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Productivity Commission

Economic Implications of an Ageing Australia

Productivity Commission Technical papers

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Technical papers

This document includes all technical papers associated with the study. The technical papers were not published in the main body of the report, but were included on the Commission's website. The first eleven technical papers were published on 24 March 2005 and issued on a CD accompanying the report. Technical paper 6 (health cost decomposition) has been updated. New technical papers 12 (household projections), 13 (costs of death and health expenditure) and 14 (child care and ageing) have been issued recently.

Contents

Demographic projections

This technical paper sets out the assumptions and methodology used by the Commission in its demographic models, the data used to calibrate them, and the nature of scenarios explored.

The economic effects of ageing depend primarily on the relative number of the future old. Estimates of population ageing can be derived using well-established population models that make assumptions about the future paths of fertility, mortality and net migration.

The Commission developed several demographic models to:

- consider scenarios other than those used in the PC-M series (chapter 2), reflecting the considerable uncertainty about future fertility rates, mortality rates and net overseas migration;[1]
- understand what would have happened had Australia's past demographic trends been different. This explains the demographic pressures underlying Australia's present ageing trends. For example, what would have happened if the rise in fertility that occurred after the Second World War had not occurred?; and
- provide separate estimates of Indigenous and non-Indigenous populations for the Northern Territory, given the distinctive demographic trajectories of these sub-populations.

The models are available publicly (see attached CD) — and can be used to explore assumptions different to those adopted by the Commission.

1.1 The cohort-component model

The standard approach to demographic projections is the cohort-component model, which is a stock–flow model of the population by age groups. It recognises that in moving from a population at a given date to a new population one year later, there are a set of inflows and outflows.

[1] For example, in its own population estimates produced in 2003, the ABS generated 54 alternative projections based on varying combinations of assumptions to reflect this underlying uncertainty.

The cohort-component model is a rigorous way of handling these flows, based on assumptions about future trends in mortality, migration and fertility. There are several steps to the model. At the national level, these involve determining:

- how many survivors there are from the previous year's population;
- the number of births in Australia that survive to be 0 years old in the projection year (the influence of fertility); and
- the impact of net overseas migration (less deaths to migrants that occur after they arrive, but before the end of the relevant projection year).

Each of these components is discussed below.

The base population

The starting point for population projections is the base year population. This is the population at 30 June 2004 classified by age and sex. This is denoted by $P_{x,s\,t}$, where x is the age, running from 0 to *max*-1 with a last open ended age interval of *max+* (in this case 100+), s is sex and t is the end of the fiscal year 2004.

Calculating deaths in the base population

Ignoring births and net overseas migration for the moment, the numbers in each age–sex sub-population remaining in year t+1 is estimated by applying survival rates to base year sub-populations:

$$P_{x+1,s,t+1} = P_{x,s,t} \times (1 - Q_{x,s,t}) \quad \text{for } (x+1) = 1 \text{ to } max\text{-}1$$

where $Q_{x,s,t}$ is the probability that someone aged x in year t will die over the next year.[2] So for example, if there were 10 000 people aged 10 years old at 30 June 2004 and one in 1000 of these were expected to die over the next year, the population of 11 year olds at 30 June 2005 (before gains from net migration) would be 9990. The population estimate for the last open-ended age interval is different because people aged 99 year olds become 100+, while many 100+ years olds survive to remain 100+ one year later. Accordingly, the population estimates (before accounting for net overseas migration) for the last age group is:

$$P_{\max,s,t+1} = P_{\max-1,s,t} \times (1 - Q_{(\max-1),s,t}) + P_{\max,s,t} \times (1 - Q_{\max,s,t})$$

2 In this context, the relevant age is not *exact age* (as in a standard life table), but rather *age at last birthday* (that is, someone whose age, A, is in the interval $x \le A < x+1$).

These calculations all require death probabilities, Q (or one minus survival rates). These are derived from age-specific central death rates and assumptions about the distribution of the probability of death over a year. Q can be calculated through a series of subsidiary calculations (which make up so-called ‘life tables’). In most model projections, the Commission had direct estimates of Q_x derived by the ABS, or assumed some pattern of change over time from a base year series of Q_x.

However, for one set of mortality scenarios the Commission needed to derive Q_x from central death rates. Following a request from the Commission, age-specific central death rates ($m_{x,s,t}$) for calendar years 2002 to 2051 were estimated by Heather Booth from the Australian National University using the Lee-Carter method based on past data trends.[3] Central death rates record the number of deaths of a person aged x (at last birthday) over a calendar year divided by the mid-calendar year population of people aged x. The Booth data are in single year increments to age 89 with a last open age interval of 90+. As this report is particularly concerned with ageing issues, the Commission derived estimates of central death rates from 90 to 99 and 100+ by relating the Booth estimates for each projection year to 2000-2002 ABS life table data (applying so-called ‘relational’ methods — Rowland 2003; Hannerz 2001). Then Q_x estimates corresponding to these central death rates were produced by constructing life tables for each projection year and sex (box 1.1).

3 The Lee and Carter (1992) model is a special case of principal components. It is used by the U.S. Census Bureau as a benchmark for their population forecasts, has been recommended by the U.S. Social Security Technical Advisory Panel and has been widely adopted in academic demographic forecasts of mortality (Girosi and King, 2003, p 36). See Booth and Tickle 2003 for more detail and background on these mortality projections. For a more general discussion of the Lee Carter method and its benefits, see Tuljapurkar, Li and Boe, 2000; Preston, 1991; Wilmoth, 1996; Haberland and Bergmann, 1995; Lee, Carter and Tuljapurkar, 1995; Lee and Rofman, 1994; Tuljapurkar and Boe, 1998; and NIPSSR, 2002). Other methods, some with apparent advantages over Lee-Carter, are also now being applied, such as functional data analysis (Hyndman and Ullah 2005 and Hyndman 2004).

Box 1.1 **Generating Q_x from central death rates**

First, the mortality rate, or the probability of dying between *exact* ages x and x+1, ($q_{x,s,t}$) was calculated. Unlike central death rates, $q_{x,s,t}$ is based on the population at the start of the calendar year (so 1 January 2002 in the base year), rather than the midpoint. Consequently, those deaths that have occurred up until the midpoint have to be added to the midpoint population to give an estimate of the starting population. This depends on assumptions about the distribution of deaths over the year, which depends on the age of people.

- Babies are much more likely to die soon after birth rather than later in the year. While there are alternative methods, the PC adopted that of Shahidullah (2001, p. 14) and the London Health Observatory (2001). q_0 was calculated as $m_0/(1+(1–f)m_0)$. f is the separation factor, defined as the share of infant deaths in year t occurring to infants born in the previous year. f is much less than 0.5 because most deaths occur in the first 4 weeks of life. The value of f used was 0.14 (from ABS 2002d).
- For the last open age interval, the probability of death (q_{100+}) is one, since over that interval the future probability of death is 100 percent.
- For other ages there are several common approaches. The PC used that of Greville (Ng and Gentleman 1995), which is based on the observation that there is a roughly linear relationship between the natural log of death rates (m_x) and age (x). Denoting the slope of this line as ln C, the mortality rate can then be calculated as: $q_{x,s,t} = m_{x,s,t} / [1 + m_{x,s,t}(0.5 + (m_{x,s,t} - \ln C)/12)]$. The ABS (2001c) notes that ln C could be assumed to be around 0.95, which was the parameter used by the PC.

Second, the numbers of an assumed starting population of 100 000 surviving at exact ages ($l_{x,s,t}$) is calculated as $l_{x+1,s,t} = l_{x,s,t}\ (1 – q_{x,s,t})$.

Third, a measure of mortality patterns that refers to age at last birthday, rather than exact ages (as in $l_{x,s,t}$) is required since statistical data is gathered on an age at last birthday basis. This measure is the average number of people alive *between* exact ages, $L_{x,s,t}$. It is formed from averaging l in the x and x+1 age categories for all ages except for the first years of life and the last open ended age category. Accordingly, $L_{x,s,t} = 0.5(l_{x,s,t}+l_{x+1,s,t})$. L_0 was calculated as $0.14\ l_0+0.86\ l_1$ recognising that the probability of death is higher earlier than later. The last age category was estimated as discussed below. Ratios of L are survival rates of people. Thus $L_{40,t}/L_{39,t}$ is the share of people aged 39 (on a last birthday basis) at 30 June 2002 who will survive to be 40 years old by 30 June 2003.

Finally, Q can be derived as one minus the survival rates based on L. Accordingly, $Q_x = (1- L_{x+1,}\ /L_x)$ up to Q_{99}. In order to estimate Q_{100+}, Q_{100} to Q_{130} was first approximated as $Q_x = \min(1, Q_{x-1} *Q_{99} /Q_{98}))$. Then L_{100} to L_{130} were estimated as $L_x = (1-Q_{x-1})L_{x-1}$. Accordingly L_{100+} was calculated as $\sum_{x=100}^{130} L_x$ and L_{101+} as $\sum_{x=101}^{130} L_x$. Then Q_{100+} was calculated as: $1-L_{101+}/L_{100+}$. The probability that a baby dies in the first year after birth, Q_b, is calculated as $1-L_{0,s,t}/l_{0,s,t}$.

Births

Births are calculated using calendar year age-specific fertility rates and the relevant sub-populations of fertile women. The fertile years are from 15 to 49 years (with any births to women of other ages added to the lower and upper limits of this age range). It is necessary to average the populations of the relevant females in the t and t+1th years to reflect the fact that females aged x at time t have an average age of x+½.

For example, in the base year of 30 June 2004, the average age of 15 year old females is 15½ years old. At 30 June 2005, those females aged 15 years were on average 14½ years old at 30 June 2004. By averaging these two sub-populations, the average number of females aged 15 years old in the period from 30 June 2004 to 2005 is obtained. Births are calculated by multiplying the two sub-populations by the relevant age-specific fertility rates.

Accordingly, Births (B_t) can be derived as:

$$B_t = \frac{1}{2}\left(\sum_{x=15}^{49} F_{x,T} \times P_{x,f,t+} + \sum_{x=15}^{49} F_{x,T+1} \times P_{x,f,t+1}\right)/1000$$

where births (B_t) occur over fiscal year ending t+1, and $F_{x,T}$ is the calendar year (T) fertility rate of females aged x.[4] For example, to determine the number of births for the projection year ending 30 June 2003:

$$B_{2001-02\ to\ 2002-03} = \frac{1}{2}\left(\sum_{x=15}^{49} F_{x,2002} \times P_{x,f,2001-02+} + \sum_{x=15}^{49} F_{x,2003} \times P_{x,f,2002-03}\right)/1000$$

Male births are calculated as:

$$B_{m,t} = \frac{\alpha}{1+\alpha} B_t$$

where α is the ratio of male to female births (set to 1.05). Female births are found as a residual.

Some live births subsequently die. The population aged zero at t+1 is calculated by subtracting deaths of babies, so that:

$$P_{0,s,t+1} = B_{s,t} \times (1 - Q_{b,s,t})$$

4 The calendar year T for B_t is from t-½ to t+½ years. For example, for calculating births over 2003-04 to 2004-05 (termed $B_{2003-04}$), T would be the calendar year 2004 and T+1 would be the calendar year 2005.

where Q_b is the probability of death over the first year from birth.

The contribution of net overseas migration

(Net) overseas migrants are assumed to arrive on average at the midpoint of the relevant projection year. Thus for the projection year ending 30 June 2005, migrants are assumed to arrive on average at midnight 31 December 2004. This means that half the migrants aged x years old arriving during the projection interval will be x+1 years old by 30 June 2005, while half of those arriving aged x+1 years old will still be x+1 years old by 30 June 2005. Because migrants are arriving on average half way through the year, only half the year's probability of death is applied. Accordingly, the contribution to population increase (CP) at the end of June in the t+1 projection year is:

$$CP_{x+1,s,t+1} = (0.5 \times NOM_{x,s,t})(1-0.5Q_{x,s,t}) + (0.5 \times NOM_{x+1,s,t})(1-0.5Q_{x+1,s,t})$$

for x+1=1 to max-1 years, where $NOM_{x,s,t}$ is the level of net (inwards) overseas migration over the year from t to t+1. The contribution of migrants to the population aged zero years is:

$$CP_{0,s,t+1} = (0.5 \times NOM_{0,s,t})(1-0.5Q_{0,s,t})$$

The contribution of migrants to the population aged max^+ years is:

$$CP_{max^+,s,t+1} = 0.5 \times NOM_{max-1,s,t} \times (1-0.5Q_{max-1,s,t}) + (NOM_{max^+,s,t})(1-0.5Q_{max^+,s,t}) .$$

1.2 Sources of data and assumptions used for the national projections

An expert group formed by the Commission suggested the base case parameters for the national projections (chapter 2). The Commission tested the implications for ageing of various high and low cases flanking the base case assumptions.

Net overseas migration

For most demographic variables, the major problem in projections is determining a realistic set of future scenarios, but there are generally few problems in the measurement of the actual variable. This is not true in the case of net overseas migration because there are significant problems in measuring the duration of stays and departures of migrants (chapter 2).

Only long-term (over a year) and permanent departures and arrivals are included in the calculation of net overseas migration. However, some short term arrivals and departures are in fact long-term or permanent departures and arrivals, and vice versa. For instance, a significant share of long-term arrivals who record an intention to stay for one than one year in Australia (and are thus included as a migrant in net overseas migration) actually stay for less than this period. The ABS makes adjustments for some of these problems. For example, the original estimates of net overseas migration (inwards) for 2002-03 was 154 225. This fell by 25 percent after adjustment to 116 498 (ABS 2004i). However, problems with the recording of stays and departures by migrants means that there remains significant uncertainties about the real underlying level of net migration.

This difficulty is compounded by tempo effects associated with the future movements of long-term visitors, which could affect projected future levels of net overseas migration (McDonald and Kippen 2002a). The net level of long-term visitors has been strongly rising in Australia. During a period of growth in such visitors, inflows of new visitors must exceed outflows of past visitors, since outflows are drawn from a smaller group of earlier arrivals. However, this could change were net visitor levels to stabilise in the future. The degree to which outflows would catch up with inflows would then depend on the conversion of long-term visitors to permanent immigrants. If conversion factors were low, then outflows would approach inflow levels, and the contribution of long-term visitors to net migration would fall significantly from present levels. All things being equal, this would reduce net overseas migration from present levels. Of course, if conversion factors were higher, this effect is considerably weakened. This issue adds an additional source of uncertainty to future migration levels.

On the recommendation of the expert group, the Commission assumed net overseas migration inwards of 115 000 for each year from 2004-05 in the base case. A fixed age structure for net migration — provided by the ABS — was assumed for all projection years.

For the high case, migration increases linearly from 115 000 in 2004-05 to 140 000 in 2014-15, and then stays fixed at 140 000.

For the low case, migration decreases linearly from 115 000 in 2004-05 to 90 000 in 2014-15, and then stays fixed at 90 000.

Total fertility rates (TFRs)

Projections of future fertility are often based on past trends in the TFR. The TFR is a synthetic measure of fertility, calculated as the average number of children women will bear during their lifetimes *if* they experienced the age-specific fertility rates that apply in a given year at each age of their reproductive lives. It is a useful measure for international comparisons of fertility since it ignores age distributions of fertile women and is simple to construct. However, past trends in the TFR may provide misleading indicators of future fertility for several reasons.

- As in all demographic variables, past trends may not pick up changing attitudes to having children or the effects of new policies (such as recent measures to address some of the costs of having children).
- There has been a significant and still continuing shift in the time in their lives when Australian women bear children (the age profile of fertility). Age specific fertility rates have been falling rapidly for younger women, and this has, after a lag, been followed by increased fertility rates for older women. This tempo effect (box 1.2 and chapter 2) means that during the transition to a stable age profile of fertility, the TFR initially falls and then, so long as the completed fertility rate (CFR)[5] does not fall too greatly, rises somewhat in the long run.

Box 1.2 **The tempo effect**

The effect of delay on the total fertility rate is called the *tempo* effect by demographers. Examining its importance requires information on age-specific and parity-specific fertility rates (ie the extent to which women have different *given* number of children, such as none, 1, 2 and so on). While these data are often incomplete or unavailable, some studies have been undertaken. Research has revealed strong distorting effects of postponement in European countries and the US (Sobotka 2003, 2004). For example, the TFR fell to below 1.5 in the Netherlands in 1983 and 1984 before resuming a gradual rise to 1.72 by 2000. In contrast, the CFR was 1.87 for the 1952 cohort, which has gone through their most fertile years during the TFR trough.

Reflecting the problems in interpreting the TFR, it has been argued that the concern over below-replacement fertility in the United States over the previous 25 years had been largely misplaced because, after adjusting for the rising age at childbearing, the underlying level of (completed) fertility was essentially constant at very close to two children per woman throughout this period (Bongaarts and Feeney 1998, p. 2).

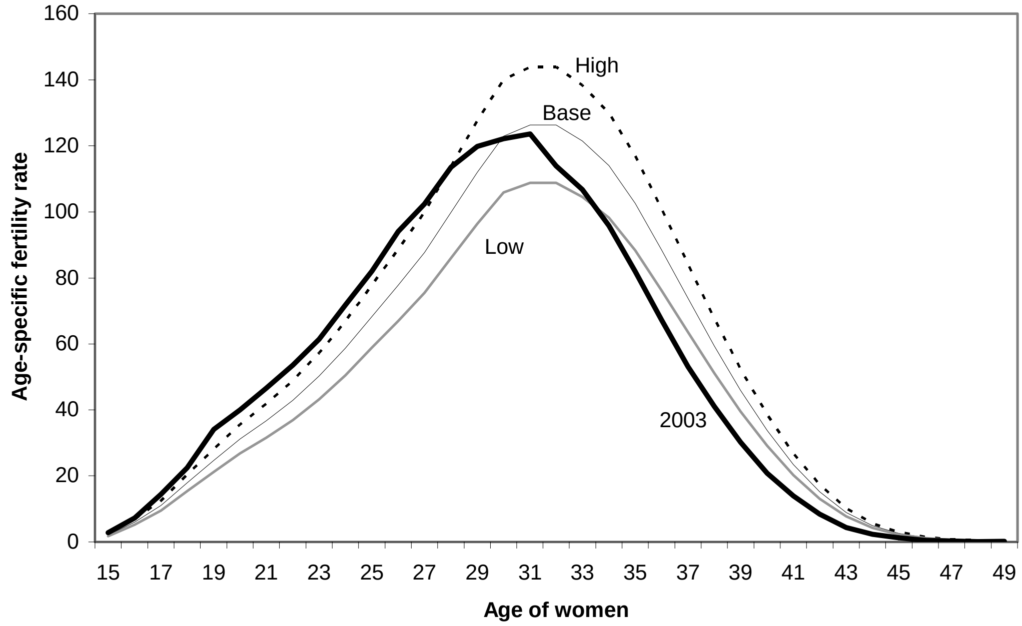
In an Australian context, Kippen (2003) has undertaken simulations that demonstrate that the distortions to the TFR from tempo effects can be pronounced.

On advice from its expert group, the Commission assumes that the TFR will begin to rise slightly over the next few years. This is also consistent with the Australian

5 CFRs measure the *actual* life time average number of births per woman of given generation.

fertility projections produced by the UN.[6] In the base case, the TFR is assumed to increase by 0.005 per year from its level of 1.754 in 2003 until 2012, and then increase by 0.001 for the next year, reaching a stable TFR of 1.8 in 2013 (and therefore a long-run CFR also of 1.8). The age–specific fertility rates associated with these TFR were provided by the ABS (figure 1.1). They reflect the continued reduction in the age-specific fertility rates of younger women (to around 30 years old) and increasing age-specific fertility rates for older women.

Figure 1.1 **The age profile of fertility under different scenarios**
Base, high and low in the long run compared with the 2003 levels



Data source: Unpublished data from the ABS for 2003, ABS estimates for the base case and Commission estimates for the high and low scenarios using Rowland's suggested scaling method (2003, p. 448).

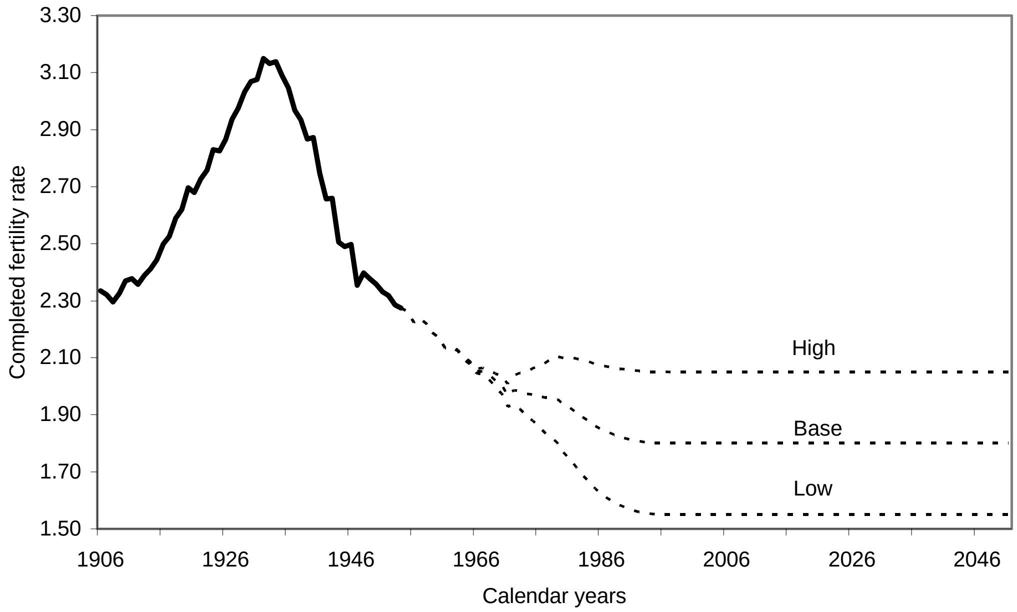
It should be noted that this projected pattern of fertility is still (realistically) associated with a decline in CFRs (figure 1.2) and that it reflects movements in age-specific fertility rates that are quite plausible given historical patterns. To give some indication of the implications of a CFR of 1.8 for the proportion of women at various parity levels, this CFR would, for example, be consistent with: a reduction in the proportion of women having four or more children at the end of their fertile lives from the 1996 levels of 14.5 per cent to 7 per cent; a reduction of the proportion of women with three children from 25.6 per cent to 18 per cent;

6 The tempo effects are more delayed in the UN estimates. The UN (2003) projects a TFR that initially falls to just below 1.70 before gradually increasing to 1.81 by 2035-40 and stabilising at 1.85 by 2045-50.

maintenance of the share of women with two children at 39 per cent; a rise in the proportion of women having only one child at the end of their fertile lives from 10.2 to 18 per cent and finally a rise in the proportion of women that remain childless from 10.7 per cent to 18 per cent. Such a distribution in parities is credible, though clearly policy and other social trends could generate different outcomes. In particular, a concern among demographers is that parity 3 and above contributes roughly half of the CFR, and yet these parities are most affected by postponement of child bearing and social and economic trends affecting women.

Figure 1.2 **Completed fertility rate**

1906 to 2051 female birth cohorts[a]



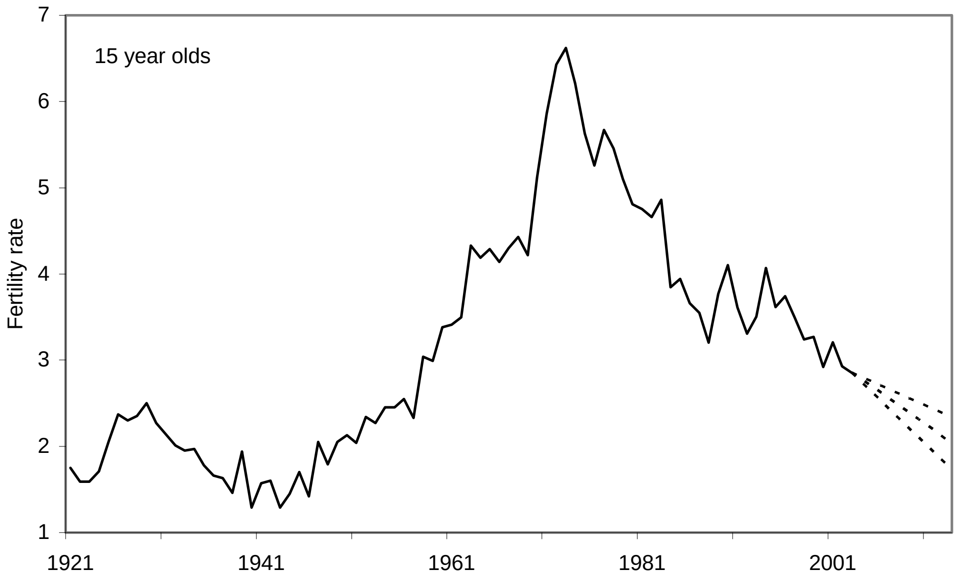
[a] The completed fertility rate is the average lifetime number of children per woman of a given birth cohort. The data up to 1954 is based on historical data, while data for subsequent years are at least partly estimates since they rely on forecasts of age-specific fertility rates for some out years.

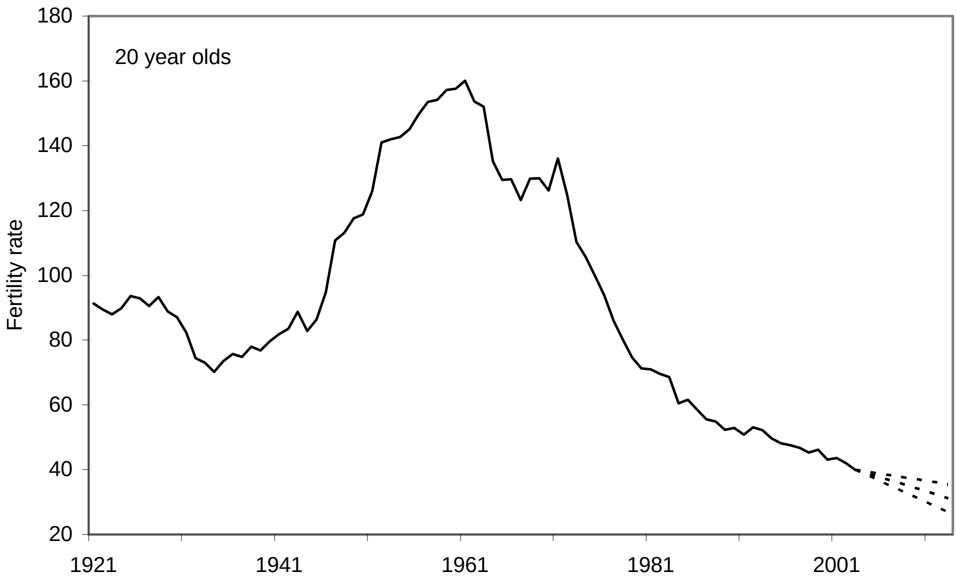
Data source: Unpublished data from the ABS based on age-specific fertility rates and projections of age-specific rates made by the Commission.

Because of such uncertainties it is important to consider different scenarios. Quite different future fertility patterns may plausibly emerge. Figures 1.3 to 1.5 show the trajectories of high and low scenarios around the base case, compared with historical trends for a broad range of ages. Such outcomes are less likely than the base case, but are still feasible.

Figure 1.3 **Age-specific fertility rates**

15 and 20 year olds, 1921 to 2013

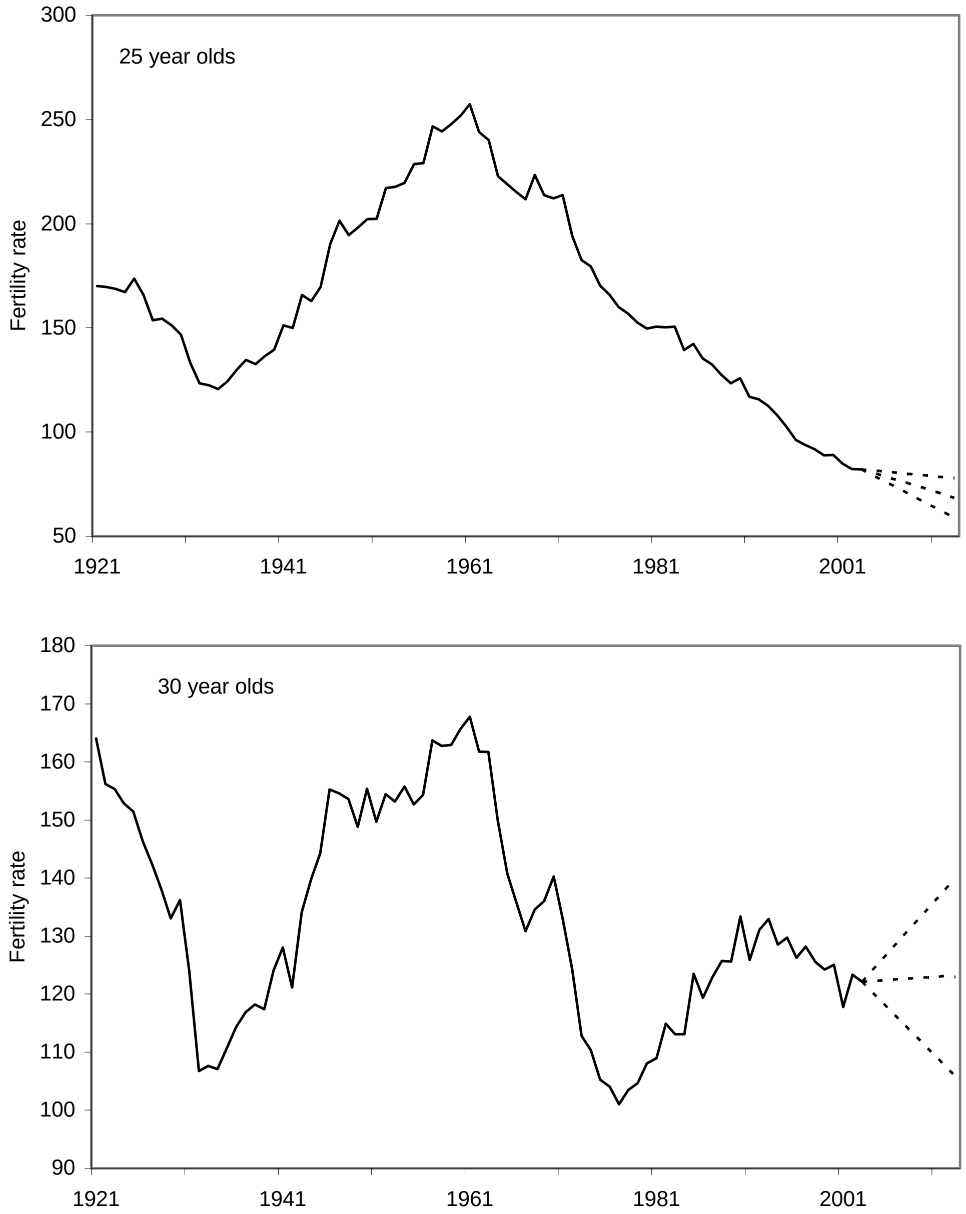




Data source: Unpublished data from the ABS on age-specific fertility rates and projections of age-specific rates made by the Commission.

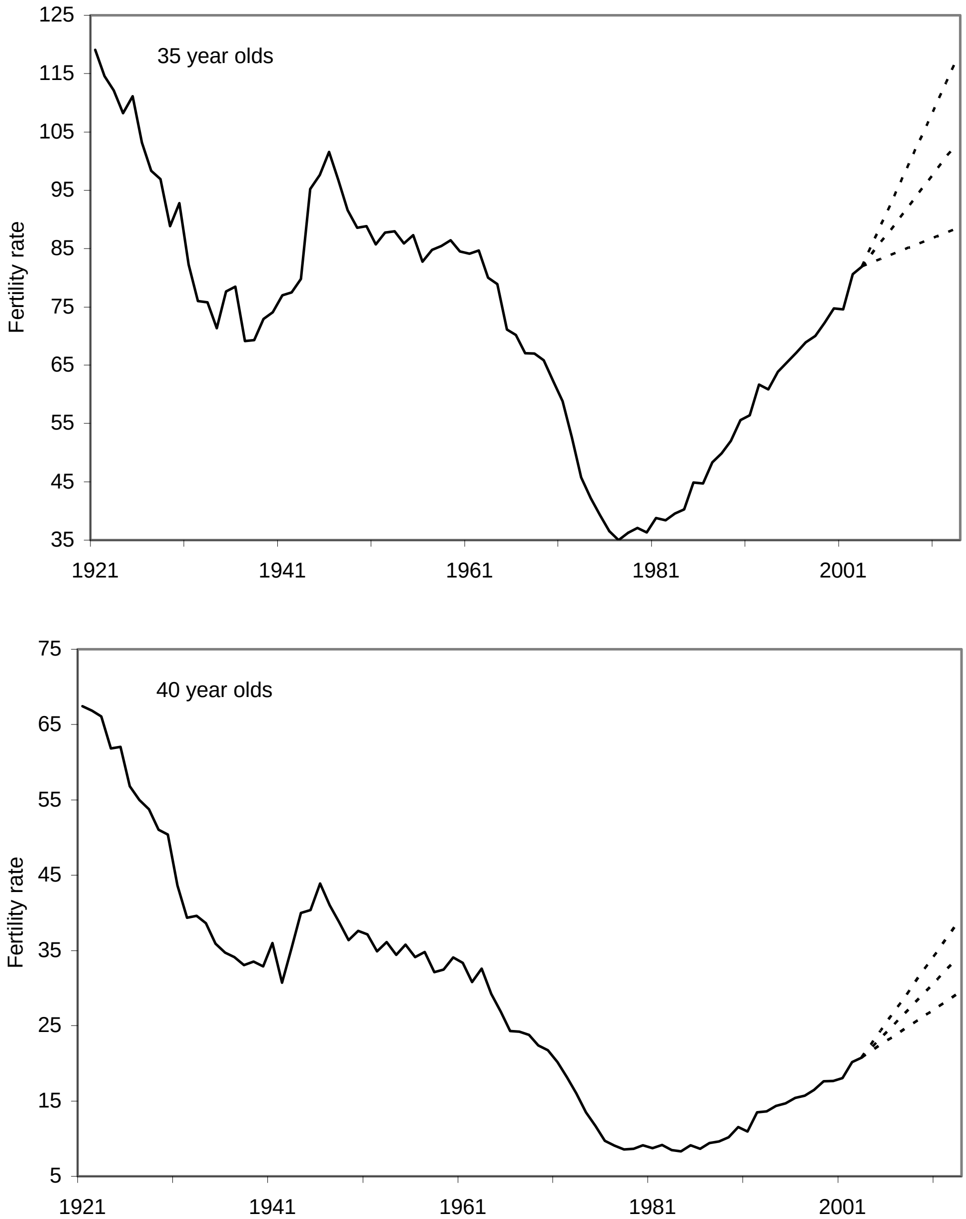
Figure 1.4 **Age-specific fertility rates**

25 and 30 year olds, 1921 to 2013



Data source: Unpublished data from the ABS on age-specific fertility rates and projections of age-specific rates made by the Commission.

Figure 1.5 **Age-specific fertility rates**
35 and 40 year olds, 1921 to 2013



Data source: Unpublished data from the ABS on age-specific fertility rates and projections of age-specific rates made by the Commission.

In the low case, the TFR decreases linearly from its 2003 level to 1.55 in 2013. The age-specific rates associated with this TFR in 2013 were estimated as $ASFR_{x,low}$ = $ASFR_{x,base\ case}$. (1.55/1.8), where x is years of age from 15 to 49. The age-specific rates for years 2004 to 2012 were linearly interpolated. The low scenario reflects less growth in fertility rates for older women and stronger declines in fertility rates for younger women. It is consistent with some of the projections suggested by

Kippen (2004) on the basis of parity data. It suggests a slightly accelerating reduction in the CFR.

In the high case, the TFR increases linearly from its 2003 level to 2.05 in 2013. The age-specific rates associated with this TFR in 2013 were estimated as $ASFR_{x,high} = ASFR_{x,base\ case} \cdot (2.05/1.8)$, where x is years of age from 15 to 49. The age-specific rates for years 2004 to 2012 were linearly interpolated. The high case reflects relatively modest future reductions in fertility rates for younger women, combined with large increases in fertility rates for older women associated with the tempo effect. Despite this, this scenario still (realistically) suggests a fall in the CFR.

The PC's demographic model allows the choice of other TFR scenarios, but imposes the same shape (not level) of the age profile of fertility (as in Rowland's 2003 model).

Life expectancy

There have been significant historical reductions in mortality rates, which are widely projected to continue. However, as noted in chapter 2, there are several methods for projecting mortality, with differing implications for the extent of such reductions. For example, Heather Booth's forecasts (commissioned by the PC) using the Lee-Carter method results in bigger reductions in mortality rates than those underlying the ABS B series. On the other hand, Hyndman (2004) has shown that Lee-Carter methods can exaggerate future reductions in mortality (at least for the United States).

In the PC-M series, the Commission has adopted the mortality rates (Q_x) underlying the ABS B series as its base case. This results in a male and female life expectancy of 84.2 and 87.7 years respectively by 2050-51. The Commission considered several other scenarios (with implied life expectancies shown in table 1.1).

- A low gain in life expectancy (PC Low series), in which life expectancy for males and females only rises to 83 and 86 years respectively by 2050-51;[7]. For example, lower gains might be precipitated by rising obesity rates and associated increases in diabetes II. Climate change, antibiotic resistance and new diseases (such as SARS) may also have unexpected impacts on mortality.
- A high gain in life expectancy (PC High series), in which life expectancy for males and females rises to 92.2 and 95 years respectively by 2050-51. These might reflect new medical technologies and lifestyle responses by people to

[7] This is a departure from the ABS practice in the 2003 population projections, which included only the possibility of medium or high gains in life expectancy.

emerging risks, such as diabetes II. The gains considered in this scenario are the same as the life expectancy gains used by the ABS in its series A projections, but the age-specific mortality patterns are slightly different. In particular, the PC high series uses a higher value of Q100+ to maintain the usual shape of the mortality profile by age.

- The ABS A series mortality rates;
- High, medium and low options estimated by Heather Booth from the Australian National University.

The projection program accompanying the report allows other assumptions by users to be assessed as well.

Table 1.1 **Life expectancies associated with various scenarios**

	2004-05		*2050-51*	
	Males	*Females*	*Males*	*Females*
	years	years	years	years
PC-M / ABS B series	78.4	83.6	84.2	87.7
PC Low series	78.4	83.6	83.0	86.0
PC High series[a]	78.4	83.6	92.2	95.0
Booth Medium series	78.2	83.4	88.0	92.2
Booth Low series	77.1	82.1	83.3	86.4
Booth High series	79.3	84.6	92.4	97.7
ABS High series	78.4	83.6	92.2	95.0

[a] Although the ABS high series and the PC high series have the same life expectancies, they have a different underlying mortality pattern.

Source: Based on data provided by Heather Booth from the Australian National University, unpublished estimates of Qx from the ABS, and Commission estimates.

Alan Hall (DR51) notes that a useful way of assessing the impact of mortality on the age-distribution is to consider the age structure of the synthetic life table population (table 1.2). This method usefully abstracts from short term influences — such as baby booms or epidemics — that can affect the age structure of a population over the medium term. Mortality-based age structures derived from a life table will only be equivalent to the actual age distribution if the population is stationary (not changing in numbers or age structure), with zero migration (Rowland p. 307). Table 1.2 confirms that much of the future ageing of the population is due to mortality gains already made (noting that the aged dependency rate of the *projected actual* population in 2004-05 is only 19.5 per cent). It also shows that potential for even older age structures in the very long run relative to those likely to be encountered in 2050-51, especially in scenarios in which life expectancy gains to that year gave been large. For example, the potential long-run age dependency rate under Booth's high case (given the life table for 2050) is around 62 percent, whereas the projected observed dependency rate for 2050-51 is 10 percentage points less. The dependency ratios predicted on the basis of mortality rates at 2050 are close to those of population projections to 2151 (chapter 2).

Table 1.2 **The aged and total dependency ratios associated with life table mortality rates versus projected populations**

	2004-05		*2050-51*	
	ADR	*TDR*	*ADR*	*TDR*
Using Life tables[a]				
PC-M / ABS B series	36.9	67.7	45.4	76.0
PC Low series	36.9	67.7	42.4	73.0
PC High series	36.9	67.7	58.8	89.1
Booth Medium series	36.1	67.0	52.1	82.5
Booth Low series	34.3	65.2	42.8	73.4
Booth High series	38.0	68.8	61.6	91.8
ABS High series	36.9	67.7	58.6	88.8
Projected populations				
PC-M	19.5	48.5	42.7	69.8
PC Low series	19.5	48.5	38.4	65.3
PC High series	19.5	48.5	49.5	76.5
Booth Medium series	19.4	48.5	43.5	70.3
Booth Low series	19.4	48.4	39.5	66.6
Booth High series	19.5	48.6	52.6	79.5
ABS High series	19.5	48.5	50.5	77.5

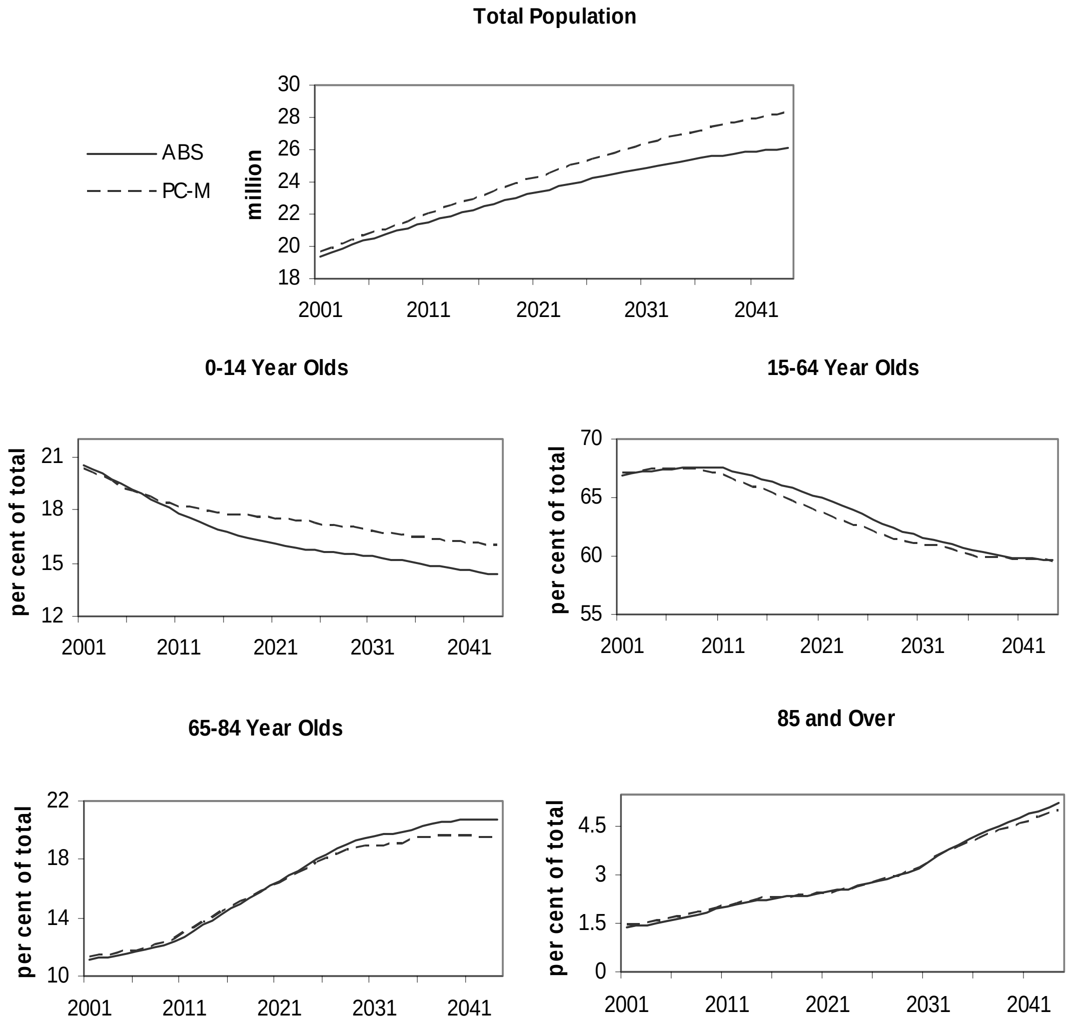
a The life table dependency ratios are based on adding up Lx for males and females for the old and young and comparing with the sum of Lx for people aged 15-64 years. Alan Hall (sub. DR51) and Rowland (2003) provide more information on the methods and interpretation.

Source: Based on data provided by Heather Booth from the Australian National University, unpublished estimates of Qx from the ABS, and Commission estimates.

How do the new projections compare with the ABS B series?

The Commission’s PC-M series have a higher population than the ABS B series, reflecting the higher fertility and net migration assumptions. They also result in less ageing (figure 1.6).

Figure 1.6 **Differences between the ABS B series and the PC-M series**



Data source: ABS B series data and Commission estimates.

1.3 Northern Territory demographic projections

The cohort-component model is also applied for the demographic projections for Indigenous and non-Indigenous populations of the Northern Territory. When summed, these produce a different estimate of the Northern Territory population than that estimated under the PC-M model. The alternative total for the Northern Territory population is referred to as the PC-NTALT model.

Estimating sub-populations for the Northern Territory involve several complicated methodological and data issues.

Net overseas migration

Zero net Indigenous net migration was assumed for the Northern Territory. For the non-Indigenous population, it was assumed that about 0.3 percent of Australian net inwards migration was directed to the Northern Territory (the assumption used by the ABS in its B series population projections in 2003). This results in net inwards migration of 345 per year. The age structure applying to all Australian net inwards migrants is assumed for overseas migrants to the Northern Territory. In the high migration case, 500 net migrants a year were assumed, while in the low case, 200 were assumed.

Net interstate migration

As well as net migration overseas, people may migrate to and from other States. This is referred to as net interstate migration and is calculated as Northern Territory arrivals minus Northern Territory departures. Several approaches were adopted for net interstate migration, depending on Indigenous status.

Net migration plays a particularly important role for non-Indigenous demography in the Northern Territory. Arrival and departure numbers are large and have significant potential effects on the age distribution of the population. It is quite common for projections — as in the approach used for net overseas migration to Australia — to assume a constant value of net interstate migration with a fixed age distribution for all projection years. However, in the case of the non-Indigenous population, simulations revealed that such a projection method can result in the complete depletion of populations in some age–sex ranges. This is unrealistic as outflows could be expected to fall as the sub-population in a given age–sex range fell, and this would then result in net migration inflows for this age range. To overcome the limitations of this approach, the Commission separately modelled inflows and outflows. This was achieved by estimating inwards and outwards interstate migration *propensities* for each age–sex group and applying these to population numbers. Propensities for outward interstate migration (POIM) from the Northern Territory (used to estimate departures from the Northern Territory) were calculated as:

$$POIM_{x,s} = OIM_{x,s} / NIPOPNT_{x,s}$$

where OIM is outward interstate migration from the Northern Territory and NIPOPNT is the non-Indigenous population of the Northern Territory. The propensities were estimated for five year age intervals from 2001 Population Census data provided by the Northern Territory Government, with propensities for single years of age derived using cubic spline methods.[8] It was assumed that these propensities remained fixed over time.

Propensities for inward interstate migration (PIIM) to the Northern Territory (used to estimate arrivals to the Northern Territory) were calculated as:

$$PIIM_{x,s} = IIM_{x,s} / POPAUS_{x,s}$$

where IIM is inward interstate migration to the Northern Territory and POPAUS is the total population of Australia less the Northern Territory.[9] As above, single year of age propensities were estimated for 2001, and were assumed to remain fixed over time.

These propensities were then applied to one year lagged NIPOPNT (estimated by the Commission) and POPAUS (ABS series B) projections to derive the inflows and outflows of non-Indigenous people in the Northern Territory.

For Indigenous people in the Northern Territory, a fixed annual value for net interstate migration was assumed (similar to the approach used for net overseas migration to Australia), with a fixed age distribution based on age of arrivals versus departures from Census data (provided by the Northern Territory Government).[10] The ABS used the same approach in its projections. This is a feasible approach because net interstate migration by Indigenous people in the Northern Territory is very small, averaging around -75 from 1996 to 2001 (ABS 2004g, p. 17). The base case for Indigenous population projections assumes net interstate migration of -75 for the Northern Territory (as in the ABS's experimental estimates). A low and high case of -100 and -50 respectively was adopted.

Fertility

Fertility is measured as in the Australia-wide projection model. Fertility rates for Indigenous women have been falling rapidly. The age-specific fertility rates for calendar years 2001 to 2003 were estimated from various ABS sources using cubic

[8] Cubic splines were applied to the cumulative shares of departures by age, and then differenced to obtain propensities by individual year. This ensured that the single year data added up to interval data.

[9] Ideally, POPAUS would exclude Indigenous people, but no long term projections of all Indigenous people are readily available. In any case, the bias resulting from their inclusion is so small as to be irrelevant because of their small share of the overall non-Northern Territory population.

