Pacific Economic Cooperation Council

Pacific Economic Outlook: Structure 2007 – Aging and Economic Growth Potentials in the Pacific Region

Background Papers

AUSTRALIA

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1. INTRODUCTION

Australia has an aging population. By mid-century, the proportion of Australians aged 65 years or over is expected to more than double. How will such a significant demographic transformation affect Australia's long term economic prospects? This question has generated significant policy interest and was the catalyst for a 2005 study by the Australian Productivity Commission examining the economic implications for the nation of likely demographic changes over the next 40 years: see Productivity Commission 2005, *Economic Implications of an Aging Australia*, Research Report, Canberra (hereafter 'PC Report').

Based on consultations with groups of experts, including the Australian Bureau of Statistics and some of Australia's leading demographers, the Productivity Commission's final report contains detailed projections across a range of economic indices. These projections, which incorporate the most recent data on trends in fertility, mortality and migration, provide a preview of what the future may hold for Australians, assuming the continuation of existing Government policies and current behavioural patterns in society.

This paper begins by reviewing the Australian Productivity Commission's (PC) projections and analysis. It then provides an analytical framework for analysing the effects of demographic change on living standards emphasising potential dividends from population aging.

2. POPULATION AGING IN AUSTRALIA

Population aging in Australia, as in other developed countries, is attributable to increases in life expectancy and reduced fertility rates. In 1901, when the Commonwealth of Australia came into being, less than one in 25 persons were aged 65 years or more. Today, they are one in every eight Australians.

Over coming decades, Australia's population is expected to age rapidly, although the rate of aging in Australia is relatively slow compared to other economies in Europe and Asia. Between 2012 and 2028, for instance, the aged share of the population is projected to increase by more than 0.35 percentage points per year – an increase around 4 times the long-term average. By 2044-45, almost one in four persons, or 7 million Australians, will be aged 65 years or more (equivalent to 24.5 percent of the population, compared to 13 percent in 2003-04). Over the same period, the proportion of people over 85 years – the 'oldest of the old' – is anticipated to rise from 1.5 percent to 5.0 percent.

However, population aging is not simply about the number of elderly people. Rather, it is about the age structure of the population – the ratio of the old to other ages. As long as there are sufficient numbers of younger people to drive the economy and provide the needed services, it should be theoretically possible to meet the needs of any given number of old people. In Australia, the age structure of the population has shifted markedly. Much of the projected change reflects slow growth in the population of younger age groups over forthcoming decades.

At the present time, there are 5.2 people in the potential workforce for every person aged 65 years or more (giving rise to an aged dependency ratio of 19 percent). By 2044-45, the figure will have fallen to less than 2.4 people (increasing the aged dependency ratio to 41 percent). This is symptomatic of the long-run decline in fertility that has occurred in Australia since the 1960s, and is not a product of the so-called 'baby boom' that followed the end of World War II, although it is often mistakenly blamed on that phenomenon.

3. MACROECONOMIC IMPLICATIONS

3.1 SAVING AND LABOUR PRODUCTIVITY

In relative terms, population aging means that labour will become more scarce and capital more abundant. As a result, it can be predicted that real wages will rise and returns to capital will fall. This change in relative prices actually makes it harder to prepare for population aging simply by saving more, because the returns on saving will be lower (Edey 2005).

Changes in the age composition of the labour force may affect aggregate productivity, since average productivity levels initially increase with age and then decline after middle age. Any assessment of the net effect of population aging on productivity turns on whether the gains from a reduced share of inexperienced (and less productive) younger workers are outweighed by productivity changes associated with a growing share of older workers (PC Report, p xxv).

Related questions concern whether demographic change influences two of the major components of labour productivity growth, namely investment and technical progress. Aging may have implications for the capital to labour ratio. As labour supply growth slows, the amount of capital required to achieve the desired capital to labour ratio will fall. At given factor prices, this acts to depress investment demand.

What of the effect of aging on technical progress? It could be negative, as an older population may be less creative and less entrepreneurial, or their depreciating skills may create impediments to the adoption and diffusion of new knowledge. Alternatively, it could be positive, as a slowdown in labour supply growth may create incentives for labour saving innovation. At this stage, according to the PC, there is insufficient evidence available to support a conclusion that aging per se will either enhance or erode Australia's labour productivity prospects.

3.2 ECONOMIC GROWTH

Population aging is expected to slow economic growth by constraining labour supply growth. A significant factor here is the impact of aging on the labour force participation rate (the share of the population in the labour force – either in a job or actively seeking one).

At present, labour force participation falls significantly for those over 55 years of age and is negligible after 70 years. As more people move into these older groups, labour force participation rates are forecast to decline, although the effect will be partly offset by new, young workers and a continuing trend for higher female participation at most ages.

Australia's aggregate labour force participation rate is projected by the PC to fall from its current level of 63.5 percent to 56.3 percent in 2044-45, as the age structure of the population shifts towards older, less participating groups. Had this change not occurred, the participation rate would have increased by some 2.5 percentage points, reflecting the importance of increasing female participation. Accordingly, by 2044-45, the difference in participation rates attributable to aging will amount to nearly 10 percentage points.

