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PROSPECTS FOR LONGEVITY IN AUSTRALIA**

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## **BEYOND THREE SCORE YEARS AND TEN: PROSPECTS FOR LONGEVITY IN AUSTRALIA**

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The average length of human life has roughly doubled over the last 200 years. Most of this increase took place over the last 100 years. In Australia, life expectancy at birth was 57 years in 1901–10 and increased to 80 years in 2000. During the early part of the century, the greatest gains were due to reductions in mortality from infectious and parasitic diseases at young ages, while during the later part reduced mortality from chronic diseases at middle and older ages was the dominant factor. Life expectancy at age 50 increased from 25 years in 1950 to 32 years in 2000.

These unprecedented increases in human life expectancy have prompted researchers to address the issue of whether there is an upper limit to human longevity.<sup>1</sup> To date, there is no consensus on whether such a limit exists, what the limit might be and how soon it might be reached.<sup>2</sup> Certainly the increases show no signs of slowing down,<sup>3</sup> giving no indication that a limit might soon appear on the horizon.

For the individual, increasing longevity presents the prospect of many years of post-retirement leisure but also the possibility of spending quite lengthy periods in various states of disability and ill-health. Thus, planning for retirement and old age — both lifestyle and financial — is becoming of increasing importance. Available evidence suggests, however, that people do not plan for a lengthy retirement.<sup>4</sup> Moreover, studies of the assets of older Australians show that many individuals (in particular, women and those living in high-cost centres such as Sydney) are woefully ill-prepared.<sup>5</sup> Further, many middle-aged Australians are grappling with issues of care of elderly parents, who are living beyond popular expectation, at a time when they are also planning for their own old age. Despite the backdrop of ever-increasing years of life, for many individuals, it is as though longevity has crept up on them without warning. Indeed, many elderly people are asking in tones of weary impatience, ‘How long will life go on?’

What then are the longevity prospects of people living in Australia today? In particular what are the longevity prospects of today’s population aged 50 years or older — those who are planning for retirement, facing retirement or experiencing old age? This paper examines this question using stochastic forecasting methods.<sup>6</sup> It concentrates on four population cohorts defined by their age in 2001: those aged 50 (labelled baby boomers), those aged 65 (labelled current retirees), those aged 85 (labelled current old-old) and those aged 90 (labelled current oldest-old).<sup>7</sup> By presenting new forecasts of sex- and age-specific mortality for these cohorts, the paper provides more reliable estimates of cohort life expectancy than have hitherto been available and demonstrates the extent to which longevity is likely to increase over the lifetime of cohorts now alive. The implications at the individual level of these forecasts of increasing longevity are discussed in relation to the baby boom and older cohorts.

## **Cohort versus period measures**

The estimates of life expectancy commonly used in discussions of longevity and ageing are period or cross-sectional measures. An example of such a measure is life expectancy at birth in 2000. This measure refers to a hypothetical population of individuals who over the course of their lifetime experience the age-specific death rates occurring in 2000. In other words, it indicates what life expectancy at birth would be if 2000 rates were to continue for 100 years or so.

Though useful as indicators of the overall level of mortality and hence of changes over time, period measures are inappropriate for examining survival over the life course, for example the survival prospects of a particular cohort. This is because mortality rates change. For babies born in 2000, for example, the period measure provides at best an estimate of the minimum life expectancy at birth because mortality rates are expected to continue to decline as they have for the last 100 years. Similarly, the 2000 period life expectancy at a given age will underestimate the average number of years of life remaining for persons of that age in 2000.

In order to take account of life course changes in mortality, cohort measures are required. Cohort life expectancy is based on the mortality experience over the life course. The difficulty in adopting cohort measures is that the mortality experience of cohorts born after 1900, or thereabouts, is incomplete. For the baby boom cohort, for example, the mortality experience of more than 92 per cent of its members has yet to occur. In order to construct cohort life tables for living generations, therefore, forecasts of their future mortality are required.

## **New forecasts of cohort life expectancy**

Based on the experience of the past 35 years or so, forecasts of period mortality at ages 50 and above have been made for females and males for the years 2001 to 2041. These forecasts embody a substantial reduction in mortality. Between 2000 and 2041, the expected age at death of persons aged 50<sup>8</sup> is forecast to increase from 84.1 to 90.7 years for females and from 80.0 to 87.2 years for males. Similarly, increases are forecast in the expected age at death of people aged 65, 75, 85 and 90, as seen in Table 1. These increases are smaller at older ages because of the shorter exposure to the forecast mortality decline and because rates are forecast to decline more rapidly at younger ages.