[10] Data were smoothed and interpolated to provide information for single years of age.

splines, with adjustment for birth over counts, as undertaken by the ABS.[11] In the base case it was assumed that in the ensuing years the age-specific fertility rates took 30 years to reach the fertility rates applying to Australia as a whole in 2013, and then stayed fixed. This gave a TFR nearly identical to that used for the relevant years of the ABS experimental estimates to 2009 (for example, in both cases the TFR was 2.4 in 2009). Under the low fertility case, it was assumed that the transition took 20 years, while in the high fertility scenario, it was assumed that it took 40 years.

The fertility rate for non-Indigenous Northern Territory women is much lower than for comparable Indigenous women, but still higher than other Australian women. Under the base case, it is assumed that the age-specific fertility rates take 15 years to reach the anticipated fertility rates applying to Australia as a whole in 2013, and then stayed fixed. Under the low case, the transition is completed in 10 years and in the high case, 20 years.

Paternity

Birth rates where the mother is non-Indigenous and the father is Indigenous are referred to as ‘paternity’ (ABS 1995). Children born from these relationships are counted as part of the Indigenous population. The method for calculating of the number of Indigenous births associated with paternity is similar to that for fertility:

$$B_t = \frac{1}{2}\left(\sum_{x=15}^{49} PR_{x,T} \times P_{x,f,t+} + \sum_{x=15}^{49} PR_{x,T+1} \times P_{x,f,t+1} \right) / 1000$$

where PR is the paternity rate, defined as the number of children of Indigenous fathers that are born to non-Indigenous women per 1000 Indigenous fathers. These births are simply added to Indigenous births associated with fertility. Of course, these births must be subtracted in the projections for the non-Indigenous population.

Age-specific paternity rates of Indigenous fathers (PR_x) for June 2001 were estimated from ABS data (2004g) using cubic splines. Under the base case it was assumed that paternity rates grew logistically:

$$\mathrm{PR}_{x,t} = (1 + \frac{1}{1 + \frac{(1/s - 1)}{1.05} \times 1.05^{(t-2001)}}) \times PR_{x,t-1}$$

---

11 The 2001 data were from ABS (*Experimental Estimates and projections, Aboriginal and Torres Strait Islander Australians*, *2004*, Cat. no. 3238.0, p.14). The 2002 and 2003 data were from ABS (*Births Australia*, Cat. no. 3301.0) with adjustment for over counts from the Experimental Estimates publication (p. 76).

with a growth in the first year of s (with s = 0.02 or 2 percent growth). The ABS assumed zero change in paternity rates in the Northern Territory in its experimental estimates to 2009. However, Northern Territory paternity rates are much lower than all other jurisdictions, so this is probably not a realistic assumption over the long projection horizon used by the Commission.[12]

In the high paternity rate case, it was assumed that s = 0.05 and in the low case, s = 0.01.

Life expectancy

The life expectancy assumptions used for Australia as a whole (above) were used to generate non-Indigenous population estimates for the Northern Territory (with high, medium and low life expectancy scenarios for non-Indigenous Northern Territorians set to the equivalents for Australia).

The expected long-term trend for Indigenous life expectancy in the Northern Territory is more difficult to forecast. This reflects several factors.

First, there are inadequacies in data on Indigenous deaths and population estimates that may distort historical trends in life expectancy (ABS 2004h, AIHW 2004, p. 195). These inadequacies appear to be less severe for the Northern Territory (ABS 2004h, p. 11), which probably reflects fewer difficulties in the identification of Indigenous status and smaller migration flows in that jurisdiction. Some commentators — for example, Ring and Firman (1998) — consider that there have been few, if any, improvements in health status and life expectancy in Indigenous Australians in the Northern Territory and Western Australia from the 1980s. Indeed, some sources of mortality have been increasing, such as diabetes (Ring and Firman) and smoking-related lung cancers (Condon et al. 2004a). In its most recent set of experimental projections and estimates of the Indigenous population, the ABS (2004) *assumed* no reduction in age-specific death rates between 1991 and 2009 for Indigenous people in all jurisdictions. However, the ABS emphasise that further research is needed to identify trends. The ABS is presently collaborating with the AIHW to determine whether Indigenous mortality has changed over recent decades. The most recent authoritative study of Northern Territory Indigenous mortality patterns over the period from 1966 to 2001 (Condon et al. 2004b) suggests that, in fact, there have been some beneficial reductions in mortality in that jurisdiction.

12 For example, the average Australian paternity rate of Indigenous fathers was 6.4 in 2001 compared with 1.0 for the Northern Territory. It should be noted that the ABS explored the implications of trend growth rates in paternity rates of 1, 2 and 5 percent, as well as its base case zero assumption.

The reductions were predictably greatest for infants (with a decline of 85 per cent over the period). Much more modest gains were realised for older Indigenous people (of 30 percent in females and 19 percent in males aged 5 years and over).

Second, there is much uncertainty about how rapidly policy measures aimed at addressing Indigenous disadvantage will begin to work. On the available data, Indigenous Northern Territorians can expect to live around 20 years less than their non-Indigenous counterparts. This provides the potential for substantial catch-up in life expectancy if the underlying causes of elevated mortality rates can be addressed (such as better health services; enhanced housing, education and work opportunities; improved diet; and reduced smoking and substance abuse). For example, Condon et al (2004a) note that enhanced pap test programs among Indigenous women could significantly reduce the high rate of fatalities associated with cancers of the cervix. Governments around Australia are trying to address these underlying causes. The experience of some other indigenous groups — such as New Zealand Maoris and Native Americans — suggest very significant increases in life expectancy can occur over several decades (Ring and Firman 1998).

In the projections undertaken for the Northern Territory, the Commission explores three scenarios for life expectancy.

The medium case

Under this case, it is assumed that it takes 100 years to realise the average life expectancy experienced by Australians as a whole in 2001-02. This implies a gain in life expectancy for males of around 11 years to 2044-45 and 12 years to 2050-51 or about 0.25 years per year (this is equivalent to one of the options selected by the ABS in its experimental estimates). Gains of this magnitude and from the same starting base were realised by the (mainly) white population of Australia over roughly 50 years in the mid 20^{th} century. For example, male Australian life expectancy improved from 57.6 to 69.6 from 1915 to 1976 (61 years), while female life expectancy improved from 65.2 years to 75.7 years from 1927 to 1974 (47 years). So it is clearly *technically* possible for sustained life expectancy gains of this magnitude over periods less than 100 years.

That said, the gains generally eclipse those apparently measured for Indigenous populations in the last 30 years. This scenario requires less rapid gains in infant mortality than found by Condon et al. (2004), but significantly better gains for older Indigenous people, particularly males. For example, it would imply a 50 per cent reduction in mortality rates (Q_x) for males aged 35 years over the 34 year period from 2000-01 to 2034-35, which is much more than the gains occurring over the 34 year period from 1966-67 to 2000-01 for this group.

The overall gain in life expectancy would still leave a large gap in life expectancy between Indigenous and non-Indigenous Northern Territorians.

It should be emphasised that a gain of 11 years in life expectancy does not mean that an average middle aged Indigenous person alive today will benefit from a 11 year extension of life.

The low and high cases

Under the (pessimistic) low scenario, no improvement in life expectancy occurs over the projection horizon.

Under the high scenario, the Commission assumes that it takes 60 years to realise the average life expectancy experienced by Australians as a whole in 2001-02. This implies a gain in life expectancy of around 16 years for males to 2044-45 and 18 years to 2050-51 or about 0.37 years gain per year. This optimistic scenario has lower gains than the highest scenario explored by the ABS in its experimental estimates to 2009 (which assumed gains of 0.5 years of life expectancy per year).

The Commission emphasises the particularly large effects of uncertainty about mortality trends for population projections for the Indigenous population of the Northern Territory. The Commission has included the projection program used to generate Indigenous population estimates and users can nominate alternative assumptions.

Unexplained growth

A major concern of the ABS is that there are discrepancies between populations in successive five year population censuses that cannot be explained by estimated deaths, births, net interstate migration and net overseas migration over the intervening period. In particular, Indigenous populations grow at a faster rate than expected, with annual unexplained growth of 1.6 per cent for Indigenous populations in Australia as a whole from 1996 to 2001 (ABS 2004g, p. 19). Problems in collection of Indigenous demographic statistics represent one reason for this. Another major factor is that some people who once identified themselves as non-Indigenous subsequently identify themselves as Indigenous. However, this problem is much less severe for the Northern Territory, with only 0.3 percent unexplained growth per annum from 1996 to 2001. This issue has been ignored in the projections undertaken here.

Differences with the PC-M population estimates for the Northern Territory

The projections under the PC-M model (as in the B series before them) give a different picture of the total Northern Territory population than that provided by adding together the sub-populations estimated above (PC-NTALT). Overall, the population projected under PC-NTALT is significantly less than the PC-M series for the Northern Territory (about 75 percent of the PC-M series by 2050-51 or around 80 000 less people). Overall, the Commission considers that PC-NTALT provides the best overall view of the Northern Territory population, since it takes account of the different trajectories of the sub-populations.

Growth curves

There are many growth curves routinely used in the analysis of growth processes that ultimately reach a steady state. These generally form a class of s-shaped or sigmoid curves. These are very useful for modelling populations, labour participation rates, inflation, productivity *growth* (not levels) or other processes where, in the long run, it is expected that the variable will not grow any further. For example, it is not plausible that age-specific per capita use of pharmaceuticals can continue to outstrip GDP growth over the very long run. It might therefore be supposed that in the long run, pharmaceuticals per capita grows at a fixed rate equivalent to GDP growth.

Two growth curves of this kind were used in the analysis in this report (principally in modelling participation and other labour market variables in chapter 3), all of them modified by the inclusion of an additive constant.

The logistic curve

The logistic curve is:

$$y_t = c + \frac{a}{(1 + b\exp(gt))}$$

At t=0, y(0) = c+a/(1+b)

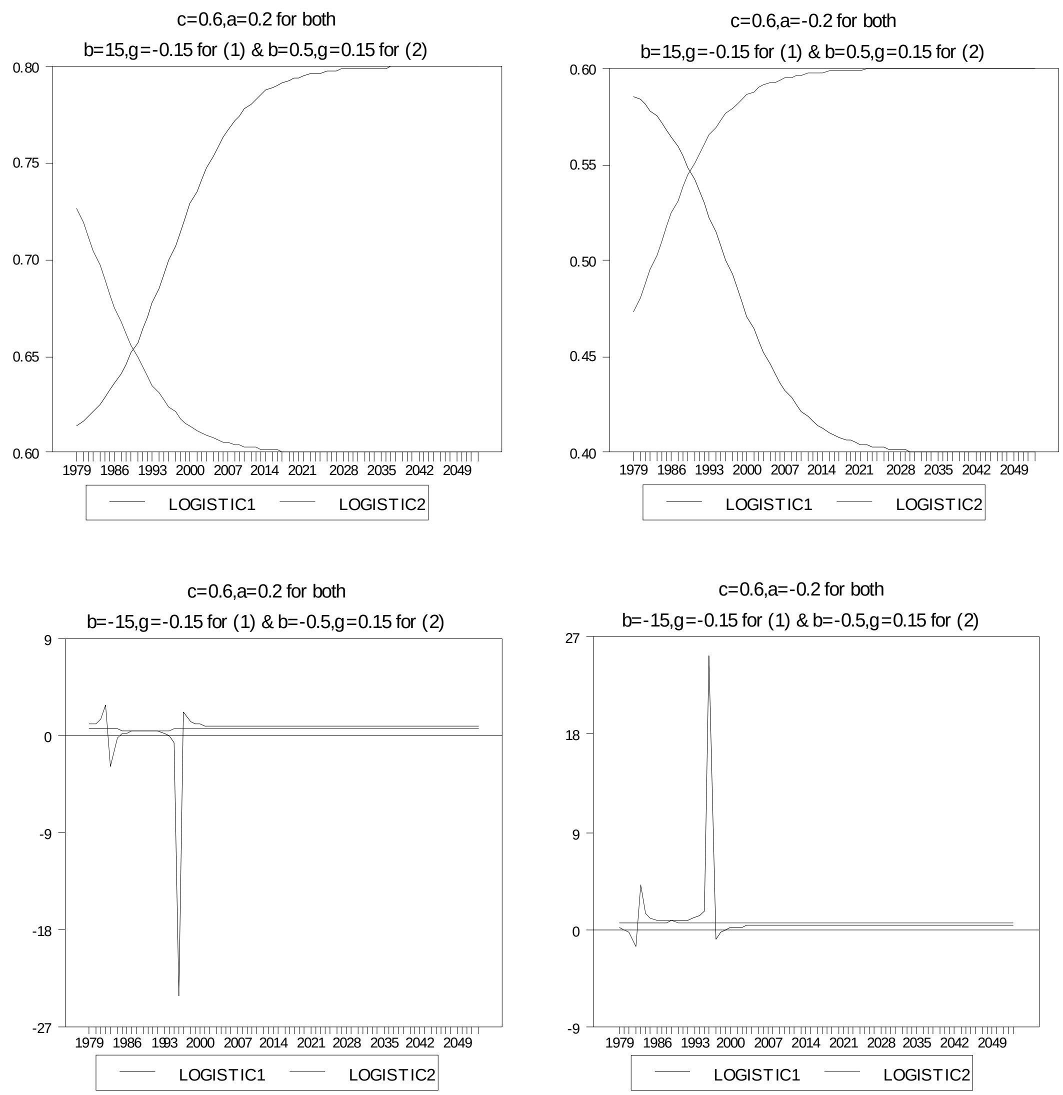
At t=∞, then if g<0, y(∞) = c+a , else if g>0, y(∞) = c.

Where g<0, a>0 and b>0, then the logistic is a positively sloped growth curve that reaches the saturation point (c+a) from below (figure 2.1). Where g, a and b>0 then the logistic is negatively sloped and asymptotes to c from above.

Where g<0, a<0 and b>0, then the logistic is negatively sloped and asymptotes to c+a from above. Where g>0, a<0 and b>0 then the logistic is positively sloped and reaches a saturation point of c from below.

Where b<0 the logistic exhibits irregularities in its growth that make it unsuited to most growth processes (figure 2.1). It is probably sensible to impose the condition that b>0 in most empirical applications.

Figure 2.1 **Logistic curves**



Getting reliable estimates of the parameters of a logistic requires some knowledge of the time of inflection in the curve (i.e. the time at which the absolute value of the growth rate is maximised). The inflection point of a logistic is when:

$$t = -\frac{1}{g}\ln(b)$$

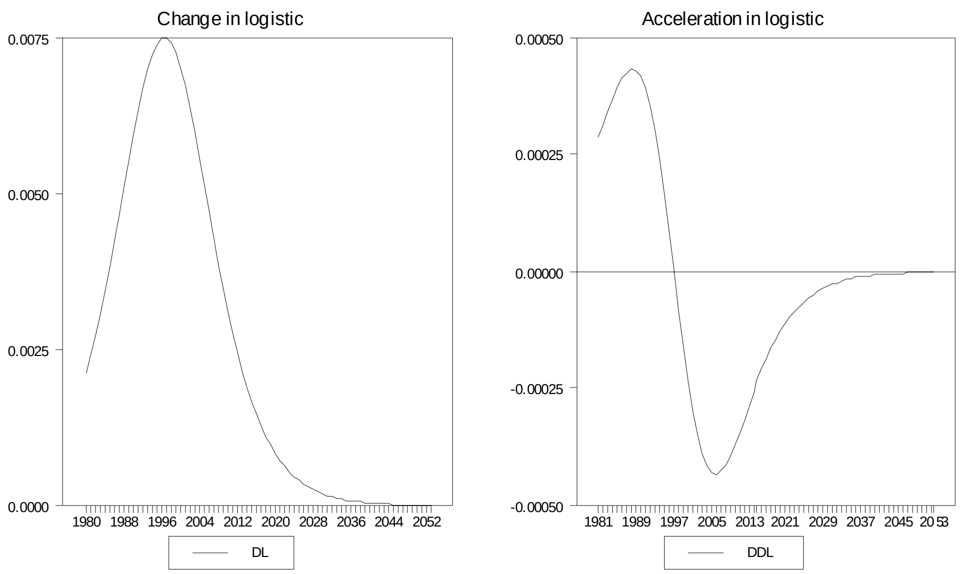
which is only defined when b>0. The inflection point of a logistic is relatively inflexible. In all cases, the remaining growth in y from the inflection point is fixed at a/2.

In many cases, the observed data do not show an obvious inflection point. Estimating a logistic function on such data without imposing an assumption about when the inflection will occur will often give nonsensical results. This is true for all other s-shaped functions. However, sometimes it may be possible to infer inflection points based on prior knowledge or extrapolation of the double difference in the data series. It is apparent from figures 2.2 and 2.3 that the inflection point is where the double differenced data crosses the time axis. So even if an inflection point is not observed, one strategy is to:

- smooth the data to eliminate high frequency cycles in the data (such as through the use of a Hodrick-Prescott filter); and
- double difference the smoothed data and guess at what time it will reach zero. This 'flex' point can then be imposed in any estimation of the function. If the inflection point, f, can be calculated in this way then it implies that $b = e^{-gf}$, which reduces the parameters to be estimated.

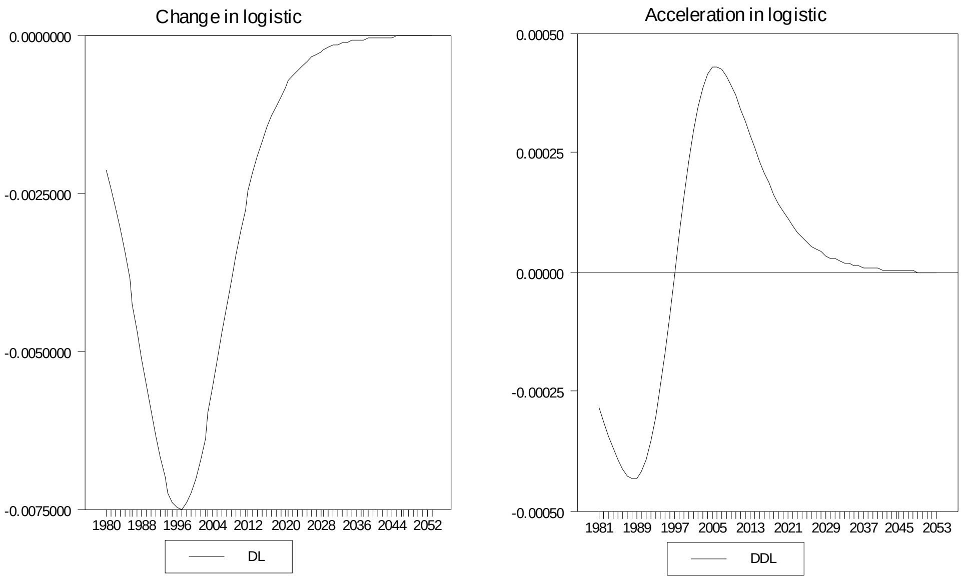
Figure 2.2 **Growth and acceleration of logistic curves**[a]

Positively sloped logistic



a Based on the parameters of LOGISTIC 1 shown in the left hand top logistic curve in the previous figure.

Figure 2.3 **Growth and acceleration of logistic curves**[a]
Negatively sloped logistic



[a] Based on the parameters of LOGISTIC 1 shown in the right hand top logistic curve in the previous figure.

The Richards curve

This is a very flexible growth curve denoted by:

$$y_t = c + a \times (1 + be^{gt})^{\lambda}$$

The Richards curve translates into many other growth curves for different values of λ (figure 2.4). It is a logistic where $\lambda = -1$, a Gompertz for $\lambda = \pm\infty$, and a Bertalanffy function at $\lambda = 3$.

At t=0, $y(0) = c + a \times (1+b)^{\lambda}$

At t=∞, then if g<0, $y(\infty) = c + a$, as with the logistic.

The inflection point of a Richards function, which depends on λ, is not in fixed proportion to its asymptote. The time at inflection is:

$$t = -\frac{1}{g}\ln(-b\lambda)$$

If there is sufficient data, then the Richards curve can be estimated using non-linear least squares. However, there are often problems in convergence, and imprecise estimates are obtained if the data does not already include the inflection point. In order that absurd estimates are not produced with shorter datasets, it is sometimes appropriate to impose restrictions on the estimation.

First, it is often the case that a limit beyond which the curve will not go can be defined (L). In modelling, the long run can be restricted so that it does not exceed this limit. We imposed this condition using the following approach $c + a = y(m) + \{1/(1+e^{\phi})\} \times (L - y(m))$, where y is the value of the observed curve at the last point (t = m). The term, $1/(1+e^{\phi})$, is bounded between 0 and 1, depending on the value estimated by non-linear least squares for ϕ, allowing some latitude in reaching the limit.

Second, there may be prior information that indicates that a particular point is likely to lie on the curve (say when t = v). In that case, $y_v = c + a \times (1 + be^{gv})^{\lambda}$. That, combined with information about the limit above, implies that:

$$a = \frac{y(v) - y(m) - \{1 - 0.5e^{\phi}/(1+e^{\phi})\} \times (L - y(m))}{(1 + be^{gv})^{\lambda} - 1}$$

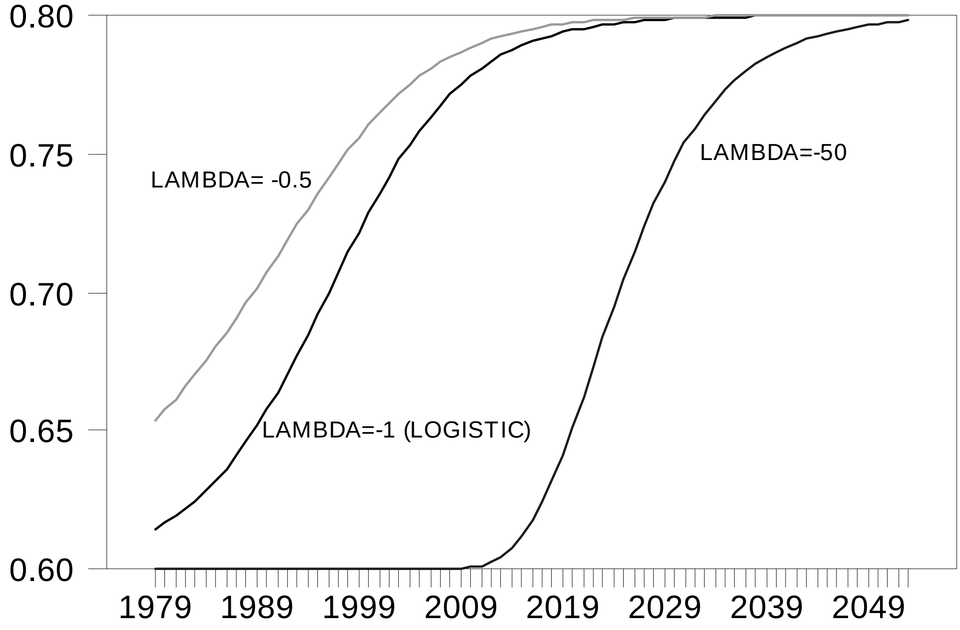
so that *a* may not have to be estimated.

Third, if the inflection point, t = f, can be anticipated, then one further parameter need not be estimated since $b = -\frac{1}{\lambda} e^{(-gf)}$.

In that case, the parameters g, λ and ϕ need only be estimated.

Figure 2.4 **Richards' curves**[a]

At different values of λ



a The parameter values are as in LOGISTIC1 in figure Z.1, except that λ varies.

Cohort analysis

3.1 Cohort analysis

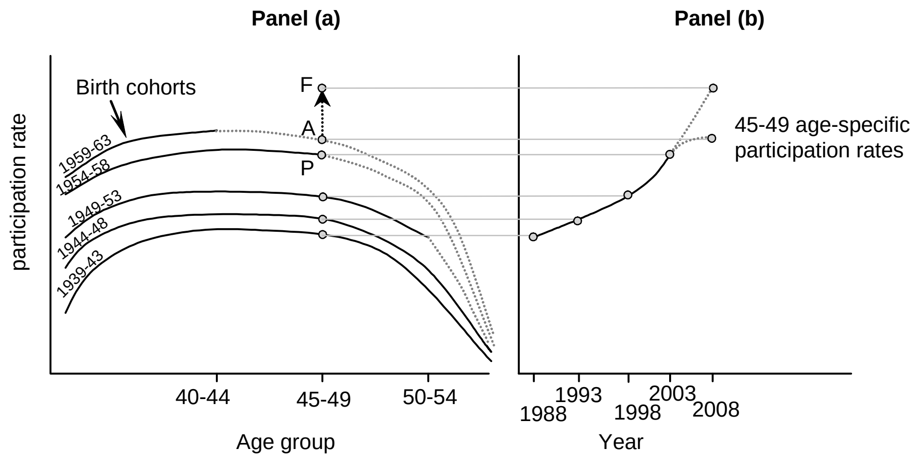
The labour market behaviour of people born in different years (so-called 'cohorts') can be quite different. This has implications for forecasting future patterns in labour supply. These generational variations may reflect their:

- different social attitudes (for example, attitudes to the role of women in the workforce after marriage or childbirth);
- varying aptitudes (due to different levels of education and different lifetime exposures to technology and opportunities for learning by doing); and
- the enduring effects of historical events (such as higher disability rates among combatants in the world wars or the potentially 'scarring' effects of mass unemployment).

Cohort effects may sometimes enable more accurate projections of participation rates. Using hypothetical data, figure 3.1 contrasts the picture of participation rates that can be given by cohort (panel a) versus age-specific information (panel b). Age-specific participation rates reflect the participation rates of different cohorts. In the example below, the observation for 2003 for those aged 45-49 years relates to the 1954-58 birth cohort, while that for 1998 for the same age group relates to the 1949-53 birth cohort.

Based on the past values of the age-specific participation rate shown in panel (b), it would appear likely that the participation rate in 2008 for 45-49 year olds would be around that shown at F. However, this ignores the information given by data in a cohort form. As shown in panel (a), the participation rate for 45-49 year olds in 2008 reflects the labour market behaviour of the 1959-63 birth cohort. In the hypothetical data, this cohort's participation rate is higher for each age than the previous cohort, but by less of an increment than the 1954-58 cohort over the 1949-53 cohort. A reasonable forecast of the participation rates for the 1959-63 cohort when aged 45-49 years is A, considerably less than the 'naïve' forecast based on extrapolating age-specific participation rates over time. Of course, in other circumstances, using a cohort approach may result in a higher projected estimate than one based on past trends of age-specific participation rates, but the point remains that cohort data may be helpful in providing more credible projections.

Figure 3.1 **How understanding cohort effects can provide better projections**



3.2 Cohort data

While true longitudinal data on participation rates are not available, it is possible to construct a synthetic panel of data.[1] However, several data deficiencies must be addressed. Data on participation rates by age are incomplete. For some periods, five year age groups are available, while for other periods, 10 year age groups are available (for example, for data from 1965 to 1977, participation rates are available for 25-34 year olds rather than separately for 25-29 and 30-34 year groups, as are available for other years). Moreover, data for some periods are missing altogether. Thus, yearly data are available from 1965, but for earlier years back to 1901, only infrequent census data are available. These data inadequacies represent an obstacle to analysis of the participation rates of people of given birth years over their lifetimes.

A method for resolving these data inadequacies is to use cubic spline smoothing and other interpolation techniques to fill in the missing gaps (box 3.1). This provides a dataset for examining cohort issues over long time frames. It is the basis for

[1] The panel data set is synthetic because it does not compare the same people over time. For example, the change in participation of women born in 1949-53 between ages 40-44 and 45-49 years is calculated by comparing women aged 40-44 years in 1998 with women aged 45-49 years, five years later. Some women present in the 40-44 group in 1998 will have died or emigrated by 2003, while some women present in the 45-49 group in 2003 will have come from overseas during the last five years.

graphical analysis, such as figure 3.7 in chapter 3. More reliable data over shorter periods have been used for the actual projections in chapter 3.

Box 3.1 **Interpolation methods for deriving cohort data**

For the various gaps in the availability of participation rates for quinquennial age groups between 1965 and 1977, a regression approach was used. A stable relationship was found between the participation rates of five year age groups and (among other variables) the ten year age groups in which they are subsumed. For example, for the period for which complete quinquennial group data were available, the following simple relationship was found for the participation rate for females aged 25 to 29 years (with t statistics in parentheses):

$$PR_{females\ 25\text{-}29} = 0.101 + 1.125\ PR_{females\ 25\text{-}34} - 0.211\ PR_{females\ 20\text{-}24}$$

(4.9) (26.7) (3.5)

This explained 99.7 per cent of the variation in participation rates for this group. This was then used to impute the female participation rate for 25-29 year olds for the years in which data were missing. Other missing quinquennial data were imputed in a similar way.

A standard cubic spline was used to interpolate data for the various missing years between 1901 to 1964. This will obviously fail to take account of business cycle impacts in missing years, and this must be noted as a limitation to the kind of analysis that can be undertaken using (at least parts of) the constructed dataset. Given the obviously approximate nature of the interpolated data, birth year cohorts were chosen in a way that favoured interpolated years that are close to, rather than far away from, years where observed data are available.

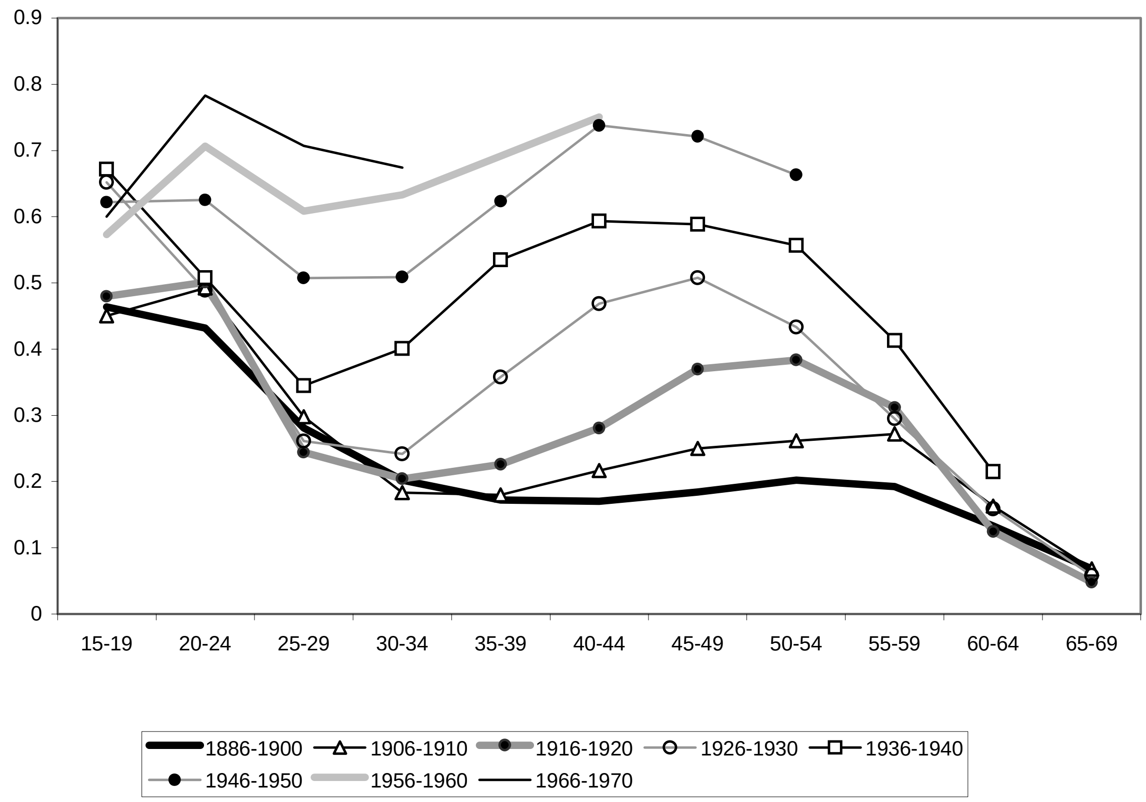
Snapshots of lifetime participation rates for people being born in each decade from the late 19^{th} century to the end of the 20^{th} century (figures 3.2 and 3.3) reveal the significant shifts that have occurred, particularly for females. (figure 3.7 in chapter 3 presents more fine-detailed 3D plots over an even longer period.)

Statistical evidence about the importance of cohort effects

The importance of cohort effects revealed by the qualitative results shown in section 3.3 of chapter 3 are confirmed by econometric analysis. On the basis of recent Australian data based on single years of age (rather than age groups in the data above), Ravindiran et al. (2002) used panel data analysis to substantiate that female cohort effects were strong and positive, while male cohort effects were weak and negative.[2] Participation with age followed the usual inverted-u shape — as above. A third general contributor to changes in participation rates — 'year' effects brought about by the business cycle — were relatively unimportant, particularly for men. Panel data analysis[3] undertaken by the Commission of the (unbalanced) data set shown in figure 3.7 in chapter 3 revealed broadly similar qualitative results to Ravindiran et al.

Figure 3.2 **Lifetime labour participation rates for females**[a]

Australia, females born in decade waves from 1886-1900 to 1966-1970



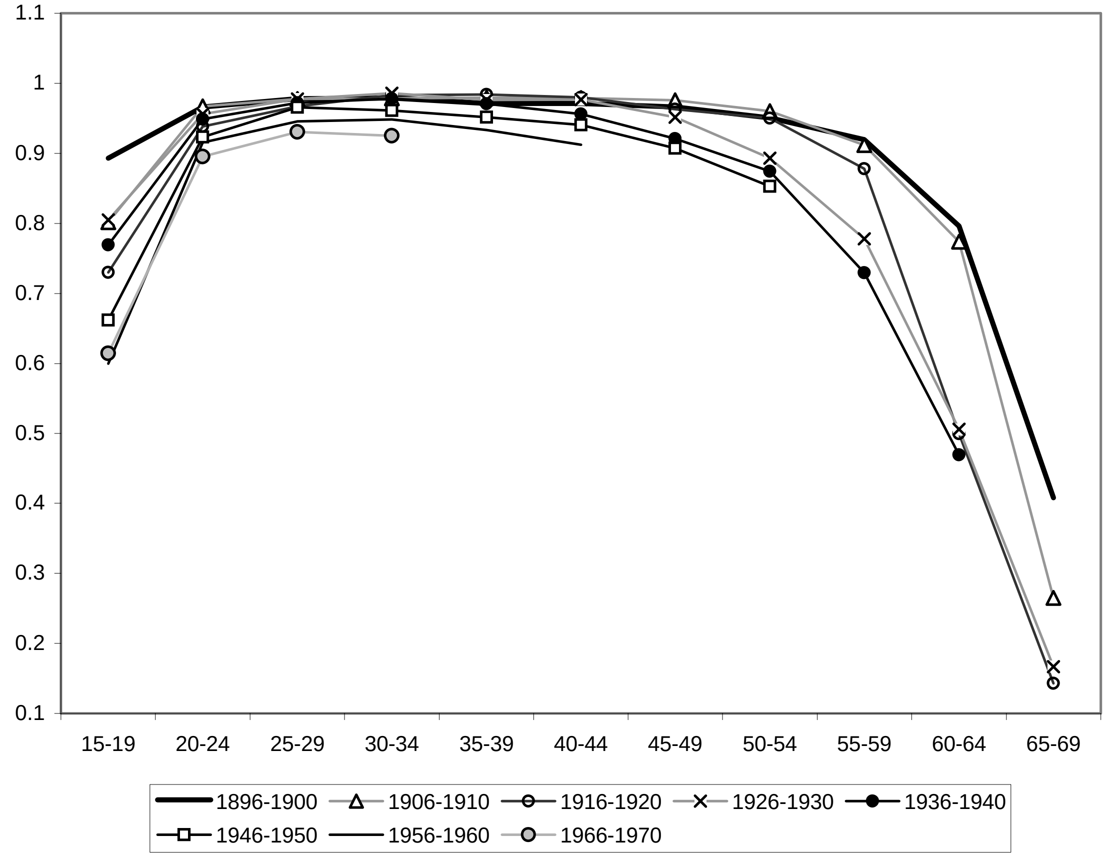
a Data on participation rates for those aged 10 to 14 years are excluded because they confuse the picture provided by other data in the graph. For this age group, participation rates have always been small, and following legislative changes relating to child labour, effectively set to zero in the mid 20th century.

Data sources: Original data sources are ABS (*The Labour Force, Australia, Historical Summary, 1966 to 1984* Cat. no. 6204.0; and *The Labour Force, Australia*, Cat. no. 6203.0) and Withers et al (1985). The Commission used various interpolation methods to construct some data.

2 Their data set relates to people born between 1937 and 1957 and charts their labour market involvement to 2001.

3 A fixed effects model was estimated (and appeared justified by the relevant test statistics compared with a random effects model).

Figure 3.3 **Lifetime labour participation rates for males**[a]
Australia, males born in decade waves from 1886-1900 to 1966-1970



[a]See **a** in figure above.

Data sources: See data sources in figure above.

3.3 Exits and entries in a cohort model

Cohort methods for forecasting participation rates rely on measures of exit from and entry to the labour market as cohorts age.

The most straightforward method for incorporating cohort effects into labour supply projections is to take account of the shape of the lifetime labour participation profile for each successive cohort and to extrapolate on that basis.[4] An example is the extrapolation shown in figure 6.1 for the 1959-63 cohort for age 45-49 years.

4 Another approach — using neural networks — was also trialed, but ultimately not used. There is a highly complex non-linear relationship between participation rates and age and cohort effects. Neural network models have the advantage that they do not impose excessive structure on the data and may capture these complex effects. However, while a range of neural network models

The shape of the lifetime participation profile is determined by the pattern of entry and exit from the labour force as a cohort ages. Given that reliable labour force data is usually only available for people in five year age ranges (people aged 15-19 years, 20-24 years and so on), entry rates must be calculated over five year periods. Accordingly, where participation rates are rising for a given cohort, the entry rate at time t is defined as the net addition to the labour force relative to the initial number of people who were *not* in the labour force five years previously:

$$Entry^{t}_{x,x+4} = \frac{increase\ in\ labour\ force\ from\ t-5\ to\ t\ of\ people\ aged\ x+1\ to\ x+9\ years\ at\ t}{number\ of\ people\ aged\ x\ to\ x+4\ years\ not\ in\ the\ labour\ force\ at\ t-5}$$

It should not be assumed that all these entries actually occur at time t — clearly, entries occur smoothly over the period from t-5 to t. The entry rate measures the completed number of entries *by* time t of the cohort aged x to x+4 years five years previously.

Estimating entry (and exit) rates is complicated by net migration and deaths, which mean that the civilian population aged between x+5 and x+9 at time t is different (generally by a small margin) from that aged between x and x+4 at time t-5. The impact of sample attrition and addition can largely be removed by assuming that the observed participation *rate* for people aged x+5 to x+9 at time t would be the same as that which would be observed had no sample attrition or addition occurred. In that case, the entry rate can be estimated as:

$$Entry^{t}_{x,x+4} = \frac{PR^{t}_{x+5,x+9} \times CPOP^{t-5}_{x,x+4} - LF^{t-5}_{x,x+4}}{NLF^{t-5}_{x,x+4}}$$

where PR, CPOP and NLF denote participation rate, civilian population and ‘not in the labour force’, respectively. Dividing through by CPOP and noting that NLF/CPOP = 1-PR, then the entry rate can be re-expressed as:

$$Entry^{t}_{x,x+4} = \frac{PR^{t}_{x+5,x+9} - PR^{t-5}_{x,x+4}}{1 - PR^{t-5}_{x,x+4}}$$

However, it is not feasible for some people in the civilian population to enter the labour force, so for the purpose of defining entry rates, NLF is defined as the difference between the maximum number of people in the civilian population who could be in the labour force (CPOP*) and the observed labour force. In that case,

produced credible short run forecasts, their long run forecasts were sometimes implausible. For example, the models forecast participation rates for 2050 approaching 100 per cent for females aged 30-34 years (at the one extreme) and 5 per cent for males aged 65-69 years (at the other).

NLF/CPOP = CPOP*/CPOP – LF/CPOP, so that the entry rate can be represented as:

$$Entry^{t}_{x,x+4} = \frac{PR^{t}_{x+5,x+9} - PR^{t-5}_{x,x+4}}{PR^{*} - PR^{t-5}_{x,x+4}}$$

where PR* is the maximum potential participation rate (with Burniaux et al. 2003 using PR*=0.99 and 0.95 for men and women respectively) and x are ages for quinquennial age groups. For example, for the 1954-58 cohort, the entry rate from 1998 to 2003 is the participation rate for 45-49 year olds in 2003, less the rate for 40-44 year olds in 1998, over the potential number of people who could enter the labour force in this group.

Where participation rates are falling for a given cohort, the *exit rate* is defined as the net reduction in the labour force relative to the number of people who were initially in the labour force in that cohort:

$$Exit^{t}_{x,x+4} = \frac{PR^{t-5}_{x,x+4} - PR^{t}_{x+5,x+9}}{PR^{t-5}_{x,x+4}}$$

3.4 Cohort exit and entry rates

Fixed exit and entry rates

The analysis by Burniaux et al. (2003) employs fixed entry and exit ratios — based on the last observed values of these ratios. If entry and exit rates remain fixed at their current values, then only data from 1999 and 2004 are required to estimate future participation rates for each of the age groups for five year intervals into the future. This has the advantage of computational simplicity and would be appropriate if exit and entry rates were non-trending.

For example, the participation rate for the 1960-64 female cohort when aged 45-49 years (that is, in 2009, five years after 2004) can be estimated as from the appropriate exit rate as:

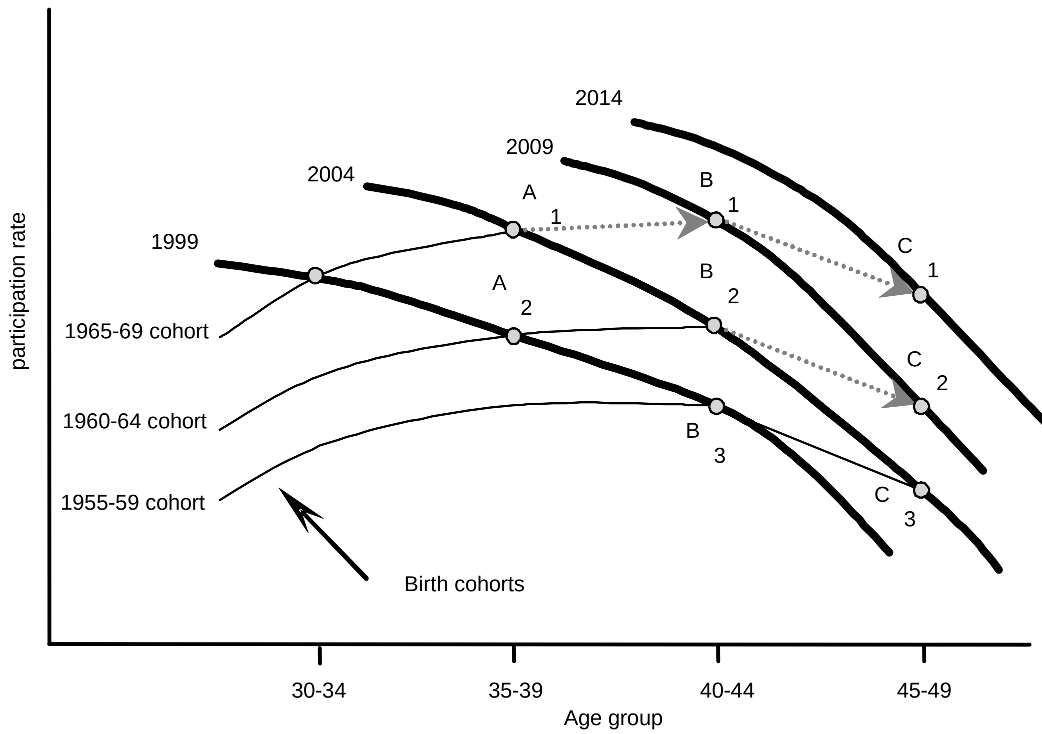
$$PR^{2009}_{1960-64\ cohort} = \left\{1 - \frac{PR^{1999}_{40-44} - PR^{2004}_{45-49}}{PR^{1999}_{40-44}}\right\}_{1955-59\ cohort} \times PR^{2004}_{1960-64\ cohort}$$

which is equivalent to $C_3/B_3 \times B_2$ in figure 3.4.

Similarly, the participation rate for the younger female cohort born in 1965-1969 when aged 40-44 years (again in 2009) can be estimated from the appropriate *entry rate* (noting from figure 6.4 that A1 to B1 rises so that entry has occurred) as:

$$PR^{2009}_{1965-69\ cohort} = PR^{2004}_{1965-69\ cohort} + \left\{ \frac{PR^{2004}_{40-44} - PR^{1999}_{35-39}}{PR^{*} - PR^{1999}_{35-39}} \right\}_{1960-64\ cohort} \times (PR^{*} - PR^{2004}_{1965-69\ cohort})$$

Figure 3.4 **The dynamic cohort method for projecting participation rates**



Data source: Burniaux et al. (2003).

This leaves gaps between each of the years 2004, 2009, 2014, 2019 and so on. These gaps can be completed using interpolation.[5]

Time varying entry and exit rates

As Burniaux et al. (2003) note, it would be desirable to also produce forecasts of participation rates that allow entry and exit rates to evolve over time. The future

[5] If fixed entry/exit rates are used, linear interpolation is probably most appropriate for several reasons. First, it is easier to implement than spline methods and is justified by the small differences between rates observed at five year intervals. Second, the participation rates converge to a set value for each of the age groups, and linear interpolation gives exact results when this occurs, whereas spline methods do not.

evolution of exit and entry rates will determine what happens to the labour force involvement of present cohorts. This section sets out the method used for estimating such dynamic exit and entry rates for Australia. Such time varying exit and entry rates were used in the projections in chapter 3.

The pattern of exit and entry rates in the past time is sometimes quite erratic, making it hard to forecast their future paths. Smoothing helps to reduce noise (but at the risk of producing spurious trends). Exit rates using smoothed data are shown in figure 3.5. Where exit rates are negative, it means that entry is occurring, and that it is more informative to graph the entry rate. For example, the comparable entry rate for people aged 15-19 years is shown in figure 3.6.

The data reveal that some rates appear to have stabilised — as in exit rates for females aged 25-29 years and entry rates for females aged 15-19 years. Others appear to still be trending. For example, exit rates for older workers of both genders (aged 55-64 years) have generally been dropping, and this may continue.

Clarifying bounds for exit and entry rates in dynamic models

There are bounds on potential exit rates, which are important when projecting dynamic exit rates. When net exits occur, then the exit rates (*Exit*) is bounded: $0 \leq Exit \leq 1$. When all members of a cohort exit the labour force over a period, then X=1, the highest possible bound. When there is no net attrition, *Exit* = 0. If there is negative net exits (entry) then, in theory, in the extreme $Exit \rightarrow -\infty$.

Given knowledge of the future path of *Exit*, forecasts of participation rates can be made by noting that:

$$PR^{t}_{x+5,x+9} = (1 - Exit_{a,a+4,t}) \times PR^{t-5}_{x,x+4}$$

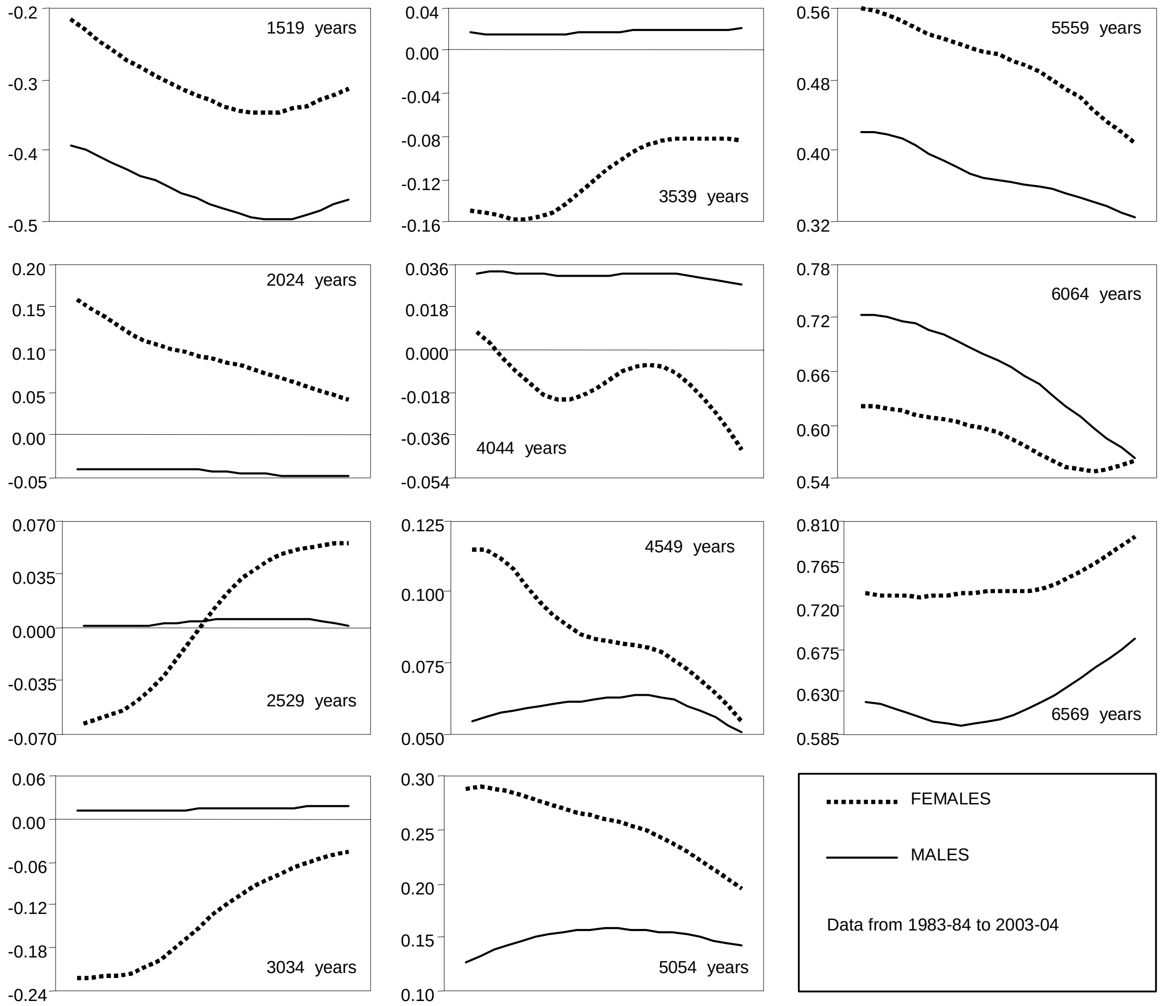
While in theory negative net exit rates cover cases where net entry occurs, it is useful to also set out a direct measure of entry rates (*Entry*). These are defined relative to the stock of people that could be, but are not, in the labour force.