The PC projects that GDP per capita growth rates will fall steadily over the next 20 years to around 1.25 percent in 2025 – roughly half the 2003-04 rate and one-third lower than without aging. The dip mainly reflects the aging and withdrawal of the baby boomers from the labour force. Over the longer run, the prognosis is for economic growth per capita of 1.75 percent a year, in line with long-term labour productivity growth. Yet the PC also recognises that these impacts must be viewed in perspective. Real per capita incomes will be much higher than they are today. Indeed, by 2044-45, per capita incomes are projected by the PC to be nearly double those of 2003-04 in real terms.

3.3 GOVERNMENT SPENDING

Many aspects of an aging Australia will be accommodated automatically by markets. Private consumption and production patterns will shift over time towards goods and services that best meet the preferences and needs of an aging population. Nevertheless, some critical age-related goods and services will continue to be funded and regulated by governments.

As far as age pensions are concerned, however, past reforms to superannuation and retirement saving policy mean that Australia is relatively well-placed compared to most developed countries. This leaves health and aged care as the most important sources of potential fiscal strain. A disproportionate amount of the lifetime health care costs for an average person is incurred in old age. Across health services as a whole, expenditure on the over 65s amounts to around four times more per person than that on those under 65, and rises to between 6 to 9 times more for the oldest groups. Accordingly, as the population ages, health care spending can be expected to increase significantly. In fact, by 2044-45, rising health costs are projected to add an extra 4 percent of GDP to government spending (Edey 2005).

The use of formal aged care increases rapidly after 80 years of age. The proportion of people aged 80 years or more is expected to almost treble, from 3.3 percent of the population in 2002-03 to 9.1 percent in 2044-45, suggesting that aging will exert substantial pressure on aged care expenditure. This trend may partly be offset by lower profound and severe age-specific disability rates, although the evidence is not clear. Allowing for modest reductions in disability rates, the number of low and high care residents is projected to increase by around 215 percent between now and 2044-45.

Some areas of government spending will actually fall as a result of aging, for instance education costs (as younger cohorts diminish in relative importance) and social welfare outlays (particularly family assistance, parenting payments and unemployment benefits). Other key public spending areas, such as defence, transport, housing, and law and order are also largely unaffected by aging.

4. AGING AND MACROECONOMIC WELFARE

The balance of evidence from recent studies of OECD countries suggests that population aging will only slightly retard the growth rate of national living standards in the coming decades. See for example, Martins et al (2005) for a sample of four OECD countries; and for Australia, see Productivity Commission (2005), Day and Dowrick (2004), and Guest and McDonald (2002). The relatively benign impact of population aging on economic growth can be traced to several factors. One is that the net impact of aging on technical progress is generally considered to be neutral. Also, there are potentially a number of offsetting 'dividends' in the future, some of which are associated with demographic change itself and some of which are due to policy changes.

The calculation of these potential dividends from demographic change is the main empirical contribution in what follows. The calculations for Australia are compared with a sample of other OECD countries, consisting of the G7 plus New Zealand, using the most recent demographic projections from the United Nations World Population Prospects 2004 Revision. The calculations are mechanical in that there are no behavioural feedback effects or explicit optimising behaviours. Hence this is not an exercise in the general equilibrium modelling of population aging. In this sense the approach is similar to that in Productivity Commission (2005) for Australia, unlike many other studies that apply CGE models such as Martins et al (2005) for the OECD and most recently for Australia, Kulish et al (2006). An aim of the calculations reported here is simplicity and transparency, at the cost of ignoring behavioural feedback effects.

In what follows Section 5 describes the demographic transition and sets up a simple analytical framework for analysing the effects of demographic change on living standards. These effects are then discussed in Section 6 where the emphasis is on recent developments with respect to potential dividends from population aging. Section 7 describes the data and reports the calculations.

5. DEMOGRAPHIC TRANSITION, ECONOMIC GROWTH AND NATIONAL PROSPERITY

Population aging is best thought of as a demographic transition that comes with economic development. The process comes in stages, starting with declining infant mortality and increases in adult life expectancy, followed later by declining fertility rates. Demographic projections show that almost all OECD countries are getting older, although countries are at different stages in the demographic transition. The first pair of columns in Table 1 of Appendix B gives the working age population share for the sample of nine OECD countries. These data will be discussed in more detail below.

Simple demographic ratios do not in themselves suggest much about the effect of aging on national prosperity. For that purpose it is appropriate to look directly at a measure of national prosperity which we will define here as national consumption per person, or living standards. Part of the effect of aging on living standards occurs through the effect on economic growth, but not all of it. To restrict ourselves to the effect on growth would be to ignore other important effects of aging on living standards.

The linkages from aging to growth and national prosperity can be expressed in the following terms. Start with the following identity for living standards defined as national consumption per person:

$$\frac{C}{N} \equiv \frac{C}{L}\frac{L}{N} \qquad (1)$$

Where C is national consumption, N is population and L is employment. Let GNP equal national consumption plus gross national saving, S, and let GNP equal GDP, Y, plus net income from foreign assets, rF, where r is the interest rate and F is foreign assets. Hence:

$$C = Y + rF - S \qquad (2)$$

Substituting (2) into (1):

$$\frac{C}{N} = \frac{L}{N}\left(\frac{Y}{L} + r\frac{F}{L} - \frac{S}{L}\right) \qquad (3)$$

Define saving as the change in national wealth, W. Saving per worker (S/L) is therefore approximately[1] equal to the change in wealth per worker plus the saving required to keep wealth per worker constant:

$$\frac{S}{L} \approx \Delta\frac{W}{L} + n\frac{W}{L} \qquad (4)$$

where n is the growth rate of new workers. Finally, define national wealth as the capital stock, K, plus foreign assets, F. Therefore:

$$\frac{C}{N} = \frac{L}{N}\left(\frac{Y}{L} + (r-n)\frac{F}{L} - n\frac{K}{L} - \Delta\frac{W}{L}\right) \qquad (5)$$

The role of economic growth, defined as growth in output per capita, is evident by rearranging (5) as follows:

$$\frac{C}{N} = \frac{Y}{N} + \frac{L}{N}\left((r-n)\frac{F}{L} - n\frac{K}{L} - \Delta\frac{W}{L}\right) \qquad (6)$$

Equation (6) shows that the effect of population aging on growth, Y/N, is only part of the story of the effect of aging on living standards.