Mortality rates for the four selected cohorts were extracted from these period forecasts and used in the construction of cohort life tables. The resulting cohort forecasts indicate that members of the baby boom cohort can expect to live a further 38.8 years if female and 34.4 years if male, giving an expected age at death of 88.8 years for females and 84.4 years for males. Similarly, as Table 1 shows, current retirees can expect to live to 88.0 and 84.1 years, the current old-old can expect to live to 92.1 and 91.0 years and the current oldest-old can expect to live to 95.0 and 94.5 years respectively.

**Table 1 Cohort and period expected age at death at specified ages by sex**

Age	Period 2000	Cohort: age in 2001				Period 2041
		90	85	65	50	
Female						
50	84.1				88.8	90.7
65	85.7			88.0	90.3	91.5
75	87.9			90.2	92.1	92.7
85	91.8		92.1	93.7	95.1	95.2
90	94.9	95.0	95.2	96.5	97.6	97.6
Male						
50	80.0				84.4	87.2
65	82.2			84.1	86.5	88.1
75	85.5			87.4	89.1	89.9
85	90.7		91.0	92.4	93.6	93.7
90	94.4	94.5	94.7	95.9	97.0	97.0
Sex difference (Female - Male)						
50	4.1				4.4	3.5
65	3.5			3.9	3.8	3.4
75	2.4			2.8	3.0	2.8
85	1.1		1.1	1.3	1.5	1.5
90	0.5	0.5	0.5	0.6	0.6	0.6

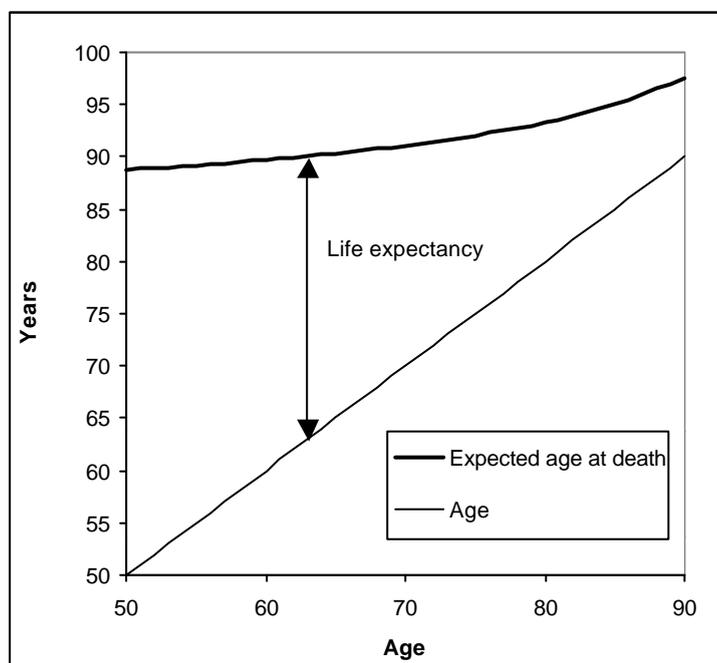
These cohort life expectancies lie between the corresponding period values for 2000 and 2041. For the baby boom cohort at age 50, expected age at death lies roughly midway between the 2000 and 2041 values because the mortality experience of this cohort will take place over the entire 41-year period. For the current old-old and oldest-old cohorts, their remaining life experience will occur in the early part of the forecasting period so that expected age at death is close to the period expectation in 2000. For females, for example, the expected age at death of the cohort aged 85 in 2001 is 92.1 years, only 0.3 years greater than the 2000 period value. By the time the baby boom cohort reaches age 85, in 2036, its future experience will be closer to that in 2041, giving an expected age at death that approaches the 2041 period value (for females, a cohort value of 95.1 compared with 95.2 in 2041). Current retirees occupy an intermediate position.<sup>9</sup>

Table 1 also shows expected age at death at future ages for each cohort. For example, baby boomers who survive to age 65 can expect to live to age 90.3 if female and 86.5 if male. Expected age at death is greater for younger cohorts (seen by comparing across the columns), due to the forecast mortality decline. In addition, the differences between cohorts are greater at younger ages, due to longer remaining exposure to differential mortality rates. For example, when the female baby boom cohort reaches age 65, its surviving members will have a greater life expectancy than current retirees by 2.3 years. When these same two cohorts reach age 85, however, the baby boomer advantage will be reduced to 1.4 years. When they reach age 90, the baby boomer advantage will be further reduced.