Where net entry occurs, then $0 \leq Entry \leq 1$. *Entry* is at its maximum of one when $PR^{t}_{x+5,x+9} = PR*$. When there is no net entry, *Entry* = 0. If there are negative net entry (positive net exits), then in the extreme it is possible that $Entry \rightarrow -\infty$. Forecasts of participation rates based on these entry rates are:

$$PR_{a+5,a+9,t} = Entry_{t} \times (\max - PR_{a,a+4,t-5}) + PR_{a,a+4,t-5}$$

Figure 3.5 **Exit rates based on smoothed participation rates**[a]

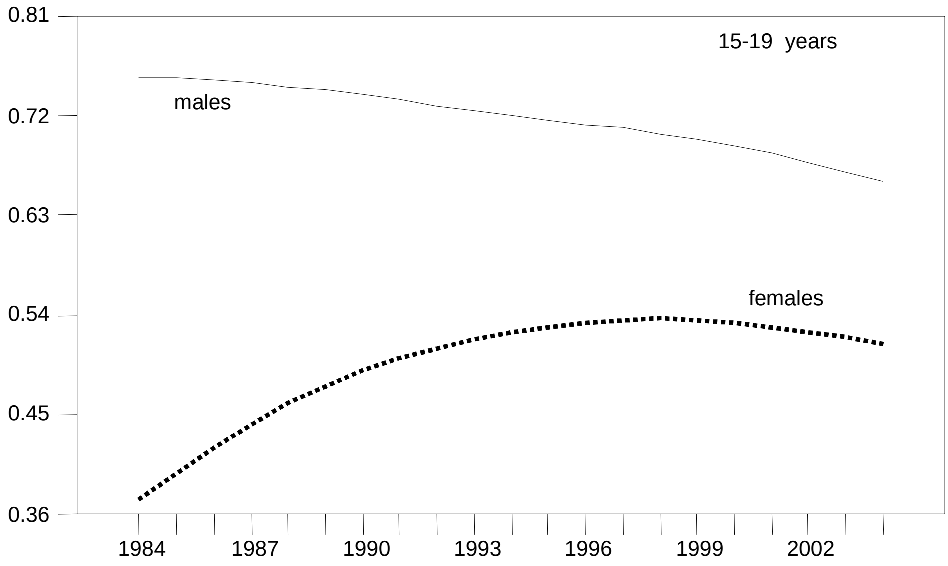
1983-84 to 2003-04



aParticipation rates were smoothed using a Hodrick Prescott filter. Note that an entry or exit rate for age x mean the rate at which a cohort aged x in year t-5 enter or exit the labour force t years later.

Data source: ABS (*Labour Force, Australia, Detailed*, Cat. no. 6291.0.55.001).

Figure 3.6 **Entry rate based on smoothed participation rates**[a]
15-19 year olds, 1983-84 to 2003-04



a Participation rates were smoothed using a Hodrick Prescott filter. Note that an entry rate for age x mean the rate at which a cohort aged x in year t-5 enters the labour force t years later.

Data source: ABS (*Labour Force, Australia, Detailed*, Cat. no. 6291.0.55.001).

Because both rates can encompass negative values, it would be possible to forecast *either* entry rates *or* exit rates and use just the single measure to project participation rates.

However, there is a major practical obstacle to forecasting just the exit rate or the entry rate alone and then deriving participation rates. This arises because there is no single observed value of exit rates at the sensible upper bound of entry rates and vice versa. For example, a rise in the participation rate for a cohort from 0.93 to 0.945 over a five year period gives an entry rate of 0.747 and an exit rate of -0.0159 (for a PR* of 0.95). However, a rise in the participation rate from 0.945 to 0.96, which violates the condition for PR*, gives the same value for the exit rate, whereas the value for the entry rate clearly discloses that the upper bound has been exceeded (table 3.1). It is even possible that a seemingly sensible value for the exit rate might result in a participation rate that exceeded one, let alone PR*. Similarly, the same indeterminacy arises when predicting participation rates from negative values for entry rates — a seemingly innocuous value for an entry rate may generate even negative participation rates.

Table 3.1 **No single measure of exit or entry gives determinate results**[a]

PR_t	PR_{t-5}	*Entry rate*	*Exit rate*
0.945	0.930	0.747	-0.0159
0.960	0.945	3.000	-0.0159
0.059	0.180	-0.157	0.6700
-0.080	0.059	-0.157	2.3486

a These calculations were made with PR*=0.95.

Source: Commission estimates.

Given these practical issues, the best approach is to model exit rates when long-run exit rates are likely to be positive and to model entry rates when long run entry rates are likely to be positive.[6] This ensures that forecast participation rates are appropriately bounded.

The fact that appropriately defined exit and entry rates must be bounded suggests that linear and log trend models are not appropriate for projection. In order that the long run does not violate bounds, various s-shaped growth curves were considered appropriate. Ultimately, the analysis used Richards' curves (a generalised logistic), since these curves allow for more flexible inflection points than other common s-shaped curves, such as Gompertz or logistic curves (technical paper 2).

3.5 Modelling and projection strategy

For each age, gender and jurisdiction, the following modelling and projection strategy was adopted.

- Participation rates were smoothed using the Hodrick-Prescott filter to reduce noise associated with the business cycle.
- Exit and entry rates were derived for each quinquennial age group for fiscal years from 1983-84 to 2003-04 (noting that estimating these requires data on smoothed participation rates from 1978-79). These were graphed. Where it appeared likely that an entry (exit) rate was likely to be positive in the long run, then the series was modelled as an entry (exit) rate.
- The smoothed series' were differenced and examined for any significant turning points to identify structural breaks in the series. Since an s-shaped curve must

[6] It may still be the case that the historical data on which these forecasts are based will have some negative values for exit or entry rates, but so long as the long run rate is positive, this does not present problems for forecasting analysis. Indeed, a modelling approach that omits data points that are negative would generate potentially significant biases.

either show decline or fall throughout its course, any sign changes in the smoothed series reveal breaks. (However, small changes relative to the mean were ignored as statistical noise.) The starting year for estimation occurred after any structural break.

- The smoothed series' were differenced twice to examine acceleration and de-acceleration of participation rates over time. This identified the inflection points in the s-shaped curves (in some case these were forecast with extrapolation methods — but in all cases, plausible inflection points could be identified). These inflection points were used in the estimation of the s-shaped curves.
- Reasonable priors about appropriate maximum or minimum participation rates were formulated, since the non-linear least squares estimation of s-shaped curves can sometimes result in long run rates that are not credible. These limits were used to constrain the estimation results — but in many cases they were not binding. Accordingly, the results largely represent a statistical approach to projection rather than subjective views about how exit and entry rates might evolve.
- Exit and entry rates were modelled as Richards curves. The rates were estimated using non-linear least squares subject to maximum (or where participation rates were falling, minimum) limits on the long run participation rates (technical paper 2).
- The projected entry and exit rates were then used to estimate participation rates by using the formulae above.

Total health expenditure

In line with the terms of reference, this study projects the fiscal pressure on Australian governments arising from an ageing population. However, international comparisons of health expenditure often focus on total public and private expenditure. To facilitate such comparisons, this paper uses a single aggregate model (in contrast to the component models used for government expenditure) to project total Australian health expenditure.

Current expenditure

In 2002-03, health expenditure in Australia was $72 billion or 9.5 per cent of GDP (AIHW 2004b). In common with many countries, health expenditure in Australia is increasing: since 1991-92 it has grown at a real average annual rate of 4.6 per cent a year, and from 8.1 per cent of GDP to its present level.

It should be noted that high level residential aged care ($4.9 billion in 2002-03) is included in the above figure. However, elsewhere in this report this spending is excluded from health expenditure and projected separately as aged care expenditure.

Data

The key elements underpinning projected health expenditure are:

- the existing age profile of health expenditure for males and females — table 4.1 shows that expenditure is significantly higher for older age groups;
- projected demographic change — consistent with the rest of this report PC-M projections are used; and
- the assumed growth rate in per capita health spending.

As discussed in chapter 6, projections of health expenditure are particularly sensitive to assumptions about increases in per capita spending arising from demand (including prevalence of diseases), technology, and price. This growth is often termed the non–demographic growth rate. In the projections this growth rate is expressed as a premium over the projected increase in GDP per capita (see appendix D). Owing to the sensitivity of results to this variable the projections incorporate a range of growth premia.

Table 4.1 **Australian health expenditure per capita by age group**
2000-01[a]

Age group	*Males*	*Females*
	$ per capita	$ per capita
0-4	1 876	1 564
5-14	1 091	1 240
15-24	1 271	1 732
25-34	1 230	2 126
35-44	1 402	1 936
45-54	1 915	2 343
55-64	3 179	3 305
65-74	5 657	5 371
75+	9 924	10 877

[a] In the projections 2000-01 data is re-calibrated to sum to total expenditure in 2002-03.

Source: AIHW (2004e).

Projected expenditure

Total health expenditure is projected to increase in Australia to between 16 per cent and 20 per cent of GDP in 2044–45 (table 4.2).

Table 4.2 shows the sensitivity of the results to small variations in non-demographic growth — primarily technology and demand. However, the impact of ageing is also significant. The Commission estimates that expenditure levels will be over 30 per cent higher than they would be if the population did not age. This is higher than the 25 per cent estimate for the government sector only, because of the inclusion of high level residential aged care in the projection, and because it does not take account of death-related costs for hospital expenditure.

Table 4.2 **Projected Australian health expenditure as a proportion of GDP**

Growth in per cap health exp above per cap GDP growth	2002-03	2014-15	2024-25	2034-35	2044-45
	%	%	%	%	%
0.5 per cent premium	9.5	11.0	12.8	14.5	16.0
0.75 per cent premium	9.5	11.4	13.5	15.8	17.8
1.0 per cent premium	9.5	11.7	14.3	17.1	19.7

Source: Commission estimates.

Aggregate studies of age and health expenditures

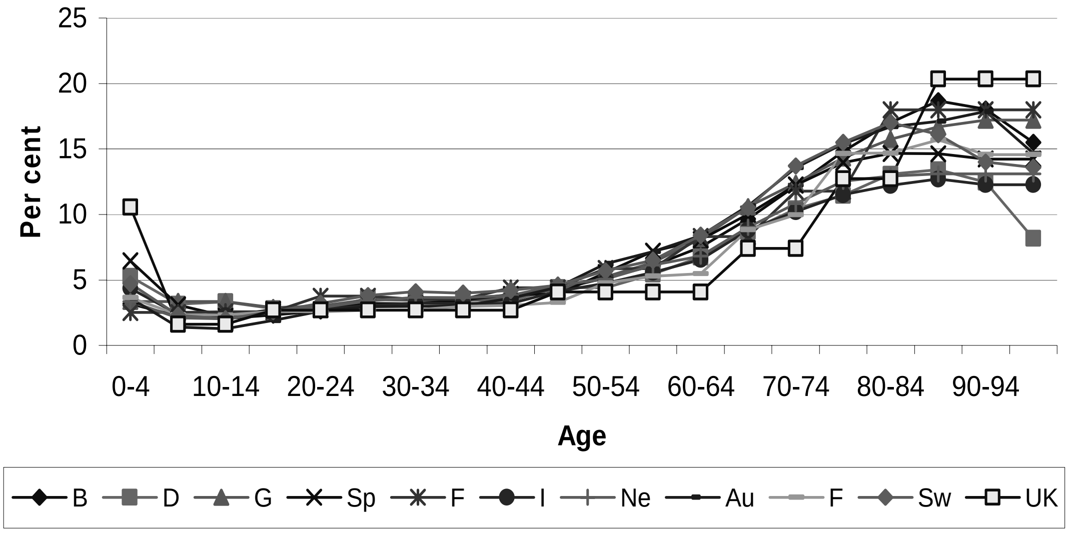
The majority of empirical studies examining the determinants of health expenditure have not found population ageing to be a significant factor in explaining the growth in expenditure.

Yet age-profiles of expenditure in most countries show that expenditure is higher for older age groups (figure 5.1). As discussed in chapter 6, there is also evidence that profiles have been relatively stable over time, implying that an ageing population will lead to increased pressure on health expenditure. Thus there appears to be an inconsistency between the data at the micro level and the data at the macro level.

This paper provides background on a range of these studies and discusses some of the factors that may explain this apparent inconsistency.

Figure 5.1 **European health expenditure[a]**

Health expenditure as a proportion of per capita GDP



[a] B=Belgium; D=Denmark; G=Germany; Sp=Spain; F=Finland; I=Italy; Ne=Netherlands; Au=Austria; F=France; Sw=Switzerland; UK=United Kingdom. Profiles are drawn using data from the year 2000 except France, 1997; Belgium, Denmark, Spain and United Kingdom, 1998; and Italy, 1999.

Data source: Bains (2003).

The literature

This section provides a brief guide to a sample of the literature. A range of empirical studies, including Culyer (1990), Gerdtham et al. (1992), Hitiris and Posnett (1992), Zwiefel et al. (1999), Richardson and Roberstson (1999), Moise and Jacobzone (2003) and Jönsson and Eckerlund (2003), have all found that ageing has not been a statistically significant factor in the growth of health expenditure (table 5.1). A partial exception is Karatzas (2000).

Variations in national income generally account for most of the cross country differences in health outlays. In his seminal article, Newhouse (1977) provides a comparison of health expenditures across some thirteen developed nations (circa 1972). Using a simple regression of per capita medical expenditures against per capita GDP, differences in the level of national incomes are able to explain 92 per cent of the variance in per capita health outlays. However, Newhouse undertook this analysis before ageing had any real momentum, and the residual, which was left unaccounted for, was unlikely to be explained by age-related factors at that stage.

Gerdtham et al. (1992) examined the determinants of health care expenditure using data from some twenty industrialised countries over a two decade period. Their regression attempts to control for a variety of both ‘background’ and ‘institutional’ influences, including income, demography and fiscal constraints. Dummy variables were used to distinguish between health care provider systems. For example, a dummy variable was used to make the distinction between those systems which employed patient reimbursement schemes rather than provider reimbursement schemes. Similar to other studies, Gerdtham et al. found GDP per capita to be a highly significant variable, while ageing (proportion of population over 75) was not. Even at more disaggregated levels of health expenditure — ambulatory care, in-patient care and pharmaceutical — ageing registered as insignificant. By contrast, health expenditures proved very responsive to even the broadest distinctions between provider arrangements.

Table 5.1 **The literature in brief**

Author	*Year*	*Nature*	*Notes*
Newhouse	1977	Cross national comparison of 13 developed nations, circa 1972	Compares per capita GDP with per capita HCE, and is able to attribute 92 per cent of the variance between HCE to per capita GDP differences across the nations studies.
Fuchs	1984	Qualitative and quantitative analysis	Examines trends in HCE, and age specific morbidity and mortality. Fuchs concludes that spending is a function of death, and aggregate expenditure has been rising with the number of persons approaching their final years.
Culyer	1990	Reviews the success and failures of the reform process of European nations battling rising health care requirements.	Concludes that given the strength of the relationship between HCE and income, growing expenditures are consequently beyond the reach of policy.
Newhouse	1992	Using a fixed weight expenditure profile, to compare health spending between 1950 and 1987 (USA).	Examines the role played by access to insurance, increased incomes, supplier induced demand, and low productivity growth of health services, concluding that these factors account for most of the rise in HCE.
Getzen	1992	Cross country study of real HCE growth between 1960 and 1990.	If income is included in the regression, ageing is not found to be significant, implying that rising HCE and rising ages are the result of an indirect relationship with other variables. Moreover, concludes that ageing affects only the allocation of expenditures, but will not substantially increase the total level of HCE.
Gerdtham, Josson and MacFarlan.	1992	Cross country study of the determinants of total HCE. Circa 1985.	Tests a variety of background and institutional variables. Background variables are mostly socio-economic, and include ageing and per capita income, as well as alcohol and tobacco consumption. Institutional variables refer to funding arrangements, access schemes etc.
Hitiris and Posnett	1992	Uses a sample of 560 cross sectional and time series observations from the OECD to test the determinants of health care spending.	Their results reaffirmed that the vast majority of expenditures on health are caused by income discrepancies. The impact of demographic variables was quite limited under all their model specifications, if even found to be significant.
Hansen and King	1996	Critical study of the econometric methods used in many of the above studies.	Suggests that standard time series models where HCE is a function of real per capita GDP and a selection of non-income variables may be misspecified. Finds variables in many OECD orientated models are not stationary, arguing that this violates an assumptions of an OLS regression.

Blomqvist and Carter	1997	Reviews methodological problems that arise from issues in the data.	
Lamers and Van Vliet	1998	Study of Dutch social insurance system.	Found that health outlays in the last year of life were some 15.3 times greater than costs than for those otherwise.
McCoskey and Selden	1998	Applies different tests to the concerns of Hansen and King.	Findings contradict Hansen and King.
Richardson and Robertson	1999	Uses Aust. SSDs in a cross sectional comparison to test for explanatory determinants of HC use.	Compares the use of GP services per capita across the 186 Australian SSDs. After standardising for a number of statistically significant variables (inc. urban/rural, aboriginality, public hospitals etc), found the age/sex variable explains only 3 per cent of the cross sectional variance.
		A short cross-nation survey of OECD countries in 1960, 1975 and 1995.	
Zweifel, Felder and Meiers	1999	Uses Swiss HC data 1983-1994 to test if rising health costs can be explained by "closeness to death."	Although calendar age variables were statistically significant the respective coefficients were of little influence on the model. Quarters to death however, contained much more explanatory power.
Karatzas	2000	Time series test of US aggregate per capita real HCE, 1962-1989	Constructs a variety of models which include economic, health stock and demographic variables to predict per capita real health expenditure.
Felder et al.	2000	Uses the same data as Zweifel et al., adjusting for age, mortality, risk and wealth.	
Gerdtham and Lothgren	2000	Tests the data for stationarity and cointegration.	OECD health expenditure and GDP data from the period 1960-1997 proves to be non-stationary. The studies which have relied on this data set to reach their conclusions may have reached the wrong conclusions.
Salas and Raftery	2001	Questions Zweifel's methodologies and results econometrically	Identifies two particular problems with the Zweifel et al study: a) Study assumes HCE and time to death to be unrelated; and b) sample selectivity problems which they claim weren't properly controlled for.
Stooker et al	2001	Tests the determinants of health expenditures in the Netherlands, primarily as a function of years remaining.	Reaches similar conclusions to Zweifel et al. Significantly however, Stooker et al, attribute only 10 per cent of total health costs to the dying, arguing that any measures taken to reduce the costs of dying will have only a moderate impact on the total health budget.
Sheehan	2002	Cross country study of 20 OECD countries, 1989-1999	Tests for correlation between real health growth over the decade and growth in the proportion of over 65s. Reports a correlation coefficient of 0.04, and a number of countries reported highly counter intuitive results- suggesting that there is no relation between the two. Concludes that we are getting older later, rather than older younger.
Dow and Norton	2002	Explores the econometric	Building on the concerns of Salas and Raftery, Dow and Norton have additional

		methodologies of the paper by Zweifel et al	problems with Zewifel et al. They claim Zweifel et al.'s choice of model selection is a flaw in the study.
Chernichovsky and Markowitz	2003	Time series study of Israeli HCE from 1966 to 1998	Uses median age, doctors per 1000 persons, mean years of schooling and GNP per capita to explain HCE per capita. Coefficient on median age is insignificant.
Moise and Jacobzone (OECD)	2003	Cross country study of OECD member states, 1997	Finds little correlation between per capita HCE and percentage of population aged over 65.
Jönsson and Eckerlund (OECD)	2003	Cross country study of OECD member states, 1998, and includes a case study of Sweden	Replicates Newhouse 1977 with more recent data, but now attributes only 77 per cent of cross country comparison to differences in income.
Bains (OECD)	2003	Projects HCE to 2050 EU member states (excluding Luxemburg)	Projections map current age-sex-expenditure profiles against predicted pop changes. Ageing will increase public HCE as a percentage of GDP by between 0.7 and 2.3 percentage points.
Jacobzone	2003	Survey article	Demography, is a secondary factor in the overall increase of HCE. The key factor is technology and rising relative prices for medical inputs, combined with the intensity of medical care at older ages. Points to the high concentration of medical costs at the end of life, and argues that failure to account for this will tend to overstate any future predictions.
Jewell et al.	2003	Tests for structural breaks in the data.	Counter's the conclusions of other econometric criticisms, claiming that after structural breaks are controlled for, the data proves to be reliable and stationary.
Seshamani and Gray (UK)	2004	Longitudinal study of hospital costs in Oxfordshire UK	Finds a relationship between proximity to death, particularly the last year of life (but extending back 15 years), and hospital costs.

Chernichovsky and Markowiz (2000) found that for Israel — one of the fastest ageing populations in the developed world — only GDP per capita and mean years of schooling proved statistically significant.[1] While their testing of Israeli data does not reveal a significant age effect, they recognise that assuming a simple linear relationship between individual and aggregate spending may be oversimplified. The authors suggest that shifting mortality and morbidity over the period has caused age-specific shifts in the profile, making the relationship more complicated.

Karatzas (2000) tested a number of hypotheses of rising health care costs, modelling real per capita US health care expenditure over the period 1962-1989 with income, health stock and demographic variables. Karatzas constructed four models to explain rising health spending, each focussing on a different set of explanatory variables. One of his conclusions was:

> …what emerges from these exercises is that changes in the economic, demographic and health stock variables produce persistent changes in the per capital real healthcare, and these findings do not support the contention that the per capita real income is the only major determinant of per capita real health care spending. (pp. 1088-1089)

Karatzas' Equation 4, which is the only of the four models to incorporate ageing, returns an R^2 value of 0.98. According to his results, a one per cent increase in the proportion of over 65s in the economy will cause total per capita health expenditure to rise by 2.55 per cent. Importantly, the model itself is not completely removed from income issues, also including a statistically significant measure of income distribution (the ratio of nominal wages to nominal GDP). Notably, as health care spending data is disaggregated to finer levels (for example per capita government outlays and per capita pharmaceutical expenditure) ageing, plays a less prominent role as a statistical explanatory variable,.

Overall, while the studies sampled are not universal in their conclusion, in general, they do not find ageing to be a statistically significant determinant of health expenditure (particularly when income is also included in the model).

Why is ageing not showing up in the data?

Although it is difficult to be conclusive, there are a number of explanations as to why ageing has not been found to have a significant influence on health expenditure.

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[1] Education is included as an indicator of economic development.

Accelerating ageing

In a climate of rapid income growth and technological advances, ageing has historically been a relatively minor issue for most countries. In Australia, the proportion of the population aged over 65 grew at an average annual rate of 0.7 per cent between 1960 and 1990 (see table 5.2). However, over this same period, the average annual rate of real GDP growth was 3.9 per cent. Relative to income growth, ageing has understandably played only a secondary role in driving health expenditures.

Table 5.2 shows the growth rate of people over 65 years over the periods 1960 to 1990 and 1999 to 2050 for 20 OECD countries. Of those listed, Japan recorded the fastest degree of ageing to 1990, with the proportion of over 65s growing annually at a rate of 1.7 per cent. Belgium and France, were the slowest over the period with a growth rate of only 0.4 per cent. Forecasting ahead, growth for all countries is expected to accelerate, with 16 nations achieving annual growth of over 2.0 per cent, including Finland and Japan at 4.4 per cent and 5.6 per cent respectively. Australia's rate of ageing is forecast to more than triple its recorded rate, rising to 2.6 per cent.

Thus, relative to the role of technology and demand, ageing may have been a relatively minor factor driving health expenditure. However, as ageing accelerates in the coming decades its significance is likely to increase.

Offsetting factors

With the modest level of ageing experienced in most countries to date, its impact may have been offset by other factors. The two factors commonly suggested include, compression of morbidity (falling age specific disability rates) and institutional rationing of health expenditure. Another is that ageing and death rates do not always move in the same direction.

Compression of morbidity

Chapter 2 suggested that disability rates are falling but this is unlikely to reduce future health expenditure because of more intensive medical treatment.

Table 5.2 **Annual growth of elderly population, as a proportion of total population, selected OECD countries**

Country	*1960-1990*[a]	*1999-2050*[b]
	per cent	per cent
Belgium	0.4	0.6
France	0.4	0.8
Austria	0.5	1.1
United Kingdom	0.6	1.7
Switzerland	0.7	2.0
New Zealand	0.5	2.0
Iceland	0.6	2.5
United States	0.7	2.5
Denmark	0.9	2.5
Australia	**0.7**	**2.6**
Sweden	1.0	2.6
Norway	0.9	2.6
Germany	1.0	2.8
Italy	1.0	3.3
Netherlands	1.0	3.4
Greece	1.0	3.7
Spain	1.1	3.7
Canada	1.0	3.8
Finland	1.4	4.4
Japan	1.7	5.6
Unweighted average	**0.9**	**2.7**

a Estimated from Getzen (1992) as the proportional change in per cent of total population aged over 65, 1960 to 1990. **b** Estimated from UN Division of Economic and Social Affairs, Population Division (1999); proportional change forecasted of per cent of total population aged over 60, 1999-2050

However, over the period covered by the majority of the studies, a greater proportion of the gains may have come from lifestyle changes or the use of relatively cheap medications. In a report for the Myer Foundation, Byles and Flicker (2002, p. 2) report that the dramatic increases in life expectancy since the late 1960s have been largely the result of:

> …declines in deaths due to heart disease, stroke and lung cancer… mostly due to a reduction in smoking, but also due to control of blood pressure and cholesterol and improvement in medical treatments.

Cutler (2001a) also attributes some of the reduction in disability in the US to reduced smoking and behavioural changes. To the extent that health of the elderly in the period from 1960 to 1990 improved from these factors it may have somewhat offset the modest impact of aging. However, the future extent of population ageing will preclude a similar effect.

Rationing

To some extent, the impact of ageing on the health expenditures may have been muted across the OECD, because of the public sector's significant influence in the market. Sticky policy mechanisms and institutional arrangements, including rigidities in expanding budgets with increased needs, may constrain spending.

Getzen (1992) argued that budget realities limit the impact of ageing on OECD public health expenditures. Getzen suggested ageing has not substantially increased the total health care bill, but only affects the allocation of expenditures:

> Ageing will increase the demand for health care, but adjustment to budgetary realities will limit that increase so the *structural*, or aggregate, effect of one person becoming older is not 200 percent or 500 percent of average per capita spending, as is assumed in age group projections, but more of the order of 5-50 percent… A clear robust negative empirical result, that ageing is *not* a significant cause of rising health care costs… may also strengthen the recognition that spending is a result of political and professional choices… (p. S103).

Similarly, Chernichovsky and Markowitz (2003, p. 7) stated:

> In the supply driven public system, the health budget grows at a given rate that may be quite independent of particular or age-specific health needs, but once established, the budget is redistributed according to socially defined needs of age-specific costs.

Health systems differ among countries, and change over time. As such, the degree of rationing is also likely to differ among countries and across time within countries. Thus, rationing is another factor that could obscure underlying demand pressure on health expenditure from ageing.

Rationing is a possible response by governments to future pressure on health expenditure from ageing. However, this would involve denial of care comparable to the standards applying in other countries. In effect, while there might be no fiscal gap associated with health care, there would be a treatment deficit.

Classification of health data

Jacobzone and Oxley (2002) present data on total care costs for the OECD. They define total care to include long-term care for the aged, as well as health care. They note that while increases in spending on these two categories are driven by somewhat different sets of factors:

> Nonetheless, the borders between these services are blurred: for example, because long-term care for the very dependent merges with hospital care and various kinds of ambulatory care may also help in keeping the elderly independent as long as possible.

Such blurring in classifications are evident in widely differing proportions of expenditure on health and long term care among developed countries. Sweden is a good case in point. Sweden is often cited as an example of why ageing may not have a significant impact on health costs. It spends less as a proportion of GDP on 'health care' than Australia (8.8 per cent compared to 9.1 per cent in 2001) yet has a greater proportion of over 65s. However, according to the OECD (2004b), Sweden spends 4.5 per cent of GDP on home care services for the elderly. It appears that significant health care provided in a home-setting may be included in this category, rather than as health care.

By contrast, the OECD data for Australia record only 0.3 per cent of GDP as publicly funded aged care. In Australia's case, high level residential care (comprising the majority of government aged care expenditure) is classified as health expenditure, in line with the World Health Organisation guidelines. To avoid double counting, such residential care is likely to be excluded from the OECD data base on aged care.

Combining health care and aged care expenditure, Sweden's expenditure was 11.1 per cent of GDP in 2001 compared with Australia's 9.3 per cent.

Overall, the blurring of the boundary between health care and aged care provides further reason to be careful when interpreting the results of studies that examine the links between ageing and 'health care'.

Divergence between ageing and death rates

As discussed in appendix C, the rate of ageing (for example, as measured by the proportion of the population over 65) and the crude death rate do not always move in sequence. For the last 20 years in Australia, the proportion of older people has been rising, but the crude death rate has been falling. A number of countries appear to show a similar pattern.

To the extent that health costs are related to the period before death (as suggested by Gray 2004), falling death rates would have reduced the historical impact of ageing.

However, as is also discussed in appendix C, Australia is entering a period where both ageing and the crude death rate both rise significantly.

Econometric issues

There is debate about the econometric methods of specific studies — such as Zwiefel's influential study on the costs of death (box 5.1) — and of the methods used in macroeconomic studies more generally.

Hansen and King (1996) raise the issue of 'stationarity' (or rather the lack of) in the data sets used by most studies. Loosely, time series data are stationary if the mean, variance and covariance do not change over time. Stationarity is one of the critical assumptions required when performing ordinary least square regression. Hansen and King survey the typical methodologies wherein real per capita health care expenditure is predicted as a function of real per capita income and other demographic or health stock variables. They argue that the:

> … results obtained may be misleading, or even completely spurious, if the variables employed are not individually, or collectively, stationary. (p. 130)

Testing by Hansen and King (1996, p. 130) found non-stationarity in approximately two thirds of the variables in data sets for health care expenditures, GDP, ageing and institutional provision across 20 OECD nations. No single country exhibited a data set entirely stationary in levels. Alternative testing for stationarity by both Blomqvist and Carter (1997) and Gerdtham and Lothgren (2000) reached the same conclusions.

While there is support for Hansen and King's results, it is not unanimous. Using a different set of tests, McCoskey and Selden (1998), and more recently Jewell et al. (2003) have obtained different results — finding that health care spending and GDP are stationary. As part of an ongoing debate, however, these results too have been met with claim and counter claim, making a definitive judgment difficult.

Jewell et al. (2003) identify the issue of structural breaks in the data. They argue that it is necessary to test for structural breaks, before asserting that health care expenditure and GDP are non-stationary sequences (or stationary for that matter):

> It is now well known that a structural break can be mistaken for non-stationarity. Therefore, it is possible that previous findings of non-stationarity in [health expenditures] and GDP may be due to the failure to allow for structural breaks. (p. 314)

Using the panel LM unit root test, Jewell et al were able to identify structural breaks in 12 of the 20 countries surveyed (the vast majority of which happened between 1973 and 1983) (Jewell et al. 2003, p. 319). These structural breaks occurred during or shortly after a recession. They note:

> … the business cycle might significantly impact health expenditures, since the government plays a major role in financing of [health expenditures] in most OECD countries. As such the structural breaks in [health expenditures] can be potentially

> influenced by significant fluctuations in the business cycle that directly impact government revenues. Close examination of the break points seems to support this conjecture, since many of the break points in [health expenditure] are consistent with recessionary periods. (p. 319)

Having correctly controlled for these structural breaks, their findings support both GDP and health spending as being stationary variables in most countries, around one or two breaks. Controlling for stationarity in this manner may overcome the problems identified by Hansen and King.

Conclusion

Many empirical studies find that ageing has not been a statistically significant factor influencing past growth in health expenditure. This may well be because the degree of ageing to date has been modest compared with what is projected to occur over the next 40 years.

The evidence about stable age-cost profiles over time (chapter 6) suggests that, all other things being equal, ageing must have contributed modestly to historical pressure on countries' health costs. That this is not evident in the data suggests that:

- nuances in the data and/or econometric issues have masked the effects of ageing; and
- that other factors — such as rationing, the importance of costs associated with death and improvements in health over the period in question — have meant that the impact of ageing has been muted.

In conclusion, the macro econometric studies alone do not provide strong evidence for rejecting the proposition that ageing will exert significant pressure on health expenditure in the future.

Box 5.1 **Debate on Zweifel et al 1999**

Zweifel et al. (1999) use data from two major Swiss private health care funds to test for a relationship between death and expenditures. Data from the two health care funds tracks the expenditure history of member decedents over the period 1983-1994. In their model age, gender and quarters to death are used to predict per capita total health care expenditure. Data from two samples returned significant coefficients on age variables (age of decedent and age of decedent squared) when testing the full sample of decedents, however, was insignificant when the sample was limited to just the over 65s. In addition the value of the ageing coefficients themselves suggested that ageing had only a minor influence on the health care costs recorded over the period.

The number of quarter year periods before death 'variable' yielded both statistically significant and sizeable coefficients leaving Zweifel et al. to conclude that the

> …relationship between age and HCE [Health Care Expenditure] is in fact a relationship between increasing age-specific mortality and the high cost of dying… (p486)

And therefore:

> …per capita HCE is not necessarily affected by the ageing of the population… Rather, an increase in the elderly's share of population seems to shift the bulk of HCE to higher age, leaving per capita HCE unchanged (p493).

The paper by Zweifel et al. has drawn substantial criticism for its method and data selection. The data pertains only to decedents and therein assumes no use for health care expenditure to actually prolong the time of death. Salas and Raftery (2001) ask that if there is no such relationship, then why is health care sought for in the first place? They argue:

> …it is clearly plausible that HCE in a given quarter does contemporaneously affect health status and thence closeness to death (p670).

In the regression estimates, Zweifel et al. assume health expenditure and time to death to be weakly exogenous. Salas and Raftery argue that they should have assumed the relationship to be endogenous, and that the conclusions reached by Zweifel et al. may be biased as a result. In response, Zweifel et al. (2001, p. 673) make the point that thus far, health economists have been unable to find a relationship between health care expenditure and measures of longevity.

Dow and Norton (2002), also raise concerns about the choice of model, stating that Zweifel et al.:

> …invoke the Heckit model for inappropriate reasons, derive the wrong marginal effects for their main tests of interest, and use an unsatisfactory test of the Heckit versus the two part model. (p. 2)

6 Health cost decompositions

6.1 Decomposition methods

Ageing will have big effects on government funded social expenditures and particularly health care costs. Other factors will also affect such costs, such as growth in Australia's population, changes in real health prices and varying patterns of demand for services per capita. This paper shows that different methods produce wildly different relative contributions of these various factors to the change in health spending. All of the answers are correct for the questions being posed — what distinguishes them is whether the questions, given the policy problems of interest, are sensible. This paper outlines the many ways of representing the effects of ageing versus other factors on health expenditure and discusses their drawbacks and advantages.

The simple approach: partial allocation methods

At the most simple level, total real health expenditure per capita at any one time is the sum of spending across age groups:

$$E_t = \sum_{j=0}^{85} S_{jt} \times C_{jt} \qquad \{1\}$$

where j represents each year of age up to 84 years and a residual group combining people of ages 85 and over; S_{jt} is the share of the total population of age j at time t; and C_{jt} is the average (government) cost of health care in year t for the jth age group.

The change in expenditure between time t and t-1 is:

$$\Delta E = \sum_{j=0}^{85} \{(S_{j,t} \times C_{j,t}) - (S_{j,t-1} \times C_{j,t-1})\} \qquad \{2\}$$

There are many different ways of casting questions about the effects of ageing and other influences on total costs, with each providing usually different perspectives. A common approach is the *discrete derivative* approach. This assesses the extent to which per capita health costs would change from present levels if the age structure changed to that prevailing 40 years later, but all age-specific costs stayed at their current values. The total change in costs would be:

$$V_1 = E_t\big|_{C_{j,t}=C_{j,t-1}} - E_{t-1} = E_{t-1}\big|_{S_{j,t-1}=S_{j,t}} - E_{t-1} = \sum_{j=0}^{85} \Delta S_{j,t} \times C_{j,t-1} \qquad \{3\}$$

where t-1 is the period 40 years before period t. This is akin to comparing today's costs with those of a fictional world in which population ageing occurs overnight.

An alternative version of this approach is to ask by how much would future health care costs change if all age specific costs remained at their *future* values, but the age structure had shifted to its present values? This is akin to comparing future projected costs with those of a fictional future world in which the last 40 years of population ageing is reversed, but with age-specific expenditures staying fixed at their future levels. It is calculated as:

$$V_2 = E_t - E_{t-1}\big|_{C_{j,t-1}=C_{j,t}} = E_t - E_t\big|_{S_{j,t}=S_{j,t-1}} = \sum_{j=0}^{85} \Delta S_{j,t} \times C_{j,t} \qquad \{4\}$$

Both {3} and {4} are answers to the question: what happens to per capita health expenditure if age structure changes, but age-specific costs stay the same. The difference between them is the choice of the benchmark period — now or the future.

There are corresponding expressions to {3} and {4} that measure the effect of rising real age-specific costs per person (which collectively picks up the effects of excess of medical inflation above background inflation in the economy and increases in real health care demand per capita). These are, respectively:

$$V_3 = \Delta E_{|\Delta S=0,\, base\ year\ is\ t-1} = \sum_{j=0}^{85} \Delta C_{j,t} \times S_{j,t-1} \qquad \{5\}$$

and

$$V_4 = \Delta E_{|\Delta S=0,\, base\ year\ is\ t} = \sum_{j=0}^{85} \Delta C_{j,t} \times S_{j,t} \qquad \{6\}$$

It is possible to extend this approach to total real expenditure or even total nominal expenditure rather than per capita expenditure, by redefining E as:

$$\hat{E}_t = \sum_{j=0}^{85} S_{jt} \times C_{jt} \times POP_t \quad \text{or} \quad \tilde{E}_t = \sum_{j=0}^{85} S_{jt} \times C_{jt} \times POP_t \times PRICE_t \qquad \{7\}$$

where POP_t and $PRICE_t$ is the total population and the general price index at time t, respectively. In the case of $\hat{E}$, the change in total real spending can be decomposed into a spending effect, and two demographic effects: changes in the age structure and changes in population numbers. This was the approach used in the Intergenerational Report.

Expressed as a share of the relevant definition of ΔE, ageing appears to play a small relative role (table 6.1), especially when the initial year is used as the base year and the decomposition is applied to the change in *nominal* health expenditure. But the results, while easily derived and technically correct, are apt to be misunderstood and have several drawbacks as measures of the effects of various factors on health costs.

Table 6.1 **Different decompositions of the change in health spending using partial effect models**[a]

2003-04 to 2044-45

Definition of health expenditure	*Ageing*	*Real age-specific per capita costs*	*Population numbers*	*General price effects*	*Sum of partial effects*
	Share of total change				
	%	%	%	%	%
Current base					
(1) Real spending per capita	12.7	67.8	..	..	80.5
(2) Real health spending	8.0	42.7	11.3	..	62.0
(3) Nominal health spending	2.5	13.2	3.5	15.0	34.2
Future base					
(4) Real spending per capita	32.2	87.3	..	..	119.5
(5) Real health spending	28.6	77.5	37.0	..	143.1
(6) Nominal health spending	24.3	65.8	31.4	69.1	190.6

a Average cost profiles for each age up to age 85 were estimated for all health costs. Rather than use the projected GDP series from chapter 5, the growth rate in age-specific health costs per person was assumed to be equal to a constant GDP per capita growth rate of 1.7 per cent per year plus a 0.6 per cent premium (or 2.3 per cent per annum). This allowed easier experimentation with different growth trajectories, while being close to the observed series (noting that the main purpose of this paper is to illustrate the impacts of different computational methods). Inflation was assumed to be 2.5 per cent per annum.

Source: Commission estimates.

Drawbacks of the simple approach

Results vary with choice of base year

Different answers will be obtained depending on whether the current year or future year is used as the benchmark year. For example, ageing accounts for under

13 per cent of the total change in real health expenditure using a current base year approach, but over 32 per cent of the total change using a future base year approach. This drawback may be alleviated by expressing the change in expenditure as a ratio to an appropriate counterfactual. For example {3} can be normalised by initial year expenditure:

$$\frac{E_{t-1}\big|_{S_{j,t-1}=S_{j,t}} - E_{t-1}}{E_{t-1}} = \frac{\sum_{j=0}^{85} \Delta S_{j,t} \times C_{j,t-1}}{\sum_{j=0}^{85} (S_{j,t-1} \times C_{j,t-1})} \qquad \{8\}$$

while {4} can be normalised by the expenditure that would occur in the future were age-specific costs to be at their future values, but with the present age structure:[1]

$$\frac{E_t - E_t\big|_{S_{j,t}=S_{j,t-1}}}{E_t\big|_{S_{j,t}=S_{j,t-1}}} = \frac{\sum_{j=0}^{85} \Delta S_{j,t} \times C_{j,t}}{\sum_{j=0}^{85} (S_{j,t-1} \times C_{j,t})} \qquad \{9\}$$

If all age groups face a common rate of change in per capita age-specific costs over time[2] (as assumed, for example in the Intergenerational Report), then {8} and {9} give the same answer. If the rates are not common, then {8} and {9} will be different, but will still be similar for credible profiles of age-specific costs over time.

One of the advantages of formulations of this kind is that the percentage effect of ageing on health expenditure is the same — at 29 per cent — regardless of whether a broad or narrow definition of spending is adopted. Accordingly, the percentage effect on nominal spending of holding all other factors fixed at the initial values, but letting the age structure shift to its 2041-42 level is the same as the percentage effect on real per capita health spending of holding all other factors fixed at the initial values, but letting the age structure shift to its 2041-42 level. This is in marked contrast to expressing partial effects relative to ΔE as in table 6.1, where the impact of ageing can be made to virtually disappear by expressing it over the change in nominal spending.

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[1] Where the effects of spending is being estimated, the counterfactual is appropriately re-defined.

[2] To be precise, {5} = {6} when, for any given set of years from t, t+1, t+2, … v, $C_{j,v} = C_{j,t} \times \prod_{k=t}^{v-1} (1+\zeta_k)$ for all j, where ζ_k is the growth rate in age-specific costs per capita in year k.

Table 6.2 **How much percentage difference does ageing and other influences have on health expenditure, all other things being equal?**

2003-04 to 2044-45[a]

Ageing	*Real age-specific per capita costs*[b]	*Population numbers*	*General price inflation*[c]
% points	% points	% points	% points
28.8	154.0	40.7	175.2

[a] Each effect is measured as the percentage difference to spending in 2003-04 made by changing the relevant component of costs to its 2044-45 value. Thus, the effect of ageing is measured as: $\{E_{t-1}|_{S_{j,t-1}=S_{j,t}} - E_{t-1}\}/E_{t-1}$

while the effect of population on expenditure, holding all other influences fixed is $\{E_{t-1}|_{POP_{j,t-1}=POP_{j,t}} - E_{t-1}\}/E_{t-1}$ with a similar form for other effects. As noted in the body of the paper, so long as all age groups face a common rate of change in per capita age-specific costs over time, the measured effects are the same as the percentage difference between spending in 2044-45 and the spending that would have occurred in the future had the relevant expenditure component been set to its 2003-04 value, with all other future expenditure components left unchanged. [b] A growth rate of 2.3 per cent real per capita age-specific health spending was assumed. [c] An inflation rate of 2.5 per cent per year was assumed.

Source: Commission estimates.

Partial methods fail an adding up condition

A second drawback in {3} – {9} is that the sum of the partial impacts (for example, V_1+V_3 or V_2+V_4) does not equal the total change in expenditures. The sum of the partials with a present base year (V_1+V_3) underestimates the total change in expenditure by ΔC ΔS, while the sum of the partials with a future base year (V_2+V_4) overestimates the total expenditure by ΔC ΔS:

$$V_1 + V_3 = \sum_{j=0}^{85}\{\Delta S_{j,t} \times C_{j,t-1} + \Delta C_{j,t} \times S_{j,t-1}\} = \Delta E - \Delta S_{j,t} \times \Delta C_{j,t} \qquad \{10\}$$

$$V_2 + V_4 = \sum_{j=0}^{85}\{\Delta S_{j,t} \times C_{j,t} + \Delta C_{j,t} \times S_{j,t}\} = \Delta E + \Delta S_{j,t} \times \Delta C_{j,t} \qquad \{11\}$$

These biases occur because as age structure changes, so do age-specific costs — this gives rise to the ‘mix’ effect, ΔC ΔS. Only where changes in each factor are very small are the sums of the partials equal to the actual change. Over a lengthy period, the changes are not small.

In a technical sense, the fact that the partials do not add to the total change in expenditure is not a problem, but it can lead to misinterpretation of partial impacts and confusion about the sources of expenditure increases. In particular, if it is found that ageing accounts for a given percentage of ΔE, **it cannot be inferred that cost factors account for the residual percentage.**

In this context, it would be useful to have a method for fully apportioning the change in expenditure to its various constituents. One method that does this is the *linear interpolation* method. Say that we observe just two points: A (C_{t-1},S_{t-1}) and B (C_t,S_t), but that we imagine a straight line joining these two points across the time interval from t-1 to t.[3] This line can be broken into n arbitrarily small segments (figure 6.1). Applying the discrete derivative method to the first segment (the move from A to a_1), the change in the value of total expenditure, given fixed age-specific costs, is $\Delta E_1|_{\text{fixed C}} = C_{t\text{-}1} \times \Delta S_t / n$.[4] The same method is applied in the second segment to estimate the effect from a_1 to a_2, but taking note of the fact that age-specific costs have changed by a small amount from A to a1:

$$(E_1 - E_2)|_{\text{fixed C}} = \Delta E_2 |_{\text{fixed C}} = \Delta S_t / n \times C_{t-1+1/n} = \Delta S_t / n \times (C_{t-1} + \Delta C_t / n) \qquad \{12\}$$

In the next segments the comparable measures are:

$$\Delta E_3 |_{\text{fixed C}} = \frac{\Delta S_t}{n} \times (C_{t-1} + \frac{2}{n}\Delta C_t), \quad \textit{and so on until...} \quad \Delta E_n |_{\text{fixed C}} = \frac{\Delta S_t}{n} \times (C_{t-1} + \frac{(n-1)}{n}\Delta C_t)$$

Thus, this method takes account of the fact that as ageing occurs, age-specific costs are also changing. Similar partials may be calculated for changes in E arising from changes in age-specific costs, given a fixed age structure over any given segment.

If the small changes in E are summed across all n intervals then the estimated components of ΔE are:

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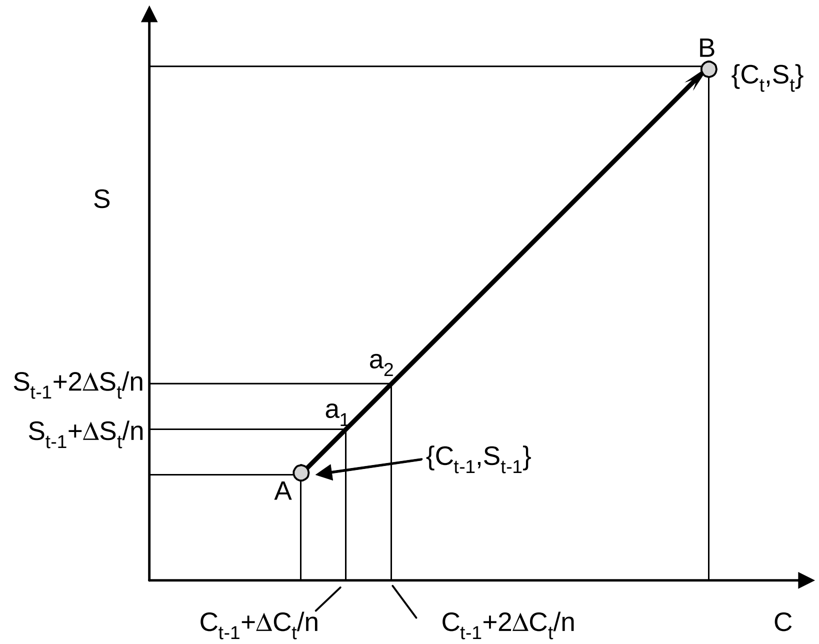
3 For ease of computation, the age subscripts have been dropped. These calculations are undertaken for each of the relevant age groups.