Equation (5) (or (6)) allows us to decompose the effects of demographic change on living standards in an open economy setting. These effects are discussed further below and are captured in a stylized way in the calculations described in Section 8.

6. EFFECTS OF DEMOGRAPHIC CHANGE ON LIVING STANDARDS (C/N)

Appendix A derives the algebraic decomposition of the effects of demographic change on C/N in the long run (or steady state), based on (5). The first of these effects is the 'dependency effect' which refers to the effect of a change in L/N, the employment to population ratio or 'support ratio' (Cutler et al, 1990). The support

[1] The approximation applies to discrete changes in time.

ratio in a given year is commonly calculated as:

$$\frac{L}{N} = \frac{\sum_{i=1}^{m} \alpha_i LFPR_i N_i}{\sum_i N_i} \qquad (7)$$

Where m is the number of age groups of workers, α_i is the productivity weight of workers of age i, $LFPR_i$ is the labour force participation rate of age group i and N_i is the population of age i.

6.1 EFFECT OF DEMOGRAPHIC CHANGE ON THE SUPPORT RATIO (L/N)

Population aging lowers the support ratio by lowering the working age population share: $\sum_{i=1}^{m} N_i \Big/ \sum_i N_i$. However,there are a number of reasons to expect the decline in the support ratio to be mitigated by a rise in the LFPRs of older workers in the future.

Younger cohorts of the population are better educated than their predecessors, which means that when they are older their LFPRs will be higher than that of current older cohorts, because better educated people participate at higher rates in the labour market due partly to their higher wage rates. Also, the demand for their labour will be higher due to their higher productivity.

In Australia for example, Day and Dowrick (2004) provide evidence that the decline in fertility since the 1960s has been associated with a substantial increase in female LFPRs. They argue that this will continue - in particular with respect to older women, as the higher educational attainments of young women today will result in much higher LFPRs of older women in the future. The Productivity Commission (2005) projections for Australia take account of these ‘ cohort effects’ by assuming that future older workers participate at higher rates than current older workers, and more so for women. The result is that the aggregate L/N falls by 10 percent over the next 40 years, whereas the working age share of the population is projected to fall by 12 percent.[2]

In Australia as in other OECD countries considerable policy attention is being directed towards increasing LFPRs of older workers and ensuring that there is demand for their labour. Policies are focusing on retirement incomes and welfare reform, incentives for older workers to enter labour market training programs, and various forms of careers/employment guidance for older workers. Of these, the changes to superannuation and pension arrangements have received the greatest attention. Re-engineering of workplaces, improvements in health of older people, the growth of less physically demanding ‘knowledge jobs’, and flexible working arrangements are all factors that can potentially increase the LFPRs of older workers in the future.

There are feedback effects on LFPRs through changes in wage rates and tax rates associated with population aging. A decline in labour supply relative to demand leads to higher wages which will tend to raise LFPRs. In addition, to the extent that population aging lowers consumption per capita both consumption of goods

[2] Their measure of L is hours worked.

and leisure would be lower. Lower leisure in turn implies greater work effort, thereby boosting effective labour supply. Effects in the opposite direction, however, will occur through the negative effect of higher taxes on after-tax real wages (see Disney (1996) for a discussion).

Finally, working age populations themselves may turn out to be higher in coming decades than indicated by current projections, due to pro-fertility policies being adopted in Australia and other OECD countries. These policies vary from cash payments to new mothers (the 'baby bonus' in Australia) to policies designed to make simultaneous child-raising and participation in the labour market more attractive to women. The latter include parental leave and child care subsidies. International empirical evidence suggests that pro-fertility policies generally do boost fertility (Milligan, 2005; Moffit, 1997), although part of the measured effect may be a timing effect where mothers bring forward childbirth in their lifecycle rather than increasing the number of births over their lifetimes.

6.2 EFFECT OF AGING ON AVERAGE LABOUR PRODUCTIVITY (Y/L)

The effect of population aging on labour productivity is a critical relationship because labour productivity growth could potentially offset – indeed swamp – the economic burden implied by a falling support ratio. Broadly speaking there are two sources of labour productivity growth: technical progress and increases in the capital-labour (K-L) ratio. With respect to the former, the magnitude and direction of the effect of demographic change on technical progress remains an elusive question - unresolved in theory and empirically. See Chapters 4-7 in Birdsall, Kelley and Sinding (2001), and Chapters 1-8 in Mason (2001). For this reason most studies take an agnostic view in assuming that the net effect of demographic change on technical progress is zero – for example, Martins et al (2005) for the OECD and Productivity Commission (2005) for Australia.