## Gains due to survival

In any life table, expected age at death increases with age. Like a reward for good behaviour, by surviving survivors gain an extra lease of life. This is seen in both the period and cohort values shown in Table 1. For the baby boom cohort, for example, female survivors to age 85 can expect to live 6.3 years longer in total than those who were alive at age 50. Most of this gain is earned after age 65, because mortality rates are higher at older ages. Survival to age 65 is not particularly difficult to achieve, so the reward is only 1.5 years of extra life. Survival at older ages, however, presents more of a challenge, with increasing rewards: 1.8 years for surviving from 65 to 75, 3.0 years for surviving from 75 to 85, and 2.5 years for surviving the five years from 85 to 90. At very old ages (not shown), the reward for surviving an extra year approaches one year, so that remaining years diminish only slightly. This phenomenon is seen in Figure 1 which represents life expectancy (remaining years) as the difference between expected age at death and age: the two lines converge at a slower rate at older ages.

**Figure 1** Life expectancy by age for the female baby boom cohort



Since these gains are greater where mortality rates are higher, gains due to survival between any two ages decrease over time as mortality rates decline. Thus current old-old females gain an extra 3.1 years by surviving to age 90, 0.6 years more than female baby boomers.

## Forecast survival probabilities

While life expectancies provide an estimate of average age at death, they do not provide information on the probability of surviving between specified ages. For many purposes, such as planning for old age, it may be more informative to know the chances of survival to a certain age. For a female baby boomer in 2001, for example, her complete life expectancy of 88.8 years gives no indication of how likely she is to survive from (say) age 50 to 65 or from 75 to 90. For this, survival probabilities are required.

Forecast survival probabilities for each cohort are shown in Table 2,<sup>10</sup> together with 2000 and 2041 period values for comparison. For example, a female baby boomer has a 95 per cent chance of surviving from age 50 to 65, a 92 per cent chance of surviving from 65 to 75, a 79 per cent chance of surviving from 75 to 85 and a 75 per cent chance of surviving from 85 to 90. Again, these cohort values lie between the corresponding period values for 2000 and 2041 and reflect the forecast decline in mortality (that is, increasing survival probabilities). The products of these survival probabilities gives the probability of surviving between relevant ages; for example, for female baby boomers the probability of surviving from age 50 to 90 is 0.52, which is the product of the four probabilities just cited. Table 2 also shows these probabilities of survival from current age for each cohort.

**Table 2 Cohort and period survival probabilities at specified ages by sex**

Probability of survival	Period 2000	Cohort: age in 2001			Period 2041
		85	65	50	
Female					
From 50 to 65	0.94			0.95	0.98
From 65 to 75	0.87		0.89	0.92	0.95
From 75 to 85	0.65		0.73	0.79	0.82
From 85 to 90	0.58	0.60	0.69	0.75	0.76
From current age to 75	0.82		0.89	0.87	0.92
From current age to 85	0.53		0.65	0.69	0.76
From current age to 90	0.31	0.60	0.45	0.52	0.57
Male					
From 50 to 65	0.90			0.92	0.97
From 65 to 75	0.78		0.81	0.86	0.91
From 75 to 85	0.50		0.59	0.66	0.70
From 85 to 90	0.48	0.49	0.58	0.64	0.65
From current age to 75	0.71		0.81	0.79	0.88
From current age to 85	0.35		0.47	0.52	0.62
From current age to 90	0.17	0.49	0.27	0.34	0.40

Note: Current age equals age in 2001 for cohort values and age 50 for period values.