4 Note that if the total change over the first segment is calculated it includes a term $(\Delta S_t \times \Delta C_t) / n^2$, but this can be ignored relative to the remaining components as n gets large.

Figure 6.1 **The linear interpolation method**



$$\lim_{n\to\infty} \sum_{i=1}^{n} \Delta E_i \,|_{\text{fixed C}} = (\Delta S_t \times C_{t-1} + \frac{\Delta S_t \Delta C_t}{2}) = \Delta S_t (\frac{C_{t-1} + C_t}{2}) = \Delta S_t \overline{C} \text{ and} \qquad \{13\}$$

$$\lim_{n\to\infty} \sum_{i=1}^{n} \Delta E_i \,|_{\text{fixed S}} = (\Delta C_t \times S_{t-1} + \frac{\Delta S_t \Delta C_t}{2}) = \Delta C_t (\frac{S_{t-1} + S_t}{2}) = \Delta C_t \overline{S} \qquad \{14\}$$

These sum to the total change in E as in equation {2}, so that the exact percentage contribution of ageing versus age-specific costs can be calculated. To produce an estimate of the impacts of ageing or costs across more than one year, the results from the linear interpolation method are simply added — representing a piecewise linear interpolation through all successive points.

The same decomposition achieved by taking limits from the linear interpolation method can be derived in a more straightforward way by noting that there are two (symmetric) representations of ΔE:

$$\Delta E_t = S_t C_t - S_{t-1} C_{t-1} = S_t C_t - S_{t-1} C_{t-1} + (S_t C_{t-1} - S_t C_{t-1}) = S_t \Delta C_t + C_{t-1} \Delta S_t \qquad \{15\}$$

and that also

$$\Delta E_t = S_t C_t - S_{t-1} C_{t-1} = S_t C_t - S_{t-1} C_{t-1} + (S_{t-1} C_t - S_{t-1} C_t) = S_{t-1} \Delta C_t + C_t \Delta S_t \,, \qquad \{16\}$$

which on averaging gives:

$$\Delta E_t = \Delta C_t \times (\frac{S_t + S_{t-1}}{2}) + \Delta S_t \times (\frac{C_t + C_{t-1}}{2}) = \Delta C_t \times \overline{S} + \Delta S_t \times \overline{C} \qquad \{17\}$$

It is possible to extend this simple approach to more complex cases, averaging over the multiple representations of ΔE. For example, suppose the variable of interest is total health expenditure (not per capita spending) and that the separate contributions of age structure, population change and age-specific costs are wanted. In that case, it can be shown that (for each age group):

$$\Delta E_t = \frac{\Delta C_t.(2\overline{S}\ \overline{P} + \overline{SP}) + \Delta S_t.(2\overline{C}\ \overline{P} + \overline{CP}) + \Delta P_t.(2\overline{C}\ \overline{S} + \overline{CS})}{3} \qquad \{18\}$$

where P is the total population. This gives rise to three partial effects that add to the total change in health expenditure and can also be shown to be the same solution as that found when the limits are taken of the results from the linear interpolation method applied to the three variable case. So, the linear interpolation approach provides the analytical motivation for deriving the partial effects as the average of the multiple representations of ΔE. The method can be seen as calculating the effects of each of the various factors on expenditure along a time path in which the values of the 'fixed' variables are updated along the adjustment path (in contrast to the discrete derivative method, which holds the value of the fixed variable at the same starting value at every point along the adjustment path).

While analytical decompositions of the form {17} can be found for any number of multiplicative terms, the expressions become increasingly elaborate. For example, for a four variables case (x1 to x4 where E = x1*x2*x3*x4) then the decomposition of the change in E from t-1 to t is made up of 4 components (these were calculated by taking the limit as iterations approached infinity in the interpolation approach). Thus for each of the transitions from t-1 to t, the change in E can be decomposed as follows:

$$\Delta E \text{ due to } x_1 = \Delta x_1 \times \left\{ \begin{array}{l} x_{4,t-1} \times x_{2,t-1} \times x_{3,t-1} + \frac{1}{2}\Delta x_4 \times x_{2,t-1} \times x_{3,t-1} + \frac{1}{2}\Delta x_3 \times x_{4,t-1} \times x_{2,t-1} + \\ \frac{1}{2}\Delta x_2 \times x_{3,t-1} \times x_{4,t-1} + \frac{1}{3}\Delta x_4 \times \Delta x_2 \times x_{3,t-1} + \frac{1}{3}\Delta x_2 \times \Delta x_3 \times x_{4,t-1} + \\ \frac{1}{3}\Delta x_4 \times \Delta x_3 \times x_{2,t-1} + \frac{1}{4}\Delta x_4 \times \Delta x_2 \times \Delta x_3 \end{array} \right\}$$

$$\Delta E \text{ due to } x_2 = \Delta x_2 \times \left\{ \begin{array}{l} x_{1,t-1} \times x_{3,t-1} \times x_{4,t-1} + \frac{1}{2}\Delta x_1 \times x_{3,t-1} \times x_{4,t-1} + \frac{1}{2}\Delta x_4 \times x_{1,t-1} \times x_{3,t-1} + \\ \frac{1}{2}\Delta x_3 \times x_{4,t-1} \times x_{1,t-1} + \frac{1}{3}\Delta x_1 \times \Delta x_3 \times x_{4,t-1} + \frac{1}{3}\Delta x_3 \times \Delta x_4 \times x_{1,t-1} + \\ \frac{1}{3}\Delta x_1 \times \Delta x_4 \times x_{3,t-1} + \frac{1}{4}\Delta x_1 \times \Delta x_3 \times \Delta x_4 \end{array} \right\}$$

$$\Delta E \; due \; to \; x_3 = \Delta x_3 \times \begin{Bmatrix} x_{1,t-1} \times x_{2,t-1} \times x_{4,t-1} + \frac{1}{2}\Delta x_1 \times x_{2,t-1} \times x_{4,t-1} + \frac{1}{2}\Delta x_4 \times x_{1,t-1} \times x_{2,t-1} + \\ \frac{1}{2}\Delta x_2 \times x_{4,t-1} \times x_{1,t-1} + \frac{1}{3}\Delta x_1 \times \Delta x_2 \times x_{4,t-1} + \frac{1}{3}\Delta x_2 \times \Delta x_4 \times x_{1,t-1} + \\ \frac{1}{3}\Delta x_1 \times \Delta x_4 \times x_{2,t-1} + \frac{1}{4}\Delta x_1 \times \Delta x_2 \times \Delta x_4 \end{Bmatrix}$$

$$\Delta E \; due \; to \; x_4 = \Delta x_4 \times \begin{Bmatrix} x_{1,t-1} \times x_{2,t-1} \times x_{3,t-1} + \frac{1}{2}\Delta x_1 \times x_{2,t-1} \times x_{3,t-1} + \frac{1}{2}\Delta x_3 \times x_{1,t-1} \times x_{2,t-1} + \\ \frac{1}{2}\Delta x_2 \times x_{3,t-1} \times x_{1,t-1} + \frac{1}{3}\Delta x_1 \times \Delta x_2 \times x_{3,t-1} + \frac{1}{3}\Delta x_2 \times \Delta x_3 \times x_{1,t-1} + \\ \frac{1}{3}\Delta x_1 \times \Delta x_3 \times x_{2,t-1} + \frac{1}{4}\Delta x_1 \times \Delta x_2 \times \Delta x_3 \end{Bmatrix}$$

It is likely that further manipulation can simplify the expressions in terms of averages as in the 3 and 2 variable cases above, but this is not straightforward or necessary. The final decomposition is achieved by summing across all of the time periods. The clear symmetry of the decompositions is apparent — and allows higher order decompositions to be derived readily.

It is also possible to use a computer intensive technique (box 6.1) to provide the appropriate decomposition for any number of multiplicative terms without elaborate algebraic manipulation and this method can readily be extended to the use of cubic splines instead of piecewise linear interpolation.[5]

There are still major variations between results based on different definitions of expenditure, but all partial effects add to the total (table 6.3).

[5] However, results using cubic splines were found to be nearly identical to those of piecewise linear interpolation.

Table 6.3 **Different decompositions of the change in health spending using the 'full allocation' approach**[a]

2001-02 to 2041-42

		Ageing	*Real age-specific per capita costs*	*Population numbers*	*General price inflation*	*Total*
		Share of total change				
		%	%	%	%	
(1)	Nominal health spending[b]	8.6	38.3	11.5	41.6	100.0
(2)	Real health[c] spending	15.6	63.8	20.7	..	100.0
(3)	Real health spending per capita[c]	20.0	80.0	..	..	100.0

[a] Where a 'full allocation' result is shown it is based on piecewise linear interpolation using data for all years between the two endpoints. [b] Inflation is assumed to be 2.5 per cent per annum. [c] The growth rate in age-specific health costs per person is assumed to be 2.3 per cent per annum.

Source: Commission estimates and 'Health Decomposition' spreadsheet accompanying the technical appendix.

Using an inappropriate benchmark for significance

As is apparent in tables 6.1 and 6.3 Interpreting the relative extent to which ΔE can be ascribed to one effect on another can be crucially dependent on how expenditure is characterised.

For example, suppose that instead of apportioning the increase in real health care expenditure between ageing, population growth and real age-specific expenditures, an analyst decided to apportion the increase in *nominal* health care expenditure between ageing, population growth, real age-specific expenditures and inflation. In the case where inflation is running at 2.5 per cent per annum, the contribution of ageing to the total change in expenditure is only 2.5 per cent when a partial approach with an initial base year is used (table 6.1), and still only around 9 per cent with a full allocation method (table 6.3). If inflation were higher, then the share of the increase explained by the remaining factors would be even smaller, and over the long run, nearly zero, though clearly nothing real would have changed in the economy.

Box 6.1 **Computer intensive methods for linear interpolation**

Suppose that there are m variables denoted $\{x_1, x_2, \ldots x_q, \ldots x_m)$ such that for any given age and time period:

$$E = \prod_{i=1}^{m} x_i$$

In this case, the impact of the qth variable on the change in aggregate spending (i.e. across all ages) from the starting period (period 1 eg 2004) to a completion year (period T eg 2045) is:

$$\Delta E \mid due\ to\ x_q = \sum_{t=1}^{T-1}\left[\sum_{j=0}^{85}\left(\sum_{k=1}^{n}\frac{\Delta x_{q,j,t+1}}{n}\prod_{i=1,i\neq q}^{m}\left\{x_{i,j,t} + k\times\frac{\Delta x_{i,j,t+1}}{n}\right\}\right)\right]$$

For example, in a three variable case, where E = C.S.P (as in the main text) a computer algorithm would be:

Step 1: sum1=0, sum2=0, sum3=0 *; initialise the partial effects to zero*

Step 2: For t = 1 to T-1 *; set up a loop across periods, ages and iteration counts (n)*
For j = 0 to 85
For k= 1 to n *; n needs to be around 100 for good accuracy*

Step 3:

$$sum_1 = sum_1 + \frac{\Delta C_{j,t+1}}{n}(S_t + k\times\frac{\Delta S_{j,t+1}}{n})(P_t + k\times\frac{\Delta P_{j,t+1}}{n})$$ *; the effect due to C*

$$sum_2 = sum_2 + \frac{\Delta S_{j,t+1}}{n}(S_t + k\times\frac{\Delta C_{j,t+1}}{n})(P_t + k\times\frac{\Delta P_{j,t+1}}{n})$$ *; the effect due to S*

$$sum_3 = sum_3 + \frac{\Delta P_{j,t+1}}{n}(S_t + k\times\frac{\Delta S_{j,t+1}}{n})(P_t + k\times\frac{\Delta C_{j,t+1}}{n})$$ *; the effect due to P*

Step 4: Next k *; iterate loops*
Next j
Next t

Step 5: $Partial_1 = sum_1$, $Partial_2 = sum_2$, $Partial_3 = sum_3$ *; solutions are the cumulative sums*

In that case, a statement to the effect that ageing does not matter much to rises in health care expenditure would be misleading, merely reflecting the extraneous influences of inflation. The nominal rise in expenditure is not interesting for policymakers since the purely inflationary component does not represent a burden to government. As shown in table 6.4, inflation would push up the tax revenue needed to finance nominal health care spending by around the same amount as the inflationary component of health care.

Table 6.4 **Putting the different contributors to health expenditure change into context**[a]

Effect	*Contribution to change in health spending*	*Contribution to change in government revenue to finance health spending*	*Net budget position*
Population	α	α	0
General inflation	π	π	0
Population age structure	β	$-\phi$	$-\phi-\beta$
Increases in real age-specific spending per capita	Δ(GDP/POP)+γ	Δ(GDP/POP)	$-\gamma$
Total	$\alpha+\pi+\beta+\lambda+$ Δ(GDP/POP)	$\alpha+\pi-\phi+$ Δ(GDP/POP)	$-\phi-\beta-\gamma$

[a] The results here are illustrative rather than precise, and would apply only for small changes and short intervals of time. An accurate decomposition is derived below.

Two other approaches to measuring impacts on expenditure have similar deficiencies:

- Analysing total real expenditure (as was undertaken in the Intergenerational Report) instead of real expenditure per capita is also problematic. Governments would not generally be concerned about a rise in total health spending that arose only from population growth so long as per capita income levels were maintained. As with the inflation example, government revenue would also grow with population, so that the net position for government (for a given age structure) would not deteriorate (row 1 of table 6.1).
- More subtly, analysing the full impact of rises in age-specific expenditure rates can be misleading since much of the increase in such rates stems from economic growth, which also enhances governments' capacity to finance such increases. It is only the premium on the growth rate of age-specific health expenditures above GDP per capita growth rates (λ in table 6.4) that presents a potential funding problem for government.

In contrast, ageing has a double effect. It both increases expenditure in a way that is not automatically compensated by revenue benefits and reduces GDP growth by depressing labour participation rates.

This suggests that the significance of various factors on expenditure should abstract from changes that have no effective policy significance. A way to do this is to ask what level of revenue governments would collect in the future were they to maintain the implicit tax rate needed to fund current value health spending in current dollars. Clearly, this represents the status quo in that no change in tax or funding policy is required by that stance. With nominal total health expenditure of ($\tilde{E}$), the implicit tax rate (τ) is:

$$\tau = \frac{\tilde{E}_{t-1}}{POP_{t-1} \times P_{t-1} \times GDPt - 1} \quad or \quad \frac{\sum_{j=0}^{85} (S_{jt-1} \times C_{jt-1})}{GDP_{t-1}} \qquad \{19\}$$

the revenue it would collect with such a tax rate in subsequent years would be:

$$REVENUE_t = \sum_{j=0}^{85} (S_{jt-1} \times C_{jt-1}) \times POP_t \times P_t \times \frac{GDP_t}{GDP_{t-1}} = \sum_{j=0}^{85} (S_{jt-1} \times C_{jt-1}) \times POP_t \times P_t \times IGDP_t \qquad \{20\}$$

where IGDP is an index of real GDP per capita (with a value of one at time t-1). The actual cost of health expenditure at time t is:

$$COSTS_t = \sum_{j=0}^{85} (S_{jt} \times C_{jt}) \times POP_t \times P_t = \sum_{j=0}^{85} (S_{jt} \times C_{jt-1} \times IGP_t \times IGDP_t) \times POP_t \times P_t \qquad \{21\}$$

where IPG is an index of the *premium* real per capita age-specific health spending, set such that $IPG \times IGDP = IH$ where IH is an index of age-specific per capita real health spending (with IPG equalling one at t-1).[6] The revenue shortfall between costs and revenue — which is the policy-relevant issue — is:

$$(COSTS_t - REVENUE_t) = \sum_{j=0}^{85} \{C_{jt-1} \times IGDP_t \times POP_t \times P_t\} \times (S_{jt} \times IGP_t - S_{jt-1}) \qquad \{22\}$$

In per capita real GDP growth-adjusted terms, this shortfall is:

$$BURDEN_t = \sum_{j=0}^{85} \{C_{jt-1} S_{jt} \times IGP_t - C_{jt-1} S_{jt-1}\} = \sum_{j=0}^{85} \{\hat{C}_{jt} S_{jt} - C_{jt-1} S_{jt-1}\} \qquad \{23\}$$

where $\hat{C}_{jt}$ is real per capita age-specific expenditure adjusted for the effects of GDP growth. This can be decomposed into ageing and cost factors using the approaches described above (box 6.2 provides another insight into this decomposition).

6 That is, if GDP growth is g per cent per annum and total per capita real health spending is h per cent per annum, then the premium growth rate is $\lambda=(h-g)/(1+g)$.

Box 6.2 Conceptualising GDP-adjusted spending

Another way of conceptualising the GDP-adjusted measure is to note that adjusting for effects such as prices or population is equivalent to normalising their values to unity for all periods:

Thus: $$\underbrace{\sum_{j=0}^{85}(S_{jt}\times C_{jt}\times POP_t\times P_t)}_{\text{total nominal spending}} \Rightarrow \underbrace{\sum_{j=0}^{85}(S_{jt}\times C_{jt})}_{\text{real per capita spending}} \quad if\ POP_t = P_t = 1$$

Accordingly, GDP-adjusted spending merely extends this principle:

$$\underbrace{\sum_{j=0}^{85}(S_{jt}\times C_{jt-1}\times IPG_t\times IGDP_t\times POP_t\times P_t)}_{\text{total nominal spending}} \Rightarrow \underbrace{\sum_{j=0}^{85}(S_{jt}\times C_{jt-1})\times IPG_t}_{\text{real per capita spending adjusted for GDP growth}} \quad if\ POP_t = P_t = IGDP_t = 1$$

This implies, as in the main text, that:

$$V_5 = (E_t - E_{t-1})\Big|_{\substack{IGDP_t=IGDP_{t-1}=1\\ POP_t=POP_{t-1}=1\\ P_t=P_{t-1}=1}} = \sum_{j=0}^{85}(S_{jt}\times IPG_t\times C_{jt-1} - S_{jt-1}\times C_{jt-1})$$

$$= \sum_{j=0}^{85}(S_{jt}\hat{C}_{jt} - S_{jt-1}C_{jt-1})$$

It is possible, with assumptions about γ (the premium rate of health expenditure growth), to determine how much of the change in this adjusted measure of health expenditure can be attributed to 'unbalanced' health expenditure growth and how much to changes in the age structure.

With the assumption that yearly growth in (age-adjusted) per capita real health spending exceeds GDP growth by 0.6 percentage points, ageing accounts for about half of the increase in real health expenditure that could be expected to concern policymakers. This is much more than is sometimes suggested by more simple, policy-naïve, decomposition methods.

Table 6.5 **Policy relevant decomposition of the change in health spending**
2001-02 to 2041-42[a]

	Ageing	*Real age-specific per capita costs*	*Total*
	Share of total change		
	%	%	%
Real health spending per capita[c] GDP adjusted	50.4	49.6	100.0

[a] Based on piecewise linear interpolation using data for all years between the two endpoints, it is assumed that the difference between annual real GDP growth and total age-specific real health expenditure growth is 0.6 percentage points. This implies that the premium growth rate is (1.017+0.006)/1.017-1.

Source: Commission estimates.

In conclusion, there are a plethora of methods for decomposing expenditure, but only several answer interesting questions or are of real value in understanding the dynamics of spending over time. In our view, these are:

- using a ‘percentage effect’ approach (table G2). This assesses the percentage impact of ageing on spending were all other factors to remain fixed; and
- the ‘revenue shortfall’ approach (table G5), where policymakers want an estimate of the contribution of aging to the *change* in spending over some period.

The prevalence of disability

As the population ages, there will be increasing numbers of people with a disability because disability rates are substantially higher among the old. While ageing will be a major cause of disability in future years, the prevalence of disability also depends on changes in the underlying health and social environment. The monitoring of disability trends is important to provide information on future healthcare requirements and the costs of caring for older people.

Drawing on the ABS survey of Disability, Ageing and Carers (SDAC), this paper presents a picture of people with disabilities in Australia, with an emphasis on older age groups. It examines trends in the prevalence of disability both in Australia and overseas and examines the characteristics of people with a disability by employment status. It then compares ABS data with that on Disability Support Pension recipients and presents the Commission's projections on disability trends which were used as a basis for expenditure projections in chapter 8.

7.1 Measuring disability

Disability is a growing social concern, but how it is measured is the subject of much debate. Disability is a difficult concept to measure because it encompasses a wide range of physical and cognitive problems that are difficult to categorise (Mayhew 2001, p. 3).

Disability also depends on a person's perception of their ability to perform activities associated with daily living. Survey data can underestimate some forms of disability. People may not report certain socially stigmatised conditions, such as alcohol and drug related conditions, schizophrenia, and mental degeneration.

On the other hand, disability data can be too inclusive and measure minor difficulties in functioning that do not require assistance from the community. It also has the potential to count people with disabilities more than once.

The most comprehensive survey about people with disabilities in Australia is the ABS *Survey of Disability, Ageing and Carers* (SDAC) The survey collects information about the nature and severity of disability. The most recent survey was conducted in 2003.

The ABS disability survey measures varying degrees of disability. The survey records a person as having a disability if he/she has a restriction or impairment that restricts everyday activities and has lasted or is likely to last for at least six months. The core levels of restriction are whether a person needs help, has difficulty or uses aids or equipment with a core activity task (namely communication, mobility and self care). Four levels of restriction are measured.

- **Profound**: the person is unable to do, or always needs help with a core activity task.
- **Severe**: the person sometimes needs help with a core activity task or has difficulty understanding or being understood by family or friends or can communicate more easily using sign language or other non-spoken form of communication.
- **Moderate**: the person needs no help, but has difficulty with a core activity task.
- **Mild**: the person needs no help and has no difficulty with any of the core activity tasks, but uses aids and equipment; or cannot easily walk 200 metres or cannot walk up and down stairs with a handrail; or cannot easily bend to pick up an object from the floor; or cannot use public transport, has difficulty using public transport or needs help or supervision to use public transport.

In addition to measuring restrictions to core activities, the ABS measures schooling or employment restrictions. For example, an employment restriction occurs when, because of their disability, a person is permanently unable to work; is restricted in the type of work performed; requires an average of one day off a week; is restricted in the number of hours worked; requires the employer to provide special equipment, modify the work environment or make special arrangements; needs ongoing assistance or supervision; or would find it difficult to change jobs or find a better job (ABS 2003d).

In practise, disability is appropriately measured according to the purpose for which it is being used. For example, in a social policy context, the main interest is in people with profound or severe levels of disability, as these people are in most need of income support and services, such as aged care.

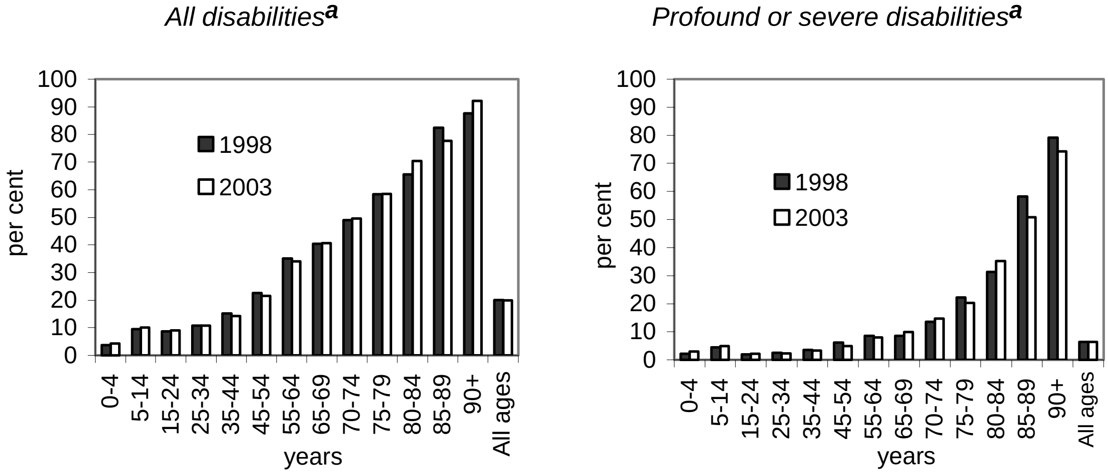
7.2 Trends in the prevalence of disability by age

The 2003 ABS SDAC found that one in five Australians are living with a disability, unchanged from five years ago (after age standardisation). The overall disability rates for males (19.8 per cent) and females (20.1 per cent) were almost identical in the two surveys.

The prevalence of disability steadily increases with age. In 2003, the rate of disability increased from 4 per cent for those aged less than four years to 41 per cent for those aged 65 to 69 years and 92 per cent for people 90 years and older. Similarly, rates for profound and severe disabilities increased with age, reaching over 70 per cent for people aged 90 and over (figure 7.1).

The ABS found that for all age groups the difference between disability rates in 1998 and 2003 was not significant (figure 7.1).

Figure 7.1 **The prevalence of disability by age group 1998 and 2003**
Prevalence rates, per cent



[a] Data for all ages has been age standardised to 2003 survey.

Data source: ABS (2003d).

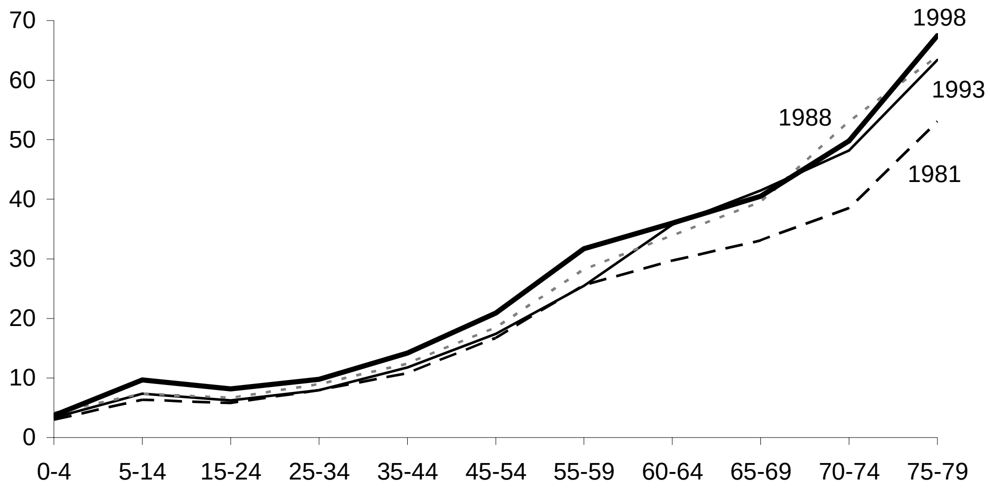
Changes in survey design between 1981 and 1998 have previously made it difficult to compare disability rates prior to 1998. However, in 1998 the ABS produced adjusted estimates, using criteria common only to the 4 surveys conducted between 1981 and 1998, in order to compare disability trends over time.

Adjusted estimates between 1981 and 1998 indicate that the prevalence of disability has been increasing over time (figure 7.2). Much of the increase has been in the severe restriction category.

> … the total specific restriction rate increased from 14.7% in 1988 to 16.1% in 1998, though dipping to 14% in 1993. The rise in 1998 was primarily due to increased rates of severe restriction (from 4.4% in 1993 to 5.5% in 1998) and mild restriction which has increased steadily since 1988. (Davis et al. 2001, p.9)

Figure 7.2 **The prevalence of disability by age group 1981 to 1998**
Prevalence rates, per cent

1981, 1988, 1993 and 1998[a]



a Estimates have been adjusted for comparability, only criteria common to the four surveys have been used
Data source: ABS (1998b).

A few age groups accounted for a large proportion of the increase:

> Over 80 per cent of the difference between 1993 and 1998 and 75 per cent of the difference between 1998 and 1988 is contributed by the 5 to 14 years, 45 to 64 years, 75 to 79 years and over 85 years age groups. (Davis et al. 2001, p.10)

Several reasons have been suggested as to why age-specific disability rates may have increased from 1981 to 1998. These include improved survival rates (more people are surviving life-threatening events such as premature birth, accidents and disease and these can have ongoing effects that limit activities) and greater awareness of disabilities (Davis et al. 2001, p.13).

However, it is difficult to ascertain whether the increase in disability rates is *real* or a statistical anomaly resulting from methodological and conceptual problems. Some of the measured increase can be explained by:

- a greater willingness of people to self-identify in surveys as having a disability. This may be the result of economic incentives to report disability such as the Disability Support Pension or a greater acceptance of, and openness about, people with disabilities in society; and
- improved survey methods and designs. In particular, the wider scope of survey screening questions identifying people with disabilities and the introduction of computer-assisted interviewing in 1998 has resulted in the greater capture of people with disabilities.

The Australian results appear at odds with international trends. Internationally, a growing body of research has found a decline in the prevalence of disability and in particular among the older population.

> Declines in disability prevalence were reported for the USA, Germany, France and Japan; moderate declines in disability were reported for Sweden; mixed patterns of prevalence were reported for Canada, with a clear decline for people aged 65 to 74 years, but an increase in most age groups over 75 years; and no consistent declines were reported in the UK and the Netherlands (Wen 2004, p.3).

A number of factors have been proposed as to why some measures of the prevalence of disability may be falling, including education, socioeconomic status, medical improvements, increased use of aids and equipment, health-related behavioural change and access to technology and assistive devices (Cutler and Schoeni in AIHW 2003d).

However, there have been some mixed trends. In some OECD countries the decline in the prevalence of disability has been accompanied by an increase in the reported prevalence of chronic diseases or conditions (Wen 2004, p. 3). Further, there is contention about measurement of disability, limited survey data and the quality of data on which these results are based (Schoeni et al. 2001, p. 206; Freedman et al. 2004; Freedman and Schoeni 2004).

And even in the US, where declines are usually reported, there is less clear evidence regarding trends in severe disabilities that affect Activities of Daily Living, such as bathing and dressing. There is even less evidence regarding trends in cognitive function among the aged population (Freedman and Schoeni 2004).

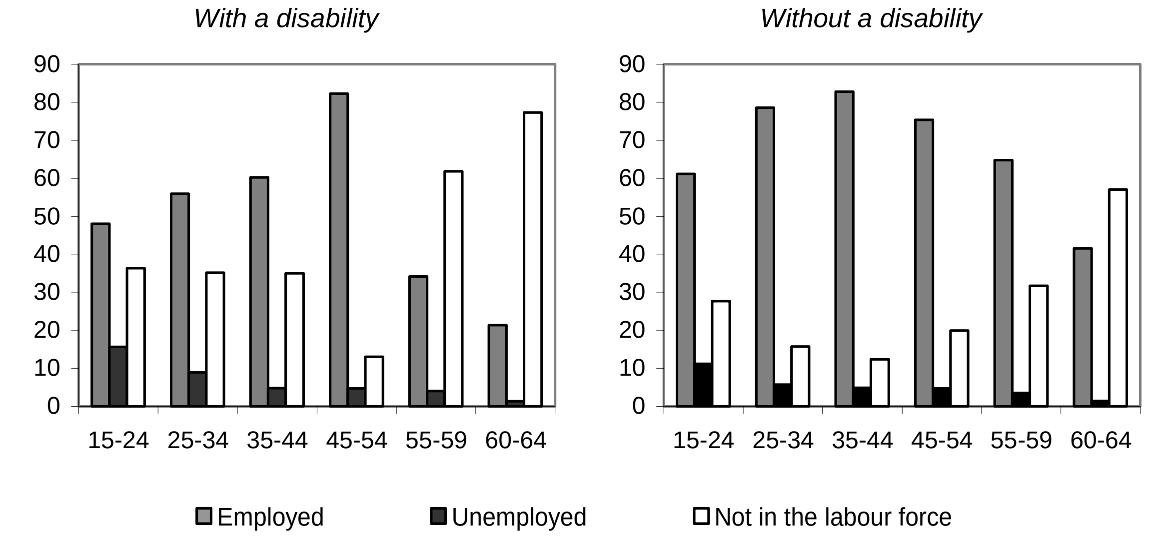
Notwithstanding these concerns, there is no consistent evidence internationally that the prevalence of disability is rising. In this context, this study has projected declining disability rates for the purpose of admission to residential nursing homes, despite the historical ABS data and the difficulties in establishing trends. This approach has also been adopted in other projections, such as Hogan (2004).

7.3 Disability and labour force status

People with a disability have lower participation rates, lower rates of employment and higher unemployment rates than people without a disability. For older age groups, people with a disability have significantly lower participation rates and employment rates (figure 7.3).

In this section, the Commission uses unpublished data from the 1998 ABS SDAC to explore the characteristics of people with a disability according to labour force status, with an emphasis on older age groups. Although somewhat outdated, the labour market trends observed in the 1998 data are likely to be similar today.

Figure 7.3 **Employment and disability status, 1998, per cent**



Data source :Unpublished data from ABS (1998b).

Disability and labour force participation

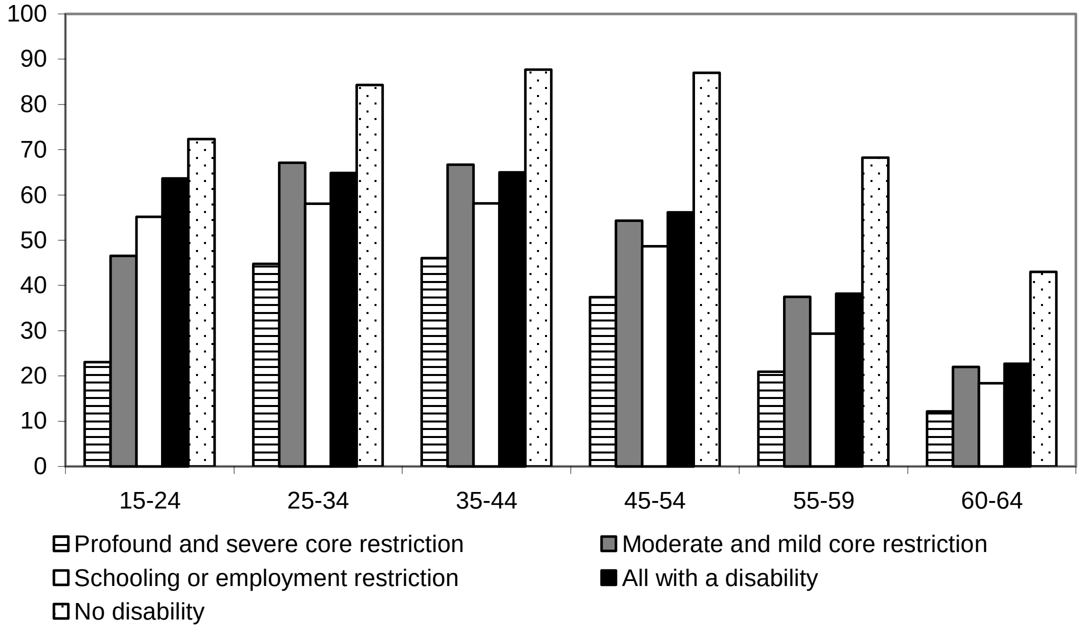
Many people with disabilities are not in the labour force. In 1998, 47 per cent of people aged 15-64 years with a disability were not in the labour force, compared with 20 per cent of those without a disability.

Participation in the labour force decreases markedly with greater levels of disability. In 1998, the participation rate for people that reported a profound core activity restriction was 19 per cent compared with 57 per cent for people with a mild core activity restriction and 80 per cent for people without a disability.

Participation is also lower for older age groups. In 1998, 23 per cent of people aged 60 to 64 years with a disability were in the labour force compared with a participation rate of 43 per cent for people without a disability. For people in this age group with a profound or severe disability the participation rate was even lower at 12 per cent (figure 7.4).

Figure 7.4 **Participation rate by age group and level of disability**[a]

1998, per cent



[a] Data by age group are subject to high standard errors; Most people that reported a schooling or employment restriction also reported a profound, severe, moderate or mild restriction to a core activity; all with a disability includes those with and without a specific restriction.

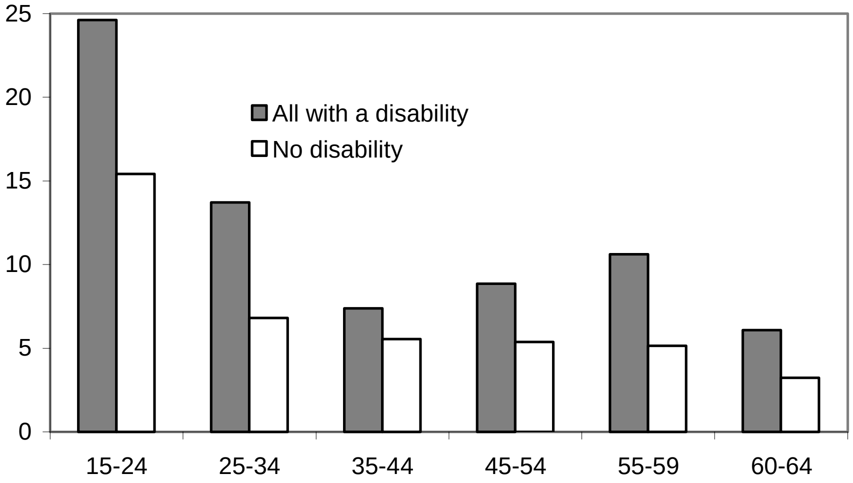
Data source : Unpublished data from ABS (1998b).

Disability and unemployment

People with a disability experience significantly higher rates of unemployment than people without a disability. In 1998, the unemployment rate for people with a disability was 12 per cent compared with 8 per cent for people without a disability.

The difference in unemployment rates for people with and without a disability is significant for all age groups. It is particularly apparent for younger age groups as well as the 50 to 59 years age group (figure 7.5).

Figure 7.5 **Disability and unemployment rate, 1998, per cent**



[a] The 1998 data revealed that for the age groups 15-24, 25-34, 55-59 and all ages the unemployment rate was highest for moderate and mild restriction rather than profound and severe restriction. These estimates are subject to high standard errors and contradict aggregate results from the 2003 survey. (The all ages data for 2003 show that the unemployment rate is highest for profound and severe levels of disability.) For these reasons, the Commission has chosen to report only the 'disability' and 'no disability' statistics, rather than the different degrees of disability as in figure 7.3.

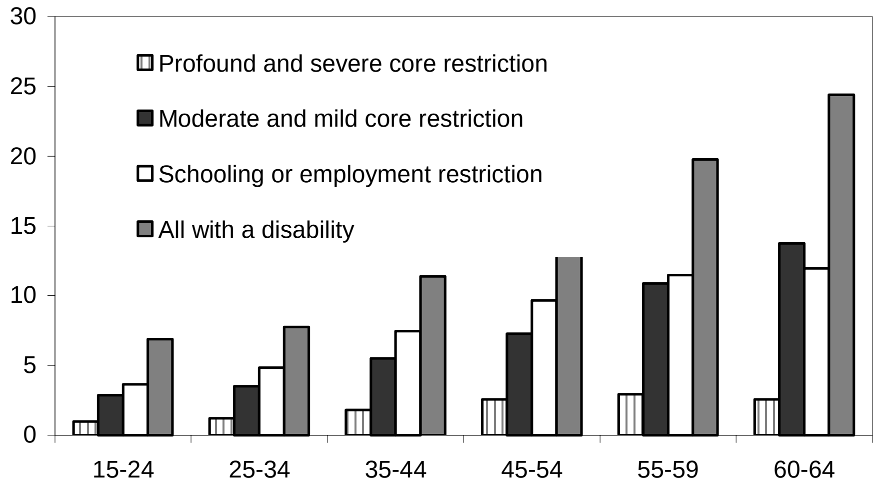
Data source : Unpublished data from ABS (1998b).

Disability and employment

In 1998, over 11 per cent of people employed had a disability. Older employed workers have higher rates of disability. In 1998, nearly one in four workers aged 60 to 64 years and 20 per cent of workers aged 55 to 59 years had a disability. This compares with 7 per cent for those aged 15 to 24 years and 8 per cent those aged 25 to 34 years.

People employed with a disability generally have a low level of disability. In 1998, less than 2 per cent of employed workers stated they had a profound or severe or core restriction and over 5 per cent reported a moderate or mild core restriction. For employed people aged 60 to 64 years, the rate of profound or severe restriction was 3 per cent compared with 14 per cent for a moderate or mild core restriction (figure 7.6).

Figure 7.6 **Workers employed with a disability by degree of disability**
1998, per cent



[a] Data by age group and degree of disability are subject to high standard errors; Data are not additive. Most people that reported a schooling or employment restriction also reported a profound, severe, moderate or mild restriction to a core activity. All with a disability includes those with and without a specific restriction.

Data source : Unpublished data from ABS (1998b).

Further, older workers have significantly higher rates of employment restriction than younger workers. In 1998 nearly 12 per cent of workers in the 60 to 64 year age group reported that they had an employment restriction. This compares with 4 per cent for those aged 15 to 24 years and 5 per cent for those aged 25 to 34 years (Figure 7.6).

7.4 Disability Support Pension

One would expect that the level of disability within the community would move in line with changes in the number of Disability Support Pension recipients. However, the number of recipients of Disability Support Pension as a percentage of the population has been increasing at a significantly greater rate than the prevalence of disability measured by the ABS.

A comparison with ABS data

ABS surveys found no statistically significant difference in age adjusted disability rates recorded in 1998 and 2003. In comparison, the percentage of the population (aged 16-64 years) receiving Disability Support Pension increased 14 per cent between 1998 (4.5 per cent) and 2003 (5.2 per cent). Moreover, ABS (adjusted) statistics found that disability rates increased less than 30 per cent between 1981

(14.6 per cent) and 1998 (18.8 per cent). And over the same period, the percentage of population (aged 16-64 years) in receipt of the Disability Support Pension nearly doubled (2.3 per cent in 1991 and 4.5 per cent in 1998).

Comparing ABS survey data with measures of Disability Support Pension recipients is problematic. The pension data are sourced from administrative records and the primary condition is clinically assessed. In contrast, the ABS data are based on a large scale population survey and the assessment of a disability is dependent on the awareness and self perception of the respondents.

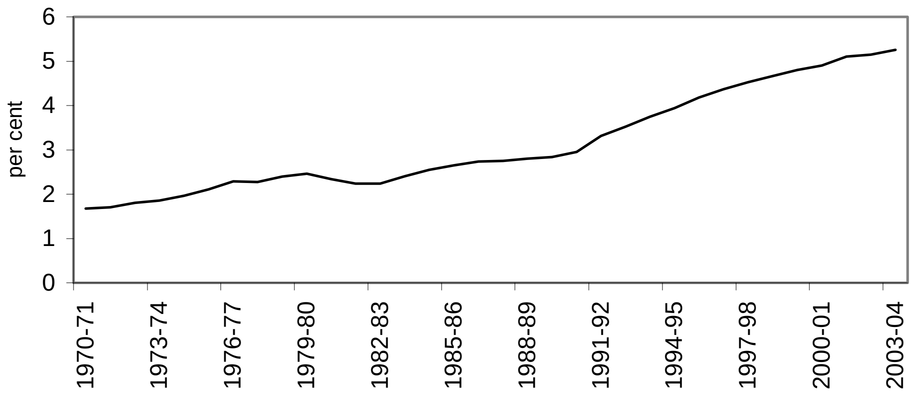
Further, the definition of disability for ABS measurement differs from that employed by the Department of Family and Community Services (FaCS) for Disability Support Pension purposes. For example, the ABS disability survey includes Down's Syndrome in congenital abnormalities and cerebral palsy in nervous system disorders, while for Disability Support Pension purposes these disabilities may be recorded as intellectual disabilities (Davis et al. 2001, p.22).

Another concern is that there may be a possible bias resulting from undercounting in the ABS survey. The FaCS data measure all recipients of the Disability Support Pension, whereas the ABS survey is unable to capture all recipients of this pension.

In recent times, it appears that the major driver of the number of Disability Support Pension recipients have been changes in the way Disability Support Pension and other substitute payments have been administered, rather than changes in the prevalence of disability in the community. Prime among them have been changes embodied in the Disability Reform Package of 1991.

Prior to the introduction of the Disability Reform Package applicants for Disability Support Pension had to demonstrate a 'permanent incapacity'. This was replaced by a requirement that applicants must be 'substantially incapacitated' for at least the next two years. This easing of the eligibility criteria in 1991 has resulted in a significant increase in the percentage of the population receiving Disability Support Pension (figure 7.7).

Figure 7.7 **DSP recipients 1970-71 to 2003-04**
percentage of population aged 16 to 64 years



Data sources: Treasury and FaCS.

Loss of access to other forms of support, such as Veterans' Affairs Service Pension, Widow B and Wife Pension and the gradual lifting of the minimum age for the Age Pension for women (from 60 to 65 by 2014) women, has also been a significant driver of the number of Disability Support Pension recipients. It has resulted in an increase in the proportion of people claiming Disability Support Pension as their capacity to access other payments is reduced.

Overall, there are significant differences between the ABS survey data and FaCS Disability Support Pension data in terms of the way disability is measured. Any comparison should be treated cautiously. The FaCS data provide comprehensive information on the number of recipients of the Disability Support Pension over time, but is not able to measure changes in the prevalence of disability. In recent years the number of Disability Support Pension recipients has been driven by policy change rather than changes in the underlying health and social environment.

Disability Support Pension projections

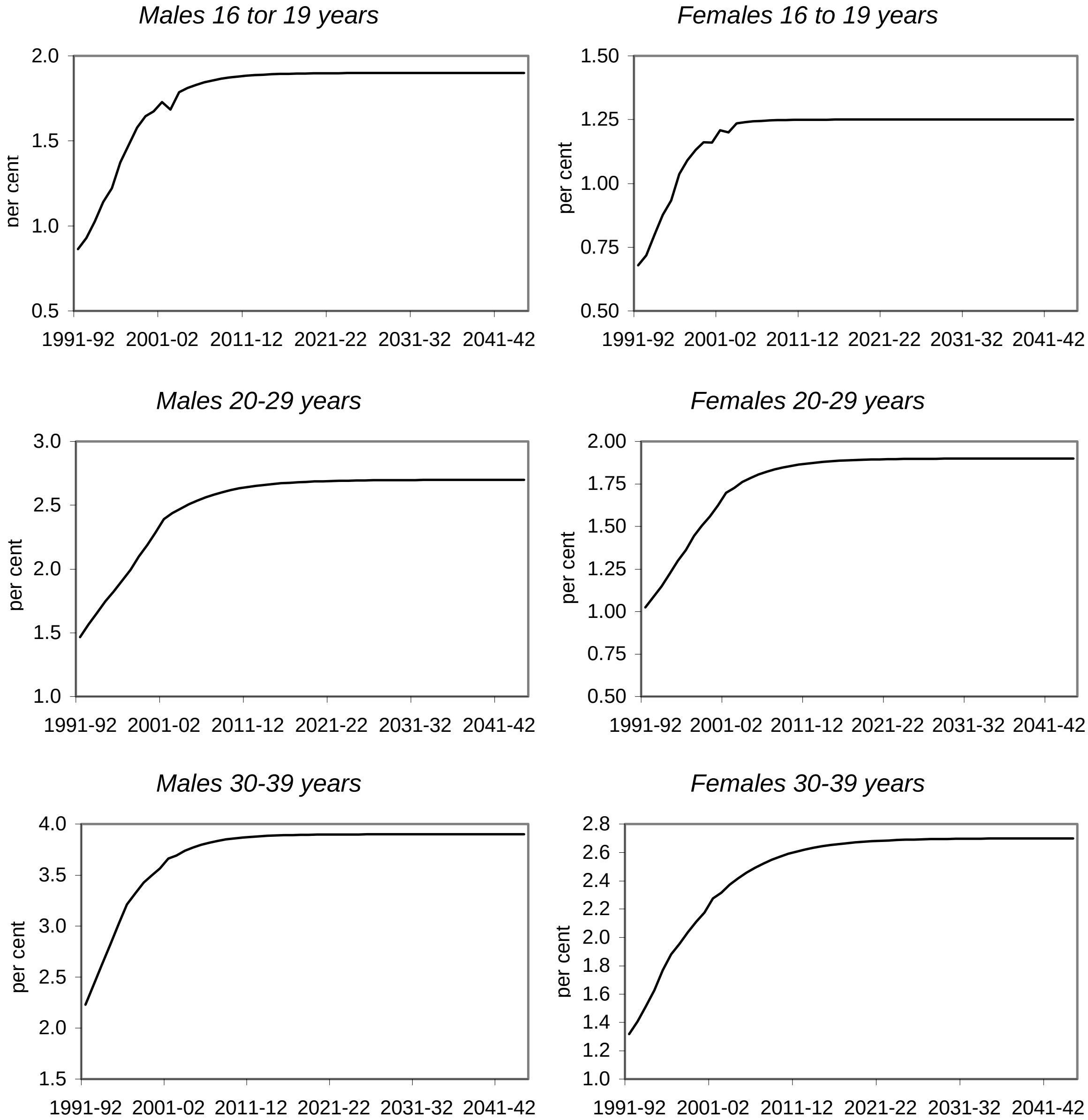
Chapter 8 examined the likely trajectory of expenditure on the Australian Government's major personal benefit payments, including Disability Support Pension.

