of higher future government expenditure), it is important to have some idea of the probability of future contingencies as well as their possible size.[3]

One approach is to consider a number of alternative 'scenarios', characterised by, for example, high labour force participation or higher mortality rates. However, there is no way to attach probabilities to such alternatives, and in the present context there are many parameters to consider. The starting point of the present stochastic approach is to regard

[2] See, for example, contributions collected in Creedy (1995) and Creedy and Guest (2007).

the parameters (fertility, labour force participation rates, age specific per capita expenditures, and so on) as being characterised by a distribution, rather than being fixed values. A large number of projections of the variables of interest (such as total social expenditure in relation to GDP) can thus be made, in each case taking a random draw from each of the specified distributions. This kind of 'Monte Carlo' approach thereby generates a distribution of values in each year of the projection period, whose properties can be examined. The method used here is based closely on the earlier work of Creedy and Scobie (2005).[4]

In specifying the form of the distribution (along with, say, the mean and standard deviation) of each relevant parameter, Creedy and Scobie (2005) used information about its past variability, which clearly involved the collection and analysis of a great deal of data. This was helped by, among other things, the existence of the Long Term Data Series, which was compiled within the Treasury. As this data series has not been maintained and regularly updated in more recent years (having been transferred to Statistics New Zealand), the present paper makes use of the growth rates and standard deviations obtained by Creedy and Scobie (2005). However, as indicated below, these were modified to some extent, either by 'rounding' a number of values or by using a priori assumptions.[5]

Section 2 briefly describes the framework of analysis: for details see Appendix A. Section 3 presents the benchmark results. Sensitivity analyses are reported in Section 4. Conclusions are in Section 5.

2 The projection model

This section provides a brief description of the projection model: further details are given in Appendix A.[6] Exogenous age-specific and gender-specific rates are used and, as mentioned above, no allowance is made for possible feedback effects, which may for example be generated by general equilibrium changes in price and wage rates, or endogenous policy responses.

---

3 For example, see Auerbach and Hassett (2000), and on tax smoothing see Davis and Fabling (2002).

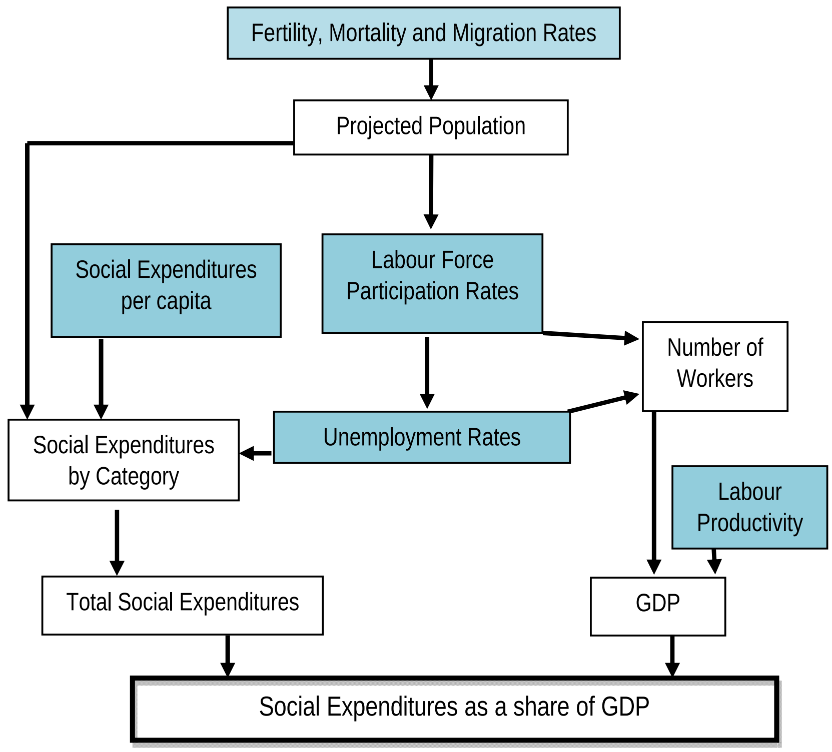
4 That paper produced the first stochastic demographic and expenditure projections for New Zealand and provides a discussion of alternative approaches and related literature.

5 The use of a priori values is examined in detail in Creedy and Alvarado (1998). They obtained stochastic projections of social expenditure for Australia but did not, unlike Creedy and Scobie (2005) and the present paper, combine these with stochastic population projections.

6 This section borrows heavily from Creedy and Scobie (2005).

The sequence of calculations is set out in Figure 1, where the grey boxes represent input data. The first stage is the production of projections for the size of the population, together with its distribution by age and gender. This requires projections of trends in fertility, mortality and net migration. Projected labour force participation rates are then combined with age and gender specific unemployment rates to generate the size of the workforce. This is multiplied by average productivity per worker to obtain GDP.

Figure 1 The Structure of the Model



Social expenditures per capita are combined with population (by age and gender) to obtain total social expenditure on each of 13 categories for each age and gender group. These categories are listed in Appendix Tables 4 and 5. The resulting total social expenditure is finally expressed as a share of projected GDP.

In moving through the sequence of calculations, a random draw from the distribution of each variable is made, as explained below. This process is repeated 5000 times, to produce a distribution of the social expenditure ratio for each projection year. The process therefore also generates distributions of the population by age and gender, as well as for each category of social expenditure.

Consider a relevant variable, X, which could be, for example, an unemployment rate, a fertility rate for women of a given age, or an item of social expenditure. In cases where the variable may take positive or negative values, it is assumed to be normally distributed. Where a variable is necessarily positive, and the distribution is positively skewed, the distribution is assumed to be lognormal.[7]

[7] The assumption of lognormality was also made, for example, by Alho (1997) and Creedy and Alvarado (1998).

Where a variable is normally distributed with mean and variance μ and σ^2 respectively, X is distributed as $N(\mu,\sigma^2)$. If r represents a random drawing from $N(0,1)$, a simulated value, x, can be obtained using $x=\mu+r\sigma$. In the lognormal case, μ and σ^2 refer to the mean and variance of logarithms. A random draw from a lognormal distribution is given by $x=\exp(\mu+r\sigma)$, where r is again a random $N(0,1)$ variable.[8]

Each social expenditure projection is associated with its own demographic structure. The populations are necessarily derived using single-year age groups, but when calculating social expenditures and employment, some age grouping is necessary in view of the more limited data available for these variables.

The growth rates and standard deviations used in Creedy and Scobie (2005) were based on considerable information about past trends and the variability in several hundred fertility rates, mortality rates, migration rates, male/female birth ratios, labour force participation rates, unemployment rates and major categories of social expenditure. Their growth rates and standard deviations were estimated from the following regression:[9]

$$\log y_t = \alpha + \beta t + u_t \qquad (1)$$

Where y_t is per capita expenditure in the relevant category at time t and u_t is an error term. This specification implies an estimated constant growth rate of, $\hat{\beta}$. Furthermore, $Var(\log y_t)=\sigma_u^2$, so the standard deviations are derived from the estimated standard error of the regression, $\hat{\sigma}_u$. The log-linear specification was found to provide a good fit to the historical data.[10]

In producing the projections reported below, data were obtained for 2010 relating to male and female populations, inward and outward migrants by single year of age, along with male and female unemployment rates by five-year age groups. The details along with data sources are given in Tables 1-3 in Appendix B. The 2010 social expenditure costs per capita, again within 5-year age groups, were also obtained for 13 categories and are reproduced in Tables 4 and 5 of Appendix B. The standard deviations for demographic

8 One limitation of the approach is the assumption of independence, whereby in any year the random draw for any variable/age is independent of draws for other variables/age groups. For example, it does not allow for changes which may systematically affect mortality rates of all age groups. Positive correlations would tend to increase the confidence intervals beyond those obtained below.

9 This form is a simplified form of the more general Box-Jenkins type of time series specification used by Lee and Tuljapurkar (2000).

10 The use of past variability to reflect future uncertainty is of course just one possible approach. The same model could be used with *a priori* assumptions about the distributions, based on a combination of past information and a range of considerations concerning views of the future; see Creedy and Alvarado (1998).

components of the model were adapted from Creedy and Scobie (2005), in view of the lack of more recent data.