### Sex differentials

Since male mortality exceeds female mortality, the sex differential in life expectancy (shown in Table 1) favours females at every age. The sex differential at age 50 was 4.1 years in 2000 and has been narrowing in recent decades due to a more rapid decline in male mortality. The forecast rates continue this trend, and in 2041 the forecast sex differential is 3.5 years. Because of differences between the sexes in mortality patterns by age, however, the cohort sex differentials tend to exceed the period values. For the baby boom cohort, for example, the sex difference in life expectancy at age 50 of 4.4 years exceeds both the 2000 and 2041 values. Further, there is no clear pattern across cohorts. For this measure (unlike those already discussed), period values do not represent the lower and upper bounds for cohort values and there is not necessarily a gradual trend across cohorts. Thus period life tables may be particularly misleading in situations where male and female mortality are being compared.

The sex differential in life expectancy diminishes as age increases. By age 90, the sex differential for baby boomers is reduced to 0.6 years. This diminution is also seen in the survival probabilities in Table 2. While female baby boomers have a markedly greater chance of reaching age 85 (69 per cent compared with 52 per cent for males), once they reach this age, survival prospects are much more equitable (a 75 per cent chance of surviving to age 90 for females compared with a 64 per cent chance for males).

### **Assessable uncertainty**

The forecasts presented above are expected values in the statistical sense and are subject to uncertainty. For example, the female baby boomer complete life expectancy of 88.8 years has a 95 per cent confidence interval of 84.6 to 93.5 years and the male value of 84.4 years has a confidence interval of 81.2 to 88.0 years.

Similar uncertainty statements can be made about survival probabilities. In addition to knowing the forecast probability of surviving to a certain age, it is possible to specify the range of probabilities for which survival is 95 per cent certain. For example, a female baby boomer has an estimated 52 per cent chance of surviving to age 90, and a 33 to 66 per cent chance of surviving to age 90 with 95 per cent certainty. Alternatively, uncertainty may be expressed as a range of ages. For example, a female baby boomer has a 75 per cent chance of surviving to between ages 78.5 and 86.9 with 95 per cent certainty. Such uncertainty is of particular interest in relation to annuities and financial planning.

### **Comparison with official longevity estimates**

Official estimates of longevity published by the Australian Bureau of Statistics (ABS) include current life tables<sup>11</sup> and future life expectancy assumptions used in population projections<sup>12</sup>; both are period measures. As seen in Table 1, the current (2000) life table underestimates cohort life expectancy by up to 4.7 years with larger discrepancies occurring at younger ages and for younger cohorts who have more years left to benefit from mortality decline. Thus financial planners and others who rely on current life tables to provide mortality information for existing cohorts will base their advice on significantly underestimated longevity.

The official assumptions about future life expectancy are also problematic as sources of information on cohort longevity. First, they are period rather than cohort values. Second, published values are usually restricted to life expectancy at birth, giving none of the detail required to address survival from other ages. Third, they are likely to be conservative: it has been demonstrated that the decline in Australian mortality has been systematically underestimated in the past.<sup>13</sup>

Projections of cohort mortality made by the Australian Government Actuary<sup>14</sup> (based on data to 1995–97) provide a few points of comparison. These projections indicate an expected age at death for the cohort aged 65 in 2001 of at most 87.4 for females and 83.6 for males; these are 0.6 and 0.5 years, respectively, lower than the values reported in this paper. Other comparisons are not possible.

## **Implications of the forecasts**

For planning and policy formulation at any level, it is of crucial importance to base decisions on the most valid and reliable evidence. The longevity forecasts in this paper represent a significant advance on previously available information. Not only are they presented in terms of the correct measure for addressing cohort longevity, but they are also likely to more accurately portray future mortality. These longevity forecasts are supplemented by corresponding survival probabilities, which constitute useful information for planning. Further, the provision of probabilistic confidence intervals is an important innovation. Information about forecast uncertainty should form an essential and integral part of the evidence on which planning is based.<sup>15</sup>

A key finding is that these forecasts show a longer complete life expectancy than previous estimates would imply. This calls for the revision of a wide range of models, plans and policies, including those forming the basis of advice on personal financial and life planning, that are predicated on years of life. The rapidly growing body of research concerned with ageing and gerontology is based on longevity prospects that fall far short of those reported here. The problems and issues addressed by this body of research are thus likely to be of even greater significance than currently acknowledged.