Coverage rates were derived for six age groups for both males and females using a coverage trend model. Trends were based on historical time series data extending from 1991-92 to 2003-04. The primary approach was to allow a tapering of growth based on logistic curves (technical paper 2). Exceptions are the rates for 50 to 59 and 60 to 64 year olds. Based on recent trends, the following was considered appropriate:

- for males aged 50-59 years and 60-64 years a slight, gradual decline in coverage rates;
- for females aged 50-59 years a constant coverage rate; and
- for females aged 60-64 years an increase in coverage rates reflecting the phased increase in Age Pension eligibility age until 2014 and then constant thereafter.

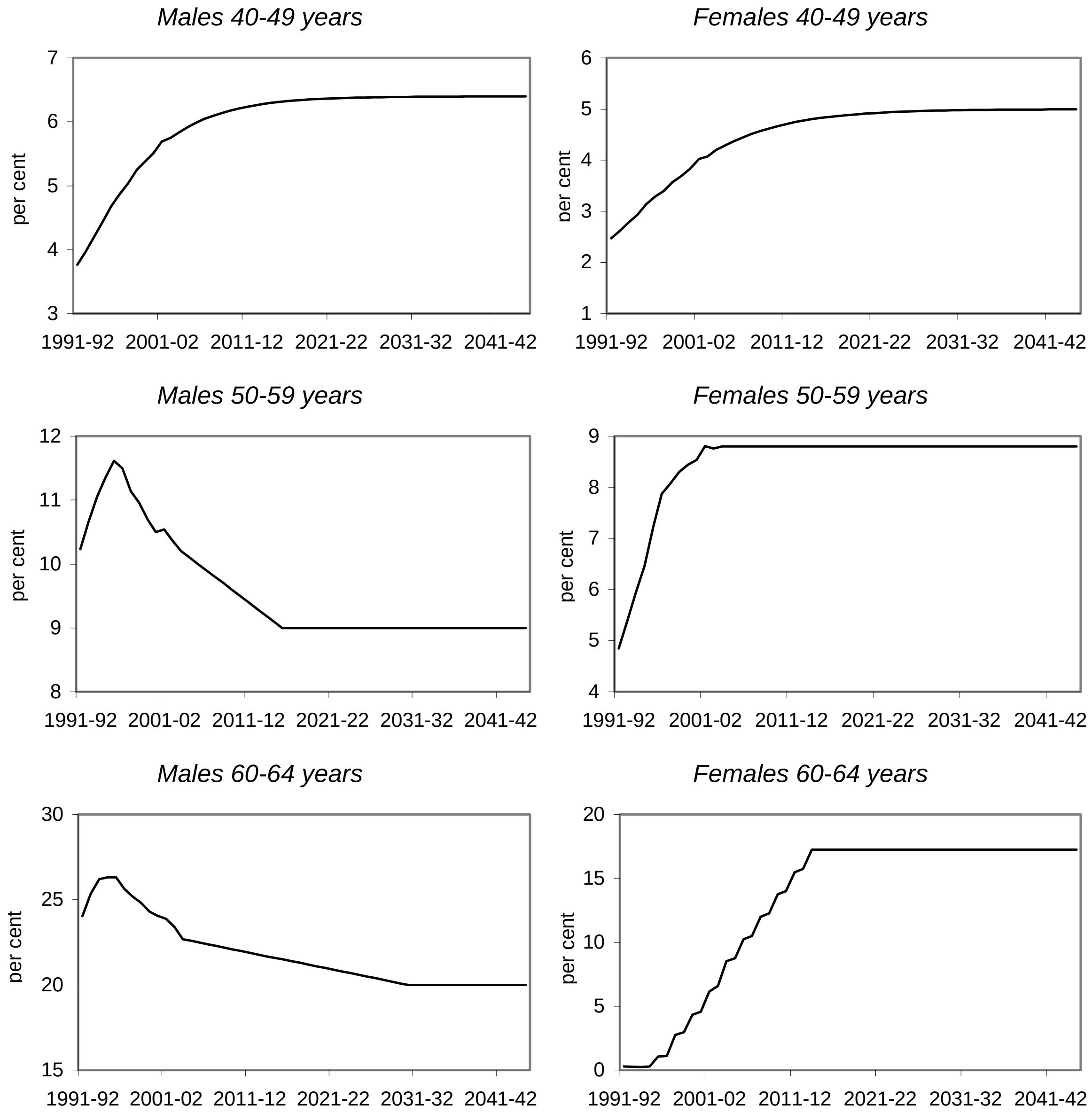
Figure 7.8 presents the Commission’s projections on disability trends, which were used as a basis for expenditure projections in chapter 8.

Figure 7.8 **Disability Support Pension coverage rates 1990-91 to 2044-45**[a]



(Continued next page)

Figure 7.8 **(Continued)**



Data source: Data between 1991-92 and 2003-04 are from FaCS (2001) and provided by FaCS. Data between 2004-05 and 2044-45 are Commission estimates (chapter 8).

Non-demographic expenditure pressure

8.1 Demography is not the only pressure on government spending

Ageing is not the only, or in some cases, even the major pressure on future government spending. Non-demographic factors, such as those arising from new technologies and public expectations about the quality or scope of services also exacerbate fiscal pressures. For example, the public may demand smaller school class sizes, a more visible police presence, or better health and military technologies.[1] Other non-demographic factors may reduce fiscal pressures. For instance, general improvement in the efficiency of government services may produce cost savings.

Were there to be large reductions in the GDP shares of non-age related government spending areas, then ageing would present no fiscal challenges for governments. On the other hand, State Governments have generally argued that, in fact, there are future pressures to spend more in such areas, which will add to ageing pressures on their budgets. For example, the New South Wales Government (sub. 45, p. 23) estimated that while ageing would produce a fiscal gap of 1.3 percentage points of GSP by 2041-42, there would be further pressure of 3 percentage points of GSP associated with non-demographic factors.[2]

This paper examines the potential magnitude and scope of non-demographic fiscal pressures so as to place ageing effects into context. It is organised as follows.

- Section 8.2 examines the relative importance of expenditure categories. This identifies which areas of expenditure may be the most important for considering non-demographic pressures.

[1] In health care, such non-demographic effects are intertwined with age effects. For example, new technologies in medicine are often applied most intensively to older people. These interactions are complex and are examined elsewhere in this study (chapter 6).

[2] Non-age expenditure growth for health and education accounts for 1.1 percentage points (of the 3.0), but other functions were also estimated to face significant non-age related fiscal pressure, including transport and communications (0.8 percentage points) and public order and safety (0.6 points).

- Section 8.3 examines historical non-demographic expenditure growth. A key issue is whether projections should be based on past trends.
- Section 8.4 briefly notes the non-demographic growth rate assumptions used in the Intergenerational Report and the ageing analysis by the States. This reveals there is no commonality in the magnitude and scope of non-demographic effects across studies.
- Section 8.5 explains the Commission's approach.

8.2 The relative importance of expenditure categories

The impact of non-demographic factors depends on the share of total expenditure by each function.

There are quite different profiles for the Australian Government and combined State governments

There are no major differences in the expenditure profiles of the Australian government and those for the combined States (table 8.1). Social security and welfare expenditure is the largest component of expenditure by the Australian government (35.8 per cent), followed by health (15.5 per cent), other[3] (12.9 per cent), defence (6.7 per cent) and education (6.1 per cent). In contrast, education and health comprise about half the expenditure for the combined States, with significant expenditures also for transport and communications (10.0 per cent) and public order and safety (9.9 per cent). Given these divergent profiles, it is clear that age and non-age factors will have disparate fiscal implications for the Australian and State governments.

No significant differences between States

There is little difference between different States in the relative importance of the six largest government expenditure categories (table 8.2). Accordingly, variations in non-demographic growth rates and of population ageing will be the key determinants of different fiscal pressures in the States, rather than differences arising from the mixes of government services.

[3] Other includes general purpose inter-government transactions and natural disaster relief.

Table 8.1 **Government expenses by purpose, 2002-03**

General Government Sector

	Australian government	*States and Territories*
	%	%
General public services	5.4	3.6
Defence	6.7	0.0
Public order and safety	1.0	9.9
Education	6.1	26.5
Health	14.7	24.4
Social security and welfare	35.6	6.2
Housing and community amenities	0.9	4.2
Recreation and culture	1.0	2.8
Fuel and energy	1.7	0.8
Agriculture, forestry and fishing	0.9	2.3
Mining, manufacturing and construction	0.8	0.4
Transport and communications	1.1	10.0
Other economic affairs	1.9	2.5
Nominal interest on superannuation	2.7	2.8
Public debt transactions	2.4	2.1
Other	17.2	1.4
Total	**100.0**	**100.0**

Source: Estimates based on ABS (*Government Finance Statistics, Australia*, 2002-03, Cat. no. 5512.0, table 31).

Table 8.2 **Expenditure profile, individual States, 2002-03**

General Government Sector

	NSW	*Vic*	*Qld*	*SA*	*WA*	*Tas*	*NT*	*ACT*
	%	%	%	%	%	%	%	%
Education	27.1	26.7	26.4	25.4	27.2	26.8	19.2	22.4
Health	24.5	27.6	21.6	25.2	24.1	20.7	19.8	20.4
Transport and communication	10.5	10.8	10.2	7.8	10.8	6.9	3.1	6.6
Public order and safety	10.2	9.5	9.6	10.7	10.8	8.9	9.8	8.4
Social security and welfare	7.3	7.5	4.1	6.3	4.4	6.6	3.6	5.2
Housing and community amenities	4.2	2.9	4.6	6.1	5.4	5.1	1.6	3.0

Source: Estimates based on ABS (*Government Finance Statistics, Australia*, 2002-03, Cat. no. 5512.0, table 31).

8.3 Historical expenditure growth patterns

Methodology

A common approach suggested for projecting fiscal pressure is to extrapolate historical trends in the ratio of nominal expenditure to nominal GDP. This ratio removes the common influences of price and population growth, and reveals the extent to which real per capita expenditure growth exceeds growth of GDP.[4] Hence this method is sometimes called the 'excess expenditure growth' (EEG) method.

There are many ways of characterising the EEG and its trends.

- *Method 1:* The New South Wales Treasury measured the EEG as the difference in the percentage growth rates of the *i*th nominal spending category at time t ($E_{i,t}$) and nominal GDP or GSP (Y):

  $$EEG_{i,t} = \left(\frac{E_{i,t} - E_{i,t-1}}{E_{i,t-1}} - \frac{Y_t - Y_{t-1}}{Y_{t-1}}\right) \times 100$$ [5]

  The New South Wales Treasury then averaged annual EEGs for a given period (usually 1978-79 to 1997-98) to derive a perspective on typical excess growth.

- *Method 2:* A simple alternative estimate of the EEG is the difference between the compound growth rate of an expenditure category over a given period and the compound growth rate of nominal GDP, but this ignores all data between start and endpoints.

- *Method 3:* Another method for estimating the EEG is to regress the natural logarithm of the ratio of expenditure to GDP on a time trend (and constant) for the relevant period, that is, estimating:

  $$\ln\left(\frac{E_{i,t}}{Y_t}\right) = \alpha + \beta t$$

  This has the advantage of providing a statistical test of the significance of any trend (on β) and revealing misspecification in the relationship. It should be noted that for small changes in expenditure shares, $100*\beta$ is approximately equal to the average percentage change in the spending share. The trend rate shown in tables 8.3 and 8.4 are $100*\beta$.

[4] Note that Δ log (E/(P*POP)-Δ log (Y/(P*POP) = Δ log (E/Y), where E is nominal expenditure, Y is GDP or GSP, POP is population and P2 is an implicit price deflator for GDP, a measure of general price levels.

[5] This is equal to Δ log (E/Y) for small changes in E and Y.

- *Method 4:* An alternative regression model is to assume that expenditure shares move linearly over time, so that the EEG (measured as β) is estimated by regressing $(\frac{E_{i,t}}{Y_t}) = \alpha + \beta t$.

- *Method 5:* On theoretical grounds, it might be expected that given expenditure shares of GDP may move around for periods, but ultimately neither asymptote to zero or one, as any sustained negative or positive value for the EEG implies. In this context, autoregressive (moving average) time series models of the spending share, may be more satisfactory.[6] The Commission has explored some simple autoregressive models for some key categories of spending.

Results for methods 1 to 3 are shown in tables 8.3 and 8.4, while those of other methods are considered when experimenting and evaluating possible projection methods in section 8.5.

Starting from time *t*, the value of any future spending share of nominal GDP at time *T*, for expenditure category *i* can be calculated using the estimate of EEG derived by any of the above methods. For methods 1 and 2 it is:

$\frac{E_{i,T}}{Y_T} = \frac{E_{i,t}}{Y_t}(\gamma/100 \times \{1+g\}+1)^{T-t} \cong \frac{E_{i,t}}{Y_t}(\gamma/100+1)^{T-t}$ where γ is the estimated value of EEG, since g (the average projected annual nominal growth rate of GDP or GSP) is small.

For method 3, it is: $\frac{E_{i,T}}{Y_T} = \frac{E_{i,t}}{Y_t} e^{\beta(T-t)}$ while for method 4 it is: $\frac{E_{i,T}}{Y_T} = \frac{E_{i,t}}{Y_t} + \beta(T-t)$. Results for method 5 depend on the form of the time series model.

Broad trends

Notwithstanding differences in estimates due to different methods and data (discussed further below), some general patterns are apparent in the ratios of spending to GDP for the combined States (table 8.3).

- Not surprisingly, the share of total spending in GDP has exhibited greater stability than specific expenditure categories, because trends among the component categories tend to offset each other.
- Some expenditure areas increased very rapidly as a share of GDP between 1978-79 and 1997-98, such as Social security and welfare, Housing and community amenities, and Recreation and culture. It is clear that such increases are from a small base (table 8.1) and, given their magnitude, are not likely to be sustainable.

[6] This would imply co-integration between spending categories and GDP.

- Four areas declined relative to GDP between 1978-79 and 1997-98 — education, general services, transport and communications, and all other.
- There are some significant changes in trends since 1997-98.[7] Growth over the four years (1998-99 to 2002-03) in health, education, public order and safety and transport and communications was much stronger than the preceding twenty year average. At the same time, growth in housing and community amenities and social security and welfare eased relative to the past, and there were significant declines relative to GDP for general services and other.

Table 8.3 **Trends in the ratio of expenditure to output, combined States**[a]

	1978-79 to 1997-98 adjusted cash-based series			*1998-99 to 2002-03 accrual series*
	Compound growth rate	Trend rate[b]	NSW Treasury[c]	Compound growth rate
	points	%	points	points
Education	-1.5	-1.8	-0.2	1.0
Health	1.0	1.0	0.9	2.0
All other[d]	0.4	0.5	0.1	-2.6
General services	-1.4	-1.9	-1.8	-16.2
Public order and safety	1.7	1.2	1.3	3.1
Social security and welfare	3.9	4.0	3.7	2.4
Housing and community amenities	5.3	4.5	4.8	3.7
Recreation and culture	3.5	2.8	2.8	1.3
Transport and communications.	-0.6	-0.4	-0.3	0.8
Other	-0.8	-0.2	-0.8	-7.5
Total expenditure	**-0.0**	**-0.1**	**0.2**	**-0.6**

[a] The results here are shown for two periods. The first, 1978-79 to 1997-98 is based on a cash-based series, adjusted by the ABS to be more consistent with the accrual accounting framework. While data are available from 1962-63, the period from 1978-79 was chosen so that results could be compared with those prepared by the New South Wales Treasury. The second period is based on accrual accounting data. [b] The trend estimate was derived by regressing the natural logarithm of the expenditure ratio against a time trend and constant (intercept). All trends are statistically significant at the 95 per cent level of confidence except for total and other [c] New South Wales Treasury estimates using the average yearly growth method. Some of the data used by the New South Wales Treasury differ from that used for the other estimates shown here. For example, the estimates of non-demographic growth rates for education differ markedly because of different accounting for funding from the Australian Government.[d] The figure shown for the New South Wales Treasury value for all other is based on a weighted average of its estimates of the categories making up All other, using 1988-89 expenditure shares.

Sources: ABS (*Government Finance Statistics*, various years, Cat. no. 5501.0; *GDP current price series, D*X data, National Accounts, 5204-1).

[7] The Government Finance Statistics from which the data are drawn were subject to major changes with the replacement of cash estimates from 1962-62 to 1997-98 by accrual accounting in subsequent years. The ABS has adjusted the earlier cash series so that they are more consistent with the later accrual accounting series. However, as the adjustments are incomplete, analysis in this appendix provides separate trend growth estimates for the two periods.

As for the combined States, GDP spending shares on particular categories by the Australian Government have not kept in line with each other (table 8.4). Some categories, like health, have grown significantly since 1978-79, while others, such as defence, have fallen. Over the period 1978-79 to 1997-98, Australian Government spending grew as a share of GDP.

Table 8.4 **Trends in the ratio of expenditure to output, Australian Government**[a]

	1978-79 to 1997-98 adjusted cash-based series			*1998-99 to 2002-03 accrual series*
	Compound rate	*Trend rate*[b]	*NSW Treasury*	*Compound growth rate*
	points	%	points	points
Education	-0.7	-0.3	0.5	-5.2
Health	2.3	2.6	3.7	-0.2
Social security and welfare	1.3	1.6	0.9	1.1
All Other[c]	-0.9	-0.8	-0.7	3.0
General services	1.4	-1.3	-1.6	-2.0
Defence	-2.2	-2.3	-2.3	-3.6
Public order and safety	2.6	3.1	1.7	6.0
Housing and community amenities	3.7	2.1	4.3	-5.2
Recreation and culture	0.0	-0.0	-0.2	-1.2
Transport and communications	-4.7	-3.5	-3.7	-4.9
Other (excluding general grants)	0.1	0.1	0.1	-4.8
Total (excluding general grants)	**0.5**	**0.7**	**0.4**	**1.3**

a The different growth rate methods are described in the main text and in the notes to the previous table. The data exclude the Australian Government general purpose payments to the States (see a discussion of this in section 8.5). However, for the accrual accounting period from 1998-99 to 2002-03, data on social security and welfare, all other and other *include* any inter-government General Purpose Payments. Due to this and the short period involved, estimates for this period should be treated with caution. **b** The trends for education, housing and community amenities, recreation and culture and other were not statistically significant at the 95 per cent level of confidence except. **c** The figure shown for the New South Wales Treasury value for all other is based on a weighted average of its estimates of the categories making up all other, using 1988-89 expenditure shares.

Sources: ABS (*Government Finance Statistics*, various years, Cat. no. 5501.0; *GDP current price series, D*X data, National Accounts, 5204-1).

Separating ageing and non-demographic influences

Since the purpose of this technical paper is to consider the extent to which *non*-demographic factors have been and will be important for government spending, it is necessary to gauge, and if necessary adjust for, ageing influences on the excess expenditure growth rates shown in tables 8.3 and 8.4. The Commission's analysis has shown the importance of ageing for health, aged care and education generally and for personal benefit payments by the Australian Government (chapters 6, 7, 8 and 9). Analysis by the States confirms this picture, but also suggests modest ageing effects are present for housing and community amenities, public order and safety, and social security and welfare (at the State level).

Table 8.5 presents estimates by the New South Wales Treasury of the ageing and non-demographic components of excess expenditure growth for the period 1978-79 to 1997-98. The non-demographic growth rate for different areas of government spending is derived by subtracting the ageing component from the excess expenditure growth rate. For example, using GFS data, health (including aged care) expenditure grew faster than GDP by an average of 0.9 percentage points per year, consisting of an estimated 0.6 percentage points because of ageing and 0.3 percentage points for non-demographic reasons. In contrast, ageing eased budgetary pressure in the areas of education and public order and safety.

While there are some ageing effects apparent for particular spending categories *within* the combined 'all other' group, the estimates suggest that, overall, ageing has a negligible effect on the aggregate expenditure share of this combined group. This reflects the offsetting influences of ageing within spending categories in this group.

8.4 Non-demographic growth rate assumptions in other studies

In their projections of fiscal pressure, the Australian and State Governments have made provision for non-demographic factors to compound or relieve pressures that result from ageing (box 8.1). However, reflecting the inherent subjectivity in such exercises and uncertainty about the robustness of historical estimates, there is no commonality in either the magnitude or scope of non-demographic assumptions.

Table 8.5 **Growth in expenditure relative to output, non-demographic and age components, 1978-79 to 1997-98**

Average percentage points per year

	Combined States			*Australian Government*		
	Average excess growth (1)	*Age component (2)*	*Non-demographic component (3) = (1) - (2)*	*Average excess growth (1)*	*Age component (2)*	*Non-demographic component (3) = (1) - (2)*
	points	points	points	points	points	points
Education	-0.2	-0.9	0.7	0.5	-0.6	1.1
Health	0.9	0.6	0.3	3.7	0.7	3.0
Social security and welfare	3.7	0.9	2.8	0.9	0.8	0.1
All other						
General services	-1.8	0.0	-1.8	-1.6	0.0	-1.6
Defence	na	na	na	-2.3	0.0	-2.3
Public order and safety	1.3	-0.3	1.6	1.7	-0.2	1.9
Housing and community amenities	4.8	0.5	4.3	4.3	0.6	3.7
Recreation and culture	2.8	-0.1	2.9	-0.2	0.0	-0.2
Transport and communications.	-0.3	0.1	-0.4	-3.7	0.1	-3.8
Other	-0.8	0.0	-0.8	0.1	0.0	0.1
Total expenditure	**0.2**	**-0.1**[a]	**0.3**	**0.4**	**0.2**[a]	**0.2**

[a] Commission estimates using 1988-89 expenditure shares.

Source: New South Wales Treasury.

A comparison of the assumptions revealed:

- no study included non-demographic pressures for all functions, or even, most functions;
- jurisdictions used different non-demographic growth rates for the same function (such as health);
- non-demographic growth effects for health were included in most base cases, but other non-demographic effects were mostly included in scenarios separate from the base case; and
- some estimates were set according to historical trends, while in other cases, a degree of judgement was often employed, or hypothetical, illustrative values were used.

Box 8.1 **Non-demographic growth rate assumptions in other studies**

The NSW Government applied (non-zero) non-demographic growth rates in six expenditure areas (public order and safety, education, health, social security and welfare, housing and community amenities, and transport and communications), based on historical estimates.[8]

The Victorian, South Australian and ACT Governments applied a non-demographic growth rate only to Health.

- The Victorian Government (sub. 29, p.15) assumed in the base case that (non-aged care) health prices rise one percentage point more than the general price level.
- The South Australian Government (sub. 23, p.25) assumed unit health costs increase by 2.6 per cent per year in real terms for the Australian government and 1 per cent per year in real terms for State governments.
- The ACT Government (sub. 21, p.19) assumed nominal health expenditure grew at 7 per cent per annum (comprising 3 per cent for wage growth, 1.9 per cent for demographic factors and 2.1 per cent for non-demographic factors).

The Queensland Government (sub. 17, table A4.1) incorporated ‘additional cost factors’ for Health, Education and Public order and safety into two of its ten scenarios, based partly on historical trends.

The Western Australian Government (sub. 39, p.36) set the demographic growth rates for Public order and safety and for sub categories of Health and Education according to estimates for 1978-79 to 1997-98.

The Tasmania Government (sub. 40, p.43) compared the effects of three hypothetical excess expenditure scenarios (zero excess, 0.5 per cent per year and 1.0 per cent per year).[9]

In the Intergenerational Report, expenditure on health, personal benefit payments, education and superannuation grows at a different rate to GDP after accounting for the effects of changing age structures. All other expenditures (such as defence) were assumed to grow in line with GDP.

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[8] The non-age expenditure growth rate for education, health public order and safety, and transport and communications were set according to estimates for 1978-79 to 1997-98. For both social security and welfare and housing and community amenities the rate was set according to estimates for 1988-89 to 1997-98 (resulting in lower growth rates). The much higher growth rates for the longer sample period were said to reflect the rapid (policy) expansion in these functions at the State level during the early and mid-1980s, and 1980’s inflation, and judged as unlikely to be sustained over the next 40 years.

[9] The Tasmania Government noted that it had undertaken preliminary research to determine historical rates of excess expenditure growth for health, education and public order and safety in Tasmania. The results were highly sensitive to assumptions concerning the appropriate measure of real per capita income growth and the time period. This, together with lack of long term (future) data for certain variables, led it to illustrate the potential effects of non-age factors by using the three hypothetical assumptions.

8.5 The Commission's approach

The Commission included non-demographic factors in projections of several key spending areas — most particularly health, aged care, education and various social welfare payments (chapters 6 to 9). For example, the Commission has incorporated 0.6 percentage points of excess growth per annum in health above GDP growth. For some spending areas, the Commission has also allowed for a period of temporary wages catch-up where wage pressures were significant (such as in aged care).

For all remaining areas of expenditure, the Commission considered the option of assuming a non-demographic expenditure growth rate for each portfolio area (and each jurisdiction) separately. However, since trends appear more erratic at the disaggregated level for these residual items, a simpler approach is to model and project a single non-demographic growth rate for aggregate 'residual' expenditure. This residual expenditure category is the relevant 'all other' group shown in tables 8.3 and 8.4 — encompassing spending categories for each level of government that, as a whole, have little or no relationship to ageing. Accordingly, the degree to which these residual categories exacerbate or relieve fiscal pressure will largely depend on non-demographic factors.

The Commission used estimation methods 3 to 5 to assess excess expenditure growth for this residual (all other) spending category (table 8.6).[10] These three methods have the advantage of providing some measure of the statistical significance of the historical trends and of providing evidence about potential misspecification (for example, significant serial correlation of the regression residuals would suggest model misspecification).

The estimates suggest very different possible additional fiscal pressures from non-demographic growth for the residual spending categories (table 8.7).

[10] Only data up to the introduction of accrual accounting were used.

Table 8.6 **Trends in the share of 'All Other' government spending to GDP**[a]

Combined States	*1961-62 to 1997-98*	*1978-79 to 1997-98*	*1982-83 to 1997-98*
Method 3 (log share regression)			
β estimate	0.00702	0.004503	-0.00242
t statistic	4.8	2.0	1.0
Durbin-Watson statistic	0.55	0.53	0.59
Method 4 (share regression)			
β estimate	0.000463	0.000308	-0.000167
t statistic	4.8	2.0	1.0
Durbin-Watson statistic	0.49	0.54	0.59
Method 5 (first order autoregressive model)			
α estimate	-1.099	-0.648	-1.419
β estimate	0.586	0.755	0.459
t statistic	8.0	5.5	2.2
Durbin-Watson statistic	1.55	1.46	0.77
Australian Government (excluding general purpose grants)	*1961-62 to 1997-98*	*1974-75 to 1997-98*	*1986-87 to 1997-98*
Method 3 (log share regression)			
β estimate	0.00877	0.0117	-0.0173
t statistic	2.3	2.6	2.1
Durbin-Watson statistic	0.34	0.28	0.72
Method 4 (share regression)			
β estimate	0.000260	0.000342	-0.000634
t statistic	2.1	2.2	2.2
Durbin-Watson statistic	0.31	0.28	0.69
Method 5 (first order autoregressive model)			
α estimate	-0.586	-0.588	-0.963
β estimate	0.826	0.826	0.721
t statistic	10.1	9.7	4.0
Durbin-Watson statistic	1.37	1.11	1.05

a Social security and welfare is included in all other for the combined States and excluded for the Australian government (as per tables 8.3 and 8.4). For all regressions starting in 1961-62, a dummy was included for the sustained shift in spending that occurred after the Whitlam Government. The constant shown for the autoregressive model in method 5 includes the value of that dummy as well as the constant. The value of β shown in method 5 is the coefficient on the lagged log spending share. The t-statistic is used to test whether the estimate is significantly different from zero. The Durbin-Watson statistic is used to test first order serial correlation. Other than the full period regressions, the time periods selected for the Australian Government estimates are different from those for the combined States, reflecting different apparent breaks in the data.

Source: Commission estimates.

For the Combined States

For the combined States, the additional fiscal pressure (in GDP percentage points) from 2003-04 to 2044-45 associated with the growth of such expenditure categories could be, depending on the estimation method and period selected:

- effectively no change (+0.01 to 0.06 points change, according to method 5 for any period);
- moderate decreases (-0.6 to -0.7 points change, according to either method 3 or 4 for 1982-83 to 1997-98); or
- even large increases (1.3 to 2.4 points change, according to other combinations of method and period).

Table 8.7 **Implications for fiscal pressure of non-demographic growth in residual spending**

Percentage points change in share of GDP, 2003-04 to 2044-45

Combined States	*Estimation period for non-demographic growth rate used in projections*		
	1961-62 to 1997-98	*1978-79 to 1997-98*	*1982-83 to 1997-98*
	points	points	points
Method 3	2.36	1.42	-0.63
Method 4	1.90	1.27	-0.69
Method 5	0.01	0.06	0.00
Australian Government	*Estimation period for non-demographic growth rate used in projections*		
	1961-62 to 1997-98	*1974-75 to 1997-98*	*1986-87 to 1997-98*
	points	points	points
Method 3	1.34	1.94	-1.35
Method 4	1.07	1.40	-2.60
Method 5	0.17	0.15	0.03

Source: Commission estimates.

Statistical tests of the regression residuals point to problems with using methods 3 and 4, and suggest the trends may be spurious — the result of sporadic shifts in spending patterns. The autoregressive model (method 5) appears to better characterise past patterns (with the least evidence of specification error, as suggested by the relative absence of serial correlation). Method 5 predicts that residual spending categories will grow in approximate parity with GDP. This suggests that for the combined States, fiscal pressures are likely to mostly depend on intergovernmental fiscal relations and on the growth of age-related health and education spending. But clearly, significant uncertainty remains about the future expenditure pressures in other portfolios.

The Australian Government

For the Australian Government, data on the residual items are even more erratic than for the combined States. Policy shifts and unexpected factors have significantly influenced the pattern of spending. With the advent of the GST and new intergovernmental fiscal relations, past trends in overall residual spending to GDP ratios provide a particularly poor guide to the future. In particular, past untied grants to the States muddy the identification of trends for other spending items. Consequently, general purpose payments were removed from residual Australian Government spending in the estimates and projections shown in tables 8.6 and 8.7. The most appropriate depiction of past long-run patterns (method 5, 1961-62 to 1997-98) suggests that from 2003-04 to 2044-45, there could be a 0.17 percentage points rise in fiscal pressure from Australian Government spending areas over and above the pressure listed in tables 13.1 to 13.3 (chapter 13). But, given the data problems and the small magnitude of the estimate, this is probably best characterised as zero, plus or minus some error.

The bottom line

As noted in section 8.4, there is no commonality in the magnitude and scope of non-demographic fiscal impact in other studies of ageing. The Commission has found that a wide range of possible non-demographic fiscal impacts in the residual spending areas could arise if past trends continued. However, the most plausible results favour ascribing zero additional fiscal pressure to non-demographic factors for this residual category. This assumption has been adopted in the Commission's base case.

Conveyancing revenue

This technical paper examines the nexus between population ageing and property market activity, and the implications for conveyancing duty — a transaction based property tax. Conveyancing duty receipts are an important component of States' own revenue.

9.1 Introduction

What is conveyancing duty and when does it apply?

Conveyancing duty is a stamp duty levied on the value of property purchased. It is a transactions based tax — duty is only payable when a transfer of ownership occurs. State governments levy conveyancing duty in a broadly similar fashion. All transfers of property are subject to conveyancing duty, with few exemptions.[1] There are no tax free thresholds but some concessional arrangements exist for certain home buyers. Each jurisdiction operates a tiered rate structure, with increasing marginal rates. The number of tiers vary between States ranging from nine tiers in South Australia to two tiers in the Northern Territory. The top marginal rates of duty vary between the jurisdictions, as does the transfer value at which it applies. The Northern Territory applies its top marginal rate to the entire transfer. All other jurisdictions apply the top marginal rate to the value in excess of the top tier, together with a fixed fee reflecting the cumulative effects of previous tiers (table 9.7).

The importance of conveyancing duty as a source of revenue for States

Collectively, conveyancing duty raised approximately $8.79 billion in revenue in 2002-03, around 24 per cent of States' own revenue. The overall importance of conveyancing duties varies considerably between the States, reflecting both differing rates (table 9.7) as well as underlying property values. Conveyancing duty

[1] For example, exemptions apply to transfers relating to charitable, benevolent, religious recreational and social purposes in some jurisdictions.

receipts accounted for around 27 per cent of States' own revenue for Western Australia. In contrast, duties only made up 16 per cent of States' own revenue in Tasmania (table 9.1).

Table 9.1 **Conveyancing duty, State Governments**
2002-03

Jurisdiction	*Stamp duty on conveyances*	*Stamp duty on conveyances as a proportion of total receipts*	*Per capita stamp duty on conveyances ($)*
	$m	%	$s
NSW	3 623	25.58	541.41
Vic	2 116	22.87	429.23
Qld	1 382	24.69	366.16
SA	428	17.61	280.08
WA	929	27.42	476.08
Tas	91	16.13	191.10
NT	43	17.48	218.15
ACT	176	25.73	543.56
Total	**8 788**	**24.19**	**442.16**

Source: ABS (*Taxation, State and Territory Governments,* 2002-03, Cat. no. 5506.0 table 13).

Historical movements in conveyancing duty receipts

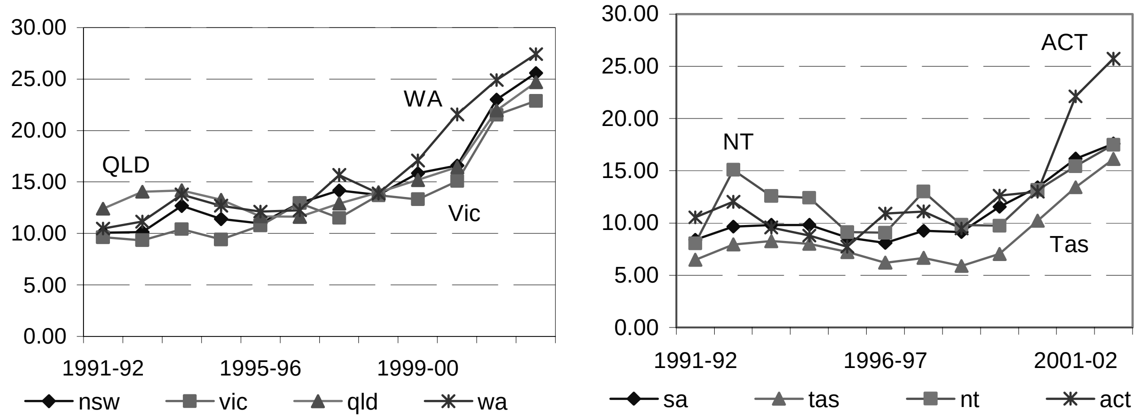
Conveyancing duty receipts have moved in a cyclical pattern, in line with swings in property market values, especially in the residential market.

Revenue increased with the booming property market of the 1980s, before declining with the downturn that followed. As activity in the commercial property market picked up in the early 1990s, so did the revenue from conveyancing duty. The steady growth in housing prices from 1996 to present, particularly in the last three years, and increases in housing turnover, has seen strong growth in conveyancing duty revenues in recent years (figure 9.1).

Increases in conveyancing duty receipts also reflect changes in the rate structure applied to the underlying land values. Scheduled rates of duty in Western Australia, South Australia and the ACT have all increased in the last five years (PC 2004a).

Figure 9.1 **Conveyancing duty as a proportion of States' own revenue**

Actual and estimates (per cent)[a]



[a] Data on conveyancing duty receipts were available for New South Wales, Victoria, South Australia and Tasmania for the entire period depicted above. Estimates were used for Queensland (1991-92 to 1997-98), Western Australia (1991-92 to 1997-98), Northern Territory (1991-92) and the Australian Capital Territory (1991-92 to 1997-98). Estimates assume that conveyancing duty receipts were approximately 75 per cent of stamp duty on properties.

Data source: ABS (*Taxation Revenue, Australia*, Cat. no. 5006.0).

9.2 Housing stock – the projected number of households

Houses are occupied by households. Therefore, allowing for unoccupied dwellings, the projected stock of housing is equivalent to the projected number of future households.

Commission projections of household formation

The Commission projected the number of households for each jurisdiction to 2044-45 using the 'propensity' methodology developed by McDonald and Kippen (1998). This method is also employed by the ABS (in its more short-run projections). The methodology, based on data collected from the Census of Population and Housing, identifies the propensity of people to belong to different living arrangement types. Trends observed in the propensities over the last four censuses for each five-year age group are then projected forward and applied to the projected population (ABS 2004d). Numbers of households are then derived from the projected living arrangements of the population.

The Commission's projections of households are based on the assumption that there is a 'low rate of change' in propensities over time. Specifically, it is assumed that the trends observed over the period 1986 to 2001 continue at the full rate of change to 2006, half the rate of change to 2011, one quarter the rate of change to 2016 and then remains constant to 2045.[2]

Changes in the housing stock over time

During the 1990s and into the 2000s, growth in the number of dwellings (1.8 per cent per annum) exceeded population growth (1.2 per cent per annum) resulting in a decline in the average number of residents per household. During this period, average household size has declined from 2.8 to 2.6 people.

This pattern is expected to continue into the future. The Commission estimates that the number of households will increase from 7.4 million in 2001 to around 12.3 million in 2045, an increase of around 67 per cent. This growth is faster than Australia's projected population growth of 44 per cent for the same period. As a result, average household size will continue to fall to around 2.3 persons per household by 2045.

This pattern is attributable in part to growth in the number of lone person households. Such households are projected to double over the 40 year projection period. This is related to the ageing of the population and the fact that older women, in particular, are more likely to live alone than others. Most older people remain living in separate houses as their children leave home or their spouse dies (McDonald 2003).

Changes in the housing stock by jurisdiction

Trend growth rates in the number of households over the period 2004-05 to 2044-45 for each jurisdiction are given in table 9.2. Growth in household numbers is projected to taper in most jurisdictions, commensurate with reductions in population growth. In both Tasmania and South Australia household numbers are projected to fall from around 2034 and 2040 respectively reflecting, in part, declining populations in those jurisdictions.

2 These assumptions are based on the assumptions underlying the ABS Series II projections of households, with the exception that the ABS estimates only cover the period to 2026.

Table 9.2 **Projected growth in households**

Annual trend growth rates, by jurisdiction, various periods[a]

State	*2003-04 to 2014-15*	*2014-15 to 2024-25*	*2024-25 to 2034-35*	*2034-35 to 2044-45*	*2003-04 to 2044-45*
	%	%	%	%	%
NSW	1.44	1.11	0.81	0.56	0.99
Vic	1.50	1.12	0.81	0.55	1.00
QLD	2.38	1.76	1.33	1.01	1.61
SA	0.99	0.55	0.22	-0.08	0.42
WA	2.07	1.50	1.10	0.79	1.36
Tas	1.05	0.44	0.04	-0.34	0.29
NT	1.32	1.03	0.78	0.65	0.94
ACT	1.42	0.95	0.62	0.40	0.84
Australia	1.66	1.23	0.90	0.63	1.11

[a] Trend growth rates were estimated by fitting a regression of the natural log of the household numbers against a time trend.

Source: Commission estimates.

9.3 Housing turnover

In the three years spanning 1999-2001, around 1.1 million households purchased a home, representing around 15 per cent of households (ABS 2001a). This equates to an average of around 5 per cent of households per annum. Housing turnover varied by jurisdiction, ranging from 4.5 per cent of households in Tasmania to 5.8 per cent in Western Australia (figure 9.2).

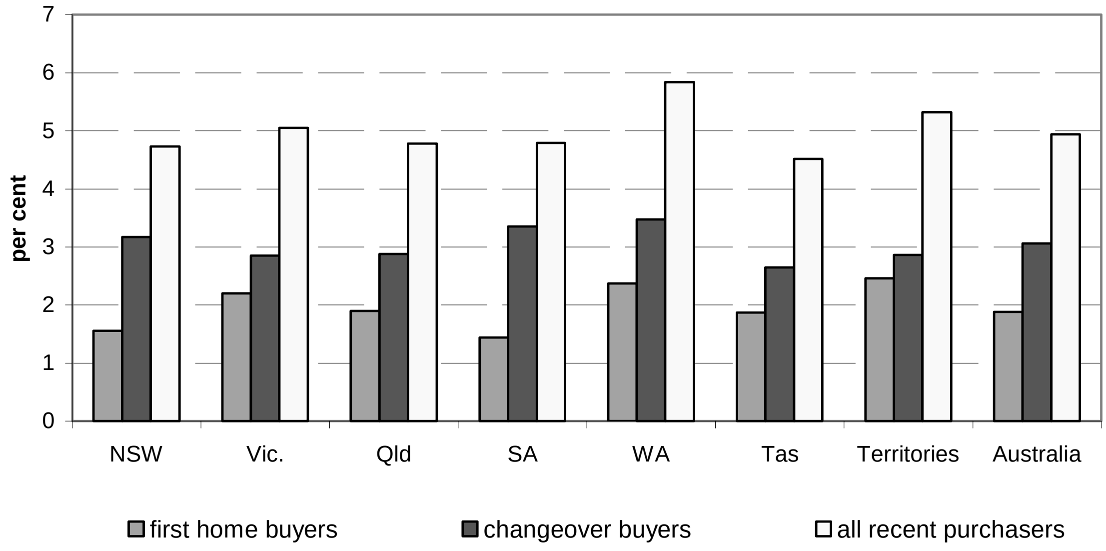
Housing turnover by age of the household reference person

As noted by the Queensland Government, population ageing might slow the level of activity within the property market:

> Population ageing could slow property market activity, particularly turnover of properties. Younger and middle aged adults have a greater propensity to form new households and upgrade accommodation as they leave home, marry and have families. The decline of this age group as a proportion of the population … is likely to lead to a reduced rate of property turnover. Moreover, older people are generally not inclined to adjust their housing and may continue to live in their pre-retirement homes (Kendig and Neutze). This trend would reinforce any slowdown in property turnover. (sub. 17, p. 43).

Figure 9.2 **Recent home buyer households**

Proportion of households who purchased a home (per annum)



Data source: Commission estimates based on ABS unpublished data from the Surveys of Income and Housing Costs 2001 (Cat. no. 6541.0).

This view is supported by the ‘purchase’ rate profiles by age of the household reference person. The purchase rate defines the number of households who purchased a dwelling expressed as a proportion of total households (figure 11.10 in chapter 11).

Those aged 25-29 years recorded the highest rate of dwelling purchase (9.9 per cent of households), followed by the 30-34 years age group (8.2 per cent of households). In contrast, purchase rates for older households were very low (for example, 1.5 per cent for the 70-74 years age group).

Method for projecting dwelling sales

In order to project the total number of residential transactions per annum a series of ‘purchase’ rate indices were developed. Data were collected on the number of purchasers as a proportion of households:

- for each of the six States plus a combined category incorporating both the Northern Territory and the ACT;
- by age of the household reference person, incorporating 13 different age cohorts; and

- by type of purchase (whether it was a first home purchase or 'change over' purchase and a summary category incorporating all recent purchasers).

This yielded a total of 273 purchase rate indices. Due to the small number of observations for some of the categories, the national purchase rate index for a particular age cohort scaled by the ratio of total state to national purchasers replaced any spurious indices. Six such replacements were made.[3] Purchase rate indices were then multiplied by the projected number of households in the relevant category in order to obtain projections of dwelling sales.

The approach adopted assumes that the patterns of home purchase exhibited over the period 1999 to 2001 will continue into the future. Implicit in this is that current levels of (relatively high) home ownership will also continue. Some question this. For example, Yates (1997), Yates (1999) and Beer (1999) point to a number of factors that may curtail home ownership rates in the future, including: increasing income polarisation; reduced job security for many low income earners; high real estate prices in metropolitan areas; and changes in family size and consumption preferences. On the other hand, the expected growth in average income per person is likely to lead to a higher level of home ownership. On balance, we assume that the current pattern of tenure by age group will remain unchanged.

Finally, it was not possible to construct individual indices for the Northern Territory and the ACT due to lack of available data — results for these jurisdictions should be treated with caution. [4]

Projected number of dwelling sales

Given the lower rate of dwelling purchase recorded for those in the 60 plus age cohorts, there is a reduction in the growth rate of dwelling sales over time as the population ages (table 9.3).

The projected trend growth rate of dwelling sales reduces over time in all jurisdictions and indeed, South Australia and Tasmania are both projected to experience negative growth after a period.

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3 Replacements were made for change over buyers aged 40-44 years and 60-64 years in South Australia, first home buyers aged 15-19 and change over buyers aged 55-59 in Victoria, change over buyers aged 65-69 years in Tasmania and change over buyers aged 40-44 years in Queensland. The proportions of all buyers (first home buyers plus change over buyers) were then updated to reflect these replacements.

4 What data there are suggests that actual dwelling sales in the ACT are likely to be somewhat higher than projected, and those in the Northern Territory correspondingly lower. But in the absence of sufficiently good data, it was not possible to determine by how much.

Table 9.3 **Projected growth in dwelling sales**

Annual trend growth rates, by jurisdiction, various periods

State	*2003-04 to 2014-15*	*2014-15 to 2024-25*	*2024-25 to 2034-35*	*2034-35 to 2044-45*	*2003-04 to 2044-45*
	%	%	%	%	%
NSW	1.12	0.67	0.38	0.39	0.62
Vic	0.92	0.53	0.25	0.30	0.46
QLD	1.90	1.43	1.02	0.87	1.28
SA	0.43	0.07	-0.10	-0.18	0.01
WA	1.75	1.15	0.76	0.70	1.06
Tas	0.44	-0.25	-0.40	-0.49	-0.20
NT	0.62	0.81	0.53	0.46	0.66
ACT	0.83	0.62	0.30	0.28	0.51
Australia	1.24	0.78	0.48	0.48	0.71

Source: Commission estimates.

9.4 Projections of conveyancing duty receipts

Modelling assumptions

In order to project conveyancing duty receipts it was necessary to make assumptions about the rate of conveyancing duty over time and real house price growth.

Rate of house price growth

Since 1970, real prices for (detached) houses in Australia have grown at around 2.3 per cent per annum (PC 2004a). For the purposes of projecting conveyancing duty it is assumed that, in the main, this long-run trend will continue into the future for all jurisdictions. As noted in chapter 11, a trend of this magnitude is probably better able to pick up the fundamental determinants of house prices over the longer run than recent trends.

One obvious limitation of applying a national growth rate at a state level is the (partial) independence of the state housing markets, as evidenced by the variation in the rates of price increase between capital cities (table 9.4).[5] In particular, two jurisdictions, Tasmania and South Australia, have exhibited considerably lower house price growth than others. Moreover, these two States are projected to face

[5] It is important to note that part of the variation evidenced in the growth rates presented in table 9.4 might be explained by differences in the time periods assessed.

declining household numbers at some point in the next 40 years (after 2034 for Tasmania and after 2040 for South Australia). Accordingly, a lower trend growth rate is assumed for these two States (of 1.2 per cent per annum for non-capital city areas and 1.8 per cent per annum growth in the capital cities).

Table 9.4 **Trend growth in Australian house[a] prices**

	Period[c]	*Real annual growth rate*[b]
Sydney	1970 to 2003	2.7
Melbourne	1970 to 2003	2.1
Brisbane	1980 to 2003	3.2
Adelaide	1974 to 2003	1.2
Perth	1980 to 2003	2.8
Canberra	1980 to 2003	2.0
Hobart	1991 to 2003	1.5
Darwin	1987 to 2003	3.4
Australia	**1970 to 2003**	**2.3**

a Detached dwellings only. **b** Based on a regression of (log) real prices on a constant and a time trend, with prices deflated by the consumer price indexes for the respective capital cities. **c** Growth rates are sensitive to changes in the time period selected. For example, the Australian growth rate over the period 1959 to 2004 was around 2.5 per cent.

Source: PC (2004a, table 2.1).

Rates of conveyancing duty to apply for estimation purposes

The assumption of real house price growth and the fact that States apply progressive rate structures (table 9.7) implies an increasing proportion of transactions would be taxed at the highest marginal rate over time. As noted in chapter 11, this is not an appropriate assumption. To address bracket creep, total conveyancing duty receipts in the base year (2002-03) were expressed as a percentage of median house prices in order to obtain an average rate of duty for each jurisdiction. These average rates were held constant over the projection period.

Total conveyancing duty receipts (which include receipts from the sale of land and commercial property) rather than conveyancing duty receipts from dwelling sales alone, were used to calculate average rates of duty. This approach assumes that, over the long run, conveyancing duty receipts from the sales of dwellings remain constant as a share of total conveyancing receipts.

A further limitation of the methodology adopted relates to the proportion of buyers eligible for concessions. Calculations of average duty take account of concessions (including first home owner concessions) granted in the base year and project these out over the forty year period. However, Commission projections suggest that the proportion of first home buyers declines over the projection period in all jurisdictions. This suggests that projections might slightly underestimate conveyancing duty receipts as a share of GSP.