The other source of labour productivity growth – increases in the K-L ratio – can be affected by demographic change in two ways. The first is a mechanical effect as capital takes time to adjust to changes in labour for any desired K-L ratio. This implies a short run rise in the K-L ratio in response to population aging. The second effect is a change in the desired long run K-L ratio. The latter link is weaker the more open is the capital market to international capital flows, and therefore the more that a change in saving affects net foreign assets (F) per worker rather than capital per worker.[3]

Two potentially important effects on Y/L can also occur through the age distribution of a given workforce size. One of these effects is well known. That is, middle aged workers tend to be more productive than younger and older workers. The other effect has received less attention in the literature – namely, the possibility that a change in the age distribution of workers in a firm can change labour productivity of that firm due to imperfect substitutability, or non-zero complementarity, of workers. This has not been considered in the literature on aging until recently. Despite econometric evidence to the contrary (Card and Lemieux, 2001, for example), perfect substitutability of workers of different ages continues to be the typical assumption in macroeconomic modeling of demographic change.

Examples of complementary, rather than perfectly substitutable, age-dependent

[3] The desired K-L ratio is determined by the cost of capital. The more open is the capital market the more the cost of capital reflects the international cost of capital rather than domestic saving and investment.

skills are not hard to imagine: the physical strength, higher education levels and dynamism of young workers complementing older workers' experience, maturity of judgement, reliability, and people skills including their mentoring role. This would imply that even though 35 year olds may have the same marginal productivity as 65 year olds, as reflected in equal wage rates, employing either two 35 year olds or two 65 year olds would yield less output than employing one of each.

The notion of synergies or complementarities of workers by age gives rise to the possibility of an optimum age mix of a firm's workforce. It can be shown that, under standard neoclassical assumptions, the optimum age mix of a given workforce depends on two factors: the relative marginal productivity of workers by age and the degree of substitutability between workers by age (Lam, 1989). In the context of population aging, the question arises as to whether an older workforce is closer to the optimum age mix of the workforce or further away from it.

If we are moving closer to the optimum, we will derive a dividend in terms of aggregate labour productivity and therefore economic well being. This would be a free lunch in the sense that it would not cost any resources. On the other hand, if we are moving further away from the optimum, we would incur an efficiency loss in terms of lower labour productivity and therefore economic well being.

Evidence is emerging, based on simulations of calibrated macroeconomic models, to suggest that population aging is likely to move the workforce age mix closer to the optimal mix, implying a dividend rather than an efficiency loss (Prskawetz and Fent, 2004; Guest, 2005a). The calculations in Section 8 attempt to measure the size of this potential dividend for Australia and the sample of other OECD countries. They should be interpreted, however, as subject to wide confidence intervals due to lack of evidence about the elasticity of substitution among workers of different ages.

Human capital is another channel through which demographic change can affect Y/L, although there is no attempt to measure this effect in the calculations reported in Section 8. Lower fertility rates may boost human capital creation because parents can afford to spend more on the education of each child, on average (Becker et al, 1990). This negative relationship between fertility and human capital creation also operates in the other direction, because parents who have high levels of human capital face a high opportunity cost of having children which typically outweighs any positive income effect, thereby lowering fertility (Becker et al, 1990).

The bi-directional relationship between fertility and productivity is supported by recent empirical evidence for Australia (Guest and Swift, 2005) using data from 1950 to 2002. This further calls into question the merits of pro-fertility policies, discussed above, to the extent that they might reduce labour productivity. Note that any reduction in labour productivity from higher fertility would be permanent if the population becomes stable at a higher fertility rate.

Improvements in human capital due to lower fertility rates can be expected to increase labour productivity growth in the short run and probably in the long run.[4] The short run effect occurs through an improvement in the quality of labour inputs used in current production. Longer term feedback benefits can occur as knowledge begets knowledge - discoveries lead to further discoveries. In this sense pro-

[4] There is a debate about whether improvements in human capital increase the long run rate of productivity growth. According to 'new growth theory' they do; according to neoclassical theory productivity growth is higher only in the short run. See the discussion in Day and Dowrick (2004).

ductivity growth caused by human capital is endogenous (see, for example, Lucas, 1988, and Romer 1990).

Finally, brief mention is made of the potential for demographic change to affect Y/L via changes in the sectoral composition of demand for goods and services. This can affect labour productivity because some industry sectors have a higher capital intensity than others; and because some sectors, such as the long term aged care sector, have less potential for technical progress than other sectors such as manufacturing. In their OECD study, Martins et al (2005) provide some evidence for their conclusion that aging-induced changes in consumption shares are not large because they tend to offset each other across age groups and therefore will not produce major structural changes in the economy.

6.3 EFFECT OF AGING ON SAVING PER WORKER (S/L)

There is strong evidence to support partial – not perfect – life cycle consumption smoothing implying a bell-shaped life cycle saving pattern. See Campbell and Mankiw (1989) and Martins et al (2005). This means that aggregate saving per worker will change in response to changes in the age composition of the working age population. When the proportions of middle aged workers is rising aggregate saving per worker (S/L) rises. There is also econometric evidence for this effect (for example, Kelley and Schmidt, 1996; Higgins and Williamson, 1997).