3 Benchmark results

This section presents the benchmark projections for the distribution of social expenditure as a proportion of GDP. The essential features are that all social expenditures are assumed to grow in real terms at 1.5 per cent per year, the same rate as labour productivity. The results therefore refer to a 'pure ageing' assumption. Immigration is based on the average over recent years of 14,500 net immigrants each year (with total annual immigration of 82,500). Changes in mortality rates are assumed to continue (at values given in Table 1 of Appendix B) for 15 years, after which they remain constant. Changes in labour force participation rates, taken from Creedy and Scobie (2005), are assumed to apply for 10 years. Fertility rates are assumed to change for 10 years, after which no further changes in these rates are projected. The standard deviation of productivity growth is assumed to be 0.02, reflecting a high degree of uncertainty about this variable.

For the social expenditure categories, the standard deviations (in each age, gender and expenditure category) were set at 0.05 for each category and age group and gender.

Figure 2 shows the projected population pyramids for ten-year intervals over the 50-year projection period (for plotting purposes, the results are arranged into 5-year age groups). The figures actually show the arithmetic mean values of the various distributions. As expected, the population projections are associated with a relatively small degree of uncertainty, in that the confidence intervals around the mean values are very small. For this reason they are not shown here.

Figure 3 shows the time profile of various measures of the distribution of the projected ratio of total social expenditure to GDP from 2010 to 2060.[11] In addition to the mean, the profiles of upper and lower quartiles, and 5th and 95th percentiles are shown.[12] This diagram may be compared with Figure 3 of Creedy and Scobie (2005), which covers the period 2001 to 2051. The latter, as expected, starts from a similar base, but the present projections display slightly smaller 'spreads' in the profiles over time. Nevertheless the

[11] These summary values were produced for ten-year intervals rather than each year of the projection period, to reduce computer run-times.

[12] As in the previous analysis, the mean and median were found to be similar.

most striking feature of Figure 3 is the increasing uncertainty regarding the social expenditure ratio.

As with earlier projections, the arithmetic mean ratio of total social expenditure to GDP increases relatively sharply from around 2020, as a result of the movement of the post World War II baby boomers into retirement and old age. In Creedy and Scobie (2005) the projected profile of this ratio becomes stable by around 2040. In the present case the mean ratio falls very slightly after this date. Given the assumption that mean per capita growth rates of social expenditure are the same as that of (mean) productivity growth, the profiles are affected largely by the changing age composition over time. The slight reduction in the projected mean expenditure ratio in later years therefore seems to be explained by the fact that the baby boom generations will have all died by that time. However, given the large degree of uncertainty (the high dispersion in the distribution of the expenditure ratio), these reductions cannot be treated as statistically 'significant'.

The generally lower average social expenditure ratio in the present case is not explained by the much higher annual value of net immigration, compared with the earlier results (which were based on a long term average of only 5,000 (associated with gross immigration of 60,000), a value that has been substantially exceeded since 2001).[13] Higher immigration has very little effect, although it must be recognised that in the present model migrants are assumed to acquire existing New Zealand mortality, fertility and labour force participation characteristics as soon as they arrive (along with entitlements to benefits). And although the average age of immigrants is slightly lower than that of the New Zealand population, there are of course substantial numbers of migrants in the older age groups.[14]

[13] Comparisons with earlier results are not exact because the 14 social expenditure categories used by Creedy and Scobie (2005) are not precisely the same as the 13 categories used here, in view of data limitations.

[14] The question of whether higher net immigration can to some extent substitute for higher fertility is examined in detail in the context of Australia by Creedy and Alvarado (1998b), who allow for 'assimilation' to take several generations. They found relatively small effects.

Figure 2 Population Projections by Age Groups and Gender 2010-2060

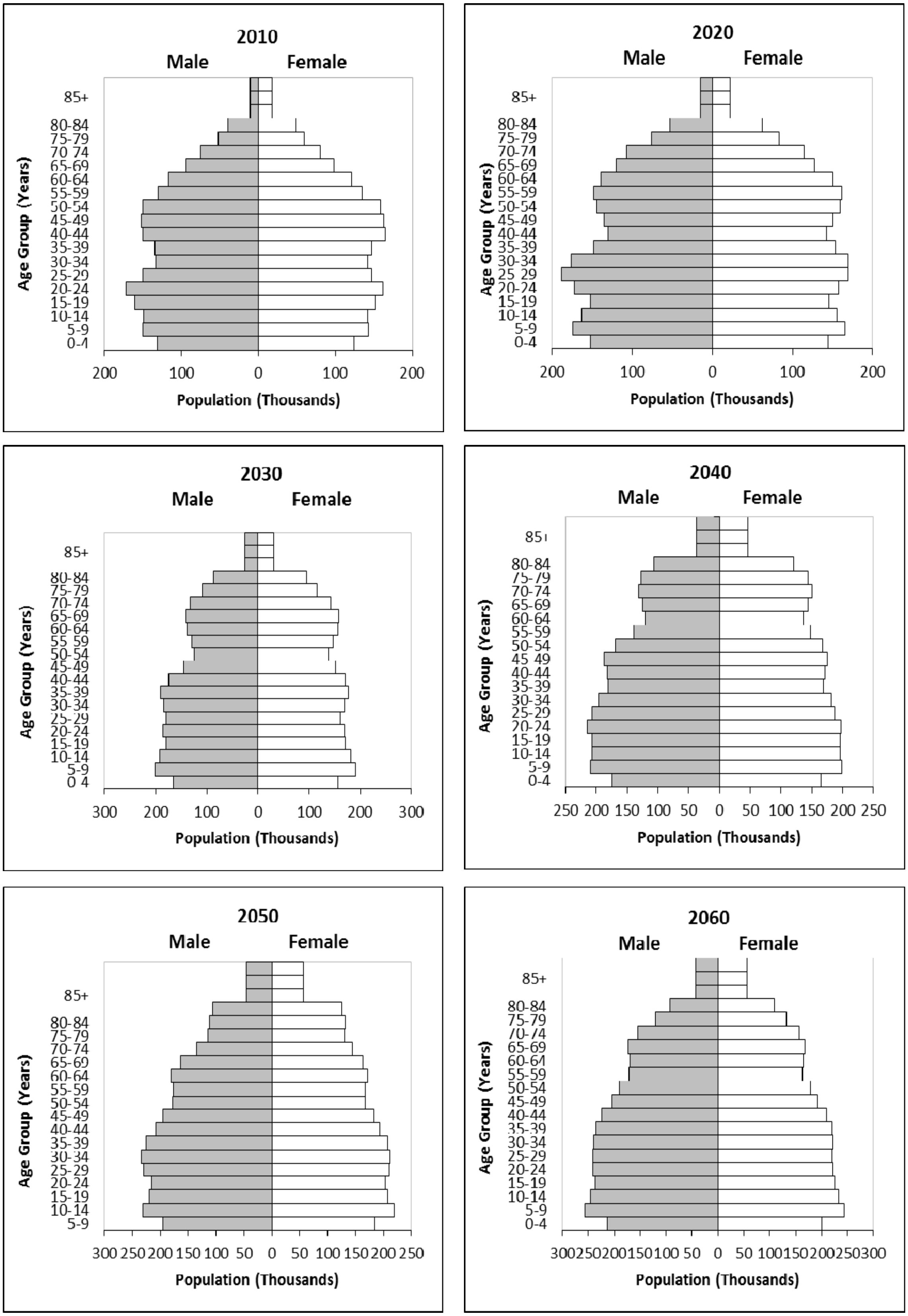
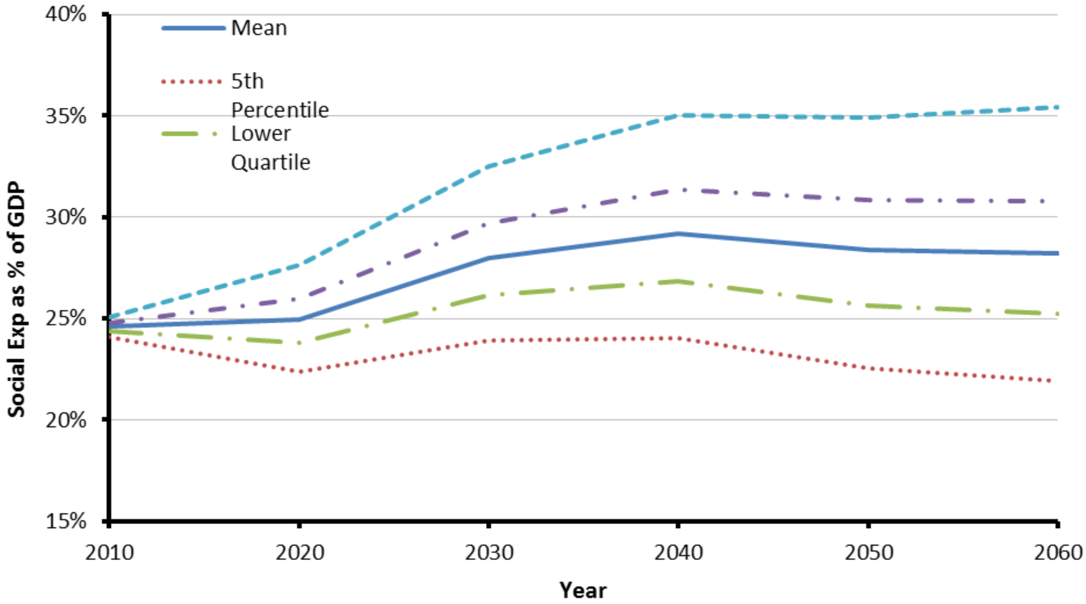