Modelling results

Commission projections suggest that an ageing population will dampen property market sales over the next forty years. However, growth in the number of households and real long-run property prices mean that conveyancing duty receipts are likely to increase marginally as a proportion of GSP in all jurisdictions. However, as noted in section three, Commission projections of dwelling sales in the Northern Territory may be overstated. Hence, projections of conveyancing duty receipts as a share of GSP for the Northern Territory should be regarded as 'upper end' estimates.

Table 9.5 **Projected conveyancing duty receipts**

Trend growth rates of duties as a share of GSP

Jurisdiction	*Stamp duty on conveyances as a proportion GSP 2002-03*	*Projected stamp duty on conveyances as a proportion of GSP 2044-45*	*Projected trend growth rate of stamp duty on conveyances as a share of GSP*
	%	%	% per annum
NSW	1.37	1.82	0.70
Vic	1.10	1.38	0.63
Qld	1.08	1.45	0.78
SA	0.88	0.91	0.23
WA	1.12	1.58	0.94
Tas	0.72	0.75	0.16
NT	0.48	0.62	0.66
ACT	1.18	1.54	0.71

Source: Commission estimates.

9.5 The effects of ageing on conveyancing duty receipts

Population ageing impacts on conveyancing duty receipts in two ways.

First is via household formation. An increase in the proportion of people aged 65 years and over will see a corresponding increase in the number of people living alone and in couple only families (as baby boomers become ‘empty nesters’).[6] This will contribute to a reduction in average household size and, for a given population, higher rates of growth in the number of dwellings.

In order to examine the extent to which population ageing is likely to result in higher levels of growth in the number of dwellings, projections of dwellings were calculated under a ‘without–ageing scenario’. In this case, the without–ageing scenario assumes that population growth occurs as forecast, but that the age structure of the population (the shares of the population of each age) remains at current levels (table 9.6).

Table 9.6 **Projected growth in households ‘without ageing’ scenario**

Annual trend growth rates, by jurisdiction, various periods

State	*2003-04 to 2014-15*	*2014-15 to 2024-25*	*2024-25 to 2034-35*	*2034-35 to 2044-45*	*2003-04 to 2044-45*
	%	%	%	%	%
NSW	1.06	0.84	0.64	0.45	0.75
Vic	1.12	0.84	0.63	0.43	0.76
QLD	1.98	1.48	1.16	0.89	1.37
SA	0.60	0.27	0.05	-0.19	0.19
WA	1.59	1.18	0.90	0.66	1.08
Tas	0.59	0.12	-0.18	-0.46	0.01
NT	1.32	1.03	0.78	0.65	0.94
ACT	0.99	0.69	0.49	0.32	0.62
Australia	1.27	0.96	0.73	0.52	0.87

Source: Commission estimates.

The second means through which population ageing impacts on conveyancing duty receipts is via lower rates of dwelling purchase by older households (chapter 11, figure 11.10). In order to assess the extent to which population ageing is likely to dampen housing turnover, projections of dwelling sales can be calculated under a without–ageing scenario. In this case, the without–ageing scenario assumes that household growth occurs as forecast, but that the age structure of households (the shares of households of each age) remains at current levels. This is analogous with growth in households under the base case scenario (table 9.2).

These two ageing effects are partially offsetting — increases in household formation are counterbalanced by a decrease in the number of transactions for a given number of dwellings. That said, conveyancing duty is likely to increase slightly as a share of GSP by 2044-45. This result is driven by the assumption that

6 Declining fertility among younger couples will also contribute to growth in the number of couple-only families.

average house prices rise at rates higher than real per capita GSP (as they have done over the long run). Were house prices to rise by only around 1.6 per cent per annum then conveyancing duty would be roughly fixed as a share of GSP for most jurisdictions. Lower growth rates would result in contraction of the conveyancing revenue to GSP ratio.

Table 9.7 **Summary of conveyancing duty arrangements, by State and Territory, as at 1 January 2004**

	NSW	*Vic*	*Qld*	*WA*	*SA*	*Tas*	*ACT*	*NT*
Number of brackets	6	4	6	5	9	7	6	2
Marginal rate:								
• at lowest threshold	1.25%	1.40%	1.50%	2.30%	1.00%	1.50% [a]	2.00% [b]	Up to 5.35% [c]
• value up to which minimum rate applies	$14 000	$20 000	$20 000	$80 000	$12 000	$10 000	$100 000	$500 000
• on highest value	5.50%	5.50%	3.75%	6.30%	5.50%	4.00%	6.75%	5.40 %
• threshold for maximum rate	$1 000 000	$870 000	$500 000	$500 000	$500 000	$225 000	$1 000 000	$500 000
Marginal rate applies to excess above lower limit of the range	yes	yes	yes	yes	yes	yes	yes	No, applies to total value of transaction
Concessions applying to home buyers generally [d]	No	Pensioners full exemption for properties up to $150 000, partial exemption for properties between $150 000 and $200 000	Concessional rate of 1% for property up to $250 000 plus scheduled conveyancing duty on the excess	Concessional rate of 1.5% applies for principal places of residence valued up to $100 000	Rebate of up to $1 500 for home units in the City of Adelaide meeting relevant criteria	No	Flat duty of $20 for eligible buyers of property up to $180 000, concessional rate of 14.30% for property between $80 000 and $93 000	Duty reduced by a maximum of $1 500 for principal place of residence

a A flat duty of $20 applies to transactions up to $1300. **b** A minimum duty of $20 applies. **c** Duty (D) calculated by the formula D=(0.065V2)+21V where V denotes the (total value/1000). **d** Does not include concessions available to first home buyers.

Gambling revenue

The gambling industry is subject to the Australian Government's GST, as well as a wide range of State taxes, license fees and levies. This paper focuses on State Government own-revenue from gambling (revenue from the GST is discussed in technical paper 11 and chapter 11). It explores the relationship between gambling and age and examines the likely trends in gambling revenue over the next 40 years.

10.1 Gambling revenue and taxation

Gambling taxation represents a significant share of State Governments' own-tax revenue. In 2002-03, State governments collected nearly $4 billion in revenue from gambling, representing 11 per cent of State taxation revenue (ABS 2004a)[1] and 0.55 per cent of GDP.

Revenue from electronic gaming machines in pubs and clubs accounts for over half of gambling revenue collected by State governments. Revenue from lotteries is also significant, representing 25 per cent of total gambling revenue. The remaining revenue is generated mainly from casino gaming and racing.

Over 60 per cent of State gambling revenue is collected in two jurisdictions — New South Wales and Victoria. However, in per capita terms Victoria (over $350 per adult) and South Australia ($300 per adult) collect the most gambling revenue (compared with the Australian average of $260 per adult).

There are wide disparities in taxation rates (government revenue as share of expenditure) for gambling across jurisdictions as well as between different forms of gambling. The highest taxation rates are in South Australia, Western Australia and Victoria, where revenue from gambling is over 30 per cent of expenditure. In contrast, the Northern Territory, ACT and New South Wales have the lowest taxation rates with revenue from gambling representing less than 20 per cent of expenditure. By form of gambling, taxation rates vary from 65 per cent on lottery products, 25 per cent on gaming machines, 18 per cent on racing and 12 per cent on casino table games.

[1] When GST is not included as a State tax.

10.2 Gambling and age

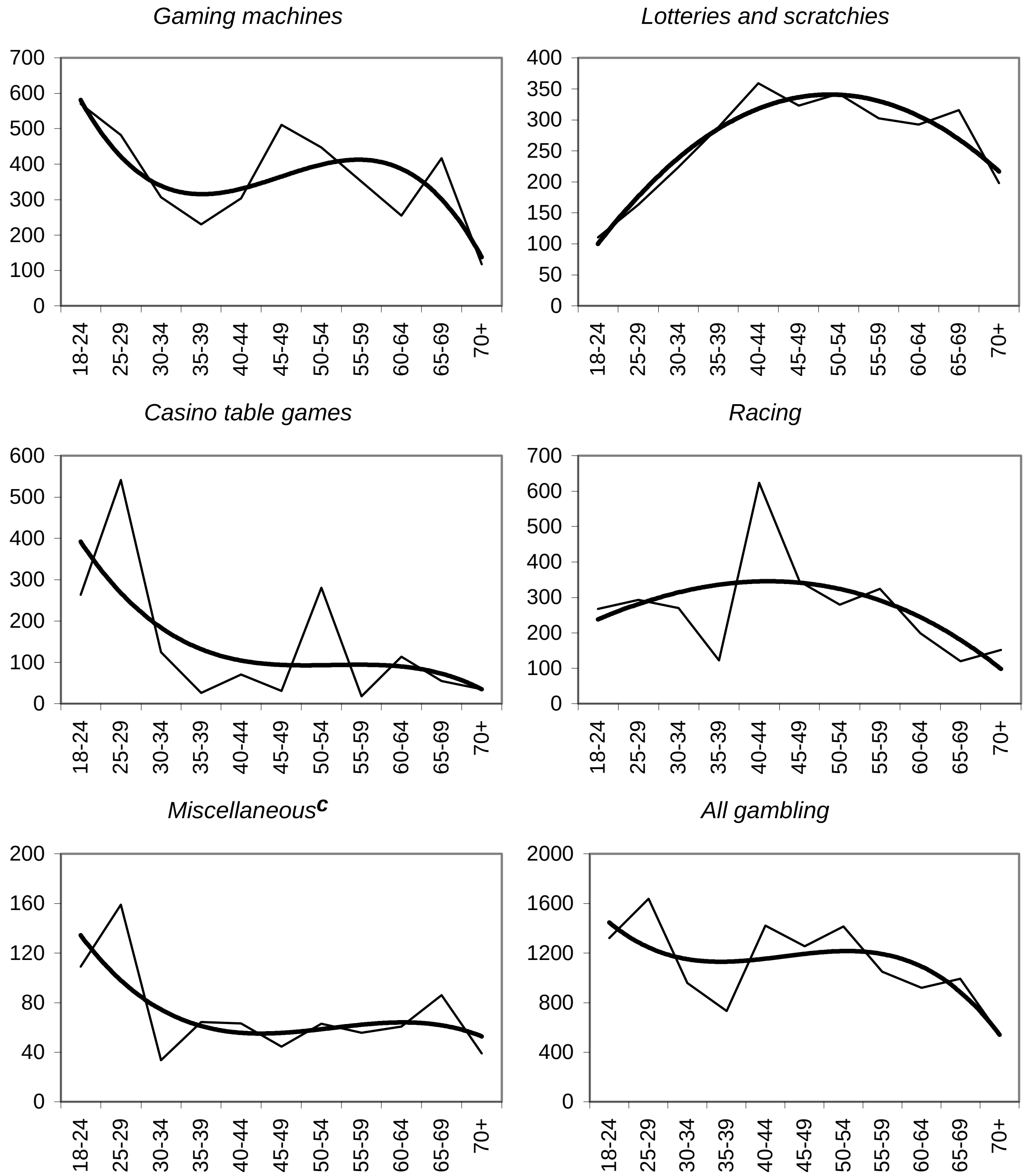
To assess the impact of an ageing population on gambling revenue, information is needed on which age groups contribute the most to gambling revenue. The ABS collects data on household gambling expenditure, through its Household Expenditure Survey (HES). The strength of the survey is that it is a national survey, conducted every five years and has a large sample size. However, gambling expenditure is severely underestimated in the survey. Survey respondents are typically unwilling to report actual expenditure (losses) or may not know how much money they spent on gambling during the reporting period. For example, the most recent HES in 1998-99 found that the average household spends $302 each year on gambling (ABS 2000, cat. 6535.0). This corresponds to an estimated expenditure of $2.2 billion for Australia — significantly less than the $12 billion expenditure estimate by the Tasmanian Gaming Commission for 1998-99 (based on reliable industry-based data). Given these problems, the HES does not constitute a reliable basis for estimating spending by age groups.

Recognising this problem, the Commission's national gambling survey conducted in 1999 as part of the inquiry into Australia's Gambling Industries asked questions on outlays (the amount of money a gambler takes to a gambling venue and uses to gamble) as well as expenditure (PC 1999a). An analysis of the Commission's survey data found that outlays by age group offered a smoother and more preferred series for examining patterns of spending on gambling by age groups (essentially, because outlays are always positive). However, a number of outliers are present in the data, an inherent problem of many surveys. To overcome this the Commission estimated trimmed means, but these did not significantly improve the estimates.

Despite outliers, the trends depicted in the data are credible.

- 18 to 24 year olds outlay the most on gaming machines; after the age of 60-65 years outlays on gaming machines fall rapidly.
- Outlays on lotteries increase progressively up to 50-54 years, after which they decrease with age.
- As age increases, outlays on casino table games fall.
- Outlays on racing increase up to the 44-45 age group and then progressively decrease with age.
- 18 to 34 year olds outlay the most on miscellaneous gambling (which comprises mainly sports betting, keno and minor gaming such as bingo).
- Overall, 18 to 30 year olds spend the most on gambling. Between the ages of 30-34 years and 55-59 years, outlays by age are similar. However, after 55-59 years outlays on gambling fall considerably (figure 10.1).

Figure 10.1 **Gambling outlays per person[a], survey data and trends[b]**

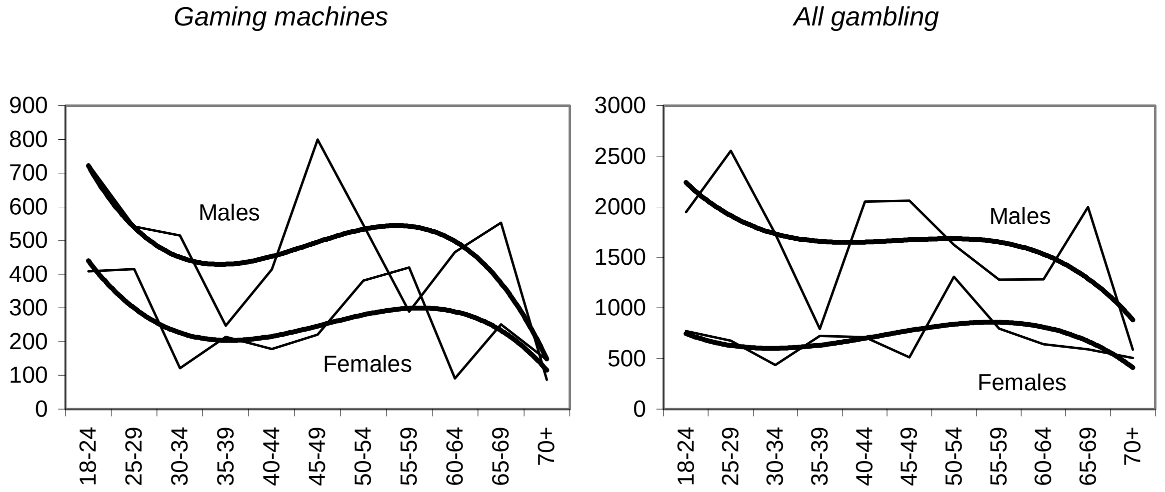


a Per person over the age of 18; **b** trends are based on third degree polynomials; **c** miscellaneous includes keno, sports betting, bingo, internet casino and other.

Data source: PC national gambling survey, PC (1999a).

The Commission also considered outlays on gambling by males and females. Males, on average outlay more on gambling than females. However, the trends between age groups are consistent. The only exception was casino gaming, where the male and female trends were driven by a few outliers. Figure 10.2 shows the similar age-based trends for males and females for gaming machines, and gambling as a whole.

Figure 10.2 **Gambling outlays per person[a], survey data and trends[b]**
Males and females, gaming machines and all gambling



a Per person over the age of 18; **b** trends are based on third degree polynomials.

Data source: PC national gambling survey, PC (1999a).

The Commission consulted a number of researchers about evidence from recent State surveys relating to gambling by age. Researchers indicated that while survey data on expenditure is understated, there is a clear relationship between gambling and age, with young males spending the most and older age groups the least.

For example, the 2001 Queensland Household Gambling Survey found:

> Non-gamblers are quite distinct from the general population. This group are more likely to be over 55, and less likely to be in their middle working years (35-54) (p.8)….
>
> A major concern in the problem gambling group is the disproportionate representation of men. The 18-34 age bracket predominates… Also significant is the smaller number of problem gamblers in the 55+ age cohort (Queensland Government Treasury 2002, p. 12).

This is consistent with the trends depicted in the Commission's survey data.

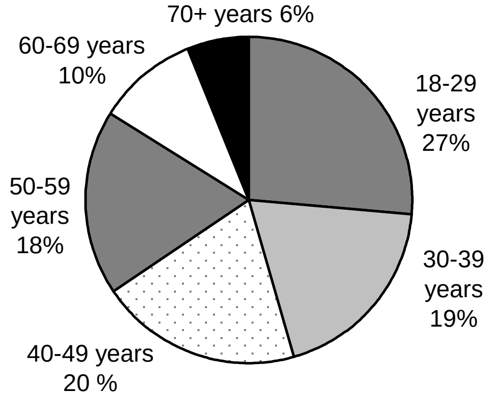
There is a consistent relationship between outlays on gambling by age group and revenue by age group. Therefore, aged based trends in outlays can be applied to aggregate revenue to provide estimates of revenue by age group.

Of the $4 billion in gambling revenue collected by State governments in 2002-03 the majority, 27 per cent, was from those aged 18 to 29 years. In comparison, 60 to 69 year olds accounted for 10 per cent and the over 70 years age group accounted for less than 6 per cent of gambling revenue. In per capita terms, each person aged 18 to 24 on average paid $345 in gambling taxes in 2002-03, compared with $130 paid by each person aged over 70 years (figure 10.3).

Figure 10.3 **Revenue collected from gambling by age group, 2002-03**

Revenue per capita
$

Share of revenue
%

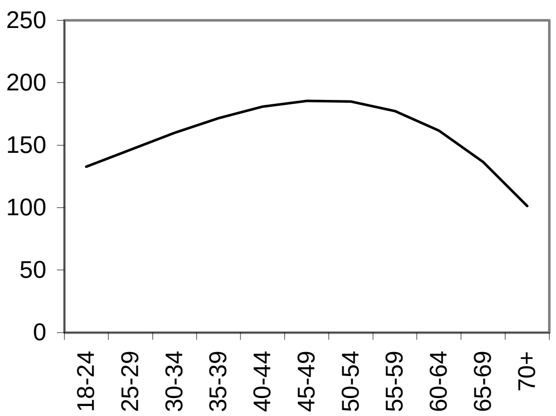


Data source: Commission estimates.

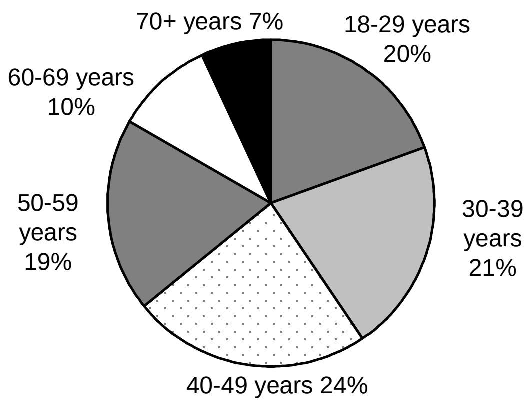
The trends depicted in figure 10.3 are similar for most States. The exception is Western Australia, which does not have gaming machines. Unlike the other States (where the majority of gambling revenue is from gaming machines) over 60 per cent of revenue in Western Australia from gambling is from lotteries. As a consequence, in Western Australia the share of government revenue for those aged 18 to 29 years is significantly lower than the national average. However, for those over 50 years revenue shares are consistent with the national average (figure 10.4).

Figure 10.4 **Gambling by age group, Western Australia, 2002-03**

Revenue per capita
$



Share of revenue
per cent



Data source: Commission estimates.

10.3 Revenue is increasing over time

State revenue from gambling has risen rapidly over the last two decades. The exception was in 2000-01 when revenue decreased 17 per cent from the previous year with the introduction of the GST (box 10.1).

- Between 1988-89 and 1999-00 revenue from gambling more than doubled, increasing from $1.5 billion in 1988-89 to $4.4 billion in 1999-00.
- Since the introduction of the GST revenue from gambling has continued to rise, increasing from $3.6 billion in 2000-01 to $3.9 billion in 2002-03.

Gambling taxation as a share of State governments' own-tax revenue has also been increasing. In 1991-92 the States raised about 9 per cent of taxation revenue from gambling. Prior to the introduction of the GST in 1999-00 this had increased to almost 12 per cent. Currently, gambling forms 11 per cent of State governments' own-tax revenue.

Much of this growth has come from gaming machines. Government revenue from lotteries, casinos and racing has remained relatively stable over the period (figure 10.5)

.

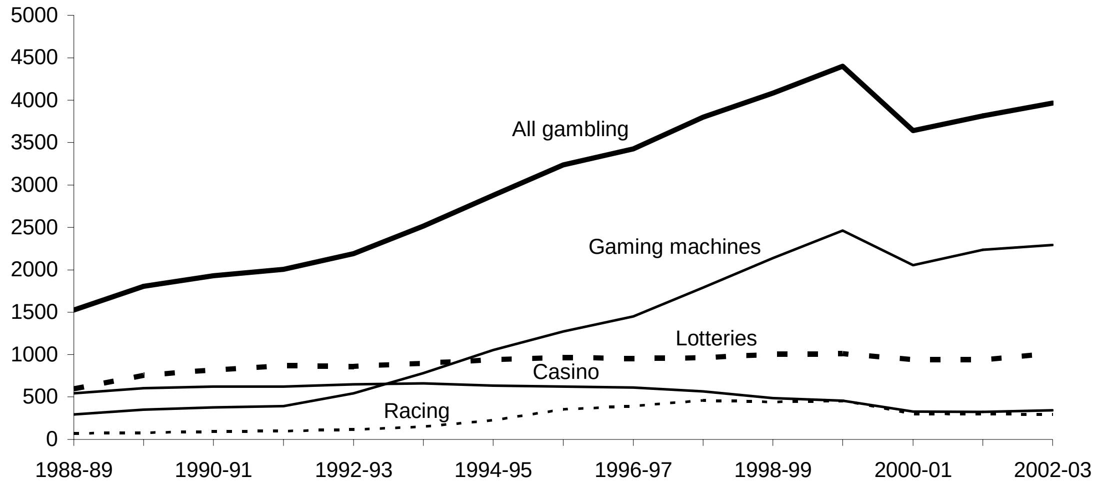
Box 10.1 **A note on the introduction of the GST**

Gambling tax rates were effectively reduced from 1 July 2000 with the introduction of the GST.

Under the Intergovernmental Agreement on the Reform of Commonwealth – State Financial Relations it was agreed that GST revenue would be distributed to the States and in return, the States would forego revenue and accept additional expenditure responsibilities. Essentially, the reduction in State gambling tax rates were to 'make room' for the Australian Government's 10 per cent GST on gambling.

As a consequence, gambling revenue data in 2000-01 are not directly comparable with those of preceding years.

Figure 10.5 **State Government revenue from gambling**
1988-89 to 2002-03[a]



[a] Does not include GST. The decline in revenue between 1999-00 and 2000-01 is associated with the introduction of the GST and Intergovernmental Agreement on the Reform of Commonwealth – State Financial Relations.

Data source: Tasmanian Gaming Commission (2004).

Future trends in gambling revenue

Growth in State gambling revenue over the last two decades has been driven by increased consumer expenditure, which has resulted from much greater access to gambling opportunities. For example:

- an expansion in the number of gaming machine licences has resulted in gaming machines being available in hotels and clubs throughout Australia (other than Western Australia); and
- the advent of interactive gambling products such as internet sports betting and telephone betting mean that consumers now no longer have to leave home to gamble.

Over the next 40 years technological change is likely to lead to the introduction of new forms of gambling and even greater access to gambling products. It is not known how governments will respond to these new gambling products. However, the Interactive Gambling Act 2001, which prohibits the provision of some interactive gambling services, signals the intention of the Australian Government to stop some forms of internet gambling.

Even if new products are introduced to the market, it is not clear that these will have a significant impact on government revenue. Since 1998-99, gambling expenditure as a share of household expenditure has remained relatively constant at about 3.4 per cent. (TGC 2004) Unless completely novel forms of gambling are introduced that capture new market niches, it is likely than any increased expenditure on new products will be offset by a fall in the market share of existing forms of gambling. Accordingly, the Commission has not projected a significant increase in expenditure on gambling as a share of household income. Assuming that new gambling products are likely to be taxed at similar rates to existing products, this in turn means that new products are unlikely to have a significant effect on aggregate gambling revenue.

Future revenue from gambling will also be determined by taxation policy. Average taxation rates on gambling fell from 38 per cent in 1988-89 to 33 per cent in 1999-00, but since the introduction of the GST have remained constant at about 25 per cent. The Commission assumes that current taxation rates are maintained to 2044-45.

10.4 Methodology for projections

The Commission used State estimates of gambling tax rates, combined with age-based trends on gambling outlays from the Commission's national gambling survey, to project the likely trends in gambling revenue.

- Estimates of gambling outlays per capita (from the Commission's national gambling survey conducted in 1999) were smoothed by fitting trendlines based on third degree polynomials to remove the effects of outliers (figure 10.1).
- These trends were applied to State estimates of government revenue from gambling (published by the Tasmanian Gaming Commission) to produce estimates of government revenue per person by age group in 2002-03 (for example, figures 10.3 and 10.4).
- Estimates of future revenue per capita were based on the projected annual percentage increase in household disposable income. Projections of gross product were used as a proxy for household income.
- Projections of total revenue were made by combining projected revenue per capita with demographic projections.

The Commission used this approach to project the trends in gambling revenues by age group and type of gambling (including gaming machines in hotels and clubs, racing, sports betting, lotteries, minor gaming, and casino gaming) for each State. Although males spend more on average than females, it was not necessary to project gambling revenue separately for males and females because (as discussed in section 10.2) their relative outlays by age are consistent.

The methodology assumes constant shares of revenue by age group over time in any given gambling form. Increases in gaming opportunities in the last decade may result in expenditure patterns by age group being different in the future. However, in the absence of panel data, it is not possible to allow for any age cohort effects.

10.5 Results

Two major demographic factors will influence spending on gambling in the future.

- Firstly, the adult share of the population is expected to increase over the next 40 years for all jurisdictions. This will increase the proportion of the population that gamble and (all else equal) result in an increase in gambling expenditure.
- Secondly, the share of population in older age groups, is projected to increase. This will offset increasing gambling expenditure as older age groups have a relatively lower propensity to gamble.

If the ageing effect outweighs the effect of a growing adult population gambling expenditure and revenue is projected to fall over time. This occurs in most States (table 10.1). The exception is the Northern Territory where the adult effect outweighs the ageing population, explaining the small rise in gambling revenue to GSP. In Western Australia the two effects effectively cancel each other out and there is a slight increase in gambling revenue to GSP.

Table 10.1 **State revenue from gambling, projections**

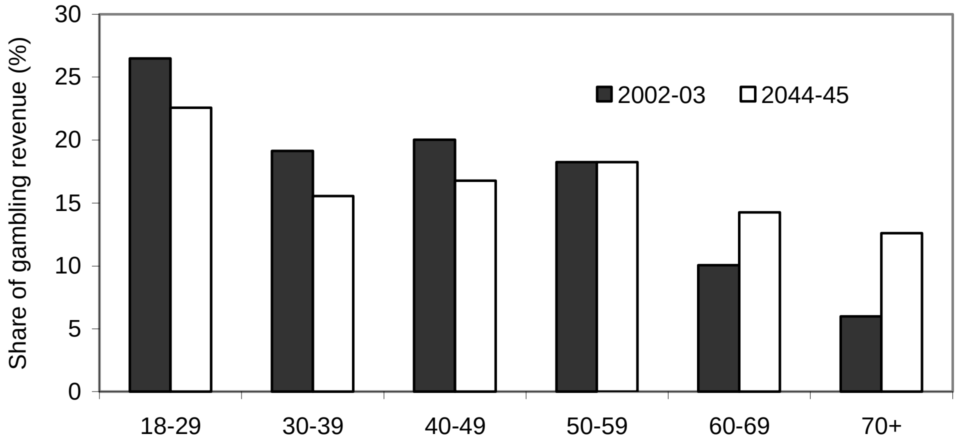
Per cent of gross product

	2002-03	*2008-09*	*2014-15*	*2024-25*	*2034-35*	*2044-45*
New South Wales	0.477	0.484	0.485	0.476	0.471	0.469
Victoria	0.683	0.693	0.696	0.682	0.673	0.670
Queensland	0.492	0.497	0.500	0.490	0.484	0.483
South Australia	0.701	0.713	0.715	0.695	0.681	0.680
Western Australia	0.278	0.284	0.286	0.284	0.282	0.282
Tasmania	0.580	0.586	0.585	0.565	0.554	0.552
Northern Territory	0.389	0.396	0.403	0.407	0.411	0.414
ACT	0.319	0.323	0.322	0.316	0.313	0.313
All jurisdictions (sum)	**0.523**	**0.527**	**0.528**	**0.515**	**0.506**	**0.502**

Source: Commission estimates.

Demographic change is also expected to have a significant effect on the share of gambling revenue attributed to older age groups. For example, in 2002-03 the Commission estimates that 6 per cent of revenue from gambling was collected from the over 70 years age group. In 2044-45 this share is projected to increase to 13 per cent (figure 10.6). This trend is consistent for all States.

Figure 10.6 **Revenue shares by age group, 2002-03 and 2044-45**

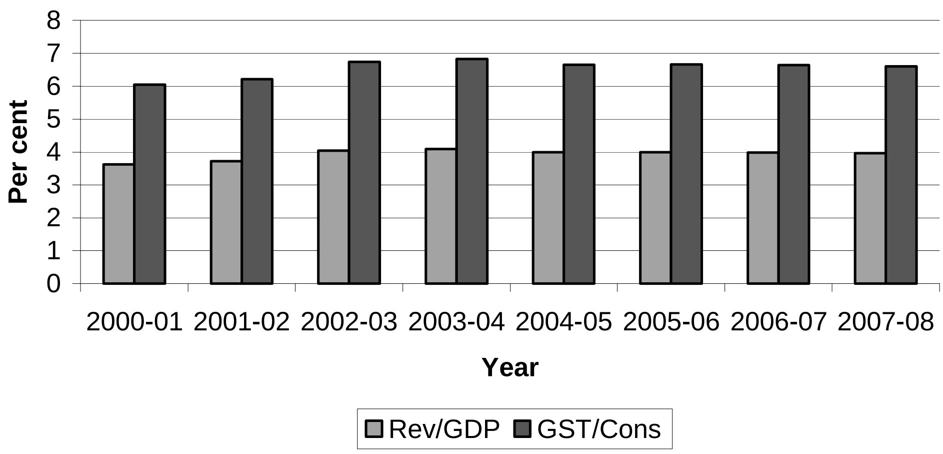


Data source: Commission estimates.

Goods and Services Tax

Australia's Goods and Services Tax (GST) is a broad based tax on the supply of most goods and services in Australia. A tax of 10 per cent is charged on the final sale of all taxable goods and services. Revenues are collected by the Australian government, but are returned directly to the State governments from which they were collected (subject to an equalisation process). Since the introduction of the GST in 2001, GST revenues as a share of both GDP and of household consumption have been rising steadily (figure 11.1). The 2004-05 Budget papers predict GST revenues to account for 4 per cent of GDP and 7 per cent of consumption expenditure.[1]

Figure 11.1 **GST revenue**



Data source: Richardson (2004).

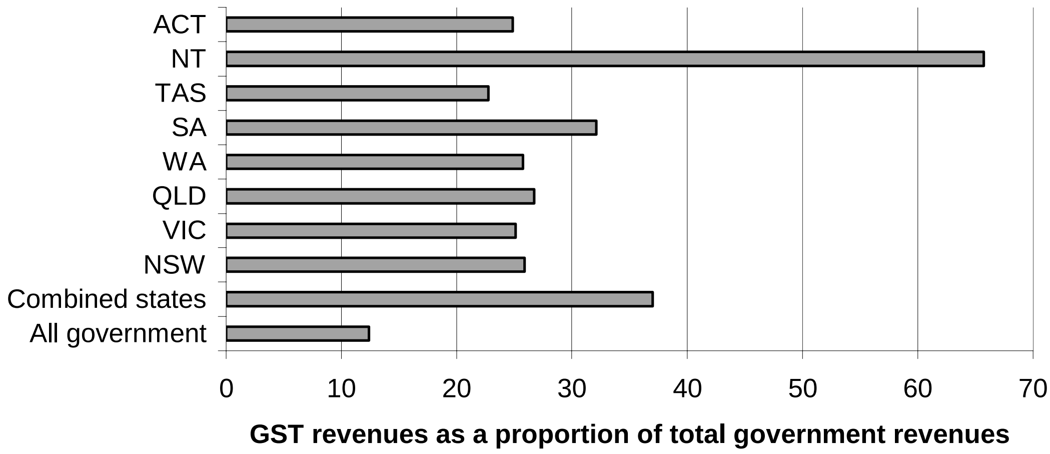
Relatively, the GST provides only a small amount of the total funding for government spending. Combined State, Territory and Federal revenues in 2003-04 amounted to $268.1 billion. GST revenues contributed to 12 per cent of this figure, around $33.2 billion. For the States, however, the revenue earned through the GST amounts to a significant component of their respective budgets. For most State and

[1] The actual budget papers' estimate of GST/GDP for 2004-05 is 4.09%. Were recent ABS data of GST revenue used (ABS 2005, *Australian National Accounts: National Income, Expenditure and Product*, Cat. 5206.0), the estimate of GST/GDP would be 4.15%.

Territory governments, the GST accounts for about one quarter of total revenues (figure 11.2) — with only the Northern Territory substantially higher.

Figure 11.2 **GST revenues**

2004-05 estimated



Data source: Treasury and State and Territory budget papers. Revenues include non-tax revenues, such as Australian Government Specific Purpose Payments.

There are several ways in which GST revenues may be affected by ageing (box 11.1):

- Some consumption items are exempt from taxation (indeed, GST-free items accounted for around 31 per cent of household consumption in 2003-04, and about 19 per cent of GDP).[2] If the old spend more or less proportionately on these exempt items than others, then ageing will shift expenditure towards or away from tax exempt goods and services, with implications for the revenue base. Since the GST is a flat rate tax, other changes in the patterns of consumption that may occur with ageing make no difference to the revenue base.
- The share of income used for households' consumption spending (or its inverse, the saving ratio) may change over time as a result of ageing, affecting the overall level of consumption in the economy and the revenue base for the GST.

[2] GST-free items include fresh foods; many educationally-related expenditures (such as education courses, materials, administrative fees and student accommodation); most health care (such as hospital treatment, medicines, many professional health services); childcare; some utility services (such as water and sewerage); residential rents; acquisition of residential properties (including investment properties and mortgage repayments); and some financial services.

- As noted in chapter 5, ageing affects overall economic growth and thereby the income from which consumption is funded. However, by itself, this factor does not change the ratio of GST revenue to GDP, and is ignored in this section.

Box 11.1 **Modelling the impact of ageing on GST revenues**

Empirically, the ratio of disposable household income (HY) to GDP has been stable over time (at around 0.6). It is assumed that this pattern continues so that:

$HY_t = 0.6\ GDP_t$

HY is directed by households to three things: consumption later (savings — S, which are not taxable through the GST), GST-exempt consumption (TEC) and consumption that is taxable through the GST (the consumption revenue base — CRB). TEC has two components.

The first includes tax exempt items whose consumption levels per capita are age-related (TECAR). These are health care, education spending and housing costs.

The value of TECAR is modelled as:

$$TECAR_t = \sum_i \sum_x \frac{C_{i,x,t}}{POP_{x,t}} \frac{POP_{x,t}}{POP_t}$$

where C(i,x,t) is consumption of the i^{th} tax exempt good by the x^{th} age group at time t. Profiles of C(i,x)/POP(i,x) by different age group (x) were obtained from current data. It was assumed that *relative* spending on tax-exempt items per capita between different age groups would remain constant over time. Further, it has been assumed that C(i,x)/POP(i,x) would grow by the same rate as GDP per capita, with the exception of health care, where the same assumptions as those used in chapter 6 were used.

The second component of TEC are items whose consumption is not age-related (TECNAR). These include fresh food and a residual group encompassing a large range of miscellaneous items. It is assumed that TECNAR comprises a fixed share of household income.

In our baseline case, we have adopted the assumption that there is no change in the ratio of savings to HY, though we explore scenarios in which this assumption is relaxed (chapter 11).

Accordingly, the consumption revenue base can be projected as:

$CRB_t = (1-\beta-\lambda)\ HY_t - TECAR_t$

Where β is the savings ratio and λ is the ratio to household income of tax-exempt consumption items that are not age-related.

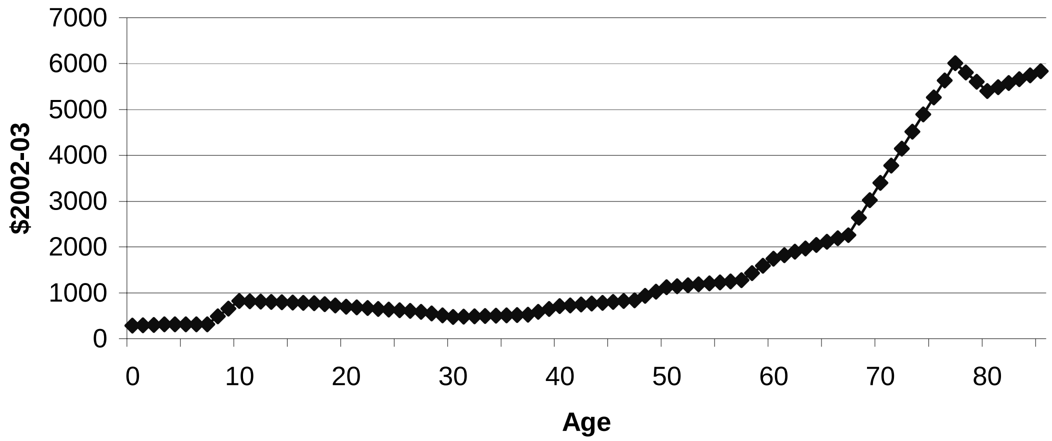
Finally, GST revenue as a share of GDP is calculated as 10 per cent of CRB/GDP.

Is there an ageing dimension to consumption of tax exempt items?

Per capita consumption of GST-exempt items increases with age (figure 11.6 in chapter 11). Approximately 28 per cent of consumption by people aged under 60 years is untaxed — most of this is expenditure on housing and fresh food. In contrast, around 35 per cent of the consumption of those aged over 75 years is untaxed. This suggests that an ageing population will shift a greater share of consumption spending to tax exempt items, reducing State and Territory revenue bases below what they would be otherwise.

Three tax-exempt consumption items have particularly noticeable age-related consumption patterns: health, education and housing (figure 11.3 to figure 11.5 and table 11.1).

Figure 11.3 **Private health expenditures**
Per capita[a]

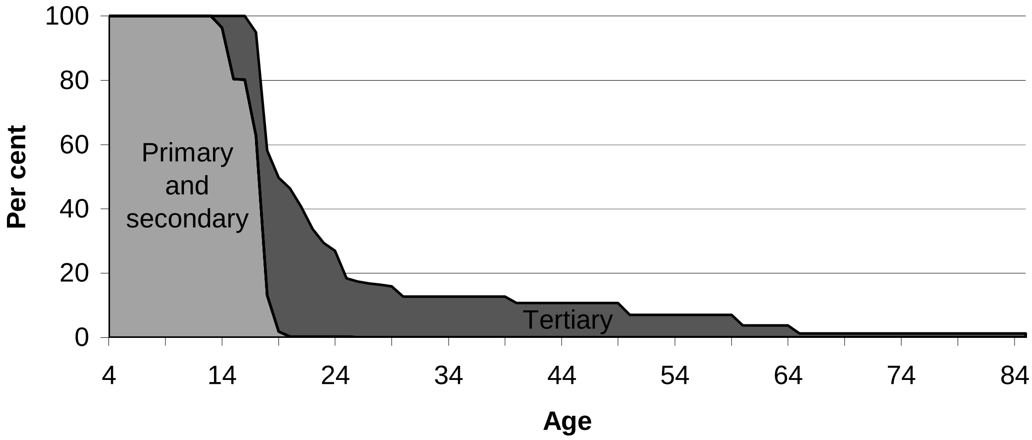


[a] The private health expenditure profile is calculated by subtracting the public health expenditure profile in chapter 6 from the total health expenditure profile in appendix A.

Data source: Commission estimates

Figure 11.4 **Participation in education**

2003[a]



[a] Direct data on private spending on education by the age of the recipient is not readily available. However, for the purposes of GST calculations, a reasonable proxy for such spending was developed from data on participation rates in education and aggregate information on private education costs. For any age group, x, private education spending (E) was estimated as:

$$E_x = PR(x,SP)C(SP) + PR(x,T)C(T)$$

where C(SP) is the average private cost per student of secondary and primary tuition (approximately $1402 per student in 1999 from the Household Expenditure Survey), PR(x,SP) is the participation rate in such schooling by a person aged x years, C(T) is the average private cost per student of tertiary education (approximately $1175 per student in 1999). And PR(x,T) is the participation rate of someone aged x in tertiary education.

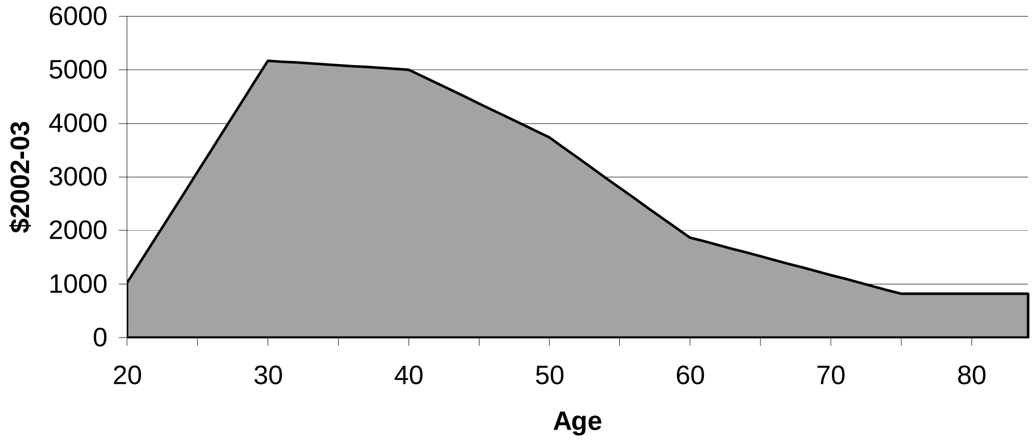
Data source: ABS (*Schools Australia, 2003*, Cat. no. 4221.0; *Education and Training in Australia*, *1998,* Cat. no. 4224.0; and *Household Expenditure Survey, Australia: Detailed Expenditure Items, 1998-99*, Cat. no. 6535.0); DEST (2004); NCVER (2003); and Commission estimates.

Forecasting future GST revenues

Initial estimates of GST as a share of GDP were produced using the methodology outlined in box 11.1 and the age profiles of consumption noted above. Non-taxable expenditure will account for around 36 per cent of total household consumption (21.4 per cent of GDP) by 2044-45 (Commission estimates), up from its current share of 31.3 per cent of household spending (18.7 per cent of GDP). The main source of this change is increased expenditure on private health services, which will increase by about 2 percentage points as a share of GDP. The surge in private health expenditures, however, is partly offset by a reduction in tax-exempt consumption of education and housing. This reflects relatively fewer children in education and an increase in homeownership that reduces tax-exempt housing consumption (figure 11.7 in chapter 11).

Figure 11.5 **Housing costs**

Per capita, 2004[a]



[a] This was estimated by applying a linear piecewise transformation to the profile of housing expenditures by age. Housing expenditures are quite high until the mid 40s, as the degree of outright homeownership is relatively low, with those in the market both renting and servicing mortgage debt.

Data source: ABS (*Housing Occupancy and Costs, Australia, 1997-98*, Cat. no. 4130.0; *Household Expenditure Survey, Australia: Detailed Expenditure Items, 1998-99*, Cat. no. 6535.0), and Commission estimates.

Table 11.1 **Housing expenditure**

2003-04[a]

Age	*Households by tenure type, thousands*			*Housing costs by tenure type*			*Total*	*Pop, millions*	*Per capita*
	Outright	*Mortgage*	*Rent*	*Outright*	*Mortgage*	*Rent*			
15-24	6.7	46.1	257.5	2 992	12 700	8 523	2 800	2.66	1055
25-34	99.3	600.7	647.9	1 750	15 240	9 483	15 472	2.87	5384
35-44	277.9	844.6	478.7	1 750	12 644	9 031	15 488	2.97	5212
45-54	586.8	612.0	287.7	1 524	11 289	8 692	10 304	2.66	3875
55-64	631.8	194.3	145.2	1 298	8 523	6 999	3 493	1.83	1908
65+	1 194.4	52.8	184.4	1 072	3 895	4 403	2 298	2.44	944

[a] The ABS reports household mean weekly housing costs by age and tenure type. Individual housing expenses were estimated by dividing aggregate housing expenditure by the number of persons in each age category. For example, given the tenure characteristics of 55-64 year olds, and the mean tenure-specific housing costs, this cohort spent some $3.5 billion dollars on housing in 2001. Per capita, the average 55-64 year old will have spent approximately $1932 on housing in 2004.

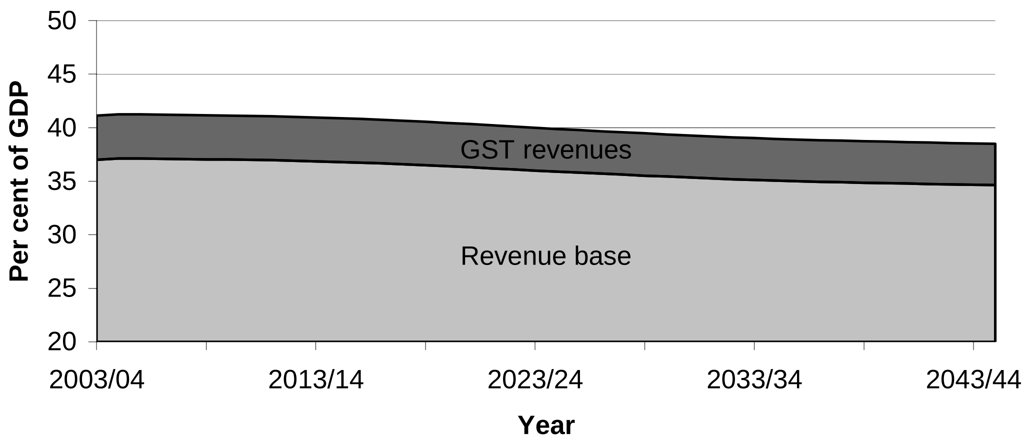
Source: ABS (*Housing Occupancy and Costs, Australia, 1997-98*, Cat. no. 4130.0; *Household Expenditure Survey, Australia: Detailed Expenditure Items, 1998-99*, Cat. no. 6535.0) and Commission calculations.

Consequently, the GST revenue base will decline over the next 40 years. Consumers today spend some 41 per cent of GDP on GST-eligible goods and services (which realises GST revenue of 4.11 per cent of GDP given the flat

10 per cent tax rate). Changes in Australia's demographic composition and growth in health spending will result in net substitution away from taxed consumption items towards tax exempt classes. This will reduce the Government's GST revenue to 3.84 per cent by 2044-45 (figure 11.6) — or a reduction in available GST revenues of around 6 per cent.

Figure 11.6 **The GST revenue base**

2003-04 to 2044-45



Data source: figure 11.7; figure 11.3; figure 11.4; figure 11.5 and Commission estimates.

These estimates assume that current age spending profiles remain constant over the medium term. This assumption has been made largely because of the uncertainty about age-adjusted trends in the housing, education and health sectors.

12 Household projections

As part of its report into the *Economic Implications of an Ageing Australia*, the Commission developed projections of future household numbers for each jurisdiction to 2044-45.

The Commission's projections of households are based on the 'propensity' methodology developed by McDonald and Kippen (1998). This method is also employed by the ABS (2004) in its more short-run projections. The ABS (2004) provides a detailed description of the methodology used.

The methodology, based on data collected from the Census of Population and Housing, identifies the propensity of people of different ages to belong to 15 different living arrangement types, such as lone person households and couple families with children.

Trends observed in the propensities over the last four censuses for each five-year age group are then projected forward and applied to the projected population — the accompanying household projections are based on the Commission's 'median' population series (PC-M).

The Commission's projections of households are based on the assumption that there is a 'low rate of change' in propensities over time. Specifically, it is assumed that the trends observed over the period 1986 to 2001 continue at the full rate of change to 2006, half the rate of change to 2011, one quarter the rate of change to 2016 and then remains constant to 2045.[1]

Propensities were produced for Australia as well as each State and Territory and applied to the respective population projections. As propensities were applied independently at each geographical level, the sum of living arrangement distributions for the states and territories differs slightly from those derived from applying nationally observed propensities to the projected population of Australia as a whole. Both versions are reported in the accompanying spreadsheet.

[1] These assumptions are based on the assumptions underlying the ABS Series II projections of households, with the exception that the ABS estimates only cover the period to 2026.