The resulting wealth accumulation, or wealth deepening, manifests in some combination of higher per worker levels of the domestic capital stock (K/L) and higher net foreign assets (F/L). These higher levels of wealth generate additional income which supports higher living standards later on when the proportion of middle-aged workers begins to fall, the point at which most OECD countries find themselves now. The result is higher living standards in the long run than would have been possible without consumption smoothing. Mason and Lee (2004) describe this as the 'second demographic dividend'. Here it is described as a saving or wealth deepening dividend and is measured for all OECD countries in a stylised way in the calculations below.

In addition, for any desired W-L ratio a fall in employment growth implies lower accumulation of domestic and foreign assets for wealth widening purposes which frees up resources for consumption. In terms of (5), n is lower which allows higher C/N for a given (W/L). This is an open economy version of the Solow dividend (Elmendorf and Sheiner, 1999) and is also calculated below.

The effect of demographic change on C/N can be mitigated through the gains from international trade in capital. The fact that countries are aging at different rates means that they face different aging-induced changes in saving and investment flows at any given time. This gives rise to opportunities for international trade in capital with attendant gains to both borrowing and lending countries. In particular, the interest rates facing lending countries will be higher than they would be in the absence of trade and, conversely, interest rates facing borrowing countries will be lower then they would be in the absence of trade.

Hence for lending countries, the gains from trade in capital are the extra returns to domestic savers from higher interest rates over and above the higher cost to domestic borrowers. For countries borrowing capital, the gains from trade are the benefits to domestic borrowers from lower interest rates over and above the losses to domestic lenders. For a discussion of these and other open economy effects of demographic change see, for example, Bryant (2004), Bosworth et al (2004) and Richardson (1997). There is no attempt here to calculate these potential gains.

7. CALCULATIONS OF THE EFFECTS OF POPULATION AGING ON LIVING STANDARDS

Attention here is restricted to calculations of demographically-induced changes in the following: the working age population, LFPRs, aggregate labour productivity via age-specific productivity weights and the age composition of the workforce, and consumption possibilities via the open economy Solow effect and wealth deepening.

Table 1 of Appendix B reports measures of employment to population ratios ranging from the crudest measure, being the working age population ratio, through to the support ratio given in (7) above which allows for both age-specific LFPRs and age-specific productivity weights. The population data is from the United Nations, World Population Prospects, 2004 Revision. The LFPR data is from the OECD Labour Market Statistics[5] by sex and age. In columns 2 to 4 the LFPRs are held constant at their 2004 levels. Columns 3 and 4 apply two alternative age-specific productivity weights, viz. those in Miles (1999) and Skirbeck (2004), both of which are plotted in Figure 10. Column 3 is taken as the base case for comparison with the later retirement case and also for calculating the effect of various potential dividends discussed above. All of the dividend calculations use the Miles (1999) productivity weights.

7.1 LATER RETIREMENT SCENARIO

Column (5) in Tables 1 and 2 of Appendix B captures the effect of later retirement by assuming that the LFPRs of workers for each of the age groups over 55 have increased by 2050 to equal the LFPRs in 2004 for the immediately older age group in 2004. For example the LFPRs of 55-59 year olds (male and female) in 2050 are set equal to the LFPRs of 50-54 year olds that applied in 2004. This is a way of allowing for the effect of forces discussed above that will tend to increase LFPRs of older workers between now and 2050.

Table 2 reports the percentage changes in each of the five measures of employment to population ratios. In the base case the L/N ratio declines for Australia by 12 percent and by 15 percent on average over the sample of nine OECD countries. These declines would amount to the demographically-induced decline in living standards, in the absence of any other effects. A decline in living standards of 15 percent between 2006 and 2050 amounts to an annual reduction of 0.17 percent from an assumed annual growth of 1.75 percent in the absence of demographic change – that is, a reduction from 1.75 percent to 1.58 percent.[6]

This is argued here to be the worst case scenario because it assumes that all of the policies and other forces to increase LFPRs of older workers fail, and that all of the

5 Available at http://www1.oecd.org/scripts/cde/DoQuery.asp

6 The formula used for this calculation is: $g^{*}=\left[(1+g)^{44}-x\right]^{1/44}-1$, where g=0.0175, x=0.155, g* is the growth of labour productivity after the effect of demographic change, and 44=2050-2006. A rate of growth of 1.75 percent in the absence of demographic change was used by the Productivity Commission (2005) for Australia and is close to the 1.6 percent adopted by Martins et al (2005).

potential dividends discussed above are zero. These numbers are very similar to those found in other studies such as Productivity Commission (2005) for Australia and Martins et al (2005) for a sample of OECD countries.

Next we allow for the three potential consumption dividends discussed above. They are reported in Table 3 of Appendix B .

7.2 OPEN ECONOMY SOLOW DIVIDEND

The "Solow" dividend refers to the idea, most clearly seen from the Solow growth model, that a more slowly growing labour force implies (proportionally) fewer new workers and therefore that less additional capital in order to equip the new workers with the same capital as the existing workers in order to maintain a given capital-labour ratio. This frees up resources that are available to produce consumption goods – hence the consumption dividend. In an open economy setting, it is the stock of wealth rather than capital that generates income. Therefore the open economy analogy to the Solow dividend is the idea that a more slowly growing labour force requires proportionally fewer new assets (consisting of capital plus overseas assets) to maintain a given wealth to labour ratio.