Figure 3 Projected Social Expenditure as a Share of GDP: 2010-2060 (Benchmark Case)



To illustrate how the assumed standard errors of the per capita growth rates of social expenditures translate into standard errors of the costs, the projected growth in health and education costs per capita, for males and females separately, are shown in Figures 4 and 5. In each case the mean is plotted, along with two standard deviations either side of it. Health includes the five health categories aggregated; these are personal health, public health, mental health, DSS older, and DSS under 65. Education includes the two categories, primary and tertiary education.[15] The largest degree of uncertainty relates to unemployment benefits, since in this case the uncertainty also includes the age and gender-specific unemployment rates. Unemployment costs per capita are illustrated in Figure 6.

[15] Early childhood education is excluded here, although recent policy changes have increased its importance.

Figure 4 Health Expenditure per Capita: 2010-2060

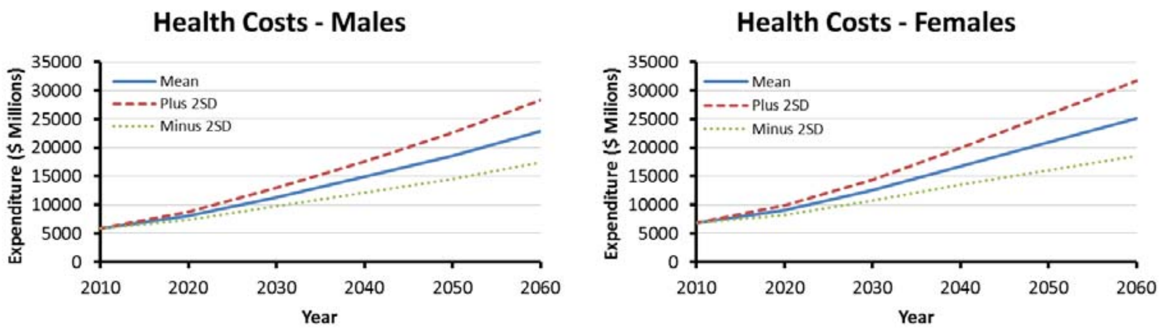


Figure 5 Education Expenditure per Capita: 2010-2060

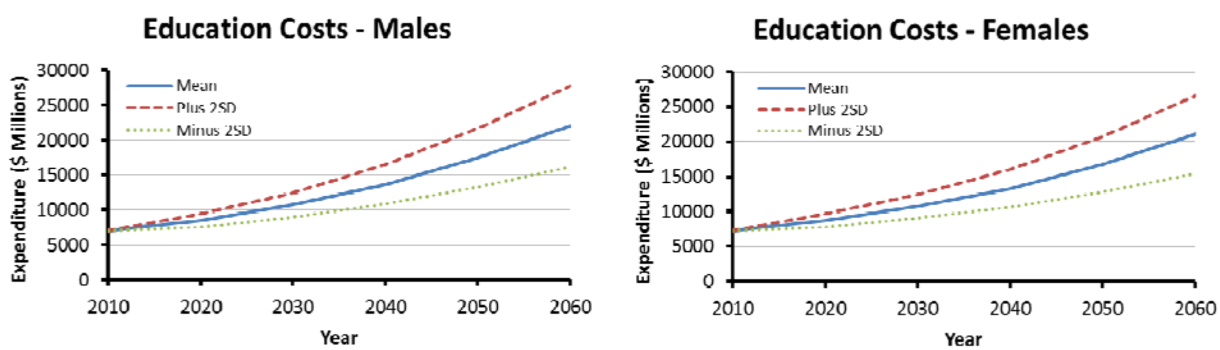
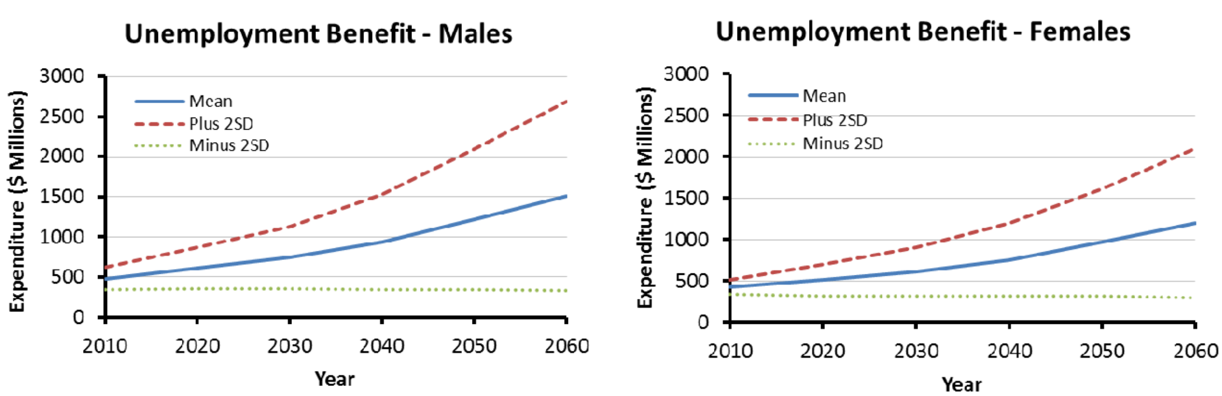


Figure 6 Unemployment Benefit Expenditure per Capita: 2010-2060



4 Sensitivity Analyses

This section explores the impact on the projected levels of social expenditure of variations to the assumptions used in the benchmark case. In order to concentrate on the effects of the anticipated demographic transition, the sensitivity analyses retain the use of a 'pure ageing' assumption (whereby average growth rates of the social expenditure categories are equal to average productivity growth).

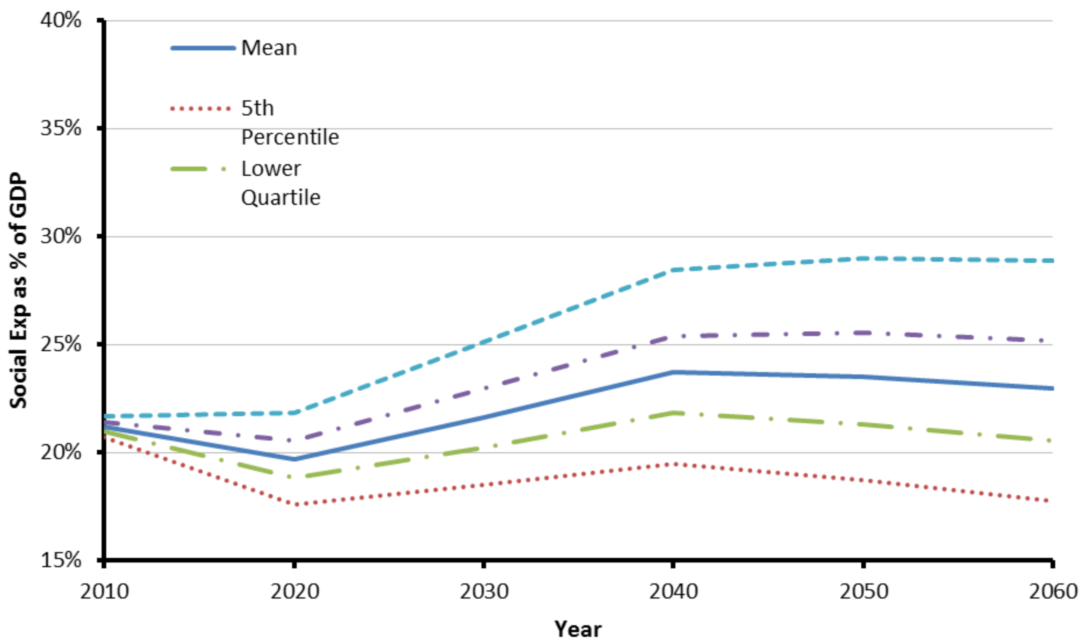
First, it is of interest to examine the implications of having a higher age of eligibility for NZ Superannuation. The full effects cannot be modelled explicitly, but suppose that the age of eligibility is raised, for males and females, to aged 70.[16] To reflect this increase, the NZS costs per capita were changed: for males and females in age groups from 60 to 69 these were reduced to zero. For the age group 70-74 the annual per capita costs were changed to 10000 and 12000 for males and females respectively. Associated with these changes, the labour force participation rates for males in age groups 55-59, 60-64, 65-69, and 70-74 were changed to 0.9, 0.9, 0.75 and 0.1 respectively. For females in the corresponding groups the rates were increased to 0.8, 0.8, 0.75 and 0.1.