Since the 15 living arrangements encompass both families and households, several adjustments were required. These are outlined in detail in ABS 2004 (pp. 117-118). In brief:

- the number of couple families (with or without children) were calculated as half the number of partners in couple families;
- the number of one parent families were calculated as the sum of male and female lone parents. Similarly, the number of lone person households were calculated as the sum of male and female lone persons;
- the number of 'other families' were calculated by dividing the number of related individuals by the average size of this family type;
- since family households can contain more than one family, families were converted to households using the 'family households to families ratios' recorded in the 2001 Census;
- the number of group households were calculated by dividing the number of persons in group households by the average size of group households as recorded in the 2001 Census; and
- family and non-family households were added to produce the total number of households.

The accompanying spreadsheet can accommodate changes in population projections as well as the average family sizes and ratios outlined above.

References

ABS (Australian Bureau of Statistics) 2004, *Household and Family Projections 2001 to 2026*, Cat. No. 3236.0.

McDonald, P. and Kippen, R 1998, *Household Trends and Projections: Victoria 1986-2011*, Victorian Department of Infrastructure, Melbourne.

Costs of death and health expenditure

13.1 Introduction

In cross-sectional data, average health expenditure increases steeply with age. Paradoxically, however, studies examining the determinants of past increases in health expenditure have not found population ageing to be a major factor. As Richardson (sub. 16, p.4) notes 'age explains little or none of the difference in the growth of health expenditures between OECD countries'. This empirical stylised fact has led many health economists to question whether population ageing will place much pressure on government-financed health systems. But this may not be a good basis for such a sanguine view. Technical Paper 5 (TP5) examined a number of possible reasons why the econometric evidence could provide a misleading perspective:

- the degree of ageing has been low in most countries;
- there has been rationing of health expenditure in many countries;
- there are inconsistencies across countries with the classification of health expenditure; and
- there are issues with the econometric methods used to test for ageing.

In addition, TP5 raised, but did not explore in detail, the possibility that high costs at the end of life may offset the past impact of demographic change on health expenditures (while not doing so for the future). This paper examines the magnitude and nature of costs incurred by those in the last year of their life. It then examines the impact that demographic change has had on past Australian hospital expenditure once changes in death rates are taken into account. Lastly, based on the Australian results, it speculates on the impact of past and future demographic change on health expenditure in a number of developed countries.

13.2 The proportion of health costs incurred in the period before death

In recent years there have been a growing number of studies examining the magnitude of health expenditure incurred in the period prior to death. Despite differences among these studies, some consistent results emerge.

Costs are much higher at the end of life

As early as the 1960s, Sutton (1965) examined the relationship between hospitalization in the last year of life in the US (Moodley and McLeod 2001). Since then there have been a multitude of studies investigating death related costs. As summarised in table 13.1, they have consistently found that costs incurred in the period prior to death are considerably higher than ongoing health costs (or survivor costs as they are often called). For example, a 1999 study by the Centres for Medicare and Medicaid services estimated that annual American Medicare costs incurred in the last year of life were on average US$24 856 compared to US$3 699 for survivors. American Medicare expenditures incurred by decedents appear to be around 6 to 7 times greater than those of survivors. In Denmark, for hospital expenditures, decedent's costs were found to be considerably higher, at 9.4 times greater than survivors for women and 13.3 greater than survivors for men (Serup-Hansen et al. 2002). These results are not surprising as people often face a substantial deterioration in health prior to their death.

Death related costs are a material component of health expenditure

Although the proportion of the population dying in any year is small, the proportion of total health costs incurred by those in the last year of life is significant, due to the high costs associated with dying. Studies on American Medicare data have generally found that around 26 to 30 per cent of total Medicare expenditures are incurred by the 5 to 6 per cent of Medicare Beneficiaries who are in the last year of their life (Lubitz and Riley 1993). Gray (2004) finds that for the UK close to 29 per cent of hospital costs are related to death. Findings from other countries vary, with the percentage of total expenditures related to death found to be as low as 10 per cent in the Netherlands (Stooker et al. 2001) and as high as one third in one Canadian study (Pollock et al. 2001).[1] A clearer picture of how this percentage varies across countries will be achieved once more research has been conducted over a wider range of countries.

[1] The picture for one Canadian state, Manitoba, is considerably less than this at 21 per cent (Menec et al. 2004)

Table 13.1 Studies on death-related health costs

Author(s)	*Year*	*Country*	*Type of expenditure*	*Percentage of expenditure related to the end of life*	*Ratio of expenditure of decedents to survivors*
Lubitz and Riley (incorporates results from Lubitz and Prihoda 1984)	1993	U.S.A	Medicare	28.2% (1976) 30.8% (1980) 27.4% (1985) 28.6. (1988)	7.1 7.8 6:55 6.9
Hoover et al	2002	U.S.A	Total Medicare Non-Medicare	22% 26% 18%	4.98 6.29 3.86
Hogan et al	2001	U.S.A	Total (for elderly)	27.2%	
Menec et al.	2004	Manitoba, Canada	Total	21%	
Stooker et al	2001	Netherlands	Total Long-term Care Acute Care	10% 5% 10%	
Pollock et al	2001	Canada	Total	33.3%	
Centers for Medicare and Medicaid services	2004	U.S.A	Medicare	26.5% (1994) 27.9% (1999)	
Emanuel, E.J and Emanuel, L,L.	1994	U.S.A	Total	10-12%	
Gray	2004	UK	Hospital	28.9%	
Serup-Hansen et al	2002	Denmark	Hospital		9.4 (women) 13.3 (men)

Most death related costs are incurred in the last year of life

Seshamani and Gray (2004) find a relationship between hospital costs and death up to 15 years prior to death. Despite this, their study still indicates that costs incurred in the period immediately before death are by far the most important. For example, average costs incurred in the last year of life are around 2.3 times greater than costs incurred in the second last year of life, and close to 21 times greater than costs incurred in the fifteenth last year of life. This is consistent with the majority of studies, which find that most of the costs related to death are incurred in the last year. Moreover, it has also been found that costs incurred in the last year of life are concentrated in the final few months of life, with 30 to 40 per cent of costs incurred in the last year incurred in the last month of life (Lubitz and Riley 1993, Stooker et al. 2001, Centres for Medicaid Services 2004).

After some point costs related to death decrease with age

Many studies have found that death related expenditures tend to decrease after a certain age. For example, a 1999 study by the Centres for Medicare and Medicaid services (2004) found that average per capita Medicare payments for those in their last year of life were US$31,702 for those aged 65-69, US$28,834 for those aged 75-79 and US$21,237 for those aged 85-89. It is often suggested that this is consistent with the hesitation of medical practitioners to use aggressive medical treatments on the very old due to their frailty. More speculatively, it could also be due to doctors making implicit judgments about the payoffs from treatments relative to the costs.[2]

However, the age at which death related costs decline differs somewhat among studies. For example:

- Studies on American Medicare expenditures have found that in general costs incurred in the last year of life decrease with age after the age of 65. Some studies have found costs to increase with age but this appears to be due to the inclusion of long term care costs (mainly residential nursing home care);
- By contrast hospital costs incurred in the last year of life have often been found to increase from the ages of 65 to 85, decreasing thereafter (Serup-Hansen et al. 2002).

Ongoing health costs increase with age

One contested issue in the literature is whether the higher relative average costs incurred by the elderly is solely due to the high cost of dying. There are some who believe that ongoing health costs are the same for all individuals and hence that the only reason why older people incur higher average health costs is because the probability of dying increases with age and the cost of dying is high (Fuchs 1984).[3] While some studies have found ongoing health costs to be constant (Yang et al. 2003), others have found them to increase with age indicating that once the high cost of dying is taken into account, there is still a substantial ageing affect.[4]

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[2] If this is indeed the case then the scope to reduce costs at the end of life may be very limited. In any case as noted by Emanuel and Emanuel (1994, p. 5) 'since there are no reliable ways to identify patients who will die, it is not possible to say accurately months, weeks, or even days before death which patients will benefit from intensive interventions and which ones will receive wasted care'.

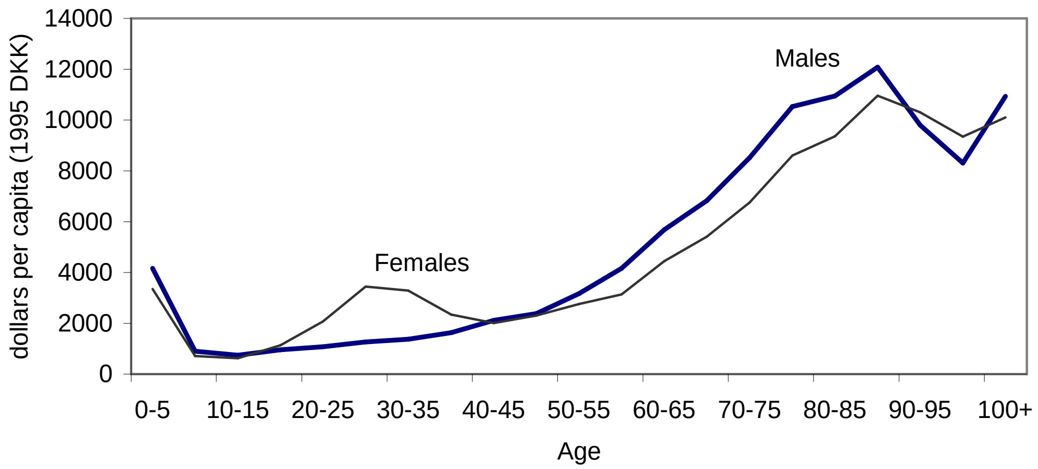
[3] As discussed in Chapter 6, later work by Fuchs suggests that he considers that ongoing health costs for the elderly (the growth of which he attributes to technology) are also a driver of costs.

[4] For inpatient care, Yang et al finds a constant cost of ongoing care, and death-related costs which consistently decline with age past 65. However, possibly because of different coverage for

As discussed in chapter 6, the Commission found that the age profile of ongoing hospital expenditures was upward sloping once costs related to death were taken into account. Serup-Hansen et al. (2002) find a similar pattern for these costs in Denmark. Indeed, there is a similarity between the age profile of ongoing costs for Denmark and the age profile of ongoing costs in Australia derived in appendix B (figure 13.1 and 13.2). Seshamani and Gray (2004) also find that age results in an increase in hospital costs of 30 per cent from the ages 65 to 85. More particularly, as discussed in chapter 6, Australian hospital data indicates that a large amount of the growth in hospital usage has been due to growth in private hospitals, mainly in same day procedures, which are mostly used for the management of conditions instead of for end of life treatments.

Figure 13.1 **Ongoing Denmark hospital costs by age**

1995, excludes death related costs

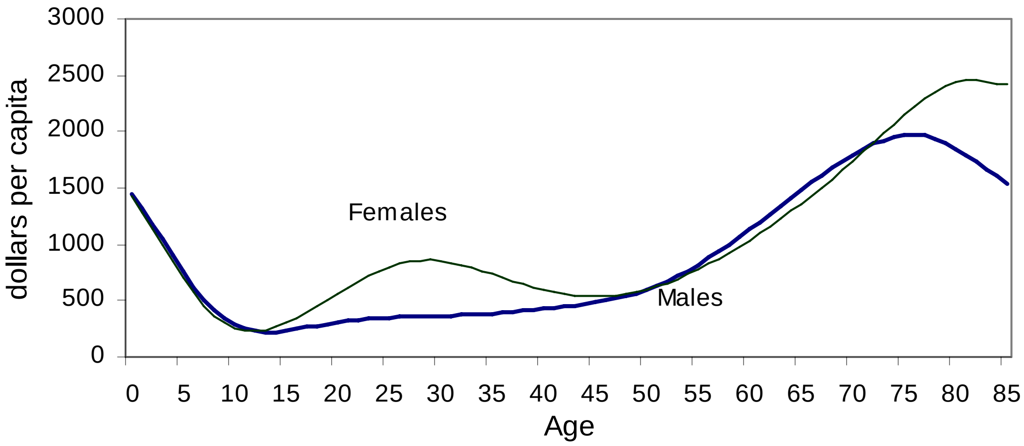


Data source: Serup-Hansen et al. 2002.

government funding between the US and Australia, these result are inconsistent with what is known about government expenditure on the hospital care in Australia. Combining Yang et al's results with Australian demographic data yields an age/cost profile in which average per person hospital expenditure increases around 1.6 times between 65 and 90. The actual increase in Australia is much greater — around 3 times. Consistent with the Commission's results, this implies that in Australia, ongoing costs increase with age or death costs do not fall significantly until well past 65, or as is most likely, there is a combination of both factors.

Figure 13.2 **Ongoing Australian hospital costs by age** [a]

2002-02, excludes death related costs



a Hodrick Prescott filter applied to raw data.

Data source: Commission estimates.

The proportion of costs related to death has been stable over time

Studies have been conducted on American Medicare data over a period of around 25 years. Significantly, throughout this period it appears that the proportion of total costs attributable to those in the last year of their life has remained fairly stable. This suggests that death related expenditures have increased at the same rate as total expenditures, and that treatment on the dying has not become more aggressive over time.

Hospital costs make up a large proportion of decedents' costs

Hospital costs make up a significant proportion of death related costs (often termed decedents costs). More particularly it has been found in the US that hospital costs account for close to 70 per cent of decedent's Medicare costs (Lubitz and Riley 1993). Roos et al. (1987) argues that this is not surprising because hospitals mainly care for people who are very ill.

Other categories of health expenditure are much less related to the last year of life. A recent study investigating expenditures on out-of-hospital prescription drugs in Denmark found that prescription drug expenditure increased only slightly with increased proximity to death:

> Drug expenditure of elderly decedents[5] increases only slightly with proximity to death. Thus, high drug expenditures among elderly are not mainly attributed to high expenditures during the last year of life. (Kildemoes et al. forthcoming, p. 24)

The authors suggest that this is because in comparison with hospital expenditure:

> … out-of-hospital prescription drugs target more chronic conditions and have a more long-term treatment and preventive aim (p.20).

Similarly Menec et al. (2004) have found long-term care days and physician care visits to be fairly constant in the last six months of life.

13.3 Implications of the costs of dying for past health expenditure

The high magnitude of hospital costs incurred at the end of life suggest that spending projections in this area of healthcare should take account of the number of deaths as well as the population age structure.

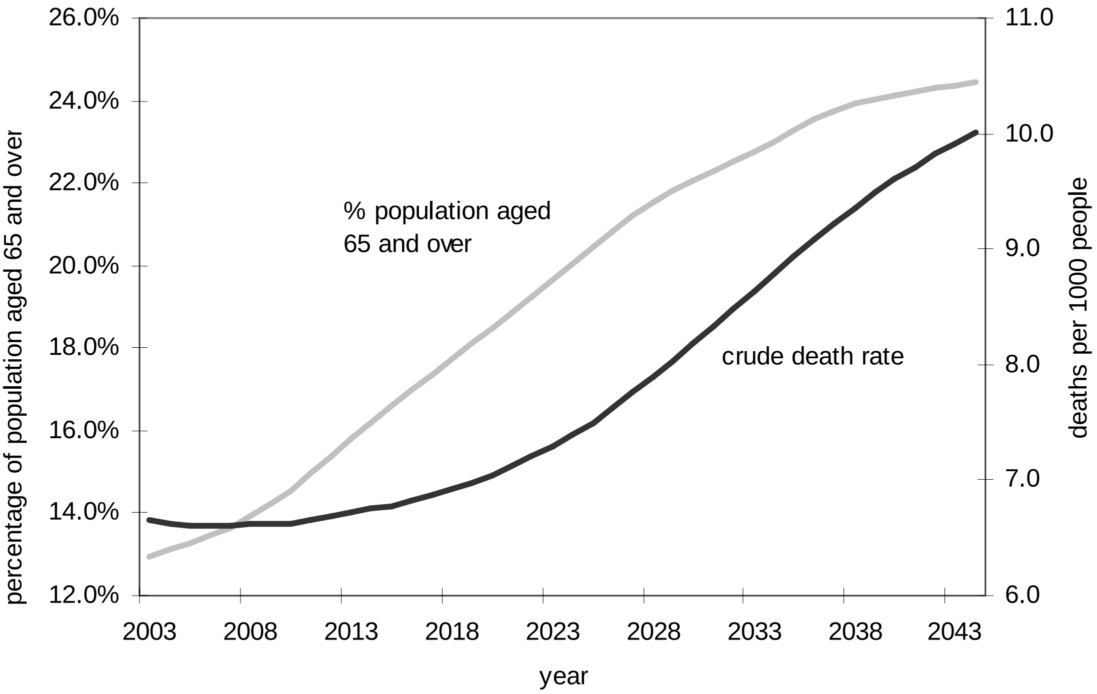
In the period to 2045 both these variables act to increase pressure on health expenditure. As described in chapter 2:

- the proportion of people aged 65 and over expected to nearly double from 13 per cent in 2003 to 24.7 per cent in 2045; similarly
- the crude death rate is also expected to increase from 6.7 deaths per 1000 people to 10.1 deaths per 1000 people throughout this period (figure 13.3), with the number of deaths predicted to increase from around 130,000 in 2002-03 to around 283,000 in 2044-45 (PC-M series).

The future escalation of deaths will come about because, as the population ages, an increasing proportion of people will be concentrated in the oldest age groups which have a high probability of dying. For example the number of people aged 100 years and over is expected to grow 11 fold from 2003-04 to 2044-45(PC-M series).

[5] Individuals in the last year of their life

Figure 13.3 **Ageing and death rates 2005-2045**



Data source: PC-M series.

Incorporating the costs of death in the projections results in slightly lower projected expenditure relative to those based only on the age structure of the population, but does not fundamentally alter the results. Overall the Commission projects that demographic factors will account for half of the projected four percentage points increase in health expenditure as a proportion of GDP between now and 2045.

In appendix C the Commission also estimated the effect of *past* ageing on health expenditure. Consistent with other studies (AIHW 1999 and the Intergenerational Report), it found that ageing increased health expenditure by around 0.5 to 0.6 per cent a year.

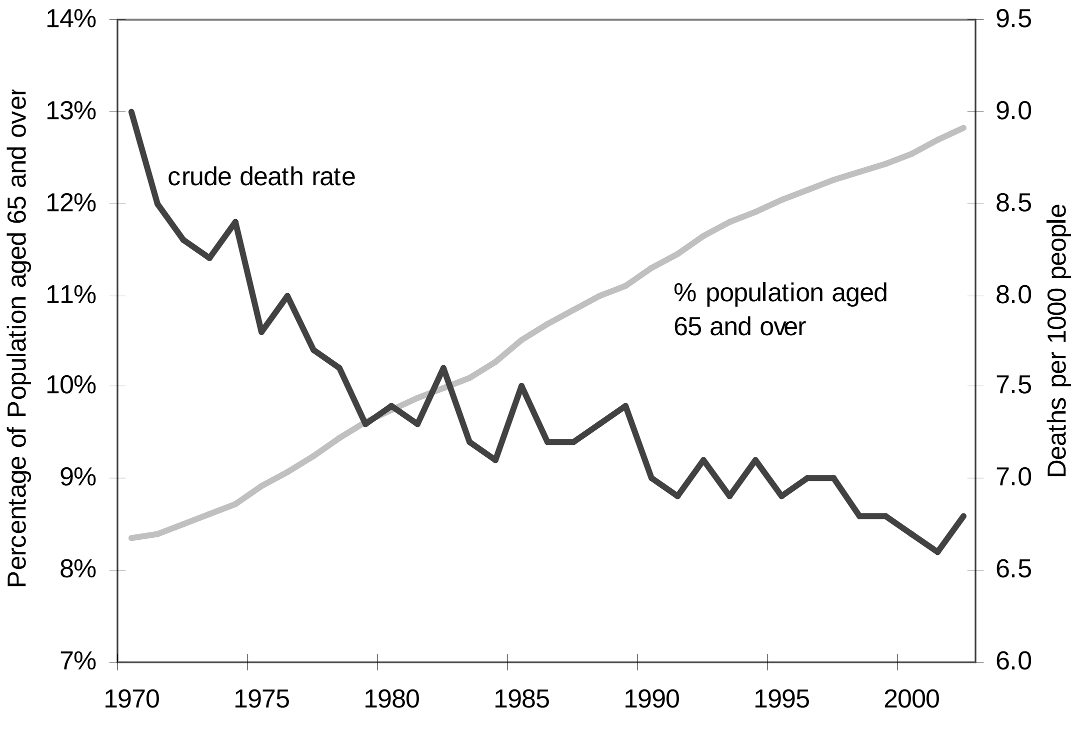
However, this estimate was based on the changing age structure of the population only, and did not incorporate costs associated with death and the number of people dying. For this paper, the Commission recalculated the impact of these factors on past government hospital expenditure. Importantly, unlike projections of future expenditure, incorporating death related costs fundamentally affects the results. This is the case because over the past 30 years there has been a significant divergence between the trend in the age structure of the population and the trend in death rates.

- The proportion of people aged 65 and over *increased* from 8.3 per cent in 1970 to 12.9 per cent in 2002; while

- the crude death rate *decreased* over the same period from 9 deaths per 1000 people to 6.8 deaths per 1000 people(figure 13.4). As outlined in chapter 2 these decreases in mortality rates have come about for reasons such as better nutrition, increased sanitation, improvements in medical technology and medical knowledge and declines in the incidence of diseases due to the increased use of antibiotics and immunization.

The divergence between ageing and the crude death rate is likely to have led to opposing pressures on expenditure. Costs associated with ongoing health care (hospital, Medicare, PBS and other) are likely to have increased owing to ageing. However, this increase is likely to have been offset by decreasing death-related hospital costs associated with the falling death rate. The decline in the crude death rate over this period implies that deaths have been growing at a slower rate than the population and hence this has the effect of reducing relative expenditure attributable to deaths.

Figure 13.4 **Ageing and Crude death rate 1970-2005**



Data source: PC-M series

The Commission's new projections for the impact of demographic change on past hospital expenditure (described in box 13.1) suggest that increases from ageing have, in fact, been fully offset by decreases from costs attributable to death. Thus demographic change is likely to have had virtually no impact on hospital expenditure over the period 1970-2002 (table 13.2).

For total health expenditure, owing to the high weighting of hospital expenditure, the annual impact of demographic change is estimated to be around 0.18 per cent. This is around one third of the previous estimate of 0.5 to 0.6 per cent a year. Therefore, demographic change is likely to have comprised only 5 per cent or so of the real per capita increase in government health expenditure of between 3 and 4 per cent per annum between 1970 and 2002. Non-demographic growth — increased demand for health services and new medical technologies — has accounted for the bulk of growth in health expenditure to date.[6]

There are two clear implications of this analysis for Australia:

- there is no inconsistency between projections which show significant *future* pressure on the health expenditure and studies of *past* expenditure which show little impact. Once costs of death are taken into account, different demographic patterns in the past and future explain any apparent inconsistency.
- therefore it is erroneous to draw the inference that because ageing has not had a significant impact on expenditure in the past, that it will not do so in the future.

Table 13.2 **Estimated annual impact of demographic change on government health expenditure, 1970-2002**

Expenditure Type	*Average annual impact of ageing on each component*	*Share of Government expenditure in 2002* [a]	*Average ageing contribution of component to total expenditure*
	%		%
Hospital	0.02	0.46	0.00
Pharmaceuticals	0.78	0.11	0.07
Medicare	0.39	0.22	0.08
Other	0.18	0.21	0.03
Total			**0.18**

a Shares of expenditure are shown for illustration. The impact of ageing each year was weighed by the share of expenditure in each year to estimate contribution to the total. For example in 1970 hospital expenditure comprised over 60 per cent of total expenditure.

Source: Commission estimates

6 An implication of these results is that the Commission's estimate of the non-demographic growth rate used to project future expenditure is quite conservative. This suggests that continuation of historical non-demographic trends would accentuate the future fiscal pressures associated with government-funded healthcare.

Box 13.1 **Method for estimating the past impact of demographic change on health**

Projecting past hospital expenditures

It is not possible to directly isolate the impact of demographic change on past health expenditure. In order to *infer* the impact that demographic change had on hospital expenditures in the past, hospital expenditures were projected backwards under the assumption that the current age profiles of ongoing health expenditure and estimated costs related to death prevailed over the whole period. In order to isolate the effect of demographic change, projections excluded non-demographic growth. This approach estimates the percentage change in expenditures attributable to population growth and ageing related factors. The known change in population growth is subtracted from the total change in expenditure for each year leaving the change in expenditure attributable to ageing-related factors.

The projection method incorporated both the affect of the high cost of dying and age per se on hospital expenditure. It involves dividing up health expenditure into two components: recurrent expenditure and death related expenditure. Recurrent expenditure is expenditure which is related to ongoing health needs, while death related expenditure is expenditure incurred in a given year by those who die in that year.

Recurrent health expenditure in year (t) = $\sum_{age=0}^{85} REC_{age} POP_{age}(t)$

Death related expenditure in year (t) = $\sum_{age=0}^{85} DCOST_{age} DEATHS_{age}(t)$

Where:

REC_{age} age specific per capita recurrent expenditure (2003)

$DCOST_{age}$ age specific per capita death related expenditure (2003)

$POP_{age}(t)$ the number of persons of a given age in a given year

$age \in (0,85)$ the reference age for per capita recurrent and death related expenditure and population size, 85 represents those aged 85 and above.

Recurrent expenditure and death related expenditure were calculated for both males and females and then summed to get total expenditure.

$t \in (0,T)$ the reference year of expenditure prediction, where t=0 represents 1970 in the past projections and 2003 in future projections.

Box 13.1 (Cont)

Projecting Medicare, PBS and other expenditures:

The expenditure for each component was projected by multiplying age and sex specific average costs (for the year 2003) with the projected population for each year.

Health expenditure for each component = $\sum_{age=0}^{85}\left(HCE_{age}POP_{age}(t)\right)$

HCE_{age}	age specific per capita health expenditure (2003)
$POP_{age}(t)$	the number of persons of a given age in a given year
$age \in (0,85)$	the reference age for per capita health expenditure and population size, 85 represents those aged 85 and above.

Expenditures were calculated for both males and females and summed to give the total expenditure for each component.

13.4 Ageing versus death rates in other countries

Findings from section 3 indicate that the impact of population ageing on Australian hospital expenditures over the last 30 years was minimal due to declining death rates. If Australia's demographic experience is typical of that for other countries, this could explain more generally why ageing has not been showing up as a major determinant of healthcare expenditure.

The past (1970-2005)

The extent of population ageing varies greatly across countries due to differences in past levels of fertility and mortality. However, in general, the degree of ageing that has occurred in the past in most developed countries is less than that which is going to be experienced in the future (table 13.3). For example, the pattern in the Netherlands is not dissimilar to that of Australia: the proportion of the population aged 65 and over increased from 10.2 per cent in 1970 to 14.1 per cent in 2005 and is predicted to increase to around 25 per cent in 2050. Many countries are predicted to have older populations in 2050 than Australia.

Table 13.3 **The proportion of the population aged 65 and over**

	1970	*2005*	*2050*
	%	%	%
Japan	7.1	17.2	35.9
Italy	10.9	20.0	35.5
Greece	10.9	20.0	35.5
Spain	9.8	16.5	34.1
Austria	14.1	16.7	30.7
Bulgaria	9.6	16.8	30.2
Germany	13.7	18.8	28.4
France	12.9	16.6	27.1
Switzerland	11.4	16.0	27.0
Finland	9.2	15.9	26.6
Canada	7.9	13.1	25.6
Netherlands	10.2	14.1	25.4
Sweden	13.7	17.2	24.7
Australia	**8.3**	**12.7**	**23.8**
New Zealand	8.5	12.3	23.6
United Kingdom	12.9	16.0	23.2
Denmark	12.3	15.0	22.8
United States	9.8	12.3	20.6

Source: United Nations (online version, World Population Prospects, The 2004 revision, United Nations Population Division, available from http://esa.un.org/unpp/).

In the past, the trend in the crude crude death rate has also varied across countries. Australia's history of declining death rates is replicated across a number of countries (table 13.4 and Annex). Countries which have had decreases in their death rates over most of the period between 1970-2005 include Japan (figure 13.6), The United States, Switzerland, France, Germany, New Zealand, Canada, Austria and Spain. Another group of countries, namely, the Netherlands, Spain, Sweden, Italy and Finland have exhibited only small increases thoughout this period (table 13.4). Greece is the only country out of the 17 OECD countries listed below whose crude death rate increased significantly throughout the whole period 1970-2005.

Table 13.4 **Percentage change in the death rate and ageing for 18 OECD countries**

	Percentage change in the crude death rate		*Percentage change in the proportion of the population aged 65 and older*	
	1970-2005	2005-2050	1970-2005	2005-2050
	%	%	%	%
Denmark	9	13	22	52
United Kingdom	-12	11	24	45
United States	-12	25	26	67
Sweden	2	7	26	44
France	-15	33	29	63
Germany	-16	38	37	51
Netherlands	10	46	38	80
Switzerland	-9	41	40	69
New Zealand	-16	51	45	92
Australia	-25	49	53	87
Canada	-4	54	66	95
Italy	2	59	83	78
Greece	22	47	83	78
Japan	16	75	177	82
Finland	-2	36	73	67
Spain	2	53	68	107
Austria	-26	43	18	84

Source: United Nations (online version, World Population Prospects, The 2004 revision, United Nations Population Division, available from http://esa.un.org/unpp/)

Implications for past health expenditure

Australia's experience of declining death rates is more pronounced than for most countries. Nevertheless, in all of the countries listed in table 13.4, the percentage change in the death rate for the period 1970-2005 is less than the percentage change in the proportion of the population aged 65 and over.

This indicates that across OECD countries it is likely that demographic change has had less impact on health expenditure in the past than implied by the level of ageing alone. The costs associated with death, therefore, provide at least a partial explanation for the weak observed relationship between ageing and health expenditure for this period.

The future

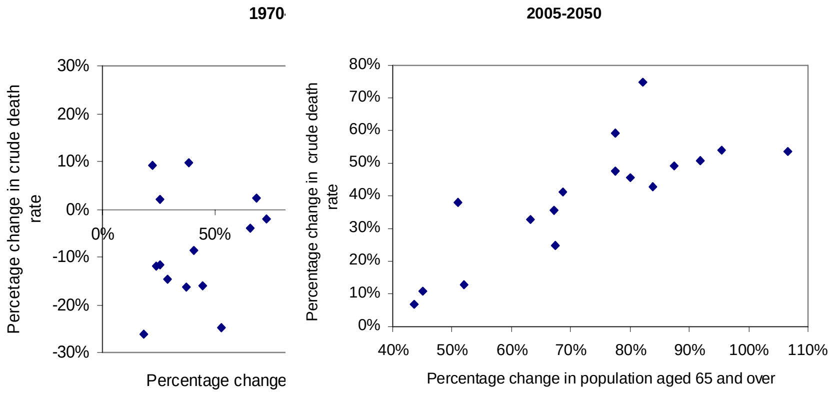
The extent of population ageing is expected to increase substantially in the future. As shown in table 13.4, Japan is projected to face the most substantial degree of ageing in 2050 with 35.9 per cent of its population projected to be aged 65 and over.

It is closely followed by a number of European countries such as Spain, Greece and the Czech Republic. The degree of ageing in Australia appears modest by comparison, yet as outlined in chapter 6 will still result in significant pressure on health expenditure in the future.

Most countries will experience an increase in their crude death rates at some point in the future (table 13.4 and the individual country figures contained in the annex to this paper). As the extent of population ageing increases, it results in increasingly more and more people in the older age groups who have a high probability of dying. The UN estimates that the number of people aged 80-89 in 2050 will be 5.1 times those in 2000, the number of people aged 90-99 will be 8 times those in 2000 and the number of people aged 100 years and over will be 20 times those in 2000 (UN 2003). Japan will be have the most number of people aged 100 and over by 2050 with close to 1 per cent of its population made up of centenarians (UN 2003). Similarly Japan's death rate is projected to increase by 83 per cent over the period 2000-2050 (UN 2003).

Hence, as summarised in 13.5, in the future (2005-2050) ageing and death rates will be moving in the same direction for most countries whereas in the past (1970-2005) no such relationship existed.

Figure 13.5 **Percentage change in death rates and ageing**
17 OECD countries



Data source: UN 2003, Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2004 revision population database, http://esa.un.org/unpp, (accessed 26th May 2005).

Implications for future health expenditure

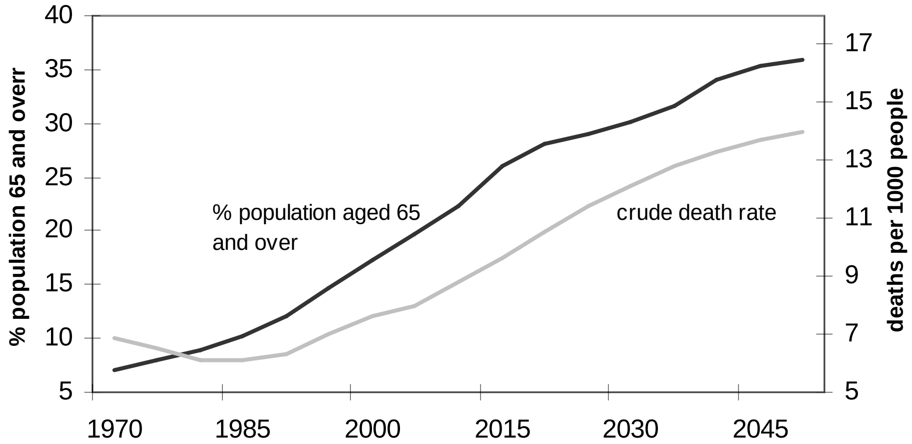
Since ageing and the crude death rate are expected to move in the same direction in the future, most countries are likely to experience considerable pressure on health expenditure. However, the magnitude of these increases will not be uniform, and will vary depending (among other things) on each country's degree of ageing and the movement of their death rates.[7]

Based on the Australian projections it is possible to speculate on the degree of pressure across different countries.

Countries likely to experience significant pressure on health expenditure in the future

Countries that could be expected to experience the most pressure on healthcare expenditure from demographic change are those which will experience both a high level of ageing and a significant increase in the crude death rate. Countries included in this category include Japan, Australia, Italy, Switzerland, The Netherlands, France, Germany, New Zealand, Canada and Greece. Out of these countries Japan (figure 13.6), Greece and Italy are expected to experience the largest degree of ageing, as well as dramatic increases in their death rates in the future. Countries similar to Australia with modest ageing and an increasing death rate are still likely to experience significant pressure for increases in health expenditure (as demonstrated in section 2).

Figure 13.6 **Ageing and death rates in Japan**



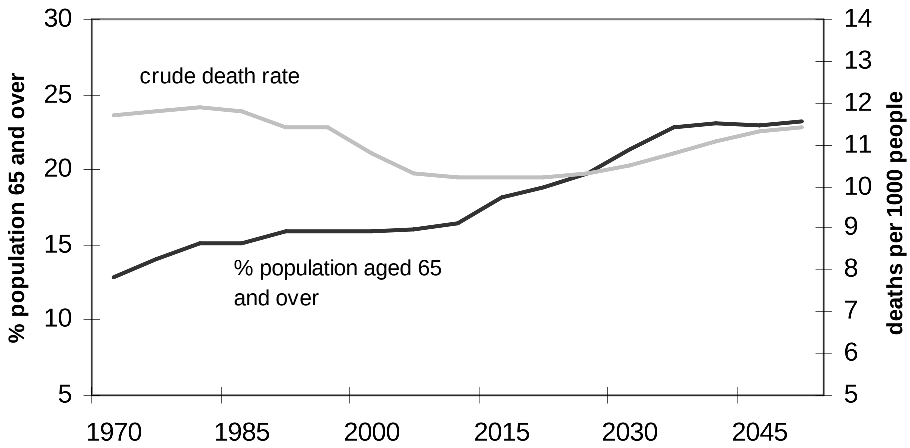
Data source: UN 2003, Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2004 revision population database, http://esa.un.org/unpp, (accessed 26th May 2005).

7 Of course, whether pressure will be manifested in higher expenditure will also depend on institutional factors such as the degree of rationing present within health systems.

Countries likely to experience muted pressure on health expenditure

Some countries will experience relatively small increases in their crude death rate between now and 2045. Indeed in Sweden, the UK and Denmark, the crude death rate is expected to continue to decline until around 2020, before slowly increasing. These countries are also expected to experience fairly modest degrees of ageing. Therefore, it is likely that the pressure from demographic change on health expenditure will be more muted in these countries than elsewhere. In Appendix C the Commission compared the United Kingdom with Australia and found that increases in hospital expenditures in the UK are projected to be substantially less than those in Australia. It was concluded that the main reason for this was due to differing demographics.

Figure 13.7 **Ageing and death rates in the United Kingdom**



Data source: UN 2003, Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2004 revision population database, http://esa.un.org/unpp, (accessed 26th May 2005).

13.5 Conclusion

There is a strong body of evidence showing that hospital costs are much higher in the year or so before death than in preceding years. For Australia, incorporating these costs, along with age-related costs, into projections of future government health expenditure results in substantial expenditure pressure. Ageing will bring with it a large increase in the number of deaths (chapter 6).

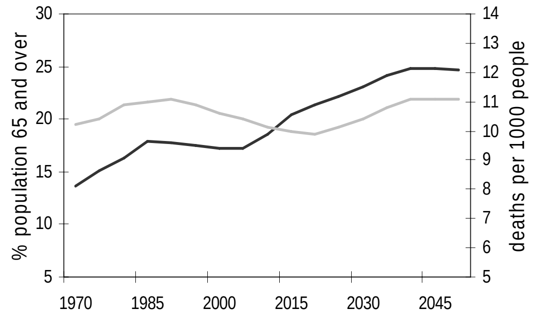
However, this has not been the case in the past. In Australia, as well as a range of other developed countries, the number of people over 65 has been increasing over the last 30 years, yet the crude death rate has been decreasing. Incorporating the costs of death in estimates of the past impact of ageing on health expenditure reveals that demographic change is unlikely to have played a major role in past increases in per capita health expenditure.

Thus a consistent methodology for projecting past and future impacts of aging on health expenditure yields asymmetric results. Future pressure on health expenditure from ageing is consistent with a very low observed impact in the past. The key message from this technical paper, therefore, is that studies finding that ageing has not had a large impact on health expenditure thus far, provide false comfort to policy makers for the future.

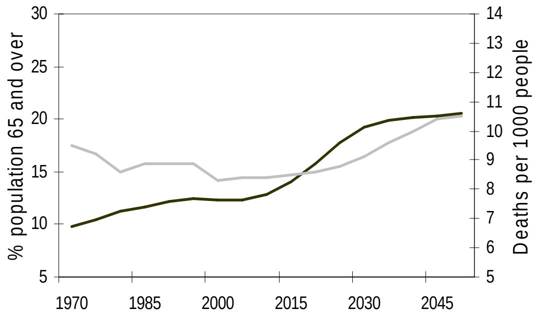
ANNEX Death rates and ageing in developed countries[a]

Percentage of population aged 65 and over — Crude death rate[a]

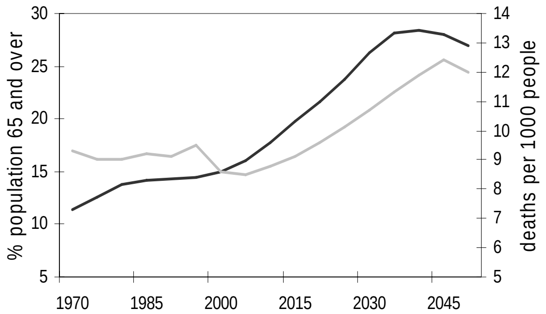
Sweden



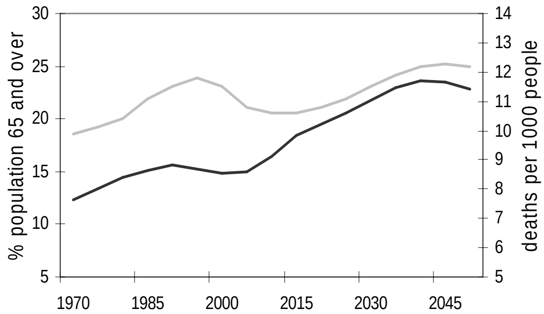
United States of America



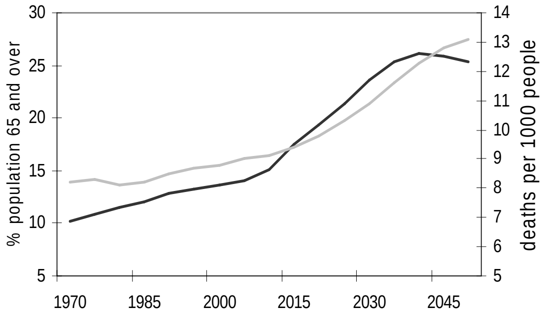
Switzerland



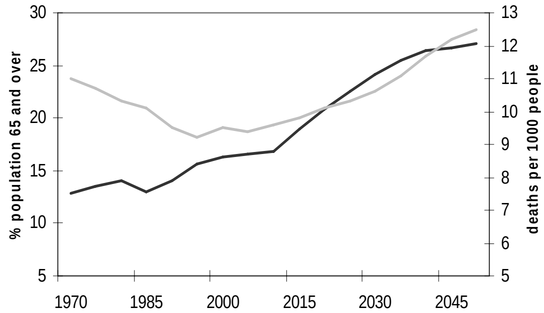
Denmark



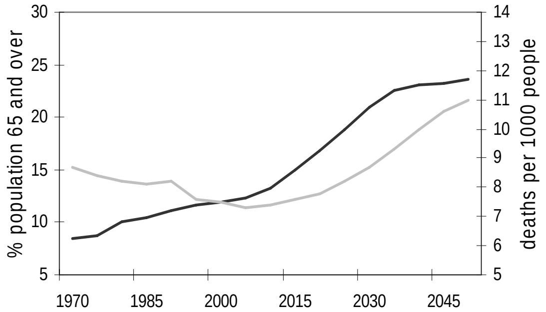
Netherlands



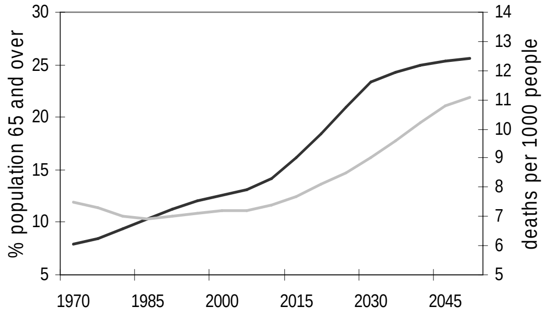
France

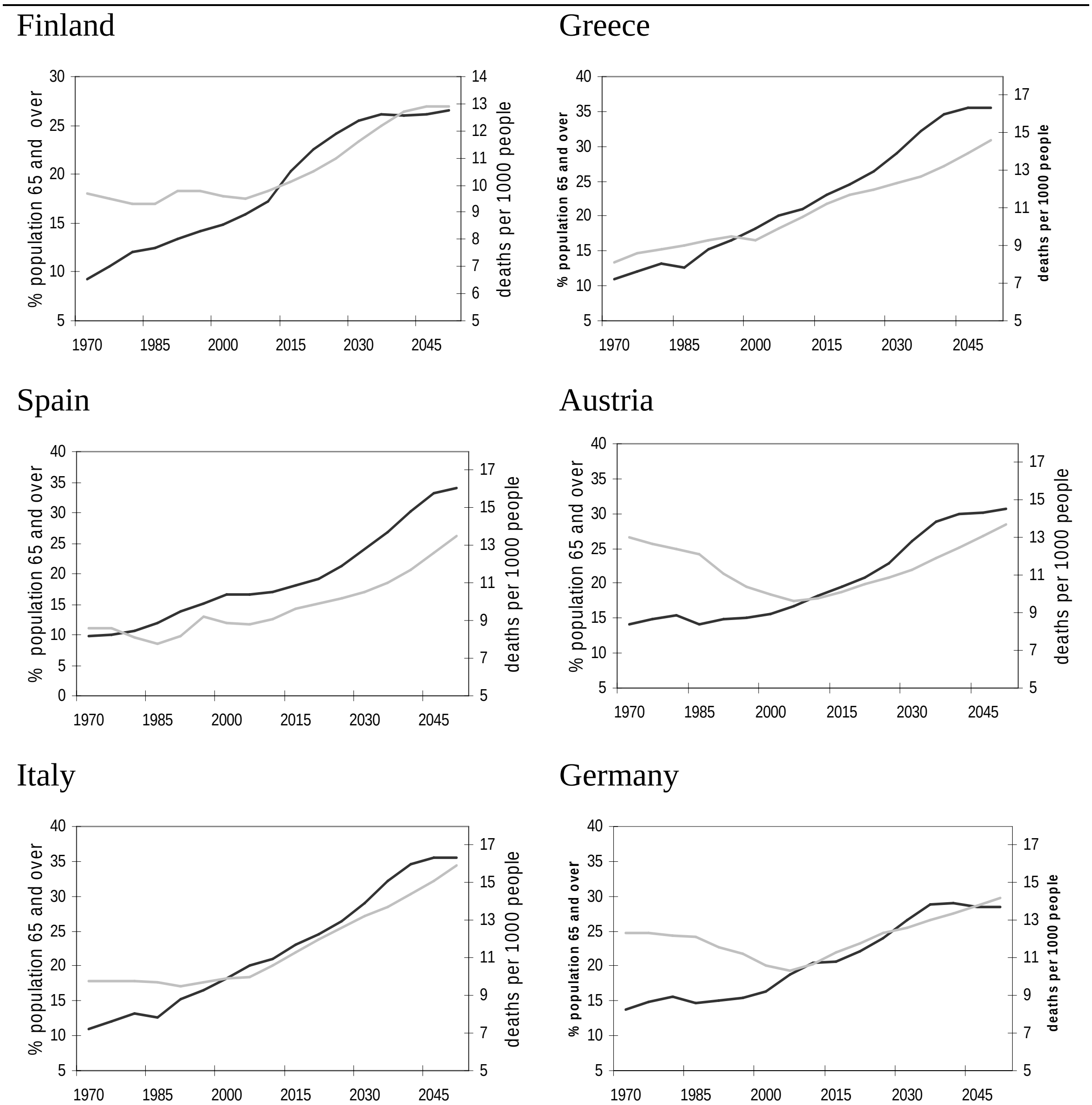


New Zealand



Canada





a: The crude death rate used for each five year period is the average of the previous five years ie. the crude death rate used for 1955 represents the average crude death rate from 1950-1955.

Data source: UN 2003, Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2004 revision population database, http://esa.un.org/unpp, (accessed 26th May 2005).

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Ageing and child care

Governments provide financial support to parents for the use of child care services, fund the provision of these services as well as undertake other types of activity in relation to child care. Children aged up to 12 years are the main beneficiaries of government expenditures on child care. Population ageing could thus be expected to reduce pressure on future child care expenditures.

This technical paper follows up the work done in the Commission's Ageing Study (PC 2005), which did not analyse in detail the impacts of demographic changes on child care expenditure by government. It examines the factors that are likely to influence future child care spending, focussing on the likely impact of population ageing on aggregate expenditure over the next 40 years.

The assessment of the impacts of ageing are based on projections to 2044-45. The projections are intended to be a guide to what would happen under existing government policies and if people's behaviour continues in much the same way as recently. But they are not forecasts in the sense that they are expected to occur.

The Department of Family and Community Services (FaCS), responsible for the bulk of total expenditure on child care, was provided with an opportunity to comment on an early draft. Its comments have been incorporated (although the Department is not implicated in the findings). As no input was sought from State and Territory government agencies responsible for preschool and child care services, projections of the impacts on State and Territory expenditure should be viewed as preliminary only.

14.1 The nature of child care

According to the ABS 2002 Child Care Survey (2003, p. 2), child care refers to arrangements (other than parental care) made for the care of children under 12 years of age. It may be formal or informal. Parents often use a combination of formal and informal child care.

- Formal child care refers to regulated care that takes place away from the child's home, for example, preschools, centre-based long day care, family day care, occasional care and outside school hours care.
- Informal care refers to non-regulated care that takes place in the child's home or elsewhere. It includes care by family members, friends, paid babysitters and nannies.

Although preschools fall within the ABS definition of child care, there is a traditional view that they are inherently different. Preschools are seen as involving the provision of early childhood education with qualified teachers, whereas child care is viewed as providing for the care of children of working parents.

However, the two are increasingly seen as the same. As McDonald (2002, p. 197) said:

> While the distinction between education and care continues to be fiercely defended at the school level by teachers, in early childhood, there is an increasing tendency to look upon the two as part of the same package. However, this is a relatively recent development.

Indeed, convergence is apparent in a number of ways. Child care centres and preschools frequently provide overlapping services and, in some cases, cooperate with each other. Some State and Territory governments provide financial support for preschool programs provided in child care centres. Also, as McDonald (2002, p. 197) noted:

> … the new generation of early childhood educators has not been as precious as teachers have been about being seen as child-carers. Tertiary institutions today produce graduates who see themselves as early childhood educators and carers. Caring for children is part of their education and part of their philosophy.

Because of the increasingly close nexus between child care and preschools, this technical paper projects government expenditures on both.