From (5), C/N is higher for a given W/L ratio the lower is the employment growth rate, n, in 2050 relative to that in 2006. The proportional increase in C/N is the open economy Solow dividend, given by (see Appendix A for derivation)[7]

$$Solow\ dividend \approx -\left(\frac{W}{C}\right)_{2006} \Delta n \qquad (8)$$

Equation (8) gives the proportional increase in consumption per capita arising from the reduction in the accumulation of wealth in 2050 compared with 2006, required to maintain the 2006 W-L ratio, as a result of a reduction in employment growth, n.

The W-C ratio was calculated as W/Y.Y/C, where W/Y=K/Y+F/Y. The values for K/Y for 2006 were assumed to be the values for 2001 given in Kamps (2004)[8] and values for F/Y were those for 2004 in Lane and Milesi-Feretti (2006). Values for Y/C were obtained from the OECD statistical database on line,[9] using the 2005 values which were the latest available.

As reported in Table 3, the magnitude of this dividend for Australia is 2.3 percent per annum by the year 2050 compared with the average of 1.8 percent for the nine economies. As a check, the value for the United States of 1.5 percent is close to the value calculated in Cutler et al (1990) of 1.7 percent for the period 2000 to 2050, assuming a closed economy. No comparison is available with Martins et al (2005) because they are only interested in effects of demographic change on output per capita and hence do not report a Solow effect.

7.3 SAVING DIVIDEND

The saving or wealth deepening dividend is the result of a changing proportion of high savers in the workforce. This could be measured by simulating a full overlap-

7 The approximation sign is used in the formulas for the various dividends because we have ignored second order terms in the derivations.

8 Values of K/Y for a few smaller OECD countries were not available in this publication. These countries were assumed to have the average value of K/Y for the other OECD countries.

9 Available at <http://www.oecd.org/topicstatsportal>.

ping generations CGE model, as do Mason and Lee (2004) for Taiwan for example. Here however we adopt a rather more modest stylised model that captures the main feature of the OLG model which is the age composition effect.

First we specify a stylised lifecycle wealth pattern[10] for a representative worker in all countries (Figure 10). This path is characterised by a rapid accumulation of wealth in the worker's 40s and 50s, peaking at age 65 after which it is run down but not to zero. We then calculate aggregate wealth to labour (W/L) as a weighted average of age-specific wealth, with the labour force shares as weights. This is calibrated for each country so that it equals actual W/L in 2006 by shifting the life cycle wealth pattern upward or downward by a fixed proportion for all age groups. Actual W/L in 2006 is calculated as W/L=W/Y.Y/L, where W/Y is calculated as described in the previous section. Y/L is derived by assuming a Cobb-Douglas constant returns to scale production function yielding:

$$\frac{Y}{L} = \left(\frac{K}{Y}\right)^{\alpha/1-\alpha} \qquad (9)$$

where labour is measured in efficiency units in order to net out the effect of technical progress on the W-L ratio.[11] Aggregate W/L for 2050 is similarly calculated as a weighted average using the labour force shares in 2050 as the weights. Hence we have values for $(W/L)_{2006}$ and $(W/L)_{2050.}$

The saving dividend is then calculated from equation (4), as the change in C/N with respect to a change in the long run W/L ratio from 2006 to 2050 (see Appendix A for derivation):

$$Saving\ dividend\ ; \left(\frac{L}{C}\right)(r-n)\Delta\left(\frac{W}{L}\right) \qquad (10)$$

Column 2 in Table 3 indicates that the saving dividend is 0.7 percent per annum for Australia and 0.8 percent per annum on average for the nine economies. These outcomes are broadly consistent with the simulation results in Martins et al (2005) for their sample of four large OECD countries using a closed economy OLG model.

7.4 IMPERFECT LABOUR SUBSTITUTABILITY DIVIDEND

Here we apply the idea, discussed in Section 7, that imperfect substitutability of workers by age implies that a change in the age distribution of workers can change average labour productivity. We can think of this as a change in the effective labour force, , through changes in the productivity parameter, A. It is a separate effect from the impact of the age-specific productivity weights, α_i, in (8).

The method for calculating this effect follows Guest (2005) and is described in more detail in Appendix B. Essentially, an index of effective labour is specified as a CRESH index of the number of workers in each age group, where the parameters in the CRESH function are chosen so that the elasticity of substitution between workers of different ages is less than perfect. The parameters are assumed to be the same for all countries. There are two simulations: one where the elasticity's of substitution between workers of different ages are relatively high (between 2 and 4) and another where the elasticity's are low (between 0.4 and 0.8). The high elasticity case is more realistic and is closer to the standard modelling assumption of per-

[10] The stylized life cycle wealth pattern was plotted using a Poisson distribution.

[11] Given $Y = AK^{\alpha}L^{1-\alpha}$, labour in efficiency units is equal to $A^{1/1-\alpha}L$.

fect substitutability. Hence we use this case in calculating the 'best case' scenario. The low elasticity case is reported as a theoretical possibility and is interesting if only because it shows the large gains that could occur if the elasticity were low enough. The low elasticity case also indicates that the results are quite sensitive to the size of the elasticity.

As Table 3 indicates, the size of this dividend (for the high elasticity case) is 0.9 percent for Australia and 0.7 percent on average for the nine countries. Note that in three countries the 'dividend' is in fact a small negative number illustrating that this dividend need not be universally positive. The positive sign of the dividend on average indicates that population aging is moving most countries a little closer to their optimum age workforce age distributions, at least according to the CRESH index. The apparent sensitivity of the size of this dividend to the value of the elasticity suggests scope for further investigation of this potential phenomenon including the need to obtain reliable econometric estimates of the elasticises.