What are the implications of these longevity prospects for the baby boom and older cohorts? First, it is of fundamental importance to acknowledge the length of forecast life expectancies. For baby boomers, the prospect at age 50 of a further 38.8 years of life if female, or 34.4 if male, may not always be fully appreciated and calls for a degree of planning most will not have envisaged.<sup>16</sup> Neither is it likely that probabilities of survival are consciously taken on board. It is sobering to observe, for example, that 52 per cent of female and 34 per cent of male baby boomers can expect to live to age 90. How many will be prepared for this eventuality?

Though the prospect of a lengthy life may be welcomed by individuals as an opportunity to achieve outstanding life goals, it also points to the need for serious consideration of plans for financial security in old age.<sup>17</sup> Moreover, the prospect of still greater longevity stemming from gains due to survival should be taken into account. The female baby boomer planning for retirement must make provision for a lifetime of 88.8 years, but if she survives to this age she can expect to live another 8.1 years. Such substantial survival gains imply that financial plans should be regularly revised. The uncertainty in the estimates should also be taken into account.

While personal retirement and financial planning would ideally take forecast life expectancy and survival probabilities into account, evidence suggests that current practice often falls below the ideal.<sup>18</sup> In particular, the forecast longevity prospects call into question the wisdom of early retirement from the labour force.<sup>19</sup> Even based on conservative conventional longevity estimates, early retirement often leads to disadvantage.<sup>20</sup> Further, the spending strategies of many retirees may prove to be inconsistent with their true longevity prospects: enjoying the fruits of one's labour in early retirement may leave one seriously short in later years when health and aged care costs can be very high. Many Australians migrate on retirement in search of lifestyle and sun, the ramifications of which may not be fully appreciated until they are upon them: the need for health and aged care without the support of nearby kin.<sup>21</sup>

Improved longevity prospects also have implications for the role of the family in aged care. Whereas in the past, middle-aged adults would typically care for family members aged 70-80, carers now face the prospect of caring for the very old when they themselves are quite elderly. With an average age at childbearing of 29 years in the 1930s, a small but significant proportion of

current retirees are finding that they are responsible in one way or another for the care of 95 year-old parents. This pre-baby-boom generation also has relatively few siblings to share the responsibility.<sup>22</sup> If elderly parents do not have sufficient assets, the retirees may find that they are obliged to build support for elderly parents into their own financial plans. Where migration of family members has taken place, care of the elderly may be an especially difficult and expensive issue, often necessitating further migration when elderly parents become frail.

These personal financial and aged care implications are all the more important when it is considered that increased years of life are likely to be spent in a state of disability. Recent research has shown that between 1988 and 1998, all of the male and two-thirds of the female increase in life expectancy was spent in a state of disability.<sup>23</sup>

The new forecasts also challenge the conventional wisdom that females can expect to live significantly longer than males. In fact, among survivors to older ages (85 and above), male and female survival prospects are quite similar: by age 90 the female advantage in life expectancy is only half a year. This calls for a change in thinking about the likelihood that females will experience an extended period of widowhood in old age. Indeed, marriage between partners of similar age may minimise years spent in widowhood, provided that both partners survive to old age. The survival prospects of each partner are also important in financial planning, where the inadequacies of period life tables for forecasting sex differentials underline the need for cohort tables.

Finally, this analysis has focused on increasing longevity and its implications at the individual level, rather than at the population level. Nevertheless, the contribution of increasing longevity to structural population ageing, particularly its effect on old-age dependency ratios and proportions who are very old, cannot be ignored.<sup>24</sup> The underestimation in official longevity assumptions, as indicated by the new forecasts, means that official population projections underestimate the extent of ageing.<sup>25</sup> Existing studies<sup>26</sup> of the financial implications of ageing for the public provision of social security and health and aged care services will therefore underestimate the full effect. Thus, though most of the existing studies indicate that the costs of population ageing are manageable,<sup>27</sup> the new longevity forecasts call for their re-examination.

In addition, these studies show that a continuation of existing trends towards the greater use per person of high-cost services would present a major challenge to fiscal sustainability. That this challenge is likely to be even greater than anticipated is a further implication of the new forecasts: it is at very old ages in particular, where health costs are highest and increasing,<sup>28</sup> that underestimation is greatest in official projections.<sup>29</sup> The new forecasts would imply, therefore, that future provision for the elderly will require a higher level of public funding than currently envisaged.