14.2 Government expenditure on child care and preschools

The Australian Government and State and Territory governments have different, but complementary roles in respect of child care and preschool services. The Australian Government seeks primarily to help families 'participate in the economic and social life of the community' through the provision of child care services and financial support (FaCS 2005a, p. 112). A historical overview of Australian Government child care support is given in box 14.1. The main focus of State and Territory involvement is to provide education and developmental opportunities for children, including preschools (SCRGSP 2006, vol. 2, p. 14.4).

Total government expenditure on child care and preschools in 2004-05 was around $2.3 billion (table 14.1) or around 0.3 per cent of GDP in that year. The Australian Government accounted for under three-quarters of total expenditure on child care and preschools and around 95 per cent of expenditure on child care. State and Territory governments accounted for all government expenditure on preschools.

Australian Government expenditure consists primarily of the four following items (table 14.1).

- *Child care benefit*. This is the main expenditure item. The child care benefit reduces the child care fees of families using approved child care or registered carers. Families can have the benefit paid directly to the child care service provider to reduce their ongoing fees, or can receive the benefit as a lump sum payment through the tax system after the end of the financial year. The maximum rate of the benefit is adjusted on 1 July each year with the CPI.
- *Child care support program* (including special purpose payments). Major changes were introduced to this program in 2004 (previously it was called the child care support broadband program) including greater clarification of objectives and principles of the program, simplification of funding arrangements and a greater emphasis on the quality of care. The program seeks to: promote, support and enhance quality child care; improve access to child care for children and families with special or additional needs; and support access to child care in areas and/or circumstances where services would not otherwise be available. Payments are made directly to providers and to the States and Territories.
- *Child care tax rebate*. The Government introduced a non-means tested tax offset of 30 per cent of out-of-pocket child care costs with effect from 1 January 2005 (the date of effect was brought forward from 1 January 2006). It would be available to tax payers who receive the child care benefit for approved care and meet the child care benefit work, training and study test. Out-of-pocket costs are total child care fees less child care benefit. The rebate is subject to a cap. For 2004-05, a maximum of $4000 per child is payable. The cap will be indexed in line with CPI. The tax rebate can only be claimed a year after the fees are paid (ATO 2005a). Although this item is expected to cost the Government around $1 billion over five years from 2004-05 (Australian Government 2005a, b), it is expected that nothing will in fact be paid until 2006-07.

Box 14.1 **A history of Australian Government child care support**

The Australian Government first became substantially involved in funding child care with the passage in 1972 of the Child Care Act. The Act enabled the Government to provide funding (through capital, recurrent and research grants) to community-managed non-profit organisations to establish and maintain long day care centres for children of working and sick parents.

A marked change in the philosophical underpinning of the funding of child care occurred in 1974 when the Government decided that child care support should go to all children and not just to children from families that were poor or needy. Also, during the mid-1970s, funding was increasingly provided to other forms of child care including family day care and outside school hours care. From the mid-1970s to the early 1980s, the main expansion in child care places was the provision of family day care.

In 1984, standardised fee relief for children in non-profit centre-based long day care, called child care assistance, was introduced and became the main means by which the Government supported child care. Over time, child care assistance expanded. For example, in 1990, fee relief was extended to commercial child care centres. Child care assistance was an income-tested subsidy directed at low and middle income earners. The subsidy was paid to the child care centre and passed on to the family by way of a reduction in fees.

The child care cash rebate was introduced on 1 July 1994. It was largely a non-means tested payment over and above child care assistance. The payment was paid through Medicare offices on receipt of claims for child care expenses. Parents were able to claim up to 30 per cent of child care costs up to a ceiling level.

The next major change occurred in July 2000 with the introduction of the child care benefit. This benefit replaced both the child care assistance and the child care cash rebate. It allowed for varying levels of benefit depending on family income and the number of children in care.

In 2004, the Government proposed a 30 per cent child care rebate on out-of-pocket child care expenses for approved care. Families can start to claim the rebate in their income tax returns for 2005-06. The rebate can only be claimed from work-related child care from 1 July 2004 and is subject to an indexed cap ($4000 per child in 2004-05).

In the 2005-06 Budget, the Government committed $266 million to significantly increase the number of child care places. This expenditure is to help parents in the transition from welfare to work arising from changes to the parenting payment and the disability support pension which are to start from 1 July 2006. Those seeking the parenting payment after 1 July 2006 would be expected to look for at least part-time work of at least 15 hours a week when their youngest child turns eight and is ready for school. A person with a disability who is capable of working 15 hours or more a week within a two year period at award wages would no longer receive the disability support payment (but could be entitled to receive the Newstart Allowance or Youth Allowance).

Sources: ABC News Online, 'Welfare-to-work rules to be eased', 7 November 2005, http://abc.net.au; ATO (2005a, b); Australian Government (2005b); Andrews (2005a, 2005b); Costello (2005); Department of the Parliamentary Library (2003, 2002, 2000).

Table 14.1 **Government expenditure on child care and preschools**[a]

Expenditure item	*2004-05*
	$'000
Australian Government	
Child care	
Child care benefit	1 462 670
Child care support	223 003
Child care tax rebate[b]	–
Child care for eligible parents undergoing training	17 215
Preschools[c]	–
Total[d]	1 702 888
States and Territories	
Child care	89 513
Preschools	503 247
Total[d]	600 304
Total[d]	2 303 192

A 2004-05 prices. **b** The tax rebate is not expected to affect the Australian Government budget until 2006-07. **c** The Australian Government provides supplementary funding to support the participation of Indigenous children in preschool programs. In 2003, an estimated $11.2 million was provided. **d** May not add due to rounding. – denotes nil or rounded to zero.

Sources: Australian Government (2005c, pp. 173–4); Centrelink (personal communication); FaCS (2005a, p. 115); SCRGSP (2006, Attachment 14 A).

- *Child care for eligible parents undergoing training.* This expenditure item helps people who receive certain Centrelink payments to improve their employment prospects by participating in study, work or job search activities. Parents can get help finding child care, and may also obtain assistance with paying child care fees. Creches established under the program provide child care for vulnerable groups of parents in areas where no other suitable child care services are available. The program is about to undergo significant change.

State and Territory expenditure covers such items as: providing preschool services; providing operational and capital funding to non-government service providers; licensing and setting standards for child care service providers; providing information and advice to parents; and providing dispute resolution and complaints management processes (SCRGSP 2006, vol. 2, p. 14.4).

14.3 Method for projecting government expenditure

The method used to project government expenditure on child care and preschools is similar to that used generally for other social expenditure areas in the Ageing Study (box 14.2).

Box 14.2 **Basic projection method**

The basic method for projecting child care (and preschool) expenditure consists of the following steps.

1. Coverage rates (C) and expenditure per child in child care or average cost (AC) for each age group are estimated for 2004–05 (or the most recent data available).
2. Coverage rates in future years are estimated by applying a compounding growth rate formula to the base year estimate.
3. Average cost in future years is estimated by applying a compounding growth rate formula to the 2004–05 estimate of average cost to incorporate growth in real costs.
4. The number of children in child care (N) for each age group in any future year is projected by multiplying coverage rates (C) by the Commission's population projections (Pop).
5. Expenditure on child care (E) for each age group and in any future year is estimated by multiplying the projected number of children in child care by projected average cost (AC).
6. Total expenditure for any future year is the sum of expenditure for each age group.

To facilitate comparison with the projections in the Ageing Study, the base year of 2002-03 is applied.

The effects of ageing are found by subtracting an age-adjusted projection from the base case projection (described above). The aged-adjusted projection is based on a simulated population projection, which retains the 2002-03 age structure for all years.

The level of government expenditure on child care and preschool expenditure in the future can be estimated from changes in:

- the number of children in different age groups in the population;
- the proportion of children in the population in child care or preschools by age group (coverage rate); and
- the cost of child care or preschools per child by age group (average cost).

The remainder of this section specifies the data and assumptions applying to each of these factors.

Although the most recent financial year data are used to estimate these factors, to facilitate comparison with the projections in the Ageing Study, the base year of 2002-03 is used.

The number of children

Of relevance to future expenditure on child care and preschools is the expected number of children in the population, in particular, children aged 0 to 12. According to the Commission's (PC-M) population projections, the share of 0 to 12 year olds is expected to fall by 20 per cent, from 17 per cent of the population in 2002-03 to 14 per cent in 2044-45. The share of 4 year olds, which is the main age group attending preschools, is expected to fall by 19 per cent, from 1.3 per cent of the population in 2002-03 to 1.1 per cent in 2044-45. This suggests that ageing should relieve pressure on future child care and preschool expenditures.

Participation in child care and preschools

Growth rate assumptions for child care coverage rates

Frequent changes in Australian Government policy on child care (box 14.1) make it difficult to use historical trends in child care coverage rates for expenditure projections. An issue therefore is what would be an appropriate proxy for estimating growth in coverage rates.

There are a number of possible growth rate measures which could operate as a proxy. As the Australian Institute of Health and Welfare has noted (AIHW 2005, p. 85) trends in the use or demand for child care is affected by trends in a range of social factors such as family structure (for example, the growing number of one parent families), employment patterns (for example, increases in the labour force participation of both couple and single parents) and population mobility (for example, moving can weaken networks of families and friends who provide most informal care). What follows is a review of what are considered in this technical paper to be the most relevant proxies for trends in coverage rates. (The growth rate assumed for preschool coverage rates is discussed later in relation to State and Territory programs).

Labour force participation of mothers

There are links between the labour force participation of parents, particularly of mothers, and child care. (The labour force participation rate is the proportion of the population who are in work or actively looking for work.)

Parental labour force participation (or labour supply) is influenced by the relative price of work and leisure — thus including after tax wages and net child care costs — as well as household income, changing cultural norms and a host of other factors. The impact of changes in the costs of formal child care depends on the resolution of their income and substitution effects. A fall in child care costs increases the overall net income from working an existing number of hours, prompting households to work less (the income effect). It also increases the hourly return from work, net of child care costs, leading households to work more (the substitution effect). In most cases, the substitution effect dominates. However, the story is complicated by the fact that child care is subsidised by governments, with thresholds for full eligibility for benefits. This means that some households may face relatively steep effective marginal tax rates associated with working extra hours, because this would entail withdrawal of full child care benefits, prompting labour supply responses. Box 14.3 reviews some recent Australian studies on the extent to which parental labour force participation is affected by child care costs.

Child care demand in turn is affected by parental labour supply (for example, hours of work) as well as other factors such as child care fees, household income, and household characteristics (for example, number of children, age of youngest child, proximity to relatives which is relevant to informal child care demand, two or lone parent households, and age of parents). Box 14.3 reports an Australian study by Doiron and Kalb (2004) on the extent to which child care demand is affected by the labour supply of parents.

Box 14.3 **Recent Australian studies on the link between child care and labour force participation of parents**

Impact of child care costs on labour supply

Although recent Australian studies have identified a negative relationship between child care costs (or prices) and labour supply of mothers, they have been ambiguous on the significance of the relationship.

Toohey (2005) found that the child care benefit reduced the costs of child care for all women with the extent of reductions most apparent for women with lower incomes and more children. However, he found that mothers with two or more children were often worse off when working full-time then part-time. He concluded that the combination of increasing child care costs and a reduction in other forms of assistance to families with children acted as a strong deterrent to full time work for mothers with several young children. Toohey took a similar approach to that of Schofield and Polette (1998) who found that child care subsidies had a large impact on the net benefit to families where mothers of preschool-aged children worked fulltime.

(Continued next page)

Box 14.3 **(continued)**

Doiron and Kalb (2004) using data from the ABS Child Care Survey, the Survey of Income and Housing Costs and the Australian Government Census of Child Care Services found negative but generally modest impacts of the price and net costs of child care on the participation rate and expected hours worked of lone parents and mothers. They found that the impacts were larger for lone parents than for mothers. For example, for lone parents, the elasticities of expected hours worked with respect to price was -0.05 (for example, a ten per cent increase in price was associated with a 0.5 per cent decrease in expected hours worked) and with respect to net cost -0.15. For mothers, the relevant elasticities were -0.02 and -0.03, respectively. The impacts on fathers in two parent households were negligible. For certain sub-groups, however, Dorion and Kalb estimated substantially larger labour supply responses. For example, for lone parents with preschool-school aged children, the elasticities of expected hours worked with respect to price was - 0.18 and with respect to net cost -0.28. For mothers in two parent households with preschool-aged children, the relevant elasticities were - 0.05 and -0.07 per cent, respectively. For women earning less than the median wage and with preschool-aged children, the elasticities were respectively -0.04 and -0.06.

Rammohan and Whelan (2004) using data from HILDA found that for married mothers, the cost of child care was relatively unimportant in both the decision to work, and given the decision to work, the number of hours worked. Even where statistically significant, they considered the impact of child care costs to be small. For example, in respect of the labour participation decision, $1 increase in the hourly price of child care is associated with a 2 per cent decrease in the probability of the woman working. This corresponded to an elasticity of around -0.12. For those that work, a $1 per hour increase in the cost of child care reduces hours worked by between 0.60 and 0.80 hours.

Cobb-Clarke et al (1999), using data from the Negotiating the Life Course Survey reported that child care costs may not be as large a barrier to employment as they were often perceived to be. Non-employed mothers with young children did not cite child care costs as the primary thing that prevents them from entering paid employment. Furthermore, many two-earner families were able to adjust their work schedules to avoid using any non-parental care at all.

Impact of labour supply on child care demand

Doiron and Kalb (2004) found that parents' employment generally increases use of both formal and informal child care, but the effects are stronger for mothers in two parent households, for formal care, and for lone parent households. For example, for working mothers in two parent households, the elasticities of demand for child care with respect to expected hours worked were 0.36 for formal care (that is a 1 per cent increase in hours worked increases the hours of formal care by 0.36 per cent) and 0.23 for informal care. For lone mothers, the relevant elasticities are 0.91 for formal care and 0.21 for informal care. For fathers in two parent households, the elasticities of demand for child care with respect to expected hours work were -0.95 for formal care and 0.1 for informal care.

Three sources of Australian data, although not directly comparable, confirm a link between the labour force participation of parents and child care — the ABS Child Care Survey, the Australian Government Census of Child Care Services and the HILDA (Household Income and Labour Dynamics in Australia) dataset.[1]

According to the ABS 2002 Child Care Survey, an average of around 50 per cent of children in formal or informal care were there because of their parents' work (table 14.2). This reason accounted for 84 per cent of children in before and after school care, 60 per cent of children in family day care, 55 per cent of children in long day care and 47 per cent of children in informal care. In contrast, the most common reason for children attending preschool, occasional care centres and other formal care was that it was beneficial for the child.

Table 14.2 **Reasons for using care, ABS Child Care Survey, 2002**

Per cent of children in care

Type of care	*Work-related*[a]	*Personal*[b]	*Beneficial for child*[c]	*Other*[d]	*Total*
Before and after school care	83.7	9.6	3.7	2.9	100.0
Long day care	55.0	15.2	27.5	2.3	100.0
Family day care	60.3	20.0	18.8	0.9	100.0
Occasional care	29.8	29.8	37.5	3.0	100.0
Preschool	16.7	4.5	73.5	5.4	100.0
Other formal care	7.7	37.6	39.3	14.5	100.0
Total formal[e]	**48.1**	**12.3**	**36.3**	**3.3**	**100.0**
Total informal	**46.3**	**37.6**	**3.0**	**13.0**	**100.0**

a Reasons include working, looking for work and studying/training for work. **b** Reasons include study or training not related to work, shopping, entertainment, social or sporting activities, giving parents a break./time alone, caring for relatives, visiting the doctor, or undertaking voluntary/community activities. **c** Includes good for child and preparation for school. **d** Includes reasons unknown. **e** Components do not add to this total as children could be using more than one type of care.

Source: ABS (2003, *Child Care, Australia,* Cat. No. 4402.0, tables 8 and 9).

The ABS Child Care Survey also shows that, within couple and one parent families, use of formal and informal care was higher for children with employed parents (table 14.3). Within couple families, 59 per cent of children from couple families used care if both parents were employed compared with 35 per cent of children with

1 The ABS Child Care Survey collects information from parents on the use of child care by children aged 0 to 11 years, with child care including all formal child care services and preschools as well as informal care. The Australian Government census collects information from Australian Government funded child care service providers, with children using these formal services generally being 0 to 12 years. The HILDA survey is a household-based panel study which began in 2001 containing broad information about economic and subjective well-being. Child care variables in the survey relate to children living in the household aged under 15 years of age and provide a measure of the particular type of child care used, the hours of each care type used, and the total cost of child care across all care types.

one parent employed and 28 per cent of children who had neither parent employed. Similarly, 74 per cent of children of employed sole parents used care compared with 44 per cent of children of sole parents who were not employed.

Like the ABS Child Care Survey, data from the Australian Government Census of Child Care Services and HILDA (tables 14.4 and 14.5) suggest that the majority of children in most types of care were in care for work-related reasons. For example, the Australian Government Census of Child Care Services data show that at least 70 per cent of children in child care (other than in occasional care) have parents that are working, studying or training for work, or seeking employment. The HILDA data show that around 70 per cent of households using child care, do so for employment purposes.

Clearly, the labour force participation of parents is not the only indicator of the level of demand for child care. As table 14.2 shows, many parents use child care for reasons other than employment. However, apart from occasional care and preschools, it is clear that these reasons are not as significant an explanation for child care demand as is employment status.

Table 14.3 **Labour force status of parents, ABS Child Care Survey, 2002**

Per cent of all children

Whether children in care or not	*Couple family*				*One parent family*			*Total*
	Both parents employed	*One parent employed*	*Neither parent employed*	*Total*	*Parent employed*	*Parent not employed*	*Total*	
In care								
Formal care	17.1	15.2	14.1	16.1	16.9	13.3	14.8	15.8
Informal care	28.9	15.6	10.8	22.0	36.1	23.9	28.8	23.3
Formal and informal care	13.4	4.2	2.9	8.9	20.9	6.8	12.5	9.6
Total	59.3	35.0	27.9	47.0	73.9	44.0	56.0	48.7
Not in care	40.7	65.0	72.1	53.0	26.1	56.0	44.0	51.3
All children	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: ABS (2003, *Child Care, Australia,* Cat. No. 4402.0, table 22).

Table 14.4 **Employment details of parent, Australian Government child care census, Australia, 2004**

Per cent of children in care

Type of care	*Work-related*[a]			*Not work-related*			*Total*
	Sole parent	*Both parents*	*Total*	*Sole parent*	*One or both parents*	*Total*	
Private long day care	16	69	85	3	12	15	100.0
Community based long day care	12	75	87	3	10	13	100.0
Family day care	20	67	87	5	9	14	100.0
In home care	19	54	73	6	21	27	100.0
Outside school hours care	26	72	98	1	2	3	100.0
Vacation care	na	na	93	na	na	7	100.0
Occasional care	na	na	49	na	na	51	100.0
Multifunctional services	16	73	89	3	5	8	100.0
Multifunctional Aboriginal children's services	36	48	84	9	7	16	100.0

a Work-related means parent is working, studying or training for work or seeking employment.

Source: FaCS (2005b).

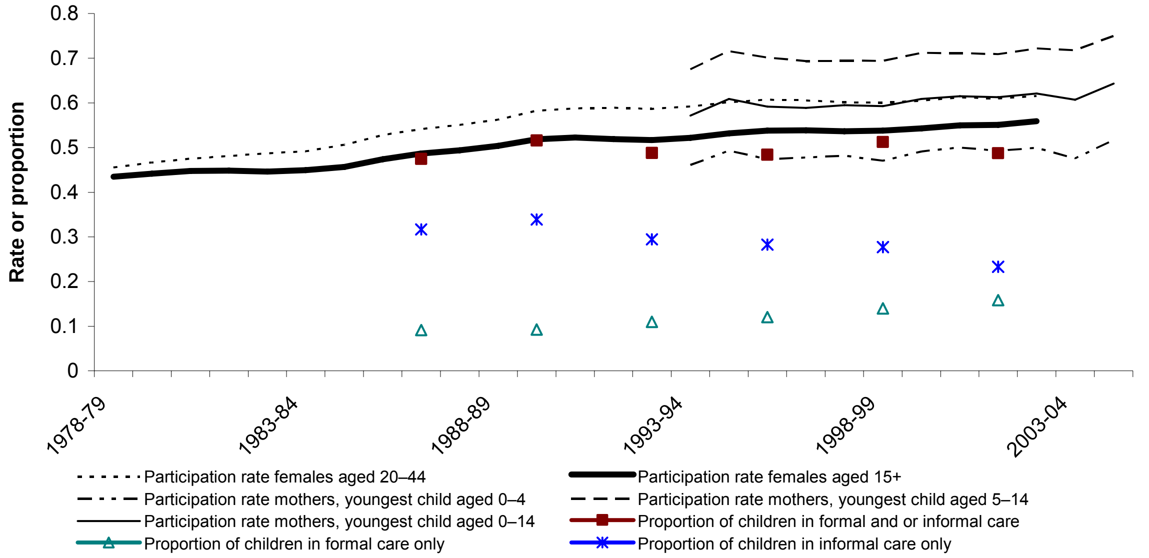
Table 14.5 **Reasons for using child care, HILDA, 2002**

Reason	*Number of households*	*Percent of households using child care for any purpose*
Households using child care		
Employment purposes only	549 463	50.6
Employment and non-employment purposes	226 462	20.9
Employment purposes	775 925	71.4
Non-employment purposes only	310 075	28.6
Non-employment purposes	537 414	50.0
Any purpose	1 086 000	100.0
Households not using child care	6 331 087	na
All households	7 417 086	na

Source: Compiled by Rammohan and Whelan (2004) which used wave 2 of the HILDA dataset collected in 2002.

Given its relationship with child care, unpublished data on the labour force participation of mothers were obtained from the ABS to measure the growth in child care coverage rates. The data were available for mothers whose youngest child's age falls into three age groups (0 to 4, 5 to 14 and 0 to 14). The earliest that this data were available was June 1994. Figure 14.1 presents this data, together with the proportion of children in care who are in formal and/or informal care. Also shown in the figure are the participation rates of females aged 20 to 44 (the typical child-bearing age range) and of females aged 15 and over since 1978-79.

Figure 14.1 **Labour force participation rates of females and children in care**



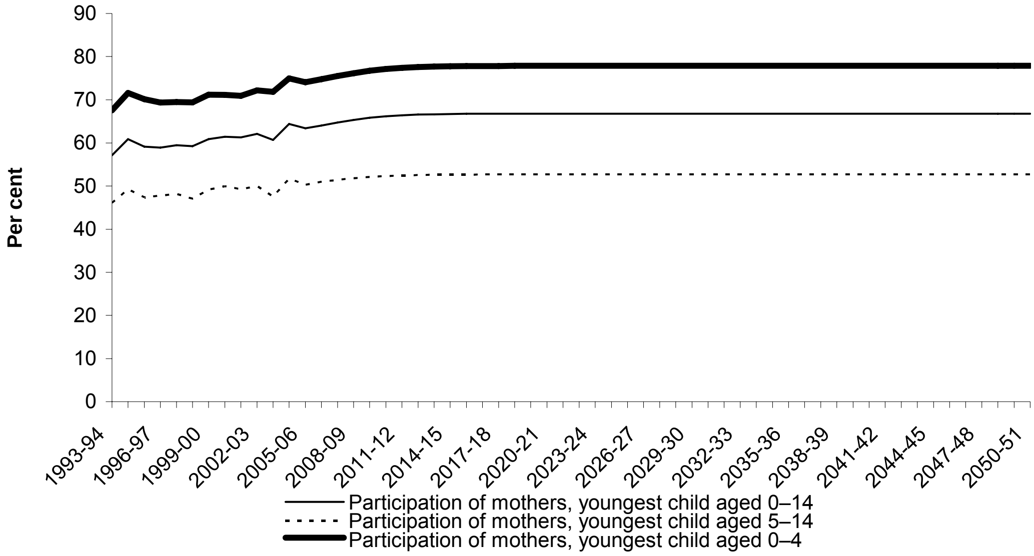
Data sources: ABS (2005, *Labour Force, Australia, Detailed* — Electronic Delivery, Monthly, Cat. No. 6291.0.55.001); ABS (various years, *Child Care Survey, Australia*, Cat. No. 4402.0); ABS commissioned data.

There are several notable features evident from figure 14.1.

- The participation rates of mothers have risen since 1993-94. Between 1993-94 and 2002-03 the average annual growth rates were around 1 per cent. Specifically, they were 0.8 per cent for mothers whose youngest child was aged 0 to 4, 0.7 per cent for mothers whose youngest child was aged 5 to 14, and 0.9 per cent for mothers whose youngest child was aged 0 to 14.
  - In comparison, the participation rates of females aged 15 and over rose at an annual average rate of 0.7 per cent. For females aged between 20 and 44, the annual average rate of growth was 0.4 per cent.
  - The participation rate of mothers whose youngest child was aged 0 to 14 is around the same as the participation rate of females aged 20 to 44.
- There has been no growth in the proportion of children in care who are in formal and/or informal care between 1992 and 2002.
  - However, there are sizeable changes in the mix of formal and informal care (see later).

The historical data on labour force participation of mothers were used to project participation rates to 2050-51 (figure 14.2). The participation rates were then used to calculate annual average growth for each year between 2002-03 and 2050-51. These annual growth rates were then applied to estimated coverage rates for the entire projection period for relevant children's age groups.

Figure 14.2 **Labour force participation of mothers, 1993-94 to 2050-51**



Data sources: ABS commissioned data; Commission estimates from 2005-06 onwards.

Labour force response to Government policy changes on child care

For school-aged children (children 5 years and older), an additional short term response to the Australian Government's recent changes to recipients of the parenting payment to encourage parents to seek work (or training) is incorporated (box 14.1). In announcing the changes, the Government also announced increases in child care funding and places of around 84 300 outside school hours care places, 2 500 family day care places and 1000 in-home care places over the next four years (box 14.1 and Patterson 2005). As the changes are to have an effect on parents applying for these payments from 1 July 2006, it is assumed that coverage rates would grow by an additional 1 per cent a year for four years from 2006-07 to 2009-10.

Use of formal care

An important trend in child care apparent from figure 14.1 is the shift from informal to formal care. Between 1987 and 2002, the share of children using formal care alone rose from 9 per cent to 16 per cent — or an average annual rate of growth of around 4.6 per cent — whereas the share of children using informal care alone declined from 32 per cent to 23 per cent — or an average annual rate of decline of 1.6 per cent.

By and large, formal and informal care may be viewed as substitutes, although ABS data show that parents may use both forms of care concurrently. The degree to which one is substituted for the other depends on such factors as relative price, with informal care typically free or cheaper than formal care, and availability or proximity of informal carers.

A main reason for the shift from informal to formal care, apart from government assistance, appears to be a decreasing supply of informal carers, particularly grandparents. Care of all children aged 0 to 11 by grandparents dropped by 21.2 per cent in 1999 to 19.1 per cent. For children aged 0 to 4 the rate of decline was sharper; from 29.6 per cent to 25.2 per cent. It is possible that grandparents today are staying in the labour force longer, are more likely to be separated by location or family breakdown, or are less physically able (because they are older) or willing to look after young children.

Were this trend to continue, it would result in a substantial increase in government expenditure on formal care, as this is the area in which most assistance is targeted. For example, there are around 54 000 recipients of child care benefit using registered care (that is, care provided by grandparents, nannies and so on who are registered with the Family Assistance Office) compared with around 670 000 recipients of child care benefit using an approved service (that is, care in most long day care centres, vacation care, family day care and so on) (ABS 2005).

It would be reasonable to expect that the trend in formal care use is likely to drive government expenditure on child care in the short term, but it is unlikely that this trend would continue in the long term. It was therefore generally assumed for the projections that the growth rate applying to coverage rates would incorporate the trend in formal care use and grow by an additional 4.6 per cent per year until 2006-07 when the percentage of children in care who were in formal care is estimated to reach 20 per cent.

Out-of-pocket costs of child care

Another potential factor affecting the growth in coverage rates is the trend in out-of-pocket costs of child care. For 4 per cent of children aged 0 to 11, the main reason quoted by parents for not using or requiring additional formal care was ‘cost or too expensive’ (ABS 2003, table 21). Thus, increasing out-of-pocket costs could mean that a small percentage of children are priced out of additional formal care. Because there is only a small percentage of children to which this reason applies, no underlying trend in out-of-pocket cost of child care was assumed.

Summing up

The base case annual growth rate applying to child care coverage rates for Australian Government and State and Territory child care programs consists of the sum of the following elements:

- a long-term trend in coverage rates measured by the annual rate of growth in the labour force participation of mothers over the projection period;
- a short-run increase in demand for child care arising from the response of parents to recent Government policy changes measured by an additional 1 per cent a year growth in coverage rates from 2006-07 to 2009-10; and
- a short run shift to formal care measured by an additional 4.6 per cent per year between 2002-03 and 2006-07 inclusive.

Where relevant, coverage rates are constrained not to exceed 1, which would mean that all children in the population in the particular age group are receiving the service.

Child care benefit

Coverage rates were estimated from data provided by Centrelink. Data on the total number of child recipients of the child care benefit as well as expenditure by age were used to estimate the number of child recipients by age between 0 and 12. This was then divided by the proportion of the relevant population age group using the Commission’s population projections. The base case annual growth rate was applied to coverage rates for child care benefit recipients.

Child care tax rebate

There are no base year data on the number of child recipients of the tax rebate with which to estimate coverage rates. Although the rebate is likely to be claimed by parents receiving the child care benefit, the number of rebate recipients is likely to be less than the number of child care benefit recipients. This is because those not using child care benefit-approved care for work-related purposes and those without a tax liability would not be entitled to the rebate. It was assumed that around 50 per cent of child care benefit recipients would receive the rebate. This is consistent with ABS Child Care Survey data which show that 48 per cent of children in care are in formal care for work-related reasons (table 14.2).

Other Australian Government programs

Data on the number of children participating in the child care support program and child care assistance for eligible parents undergoing training program were obtained from latest FaCS Annual Report for 2004-05 (2005a). The data were divided by the population of children aged 0 to 12 using the Commission's population projections. Coverage rates were assumed to grow in line with the base case growth in coverage rates described earlier.

State and Territory programs

Where possible, coverage rates for State and Territory programs were obtained for each jurisdiction from the Report on Government Services (SCRGSP 2005 and 2006, vol. 2, chapter 14). The number of children covered by the child care and preschool programs was divided by the relevant age groups in the population. Given that age of entry varies across the States and Territories for preschools, it was assumed that the relevant population age group for children in preschool in the year before full time school was age 4 and for younger children in preschool was age 3.

The base case growth rate for Australian Government child care was assumed to also apply to State and Territory child care programs.

As work-related reasons do not signify as greatly for children in preschools compared with those in child care (table 14.2), it was assumed that coverage rates for preschool programs would grow in line with average annual growth over the past six years from data in the Report on Government Services on the participation of children in preschool in the year as a proportion of the relevant age group in the population (table 14.6). The growth values are further constrained to lie within a minimum of -1 per cent a year and a maximum of +1 per cent a year; otherwise, coverage rates would be subject to unsustainable growth over the projection period. A further assumption about coverage rates of children in preschool in the year before full time school is they cannot exceed 1 (the entire population of four year olds) or be less than 0.5 (50 per cent of the population of four year olds).

Table 14.6 **Assumed growth in preschool coverage rates**[a]

Average annual growth rate	*NSW*	*Vic*	*Qld*	*WA*	*SA*	*Tas*	*NT*	*ACT*
For children in preschool in the year before full time school[b]	-0.004	0.003	0.003	0.047	-0.001	0.004	0.001	-0.012
For younger children in preschool[c]	-0.008	na	-0.007	-0.010	0.007	na	0.010	0.010

a Constrained to fall between -1 per cent a year and + 1 per cent a year. **b** This is the average annual growth in the last six years of the proportion of children in preschool in the year before full time school in the four year old population. **c** This is the average annual growth in the last six years of the proportion of younger children in preschool in the 3 year old population. **na** not available.

Source: Commission estimates based on SCRGSP (2005, 2006).

Average cost of child care and preschools

Hours of attendance

It is not possible from the available government expenditure data to obtain an estimate of the average cost of child care by age of child. However, it is apparent that average cost differs for children of different ages as the hours of attendance vary across child care service types. Data from the Australian Government 2004 Census of Child Care Services indicate that younger children aged 0 to 4 typically spend more hours in care than school-aged children (table 14.7).

Table 14.7 **Average child attendance hours per week, 2004**

Hours and minutes

Child care type	*Main ages*	*NSW*	*Vic*	*Qld*	*SA*	*WA*	*Tas*	*NT*	*ACT*	*Aust.*
Private long day care	< 5	18:32	21:38	20:54	19:19	18:27	17:13	29:16	26:11	21:38
Community long day care	< 5	19:40	20:19	20:51	16:54	17:53	15:25	28:39	22:38	20:19
Family day care	< 5	19:22	17:25	21:40	19:51	17:57	14:46	26:48	24:11	17:25
In home care	< 5	21:42	19:18	23:44	18:38	21:38	16:04	0:00	12:20	19:18
Occasional care	< 5	10:24	7:14	10:24	8:45	10:13	8:31	17:00	9:58	7:14
Multifunctional services	< 5	15:07	16:10	25:47	15:25	20:24	0:00	23:25	0:00	16:10
MAC's services[a]	< 5	15:45	19:54	30:43	18:40	20:26	17:31	23:22	0:00	19:54
Outside school hours	5+	8:53	6:56	8:09	6:18	8:08	5:32	11:28	8:51	6:56
Vacation care (days)	5+	2:90	2:80	2:90	2:60	2:90	2:50	3:80	3:30	2:80
Vacation care (hrs)[b]	5+	3:35	3:23	3:35	3:00	3:35	2:88	4:38	3:81	3:23
Adjustment factor (R)[c]		0:42	0:32	0:33	0:29	0:35	0:35	0:34	0:36	0:32

[a] Multifunctional Aboriginal children's services. [b] Converted to hours per week by assuming that children spend 6 hours a day for 10 weeks a year in vacation care. [c] Obtained by dividing the weighted average of child care services used by school-aged children by the weighted average of child care services used by children less than five years of age. The weights used are the proportions of children attending each type of service.

Source: FaCS (2005b).

For the projections, average hours of attendance data were used to adjust initial estimates of average cost of child care in the following way.

- The ratio of average weekly hours of care of school-aged children to the average weekly hours of care of younger children was estimated (R).
- An estimate of an average cost for all age groups (AC) was obtained.
- The adjustment factor R was then applied to the average cost estimate to obtain separate estimates of average cost of children under five years of age and of school-aged children using the following formulas (box 14.4):

$$AC(\text{under } 5) = 2*AC/(1+R)$$

$$AC(5 \text{ and over}) = 2*AC*R/(1+R)$$

Box 14.4 A method for adjusting average cost of child care

Where it is not possible to obtain average cost for particular age groups, but it is possible to obtain average cost for all age groups (AC), the following method and assumptions were applied to obtain an average cost of children under 5 (the young) and an average cost of school-aged children.

Average cost of child care is given by:

$$AC = C/N$$
$$N = Ny+Ns$$

where C is the total expenditure on child care in a year, N is the total number of children in child care, Ny is the number of children under 5 in child care and Ns is the number of school-aged children in child care.

The number of hours that young and school-aged children spend in care in a year is given respectively by:

$$Hy = \alpha*hy$$

$$Hs = \beta*hs$$

where α is the number of weeks that the young are in care, hy is the number of hours in a week that the young spend in care, β is the number of weeks that school-aged children are in care and hs is the number of hours in a week that school-aged children spend in care.

The number of hours that all children spend in care in a year is:

$$H = Hy+Hs$$

Assuming that $\alpha = \beta$ then:

$$R = Hs/Hy$$

Average costs of the young is given by the average hourly costs in a year for all children multiplied by the hours that the young spend in care divided by the number of young in care:

$$ACy = [C/H]*[Hy/Ny]$$

$$= C/[Ny(1+R)]$$

if $Ny = \gamma*N$ where γ is the share of children 0 to 12 who are young then:

$$ACy = C/[\gamma*N*(1+R)] = AC/\gamma*(1+R)$$

Assuming that γ is 1/2 then:

$$ACy = 2*AC/(1+R) \text{ and}$$

$$ACs = 2*AC*R/(1+R)$$

Child care benefit

The average cost of the child care benefit was estimated from data provided by Centrelink.[2] Expenditure for the age group 0 to 12 was divided by the number of children receiving the child care benefit payment. It was adjusted to reflect hours of attendance using the method above and relevant data in table 14.7. Estimates of average costs by age group were converted to 2002-03 prices using the GDP implicit price deflator. The average cost of the child care benefit was assumed to be indexed only to the CPI over the projection period, consistent with current policy to index to the CPI the maximum rate of benefit each year.

Child care tax rebate

The only available data on expenditure on the child care tax rebate are Treasury projections between 2003-04 and 2008-09 in the Australian Government 2005-06 Budget. The average cost was obtained by dividing these expenditure projections by the number of recipients of the child care benefit (assuming that this would equal the number of recipients of the rebate). These estimates were converted to 2002-03 prices using Treasury projections of CPI. It was assumed that, from 2008-09, the average cost of the rebate, because of its link with the child care benefit as well as the indexing of the maximum with the CPI, would grow only in line with the CPI over the projection period.

Other Australian Government programs

Data on expenditure on, and the number of children covered by, the child care support program and child care assistance for eligible parents undergoing training program for 2004-05 were obtained from the latest FaCS Annual Report (2005a, vol. 2). This data enabled more recent estimates of average cost then were possible for the child care benefit.

The average cost for each program was obtained by dividing expenditure by the number of children covered. It was argued by Government officials that an average cost for these programs was not a meaningful concept because the programs were capped. However, capping is a short term phenomenon; it is likely that the Government would need to make periodic adjustments to the cap. As projections are to be made over a long term horizon, it was considered appropriate to apply the average cost method, as is done elsewhere in the Commission’s Ageing Study.

2 These data were used despite more recent expenditure data being available for 2004-05 as there were no data on the number of children receiving the child care benefit in 2004-05 with which to calculate average cost for 2004-05.

Estimates of average costs were then converted to 2002-03 prices using the GDP implicit price deflator.

Although average cost was projected to grow in line with real wage growth over the long run (which was estimated as being equal to the underlying productivity growth of 1.75 per cent per annum over the projection period), a higher short term growth rate was applied for the first five years:

- The support for child care program was indexed by a combination of the Department of Finance and Administration's Wage Cost Index 2 (box 14.5) of 2.1 per cent per annum and an efficiency dividend of 1 per cent per annum.
- The child care assistance for eligible parents program was indexed by Wage Cost Index 2.

Box 14.5 **Wage Cost Index**

The Department of Finance and Administration has developed a series of wage cost indexes to index specific purpose payments, Commonwealth own purpose payments and running costs. They are based on the safety net adjustment handed down by the Australian Industrial Relations Commission and underlying inflation. The safety net adjustment covers wage components while underlying inflation covers the non-wage component of labour costs. There are a range of wage cost indexes depending on the weighting of the wage and non-wage costs of the program to the index.

Source: DOFA (2005).

State and Territory programs

Where possible, estimates of average costs were obtained for each State and Territory for 2004–05 from the latest Report on Government Services (SCRGSP 2006, vol. 2, chapter 14). Total expenditure on child care was divided by the number of participating children for each jurisdiction and then adjusted to reflect hours of attendance using the method above and relevant data in table 14.7. Total expenditure on preschools was divided by the number of participating children. All estimates were converted to 2002-03 prices using the GDP implicit price deflator. It was assumed that average cost would grow in line with real wage growth of 1.75 per cent per annum over the projection period.

14.4 Projections

Using the above method and data, government expenditure on child care and preschools as a share of GDP is projected to decline from 0.28 per cent in 2002-03 to 0.24 per cent in 2044-45, or by 0.04 percentage points (table 14.8). The decline is driven by trends in the Australian Government component of government expenditure. This is unsurprising given that Australian Government spending accounts for around three-quarters of all government spending (table 14.1).

Table 14.8 **Projected government expenditure on child care and preschools as a proportion of GDP**

	2002-03	*2044-45*
	%	%
Australian Government		
Child care benefit	0.18	0.13
Support for child care	0.03	0.03
Child care tax rebate	–	0.02
Child care for eligible parents undergoing training	–	–
Total[b]	0.21	0.18
States and Territories		
Child care	0.02	0.01
Preschool	0.06	0.05
Total	0.07	0.06
Total	**0.28**	**0.24**

[a] The difference between expenditure on the rebate between 2006-07, when the measure begins to take effect and 2044-45, is -0.01 percentage points [b] The total for 2002-03 includes child care assistance and the child care rebate which applied until 2002-03. – denotes nil or rounded to zero.

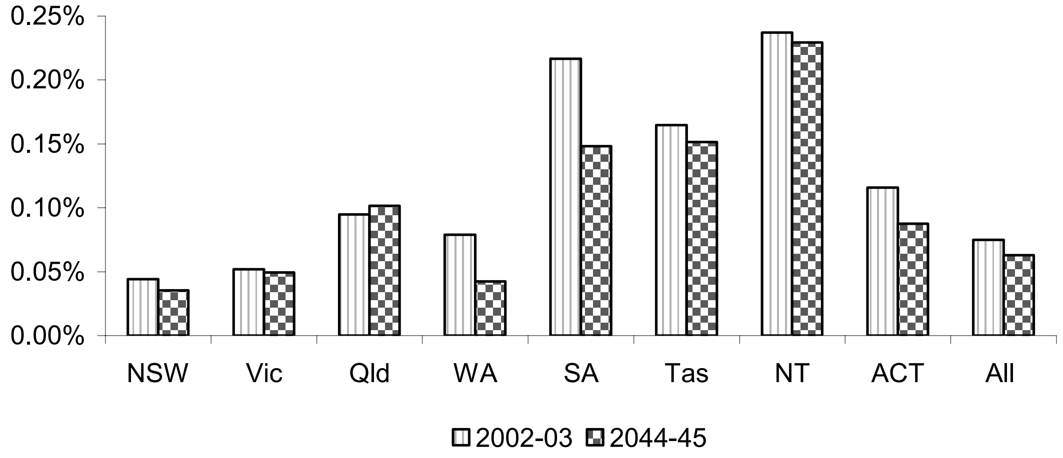
Source: Commission estimates.

The projected extent of decline in Australian Government expenditure is around 0.03 percentage points as a share of GDP. The main reason for this decline is a reduction in spending on the child care benefit as a share of GDP. There are small projected (albeit negligible) increases in expenditure on other programs, largely due to underlying assumptions about growth in average cost.

State and Territory expenditure as a share of GDP is projected to decline by 0.01 percentage points.

For individual States and Territories, apart from Queensland, expenditure on child care and preschools as a share of GSP is projected to decline from between 0.03 percentage points of GSP in Victoria to 0.07 percentage points of GSP in South Australia (figure 14.3). For Queensland, there is a projected increase of 0.01 percentage points of GSP. The differences reflect the differing growth in State and Territory GSPs and child populations and their interaction with the underlying growth assumptions for average costs and coverage rates (table 14.9).

Figure 14.3 Projected State and Territory expenditure on child care and preschools as a share of GSP/GDP



Data source: Commission estimates.

Table 14.9 What's driving growth in government expenditure as a share of GDP/GSP?

Growth in selected variables between 2002-03 and 2044-45

	Expend-iture	*GSP/GDP*	*Child pop. (aged 0 to 12)*	*Child pop. (aged 4)*[a]	*Child care recipients*	*Preschool recipients*
	%	%	%	%	%	%
Australian Government	132	171	14	15	40[b]	–
States and Territories						
NSW	106	163	10	10	31	-10
Vic	159	155	9	11	88	14
Qld	262	238	39	41	1	35
WA	59	196	1	-1	na	36
SA	34	96	-17	-17	9	-15
Tas	56	72	-24	-27	-36	-19
NT[c]	125	155	-5	-1	na	15
ACT	72	146	5	5	na	-31
All States and Territories	127	171	14	15	29	8

[a] The child population aged 4 is relevant to preschool expenditure which is the responsibility of the States and Territories. [b] Relates to recipients of the child care benefit. [c] The Northern Territory projections are from the PC-NTALT series. – denotes nil or rounded to zero. **na** denotes not available.

Source: Commission estimates.

The impact of ageing

The impact of ageing on government expenditure on child care and preschools was isolated from non-demographic factors such as growth in coverage rates as well as in average costs (table 14.10). Total government expenditure on child care and preschools is projected to be over $800 million, or 14 per cent, lower than if the age structure remained as it was in 2002-03. In its Ageing Study, the Commission estimated that the reduction in government expenditure on schools due to ageing was around 21 per cent (PC 2005, p. 221). Thus, ageing has less impact on child care and preschool spending than on spending on schools. This can be explained by differences in underlying assumptions about growth in participation rates and in average costs. In the Ageing Study, it was assumed that school participation rates were held constant and that school expenditure per child initially grew at a rate of 3.2 per cent per annum, gradually reducing over a ten year period until it reached 1.75 per cent per annum where it stayed at this rate for the rest of the projection period (PC 2005, pp. 209, 214).

Table 14.10 **Impact of ageing on government expenditure on child care and preschools, 2044-45[a]**

	Base case expenditure (with ageing)	*Expenditure if there were no ageing*	*Percentage decrease due to ageing*
	$m	$m	%
Australian Government			
Child care benefit	2 671	3 204	17
Support for child care	593	730	19
Child care tax rebate	332	383	13
Child care for eligible parents undergoing training	44	54	19
Total[b]	3 640	4 371	17
States and Territories			
Child care	278	323	14
Preschool	1 012	1 042	3
Total[b]	1 291	1 365	6
Total[b]	**4 930**	**5 737**	**14**

[a] In 2002-03 prices. [b] Totals may not add due to rounding.

Source: Commission estimates.

The impact of CPI indexation

The Australian Government indexes the child care benefit and the child care tax rebate to the CPI. As this is currently Government policy, this indexation arrangement was maintained in the base case projections.

However, the impact of this policy over time would be to reduce the child care subsidy rate as changes in the cost of providing child care services outpaces changes in the child care benefit and the child care tax rebate. It is likely that the Government would need to make periodic adjustments to the child care benefit and the child care tax rebate over the next 40 years to ensure that they were in line with costs.

Therefore, projections on the basis of CPI indexation, while consistent with Government policy, are likely to understate the long run value of the child care benefit and child care tax rebate. For example, if the Government decided to index the child care benefit and child care tax rebate to average weekly earnings (AWE), as it does for other transfer payments such as the disability support pension and the age pension, government expenditure in 2044-45 would be 14 per cent above that of the base case for that year (table 14.11).

Table 14.11 **Impact of changing the indexation arrangement for the Australian Government child care benefit, 2044-45[a]**

	Base case expenditure (CPI indexation)	*Expenditure if AWE indexation*	*Percentage increase due to AWE indexation*
	$m	$m	%
Australian Government			
Child care benefit	2 671	3 204	17
Support for child care	593	593	–
Child care tax rebate	332	619	46
Child care for eligible parents undergoing training	44	44	–
Total[b]	3 640	4 460	18
States and Territories			
Child care	278	278	–
Preschool	1 012	1 012	–
Total[b]	1 291	1 291	–
Total[b]	**4 930**	**5 751**	**14**

[a] In 2002-03 prices. [b] Totals may not add due to rounding. – denotes nil or rounded to zero.

Source: Commission estimates.

The impact of no growth in coverage rates

The impact of changing the assumption about growth in coverage rates was tested (table 14.12). The projections in the base case were compared with that of assuming coverage rates to remain at 2003-04 levels throughout the projection period (no growth). The impact of this change is that government expenditure in 2044-45 would be 18 per cent lower than in the base case.

Table 14.12 **Impact of no growth in coverage rates, 2044-45**[a]

	Base case expenditure	*No growth*	*Percentage reduction due to no growth*
Australian Government	$m	$m	%
Child care benefit	2 671	2 037	31
Support for child care	593	503	18
Child care tax rebate	332	323	3
Child care for eligible parents undergoing training	44	37	18
Total[b]	3 640	2 899	26
States and Territories			
Child care	278	244	14
Preschool	1 012	1 053	-4[c]
Total[b]	1 291	1 296	–
Total[b]	**4 930**	**4 195**	**18**

[a] 2002-03 prices. [b] Totals may not add due to rounding. [c] This means that preschool expenditure increased because of a change in the assumption about growth in coverage rates. Under the base case scenario, some States and Territories had negative growth in coverage rates. Hence, an assumption about no growth in coverage rates would restrict the extent to which expenditure in these States and Territories would fall. – denotes nil or rounded to zero.

Source: Commission estimates.

14.5 Summing up

Government expenditure on child care and preschools as a share of GDP is projected in the base case to decline by around 0.04 percentage points. The extent of this decline is too small to offer fiscal relief to governments from ageing.

If the impact of ageing were isolated from non-demographic factors, such as growth in coverage rates and average costs, government expenditure in 2044-45 would be around 14 per cent lower than if the age structure remained as it was in 2002-03.

If the indexation arrangement applying to the child care benefit were adjusted to maintain the current subsidy rate, this would increase government expenditure in 2044-45 by around 14 per cent compared with retaining CPI-indexation.

Assuming no growth in coverage rates would mean that government expenditure in 2004-05 would be 18 per cent below that of the base case for that year.

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