8. CONCLUSION AND POLICY IMPLICATIONS

Population aging will accelerate over the next few decades in Australia, although not as quickly as in other economies in Europe and the Asia-Pacific. However, the calculations presented in this paper support the general view in the academic literature that the impact of future population aging on national prosperity will be slight to modest. For Australia, the worst that can be expected on the basis of these calculations is a slowing in the rate of growth of living standards in the order of 0.13 percent per annum and the best case is a slowdown of 0.015 percent. To put that in perspective, with no demographic change living standards could be expected to grow at the rate of growth of labour productivity on average, which the PC expects to be 1.75 percent per annum. The worst case would cut 0.13 percent from that, giving a growth rate of living standards of 1.62 percent. Such effects would be greater were Australia aging at a rate comparable to other economies in the region.

This is not to deny that population aging poses challenges and will have important macroeconomic effects. There will be fiscal effects, changes in international capital flows, and changes in relative prices of labour and capital. However, these amount mainly to income transfers from some groups in society to others rather than significant effects on national living standards. It is true that fiscal effects – in particular, the effects on pensions and health care costs – imply a loss of consumption possibilities, mainly through the disincentive effects of tax rates on work effort. But evidence presented elsewhere suggests that these deadweight losses will be small to modest (Cutler et al, 1990; Davis and Fabling, 2002) and are swamped by the other effects considered in this paper.

In supporting their conclusion that population aging does not constitute a crisis for Australia, they argue that:

- an aging population is predominantly a reflection of beneficial trends – improved life expectancy and voluntary reductions in fertility

- the aging of the population is a gradual phenomenon and its economic and fiscal impacts will also gradually build up over time.

- unfunded pension liabilities, while significant, will not exert as much pressure on government budgets as they will in many other OECD countries.

- health care expenditure, though increasing, will promote community wellbeing and may reduce the need for other age-related outlays, such as residential nursing home care.

- Australia will be richer country when these impacts are felt, having a greater capacity to absorb the additional costs of its aging population. Average per capita incomes in 2044-45 will be almost twice as large as they are today.

- people contribute more to society than just through their marketplace labour. Older Australians play a significant role as volunteers, carers and community members. By 2044-45, the value of volunteering is expected to rise from 1.8 to 2.1 percent of GDP.

Nevertheless there is scope for policies that can mitigate whatever effects population aging has on living standards and the fiscal balance and therefore provide a degree of insurance against the worst case scenario. Some of these are outlined below.

8.1 POPULATION POLICIES

(a)Fertility Rates

The Productivity Commission argues that fertility rates are not very sensitive to policy and it is difficult to devise measures that do not provide substantial and tax-inefficient transfers to people who were going to have children anyway. In its view, any reversal of declining fertility would initially increase the aggregate dependency rate, with adverse implications for per capita labour supply growth, economic growth and accumulated fiscal gaps in the initial decades.

Nonetheless, there has been a significant rise in the Australian birth rate since the introduction by the Australian Government of a maternity payment (the 'baby bonus') of $3000 in July 2004 (raised to $4000 in July 2006). In the first full quarter in which the payment might have had an effect (the second quarter of 2005), the number of births was 10 percent higher than in the same quarter of 2004. Most of the additional births were to women in their mid to late 30s, many of whom already had at least one child.

(b)Migration

In the absence of net migration, Australia's population would age more rapidly. Yet, the relevant policy question is whether increases in migration above present levels would significantly affect population aging. While much larger migrant inflows would counter aging, it would be at the cost of unsustainably large population growth. For instance, to delay any increase in the aged dependency ratio over the next 40 years would require a net migrant inflow to population ratio of 3.1 percent – more than five times the present ratio. According to the PC this would result in an Australian population of around 85 million by 2044-45.

Hence, immigration policy cannot realistically be recast to substantially moderate Australia's demographic transition to an older population. But a focus on skilled migration could usefully contribute to reducing the fiscal impacts of aging. The problem is that other aging countries are also actively competing for skilled migrants.

8.2 PARTICIPATION RATES

While population policies may have limited potential, there is considerable scope to lift Australia's aggregate labour force participation rate, thereby raising Australia's future labour supply growth rates. Policies that discourage premature retirement and overcome obstacles to work could be effective in stimulating Australia's labour force participation rates. According to the PC they could also generate significant savings in social welfare payments, such as reduced outlays on disability support pensions.