A related modification is a change to the assumed length of time over which mortality declines. This was changed from 15 to 30 years. The age-related health costs (DSS Older) for age groups from 50 to 64 were also reduced to zero. The modifications to labour force participation and health costs were, for simplicity, assumed to operate immediately. This modification from the benchmark case is thus one in which people continue to live longer, but this extra length of life is associated with improved health and hence also higher labour force participation. The extra longevity ultimately leads to higher stocks of retired individuals, though this is mitigated to some extent by the assumed higher labour force participation, which raises GDP.

The projected distribution of the ratio of social expenditure to GDP is shown in Figure 7. It is clear that these more optimistic assumptions imply a downward shift in the distribution, although the spread of values (between the 5th and 95th percentiles) remains similar to that of the benchmark case.

[16] This is raised from the first year, rather than being gradually phased in. The structure of the model makes it difficult to introduce a selective gradual change of this type to the participation rates over time.

Figure 7 Projected Social Expenditure as a Share of GDP: 2010-2060 (Increased Longevity and Higher Labour Force Participation of Those Aged over 55)



Clearly a wide range of alternative assumptions could be examined, as discussed in Creedy and Scobie (2005), but in view of the present emphasis on uncertainty it is of interest to consider alternative assumptions about the standard errors of a number of the variables. First, the elimination of any uncertainty regarding demographic elements has very little effect, as expected; the resulting diagram (not shown here) is difficult to distinguish from the benchmark of Figure 3.

Two more cases are reported here. In the first variant, the standard deviations of expenditure categories in all age groups were set to zero. The uncertainty is thus attributed to demographic, labour market and productivity variations. In the second variant, the standard deviations of the unemployment and participation rates, and that of the productivity growth rate, were set equal to zero. The resulting projected distributions of the social expenditure to GDP ratio are shown in Figures 8 and 9. Comparison of these two figures shows that spread of the distributions arising from labour market and productivity variations is substantially higher than that arising from the uncertainty with regard to per capita social expenditures (as reflected in the observed variability over earlier years).

Figure 8 Projected Social Expenditure as a Share of GDP: 2010-2060: No Uncertainty Regarding Growth of all Social Expenditure Categories

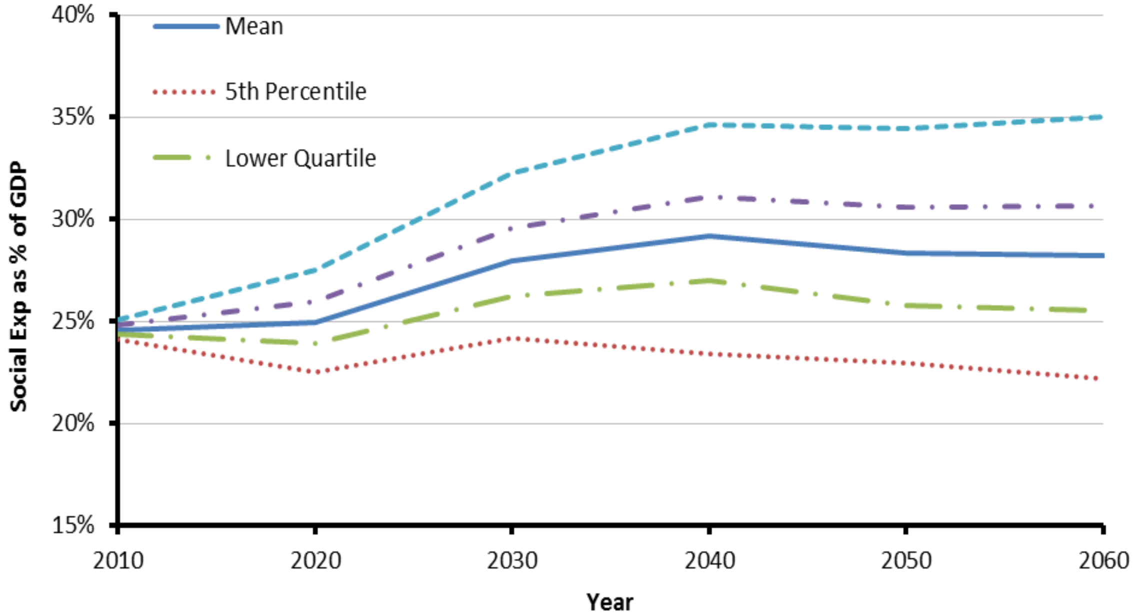
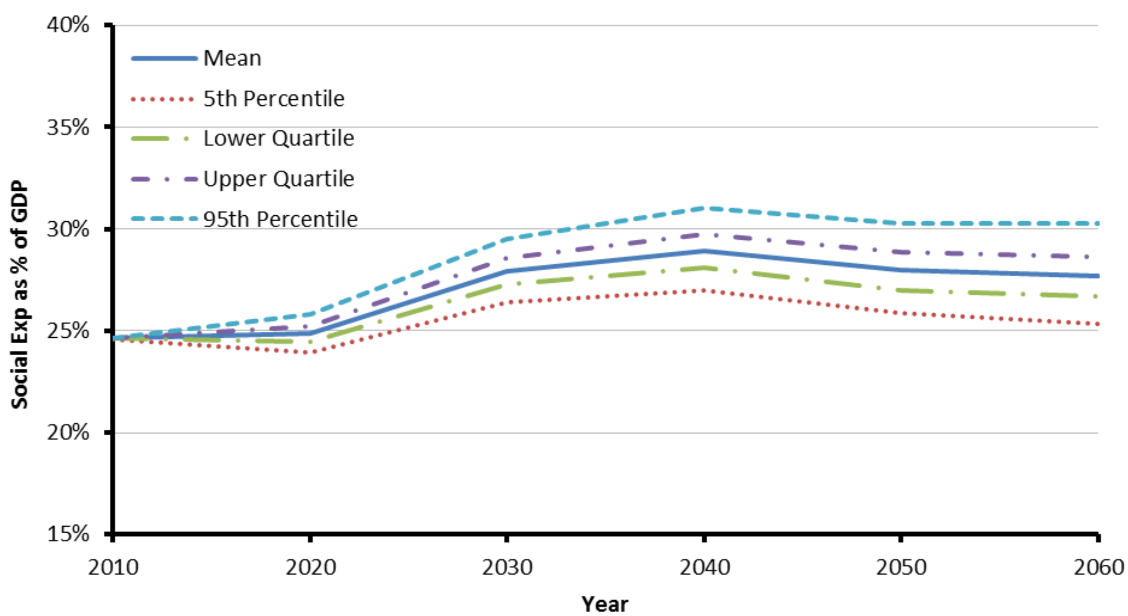


Figure 9 Projected Social Expenditure as a Share of GDP: 2010-2060: No Uncertainty in Participation and Unemployment Rates, and Productivity Growth Rate



5 Conclusions

This paper has projected social expenditures in New Zealand over the fifty-year period 2011-1061, based on a stochastic approach using 13 categories of social spending, decomposed by age and gender. By allowing for uncertainty about fertility, migration, mortality, labour force participation and productivity, and all categories of social spending, it has been possible to generate projections with accompanying confidence bands.