## **Acknowledgment**

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## Notes

- <sup>1</sup> For example, K. W. Wachter and C. E. Finch (eds) *Between Zeus and the Salmon: the Biodemography of Longevity*, National Academy Press, Washington, D.C., 1997.
- <sup>2</sup> See evidence cited in J. Oeppen and J. W. Vaupel, 'Broken limits to life expectancy', *Science*, vol. 296, 2002, pp. 1029–1031.
- <sup>3</sup> J. Wilmoth, 'Demography of longevity: past, present and future trends', *Experimental Gerontology*, vol. 35, 2000, pp. 1111–1129. J. Oeppen and J. W. Vaupel, 'Broken limits to life expectancy', *Science*, vol. 296, 2002, pp. 1029–1031.
- <sup>4</sup> *The National Strategy for an Ageing Australia, Background Paper*, Department of Health and Aged Care, Canberra, 1999, p. 14.
- <sup>5</sup> S. Kelly, 'Forecasting wealth in an ageing Australia — an approach using dynamic microsimulation', presented at the 7th Nordic Seminar on Microsimulation Models, Helsinki, Finland 13 June 2003, <[http://www.natsem.canberra.edu.au/pubs/cp03/2003\\_005/cp2003\\_005.pdf](http://www.natsem.canberra.edu.au/pubs/cp03/2003_005/cp2003_005.pdf)>. S. Kelly, 'Incomes and assets of New South Wales baby boomers in 2020', presented at the Future of Ageing Conference, Coffs Harbour, 20 February 2003, <[http://www.natsem.canberra.edu.au/pubs/cp03/2003\\_002/cp2003\\_002.pdf](http://www.natsem.canberra.edu.au/pubs/cp03/2003_002/cp2003_002.pdf)>. A. Harding, A. King and S. Kelly, 'Trends in the incomes and assets of older Australians', Discussion Paper no. 58, NATSEM, Canberra, June 2002. S. Kelly, A. Harding and R. Percival, 'Live long and prosper? Projecting the likely superannuation of the baby boomers in 2020', NATSEM, Presented at the 2002 Australian Conference of Economists Business Symposium, October 2002. P. Noad, 'Too busy, too tired — too hard! Queensland women: funding our futures', Australian Pensioners' and Superannuants' League (Qld) Inc., 2000. 'Inquiry into long-term strategies to address the ageing of the Australian population over the next 40 years', submission to the 2003 House of Representatives Standing Committee on Ageing, Occasional Paper no. 8, Commonwealth Department of Family and Community Services (FACS), Canberra, 2003.
- <sup>6</sup> The Lee-Carter method with modifications by Booth, Maindonald and Smith was applied to central mortality rates by sex at ages 50+ for the fitting period 1964–2000. These single year rates were obtained from the Australian Demographic DataBank at the Australian Centre for Population Research. The forecast experience of cohorts of specific ages in 2001 was derived from the diagonals of the matrix of forecast period rates for 2001–2041. Details of the modified Lee-Carter method are given in H. Booth, J. Maindonald and L. Smith, 'Applying Lee-Carter under conditions of variable mortality decline', *Population Studies*, vol. 56, no. 3, 2002, pp. 325–336.
- <sup>7</sup> Small numbers and inaccuracies in reported age preclude examination of individual cohorts aged over 90.
- <sup>8</sup> Also known as complete life expectancy, the expected age at death of persons aged  $x$  is obtained by adding the number of years already survived (that is,  $x$ ) to (remaining) life expectancy at age  $x$ . It should be noted that all life expectancies presented in this paper are conditional on first having survived to the specified age.
- <sup>9</sup> Longer-term forecasts are less reliable than short-term. However, only forecasts for the baby boom cohort at older ages include the later years of the forecast period.
- <sup>10</sup> In Table 2, survival probabilities from current age cannot be compared between cohorts because each cohort has a different current age. Survival probabilities cannot be calculated for the oldest-old cohort, since 90 and over is the last age group.
- <sup>11</sup> *Deaths, Australia, 2002*, Catalogue no. 3302.0, Australian Bureau of Statistics (ABS), Canberra, 2003.
- <sup>12</sup> *Population Projections, Australia, 2002–2101*, Catalogue no. 3222.0, Australian Bureau of Statistics (ABS), Canberra, 2003.
- <sup>13</sup> H. Booth, 'From modelling to forecasting: it ain't straightforward!', presentation at the ACPR Workshop on Mortality Modelling and Forecasting, Canberra, 13–14 February 2003, <<http://acpr.edu.au/Mortality%20Workshop.html>>.
- <sup>14</sup> *Australian Life Tables 1995–97*, Australian Government Actuary (AGA), Canberra, 1999.