Focussing on ‘pure ageing’ results (whereby per capita social expenditure costs in each category grow at the same rate on average as productivity growth), the projections reveal considerable uncertainty regarding the ratio of total social expenditure to GDP as the time period increases. A negligible part of the dispersion in this ratio is contributed by demographic uncertainty.

Much of the uncertainty was found to be contributed by uncertainty regarding future unemployment and labour force participation rates, and the rate of productivity growth. More optimistic assumptions regarding labour force participation and health costs among the aged produced lower average ratios of expenditure to GDP. A consistent finding was the tendency for the average expenditure ratio to fall slightly beyond around 2040, following the death of the post World War II baby boom generations.

Appendix A: The Projection Model

Population projections are obtained using a social accounting, or cohort component, framework.[17] There are $N = 100$ (single year) age groups. The square matrix of flows, f_{ij}, from columns to rows, has $N - 1$ non-zero elements which are placed on the diagonal immediately below the leading diagonal. The coefficients, a_{ij}, denote the proportion of people in the j th age who survive in the country to the age i, where p_j is the number of people aged j and

$$a_{ij} = \frac{f_{ij}}{p_j} \tag{A1}$$

where only the $a_{i+1,i,}$ for $i = 1,..., N - 1$ are non-zero. Males and females are distinguished by subscripts m and f, so that matrices of coefficients are A_m and A_f. Let $p_{m,t}$ and $p_{f,t}$ denote vectors of male and female populations at t, where the i-th element is the corresponding number of age i. The vectors of births and immigrants are b and m respectively. The forward equations:

$$p_{m,t+1} = A_m p_{m,t} + b_{m.t} + m_{m,t} \tag{A2}$$

$$p_{f,t+1} = \mathrm{A}_f p_{f,t} + b_{f,t} + m_{f,t} \tag{A3}$$

In general the matrices A_m and A_f, along with the births and inward migration flows, vary over time.

Suppose that c_i represents the proportion of females of age i who give birth per year. In general the c_i values vary over time. Suppose that a proportion, δ, of births are male, and define the N-element vector τ as the column vector having unity as the first element and zeros elsewhere. Then births are:

$$b_m = \delta \tau c' p_f \tag{A4}$$

$$b_f = (1 - \delta) \tau c' p_f \tag{A5}$$

[17] For further exploration of this model, see Creedy (1995).

where c' is the transpose of the vector c. Equations (A2) to (A5) can be used to make population projections, for assumed migration levels.

The per capita social expenditures are placed in a matrix, S, with N rows and k columns, where there are k items of social expenditure and the i, jth element s_{ij} is the per capita cost of the jth type of social expenditure in the ith age group. Suppose the jth social expenditure is expected to grow in real terms at the annual rate ψ_j in each age group. Then define g_t as the k-element column vector whose jth element is equal to $(1+\psi_j)^{t-1}$. Aggregate social expenditure at t, C_t, is thus:

$$C_t = g_t' S' p_t \tag{A6}$$

Expenditure per person in each category and age differs for males and females, so that (A6) is suitably expanded.[18]

Projections of Gross Domestic Product depend on: initial productivity (GDP per employed person); productivity growth; employment rates; participation rates; and the population of working age. Total employment is the product of the population, participation rates and the employment rate. Employment is calculated by multiplying the labour utilisation rate by the labour force. If U_t is the total unemployment rate in period t, the utilisation rate is $1-U_t$. The aggregate unemployment rate is calculated by dividing the total number of unemployed persons, V_t, by the total labour force, L_t. The value of V_t is calculated by multiplying the age distribution of unemployment rates by the age distribution of the labour force, where these differ according to both age and sex.

Let vectors U_m and U_f be the age distributions of male and female unemployment rates. If $\wedge$ represents diagonalisation (a vector is written as the leading diagonal of a square matrix with other elements zero) unemployment in period t is:

$$V_t = U'_{m,t} \hat{L}_{m,t} p_{m,t} + U'_{f,t} \hat{L}_{f,t} p_{f,t} \tag{A7}$$

The labour force, L_t, is:

$$L_t = L'_{m,t} p_{m,t} + L'_{f,t} p_{f,t} \tag{A8}$$

[18] Care needs to be taken with the treatment of unemployment costs per capita, because unemployment levels are endogenous (depending on unemployment rates, participation rates and the age structure). The unemployment costs per unemployed person in each age and gender group therefore need to be converted into per capita terms in each year.

If productivity grows at the rate, θ, GDP t is the product of the utilisation rate, $1-U_t = 1-V_t / L_t$, the labour force, L_t, and productivity, so that:

$$GDP_t = \left\{ \frac{GDP_1}{(1-U)L_1} \right\} (1+\theta)^{t-1} (1-U_t) L_t \quad \text{(A9)}$$