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- <sup>15</sup> H. Booth, 'On the importance of being uncertain: forecasting population futures for Australia'. Unpublished.
- <sup>16</sup> *The National Strategy for an Ageing Australia, Background Paper*, Department of Health and Aged Care, Canberra, 1999, p. 14.
- <sup>17</sup> An increasing proportion of people will engage in personal financial planning: while 55 per cent of persons aged 65 and over were in receipt of the full-rate age pension in 1998, this proportion will decline as employer-sponsored and private superannuation increase as a result of existing policy. See: *The National Strategy for an Ageing Australia, Background Paper*, Department of Health and Aged Care, Canberra, 1999, p. 12.
- <sup>18</sup> See note 5.
- <sup>19</sup> Labour force participation rates for persons aged 55 and over have declined sharply in recent decades. See D Carey, 'Coping with population ageing in Australia', OECD Economics Department Working Papers no. 217, OECD, Paris, 1999.
- <sup>20</sup> 'Inquiry into long-term strategies to address the ageing of the Australian population over the next 40 years', submission to the 2003 House of Representatives Standing Committee on Ageing, Occasional Paper no. 8, Commonwealth Department of Family and Community Services (FACS), Canberra, 2003.
- <sup>21</sup> This also creates considerable strain on local resources.
- <sup>22</sup> Total fertility averaged 2.2 in the 1930s.
- <sup>23</sup> This includes relatively minor disabilities. C.R. Heathcote, B.A. Davis, B.D. Puza and T.J. O'Neill. 'The health expectancies of older Australians', *Journal of Population Research*, vol. 20, no. 2, 2003, pp. 169–185.
- <sup>24</sup> Declining fertility in the past is the principal cause of structural ageing; this effect is known and fixed. Given the current structure, future longevity will determine the size of the elderly population.
- <sup>25</sup> H. Booth and L. Tickle, 'The future aged: new projections of Australia's elderly population', *Australasian Journal on Ageing*, vol. 22, no. 4, 2003, pp. 196–202.
- <sup>26</sup> *Intergenerational Report 2002–03*, 2002–03 Budget Paper No. 5, Commonwealth of Australia, Canberra, 14 May 2002. C. Cooper and P. Hagan, 'The Ageing Australian Population and Future Health Costs: 1996–2051', Occasional Papers: New Series no. 7, Department of Health and Aged Care, Canberra, 1999. Allen Consulting Group, 'The Financial Implications of Caring for the Aged to 2020: A report commissioned in conjunction with The Myer Foundation project, 2020: A Vision for Aged Care in Australia,' Final Report to the Myer Foundation, 2002. J. Creedy, 'Population ageing and the growth of social expenditure', in *Proceedings of the Policy Implications of the Ageing of Australia's Population Conference, 10 August 1999*, <<http://www.pc.gov.au/research/confproc/ageing/paper10.pdf>>. P. Johnson, 'Ageing in the twenty-first century: implications for public policy', in *Proceedings of the Policy Implications of the Ageing of Australia's Population Conference, 10 August 1999*, <<http://www.pc.gov.au/research/confproc/ageing/paper02.pdf>>.
- <sup>27</sup> The *Intergenerational Report 2002–03* (op. cit., pp. 60–62) shows that an additional increase of about one year in life expectancy over the next 40 years would necessitate an increase of 0.48 per cent of GDP in government spending by 2041–42. However, this is based on life expectancies at birth of 88.5 for females and 83.9 for males, which are likely to be lower than comparable forecast values.
- <sup>28</sup> *Intergenerational Report 2002–03*, 2002–03 Budget Paper No. 5, Commonwealth of Australia, Canberra, 14 May 2002.
- <sup>29</sup> H. Booth and L. Tickle, 'The future aged: new projections of Australia's elderly population', *Australasian Journal on Ageing*, vol. 22, no. 4, 2003, pp. 196–202.