Appendix B: The Data

Appendix Table 1 Basic Demographic Data by Age and Gender

	Male					Female						
Age	P	I	E	M	ΔM/M	P	I	E	M	ΔM/M	F	ΔF/F
0	32590	402	433	0.00519	-0.01071	31140	393	478	0.00411	-0.0125	0.00000	0.00000
1	32650	557	539	0.00049	-0.01071	30410	535	497	0.00044	-0.0125	0.00000	0.00000
2	32910	471	543	0.00026	-0.01071	31140	457	465	0.00022	-0.0125	0.00000	0.00000
3	31630	486	521	0.00024	-0.01071	30190	462	426	0.00020	-0.0125	0.00000	0.00000
4	30240	419	483	0.00021	-0.05211	28950	454	417	0.00017	0.0169	0.00000	0.00000
5	29640	429	392	0.00018	-0.05211	28160	381	354	0.00015	0.0169	0.00000	0.00000
6	29800	415	400	0.00015	-0.05211	28400	418	377	0.00012	0.0169	0.00000	0.00000
7	29030	369	327	0.00013	-0.05211	27430	390	385	0.00010	0.0169	0.00000	0.00000
8	28550	418	346	0.00012	-0.05211	27510	375	356	0.00008	0.0169	0.00000	0.00000
9	29890	350	382	0.00012	-0.02425	28420	382	372	0.00008	0.0189	0.00000	0.00000
10	30480	361	354	0.00011	-0.02425	29130	370	367	0.00008	0.0189	0.00000	0.00000
11	29710	371	398	0.00013	-0.02425	28070	330	356	0.00009	0.0189	0.00000	0.00000
12	30060	375	367	0.00018	-0.02425	28670	375	369	0.00011	0.0189	0.00007	0.00349
13	30020	401	390	0.00023	-0.02425	28880	393	373	0.00016	0.0189	0.00081	0.00290
14	31310	442	343	0.00032	-0.02732	29450	437	316	0.00021	-0.0064	0.00384	-0.00220
15	31900	565	350	0.00042	-0.02732	30280	637	360	0.00027	-0.0064	0.01301	-0.00192
16	32150	733	373	0.00051	-0.02732	30510	818	402	0.00033	-0.0064	0.02620	0.00456
17	33070	737	500	0.00065	-0.02732	31480	670	586	0.00038	-0.0064	0.04251	-0.00434
18	33580	1351	852	0.00077	-0.02732	31710	925	904	0.00040	-0.0064	0.05582	-0.00647
19	34810	1761	775	0.00088	-0.02732	32900	1255	757	0.00042	-0.0289	0.06571	-0.00730
20	34170	1649	804	0.00096	-0.04083	32930	1289	798	0.00040	-0.0289	0.06891	-0.00217
21	33360	1640	1212	0.00101	-0.04083	31580	1247	1203	0.00039	-0.0289	0.07794	-0.00277
22	32470	1778	1389	0.00103	-0.04083	30690	1493	1493	0.00035	-0.0289	0.08446	-0.00196
23	31100	1787	1620	0.00104	-0.04083	29230	1605	1613	0.00033	-0.0289	0.08781	0.00251
24	30300	1793	1598	0.00103	-0.04083	29410	1642	1551	0.00030	-0.0113	0.09299	0.00660
25	29630	1766	1598	0.00100	-0.05603	29380	1770	1592	0.00028	-0.0113	0.10073	0.01462
26	29300	1698	1638	0.00098	-0.05603	29370	1645	1473	0.00026	-0.0113	0.11040	0.01180
27	29060	1592	1477	0.00096	-0.05603	29290	1645	1313	0.00027	-0.0113	0.11749	0.01484
28	27970	1437	1260	0.00093	-0.05603	28760	1507	1133	0.00030	-0.0113	0.12445	0.01960
29	27220	1314	1105	0.00091	-0.02415	28440	1359	962	0.00034	-0.0099	0.12917	0.02857
30	26590	1221	970	0.00089	-0.02415	28400	1243	788	0.00037	-0.0099	0.13165	0.03785
31	25970	990	817	0.00090	-0.02415	28380	937	808	0.00044	-0.0099	0.13489	0.04502
32	25330	730	701	0.00093	-0.02415	27480	743	647	0.00049	-0.0099	0.12298	0.04321
33	25640	670	623	0.00095	-0.02415	27850	699	608	0.00055	-0.0099	0.11295	0.04349
34	25800	608	558	0.00102	-0.00274	27890	653	546	0.00058	-0.0178	0.10306	0.05128
35	26580	589	595	0.00108	-0.00274	29250	589	497	0.00063	-0.0178	0.08739	0.03948
36	27410	582	570	0.00116	-0.00274	30540	517	552	0.00065	-0.0178	0.07237	0.05702
37	28650	583	523	0.00123	-0.00274	31700	558	497	0.00069	-0.0178	0.05626	0.05008
38	29980	482	547	0.00133	-0.00274	33110	495	518	0.00073	-0.0178	0.04427	0.14021
39	30370	476	513	0.00141	-0.01166	33700	528	506	0.00080	-0.0091	0.03028	0.18708
40	29850	477	491	0.00152	-0.01166	32710	462	449	0.00089	-0.0091	0.02220	0.18807
41	30180	453	441	0.00161	-0.01166	32970	411	431	0.00100	-0.0091	0.01256	0.40534
42	29760	400	451	0.00173	-0.01166	32490	357	387	0.00111	-0.0091	0.00738	0.40805
43	29590	347	405	0.00181	-0.01166	32200	344	398	0.00123	-0.0091	0.00359	0.68216
44	29950	356	342	0.00192	-0.01613	32030	328	340	0.00134	-0.0189	0.00231	0.00000
45	30270	310	373	0.00202	-0.01613	32310	281	345	0.00146	-0.0189	0.00090	0.00000
46	31340	320	361	0.00216	-0.01613	33230	317	375	0.00157	-0.0189	0.00032	0.00000
47	31670	269	379	0.00233	-0.01613	34070	295	361	0.00171	-0.0189	0.00021	0.00000
48	31740	281	362	0.00251	-0.01613	33810	242	325	0.00184	-0.0189	0.00012	0.00000
49	31120	238	324	0.00277	-0.02617	33120	245	281	0.00200	-0.0341	0.00016	0.00000
50	30040	249	312	0.00307	-0.02617	31490	256	280	0.00215	-0.0341	0.00000	0.00000
51	29530	238	292	0.00340	-0.02617	30920	223	289	0.00235	-0.0341	0.00000	0.00000
52	28050	219	273	0.00376	-0.02617	29510	251	279	0.00254	-0.0341	0.00000	0.00000
53	27840	219	267	0.00415	-0.02617	28790	265	258	0.00278	-0.0341	0.00000	0.00000
54	27170	179	253	0.00453	-0.03079	28130	229	256	0.00303	-0.0330	0.00000	0.00000
55	25950	221	229	0.00492	-0.03079	27090	261	236	0.00332	-0.0330	0.00000	0.00000
56	25270	195	220	0.00534	-0.03079	26340	215	211	0.00365	-0.0330	0.00000	0.00000
57	24450	197	176	0.00581	-0.03079	25290	215	200	0.00399	-0.0330	0.00000	0.00000
58	24170	186	171	0.00632	-0.03079	24800	205	188	0.00437	-0.0330	0.00000	0.00000
59	23590	160	154	0.00692	-0.03787	24390	209	156	0.00478	-0.0332	0.00000	0.00000
60	23590	184	148	0.00759	-0.03787	24510	212	134	0.00523	-0.0332	0.00000	0.00000
61	23260	171	143	0.00832	-0.03787	23700	198	136	0.00572	-0.0332	0.00000	0.00000

	Male					Female						
Age	P	I	E	M	ΔM/M	P	I	E	M	ΔM/M	F	ΔF/F
62	23250	157	131	0.00914	-0.03787	24210	167	116	0.00626	-0.0332	0.00000	0.00000
63	23360	182	107	0.01002	-0.03787	24310	160	110	0.00687	-0.0332	0.00000	0.00000
64	19630	149	72	0.01096	-0.03996	20490	143	77	0.00754	-0.0270	0.00000	0.00000
65	18590	136	70	0.01197	-0.03996	19380	130	74	0.00832	-0.0270	0.00000	0.00000
66	17800	133	66	0.01309	-0.03996	18320	126	72	0.00916	-0.0270	0.00000	0.00000
67	15630	99	55	0.01430	-0.03996	16460	103	68	0.01014	-0.0270	0.00000	0.00000
68	17170	95	52	0.01569	-0.03996	18250	83	47	0.01120	-0.0270	0.00000	0.00000
69	16790	91	51	0.01728	-0.03966	17830	83	44	0.01241	-0.0261	0.00000	0.00000
70	15400	77	36	0.01910	-0.03966	16280	67	54	0.01374	-0.0261	0.00000	0.00000
71	13620	57	37	0.02122	-0.03966	14950	76	39	0.01523	-0.0261	0.00000	0.00000
72	13030	60	35	0.02360	-0.03966	14120	61	32	0.01684	-0.0261	0.00000	0.00000
73	12150	50	27	0.02635	-0.03966	13460	56	36	0.01861	-0.0261	0.00000	0.00000
74	11290	38	17	0.02942	-0.04095	12660	35	31	0.02055	-0.0293	0.00000	0.00000
75	10750	30	29	0.03284	-0.04095	11780	34	25	0.02274	-0.0293	0.00000	0.00000
76	10060	28	25	0.03664	-0.04095	11470	32	27	0.02524	-0.0293	0.00000	0.00000
77	9540	26	20	0.04076	-0.04095	11280	30	26	0.02816	-0.0293	0.00000	0.00000
78	9400	24	15	0.04524	-0.04095	10860	28	20	0.03156	-0.0293	0.00000	0.00000
79	9140	22	15	0.05010	-0.02316	10910	25	19	0.03556	-0.0208	0.00000	0.00000
80	8270	20	13	0.05563	-0.02316	10460	24	15	0.04022	-0.0208	0.00000	0.00000
81	7690	17	11	0.06220	-0.02316	9650	20	14	0.04566	-0.0208	0.00000	0.00000
82	7050	14	9	0.07016	-0.02316	9210	18	12	0.05196	-0.0208	0.00000	0.00000
83	6290	12	7	0.07988	-0.02316	8530	16	9	0.05923	-0.0208	0.00000	0.00000
84	5500	10	6	0.09171	-0.01992	8060	14	9	0.06755	-0.0094	0.00000	0.00000
85	4880	8	5	0.10579	-0.01992	7600	12	8	0.07714	-0.0094	0.00000	0.00000
86	4070	6	4	0.12161	-0.01992	6710	10	8	0.08806	-0.0094	0.00000	0.00000
87	3410	6	3	0.13853	-0.01992	5900	8	6	0.10057	-0.0094	0.00000	0.00000
88	2870	5	3	0.15596	-0.01992	5350	6	3	0.11478	-0.0094	0.00000	0.00000
89	2260	4	2	0.17329	-0.01365	4610	6	2	0.13085	-0.0054	0.00000	0.00000
90	1680	3	2	0.18977	-0.01365	3200	5	2	0.14865	-0.0054	0.00000	0.00000
91	1290	2	1	0.20513	-0.01365	2810	4	1	0.16809	-0.0054	0.00000	0.00000
92	1080	2	0	0.22344	-0.01365	2460	4	1	0.18894	-0.0054	0.00000	0.00000
93	880	2	0	0.24261	-0.01365	2060	3	1	0.21119	-0.0054	0.00000	0.00000
94	550	1	0	0.26324	-0.01365	1780	2	0	0.23453	-0.0054	0.00000	0.00000
95	380	1	0	0.28563	-0.01365	1510	1	0	0.25950	-0.0054	0.00000	0.00000
96	220	1	0	0.31011	-0.01365	900	1	1	0.28602	-0.0054	0.00000	0.00000
97	100	0	0	0.33761	-0.01365	640	1	0	0.31413	-0.0054	0.00000	0.00000
98	80	0	0	0.36607	-0.01365	420	1	0	0.34352	-0.0054	0.00000	0.00000
99	50	0	0	0.39900	-0.01365	230	0	0	0.37476	-0.0054	0.00000	0.00000

Notes: P = population;
I = immigration;
E = emigration;
M = mortality; ΔM/M = proportionate change in mortality;
F = fertility; ΔF/F = proportionate change in fertility.

Population data are from New Zealand Treasury Fiscal Strategy Model: http://www.treasury.govt.nz/government/fiscalstrategy/model

Immigration and emigration data are from Statistics New Zealand Infoshare Database: http://www.stats.govt.nz/infoshare/ViewTable.aspx?pxID=492172f2-ccc5-407a-97e4-671786685d49
The aggregated data provided a value for individuals aged 75+. This value has been apportioned across age years 75 - 99.

Mortality rates (2010 base year) are from New Zealand Treasury Long Term Fiscal Strategy Model: http://www.treasury.govt.nz/government/fiscalstrategy/model.

Fertility rates (2010 base year) from Statistics New Zealand Infoshare Database: http://www.stats.govt.nz/infoshare/ViewTable.aspx?pxID=ef4929f3-a56c-4ba9-9081-efefb05f4cfb

Appendix Table 2 Standard Deviations for Mortality, Fertility and Migration

				Migration						Migration	
Age	Male Mortality	Female Mortality	Fertility	In	Out	Age	Male Mortality	Female Mortality	Fertility	In	Out
0	0.10	0.10	0.00	61.00	70.00	50	0.07	0.05	1.00	45.00	14.00
1	0.10	0.10	0.00	61.00	70.00	51	0.07	0.05	0.00	45.00	14.00
2	0.10	0.10	0.00	61.00	70.00	52	0.07	0.05	0.00	45.00	14.00
3	0.10	0.10	0.00	61.00	70.00	53	0.07	0.05	0.00	45.00	14.00
4	0.10	0.10	0.00	61.00	70.00	54	0.07	0.05	0.00	45.00	14.00
5	0.10	0.10	0.00	61.00	70.00	55	0.07	0.05	0.00	45.00	14.00
6	0.10	0.10	0.00	61.00	70.00	56	0.07	0.05	0.00	45.00	14.00
7	0.10	0.10	0.00	61.00	70.00	57	0.07	0.05	0.00	12.00	14.00
8	0.10	0.10	0.00	81.00	70.00	58	0.07	0.05	0.00	12.00	14.00
9	0.10	0.10	0.00	81.00	70.00	59	0.07	0.05	0.00	12.00	14.00
10	0.10	0.10	0.00	81.00	70.00	60	0.07	0.05	0.00	12.00	14.00
11	0.10	0.10	0.50	56.00	70.00	61	0.07	0.05	0.00	12.00	14.00
12	0.10	0.10	0.50	56.00	70.00	62	0.07	0.05	0.00	12.00	14.00
13	0.10	0.10	0.30	56.00	135.00	63	0.07	0.05	0.00	12.00	14.00
14	0.10	0.10	0.30	56.00	135.00	64	0.07	0.05	0.00	12.00	6.00
15	0.10	0.10	0.08	56.00	135.00	65	0.07	0.05	0.00	12.00	6.00
16	0.10	0.10	0.08	56.00	135.00	66	0.07	0.05	0.00	12.00	6.00
17	0.10	0.10	0.08	116.00	135.00	67	0.07	0.05	0.00	7.00	6.00
18	0.10	0.10	0.05	116.00	135.00	68	0.07	0.05	0.00	7.00	6.00
19	0.10	0.10	0.05	116.00	135.00	69	0.07	0.05	0.00	7.00	6.00
20	0.10	0.10	0.05	116.00	135.00	70	0.07	0.05	0.00	7.00	6.00
21	0.10	0.10	0.05	116.00	135.00	71	0.07	0.05	0.00	7.00	6.00
22	0.10	0.10	0.05	116.00	135.00	72	0.07	0.05	0.00	7.00	6.00
23	0.10	0.10	0.05	116.00	135.00	73	0.07	0.05	0.00	7.00	6.00
24	0.10	0.07	0.05	116.00	135.00	74	0.07	0.05	0.00	7.00	6.00
25	0.10	0.07	0.05	116.00	135.00	75	0.07	0.05	0.00	7.00	6.00
26	0.10	0.07	0.05	116.00	135.00	76	0.07	0.05	0.00	7.00	6.00
27	0.10	0.07	0.05	116.00	135.00	77	0.07	0.05	0.00	18.00	6.00
28	0.10	0.07	0.07	116.00	135.00	78	0.07	0.07	0.00	4.00	6.00
29	0.10	0.07	0.07	116.00	135.00	79	0.08	0.07	0.00	4.00	6.00
30	0.10	0.07	0.07	116.00	135.00	80	0.08	0.07	0.00	4.00	6.00
31	0.07	0.07	0.07	116.00	135.00	81	0.08	0.07	0.00	4.00	6.00
32	0.07	0.07	0.07	116.00	135.00	82	0.08	0.07	0.00	4.00	6.00
33	0.07	0.07	0.07	116.00	135.00	83	0.08	0.07	0.00	4.00	6.00
34	0.07	0.07	0.07	116.00	80.00	84	0.08	0.07	0.00	4.00	0.88
35	0.07	0.07	0.07	116.00	80.00	85	0.08	0.07	0.00	4.00	0.88
36	0.07	0.07	0.07	116.00	80.00	86	0.08	0.07	0.00	4.00	0.88
37	0.07	0.07	0.07	116.00	80.00	87	0.08	0.07	0.00	4.00	0.88
38	0.07	0.07	0.07	116.00	80.00	88	0.08	0.07	0.00	0.80	0.88
39	0.07	0.07	0.07	116.00	80.00	89	0.08	0.07	0.00	0.80	0.88
40	0.07	0.07	0.07	116.00	108.00	90	0.08	0.08	0.00	0.80	0.88
41	0.07	0.07	0.15	116.00	108.00	91	0.10	0.08	0.00	0.80	0.88
42	0.07	0.05	0.15	45.00	108.00	92	0.10	0.08	0.00	0.80	0.88
43	0.07	0.05	0.15	45.00	108.00	93	0.10	0.08	0.00	0.80	0.88
44	0.07	0.05	0.30	45.00	108.00	94	0.10	0.08	0.00	0.80	0.88
45	0.07	0.05	0.30	45.00	108.00	95	0.10	0.08	0.00	0.80	0.88
46	0.07	0.05	0.30	45.00	45.00	96	0.10	0.08	0.00	0.80	0.88
47	0.07	0.05	0.50	45.00	45.00	97	0.10	0.08	0.00	0.80	0.88
48	0.07	0.05	0.50	45.00	45.00	98	0.10	0.08	0.00	0.80	1.75
49	0.07	0.05	0.50	45.00	45.00	99	0.10	0.08	0.00	0.80	1.75

Notes: Standard deviation values have been adapted from those in Creedy and Scobie (2002), and have been rounded to smooth out the variation between them.

Appendix Table 3 Means and Standard Deviations of Unemployment and Labour Force Participation Rates

	Unemployment Rate (%)				Workforce Participation Rate (%)			
Age Categories	Male Mean	SD	Female Mean	SD	Male Mean	SD	Female Mean	SD
0-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5-9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10-14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15-19	23.6	4.0	25.8	3.0	47.0	5.0	48.7	6.0
20-24	12.6	4.0	11.3	3.0	77.8	1.0	68.5	3.0
25-29	7.2	2.5	8.6	3.0	90.1	1.0	70.5	2.0
30-34	4.9	2.5	6.2	1.5	93.4	1.0	69.9	2.0
35-39	3.7	2.5	5.5	1.5	93.1	1.0	74.5	2.0
40-44	3.4	1.5	4.8	1.5	92.2	1.0	80.0	2.0
45-49	4.0	1.5	3.8	1.0	91.7	1.0	82.4	2.0
50-54	3.6	1.5	4.2	1.0	90.6	1.0	82.8	3.0
55-59	3.9	1.5	3.2	1.0	86.2	2.0	77.0	3.0
60-64	3.7	1.0	2.6	1.0	78.9	15.0	60.8	20.0
65-69	2.0	1.0	0.0	0.0	22.6	15.0	12.4	2.0
70-74	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75-79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
80-84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
85+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Notes: (a) No data available for this value. It is assumed to be zero.

The labour force participation rates and unemployment rates are those for the base year 2010. Data are from Statistics New Zealand Infoshare Database: http://www.stats.govt.nz/infoshare/ViewTable.aspx?pxID=22810555-769b-4418-9f57-a62211a57972

Standard deviation values have been adapted from those in Creedy and Scobie (2002), and have been rounded to smooth out the variation between them.

Appendix Table 4 Social Expenditure per Capita: Males

Age Group	Personal Health	Public Health	Mental Health	DSS Older	DSS Under 65	Education (Primary and Secondary)	Tertiary Eduation	NZ Super	DPB + WB	IB + SB	Family Assistance	Accommo-dation	Unemployment Benefit
0-4	2788	127	6	0	99	0	0	0	0	0	0	0	0
5-9	793	161	93	0	150	3089	0	0	0	0	0	0	0
10-14	778	159	157	0	163	2955	0	0	0	0	0	0	0
15-19	800	152	271	0	173	3913	2895	0	0	291	7	167	52
20-24	718	153	420	0	194	0	3144	0	40	500	267	590	628
25-29	747	107	525	0	246	0	3718	0	68	468	735	463	609
30-34	834	105	525	0	289	0	3741	0	149	715	1162	331	441
35-39	905	103	473	0	289	0	3806	0	533	611	1619	431	232
40-44	1105	101	384	0	281	0	4177	0	103	1048	1373	237	235
45-49	1362	99	369	0	279	0	4282	0	161	1117	855	343	238
50-54	1758	98	265	27	283	0	4189	0	140	778	679	209	45
55-59	2302	97	212	59	355	0	4219	0	100	1509	196	251	530
60-64	3006	97	152	116	533	0	3928	30	80	1156	146	94	188
65-69	4215	97	138	326	0	0	0	12227	70	72	11	216	134
70-74	5220	97	150	739	0	0	0	14226	0	55	84	106	0
75-79	6202	97	168	1537	0	0	0	13764	0	42	0	163	0
80-84	6780	97	223	2801	0	0	0	14401	0	0	0	157	0
85+	7190	96	235	5646	0	0	0	14044	0	0	0	302	[illegible]

Notes: DSS = Disability Support Services; NZS = New Zealand Superannuation; DPB = Domestic Purposes Benefit; WB = Widow's Benefit; IB = Invalid's Benefit; SB = Sickness Benefit.

Health Expenditure data for categories one to five are from New Zealand Treasury Fiscal Strategy Model: http://www.treasury.govt.nz/government/fiscalstrategy/model

Aggregate Education (Primary and Secondary) Expenditure data are from New Zealand Treasury calculations based on Ministry of Education administrative data. These data were disaggregated by age and gender using a weighted average approach according to the basic population demographic data in Table 1 for the relevant ages (4 – 17).

Aggregate Tertiary Education Expenditure data are from Statistics New Zealand: http://www.stats.govt.nz/browse_for_stats/education_and_training/Tertiary%20education/StudentLoansandAllowances_HOTP10/Tables.aspx These data were disaggregated by age and gender using a weighted average approach according to the basic population demographic data in Table 1 for the relevant ages (17 – 64). The aggregated data provided a value for individuals aged 60+. This value has been apportioned to the 60-64 age category.

Data for social expenditure data categories eight to thirteen are calculated using New Zealand Treasury model TaxWell, based on HES 08/09 and HES 09/10.

Appendix Table 5 Social Expenditure per Capita: Females

Age Group	Personal Health	Public Health	Mental Health	DSS Older	DSS Under 65	Education (Primary and Secondary)	Tertiary Eduation	NZ Super	DPB + WB	IB + SB	Family Assistance	Accommo-dation	Unemployment Benefit
0-4	2411	127	4	0	73	0	0	0	0	0	0	0	0
5-9	697	161	35	0	81	2942	0	0	0	0	0	0	0
10-14	664	159	127	0	97	2811	0	0	0	0	0	0	0
15-19	1088	152	352	0	96	3717	2735	0	556	315	366	486	285
20-24	1352	155	278	0	149	0	2997	0	1474	288	900	735	346
25-29	1549	107	335	0	236	0	3772	0	1476	311	1441	837	446
30-34	1774	105	408	0	242	0	4049	0	1385	372	2357	632	188
35-39	1577	102	431	0	311	0	4214	0	1759	786	3059	772	252
40-44	1327	101	405	0	278	0	4543	0	1177	775	1998	556	399
45-49	1480	100	380	0	345	0	4568	0	617	990	1235	395	166
50-54	1741	99	298	42	352	0	4371	0	530	716	650	368	107
55-59	2138	98	275	76	448	0	4372	0	651	973	281	456	319
60-64	2686	97	261	152	627	0	4072	805	1037	1479	81	299	147
65-69	3588	98	213	378	0	0	0	13119	97	260	26	201	331
70-74	4380	99	195	838	0	0	0	15344	0	33	40	404	0
75-79	5104	99	212	1794	0	0	0	15297	0	0	7	267	0
80-84	5590	98	254	3985	0	0	0	15628	0	0	3	229	0
85+	5965	98	217	9488	0	0	0	17510	0	0	0	296	0

Notes: DSS = Disability Support Services; NZS = New Zealand Superannuation; DPB = Domestic Purposes Benefit; WB = Widow's Benefit; IB = Invalid's Benefit; SB = Sickness Benefit.

Health Expenditure data for categories one to five are from New Zealand Treasury Fiscal Strategy Model: http://www.treasury.govt.nz/government/fiscalstrategy/model

Aggregate Education (Primary and Secondary) Expenditure data are from New Zealand Treasury calculations based on Ministry of Education administrative data. These data were disaggregated by age and gender using a weighted average approach according to the basic population demographic data in Table 1 for the relevant ages (4 – 17).

Aggregate Tertiary Education Expenditure data are from Statistics New Zealand: http://www.stats.govt.nz/browse_for_stats/education_and_training/Tertiary%20education/StudentLoansandAllowances_HOTP10/Tables.aspx These data were disaggregated by age and gender using a weighted average approach according to the basic population demographic data in Table 1 for the relevant ages (17 – 64). The aggregated data provided a value for individuals aged 60+. This value has been apportioned to the 60-64 age category.

Data for social expenditure data categories eight to thirteen are calculated using New Zealand Treasury model TaxWell, based on HES 08/09 and HES 09/10

.

References

Alho, Juha M (1997) Scenarios, uncertainty and conditional forecasts of the world population. *Journal of the Royal Statistical Society, Series A*, 160, pp. 71-85.

Auerbach, Alan and Kevin Hassett (2000) Uncertainty and the design of long-run fiscal policy. In Alan Auerbach and Ronald Lee (eds.) *Demography and fiscal policy.* Cambridge: Cambridge University Press. pp. 73-97.

Creedy, John (ed.) (1995) *The Economics of Ageing*. Aldershot: Edward Elgar.

Creedy, John and Jose Alvarado (1998) Social expenditure projections: A stochastic approach. *Australian Economic Papers*, 37, pp. 203-212.

Creedy, John and Jose Alvarado (1998b) *Population Ageing, Migration and Social Expenditure*. Cheltenham: Edward Elgar.

Creedy, John and Grant Scobie (2002) Population ageing and social expenditure in New Zealand. *Wellington, New Zealand Treasury*, 02/28.

Creedy, John and Grant Scobie (2005) Population ageing and social expenditure in New Zealand. *Australian Economic Review*, 38, pp. 19-39.

Creedy, John. and Ross Guest (eds.) (2007) *New Developments in the Economics of Population Ageing*. Cheltenham: Edward Elgar.

Davis, Nick and Richard Fabling (2002) Population aging and the efficiency of fiscal policy in New Zealand. Wellington, New Zealand Treasury, Working Paper 02/11.

Lee, Ronald and Shripad Tuljapurkar (2000) Population forecasting for fiscal planning: Issues and innovations. In Alan Auerbach and Ronald Lee eds *Demography and fiscal policy.* Cambridge: Cambridge University Press. pp. 7-72.

About the Author

John Creedy is Visiting Professorial Fellow at Victoria Business School, Victoria University of Wellington, New Zealand, and a Principal Advisor at the New Zealand Treasury. He is on leave from the University of Melbourne where he is The Truby Williams Professor of Economics.
Email: john.creedy@vuw.ac.nz

Kathleen Makale is Graduate Assistant at the School of Accounting and Commercial Law, Victoria University of Wellington, New Zealand.
Email: kathleen.makale@vuw.ac.nz