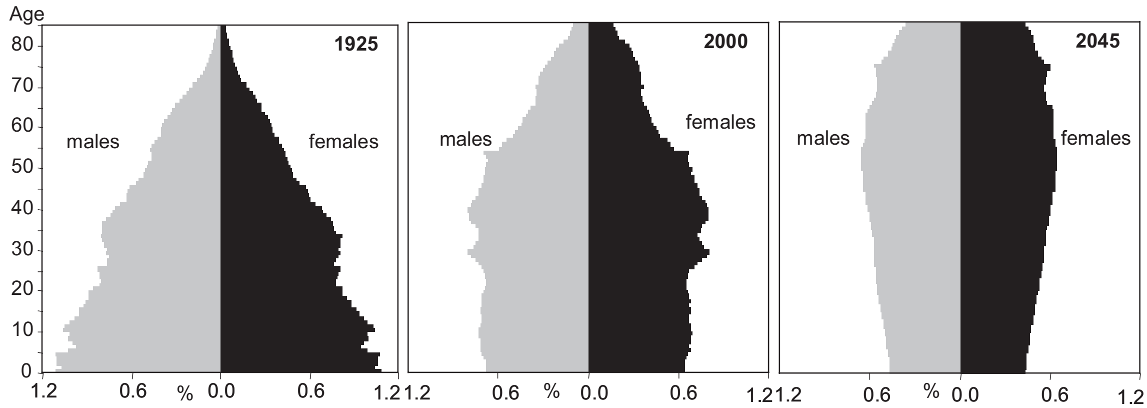
8.3 PRODUCTIVITY PERFORMANCE

The economy's capacity to cover the costs of aging over the longer term critically depends on productivity growth. Considerable scope for improving productivity performance remains through policy reforms that heighten efficiency. According to the PC Australia's productivity performance could be further improved through policies affecting economic and social infrastructure, taxation, labour markets, natural resource management, innovation policy and the regulatory environment.

Productivity gains would provide fiscal relief associated with a slower take up of the age pension as some people exceed asset and income eligibility thresholds in a higher income economy. Fiscal pressures could also be alleviated through higher productivity-induced household incomes and increased average tax revenues.

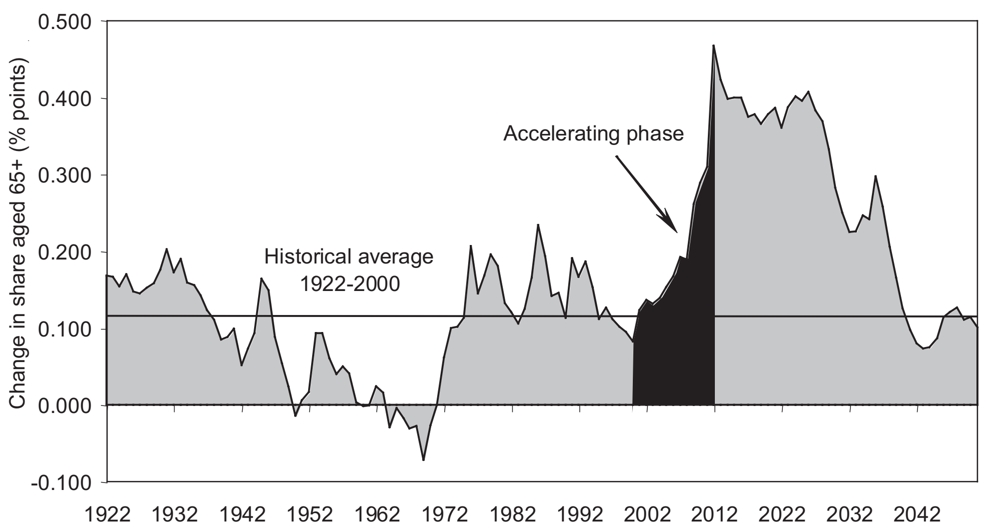
A more efficient health system could also play a direct role in reducing the costs associated with the demographic transition. There is considerable scope for such gains, including through better co-ordination across services and jurisdictions, a more flexible health care labour market, and better preventative health care.

Figure 1. Changing age structure of the Australian population, 1925-2045



Source: Productivity Commission (2005)

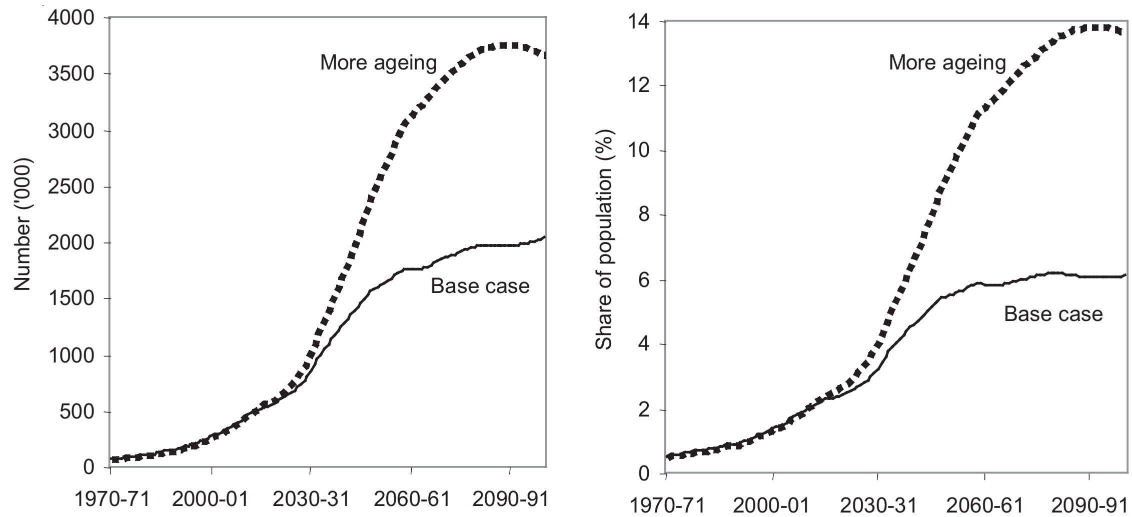
Figure 2. Annual change in the share of people aged 65+ in the population: 1922-2051



Source: Productivity Commission (2005)

Figure 3. Number and share of people aged 85 or more

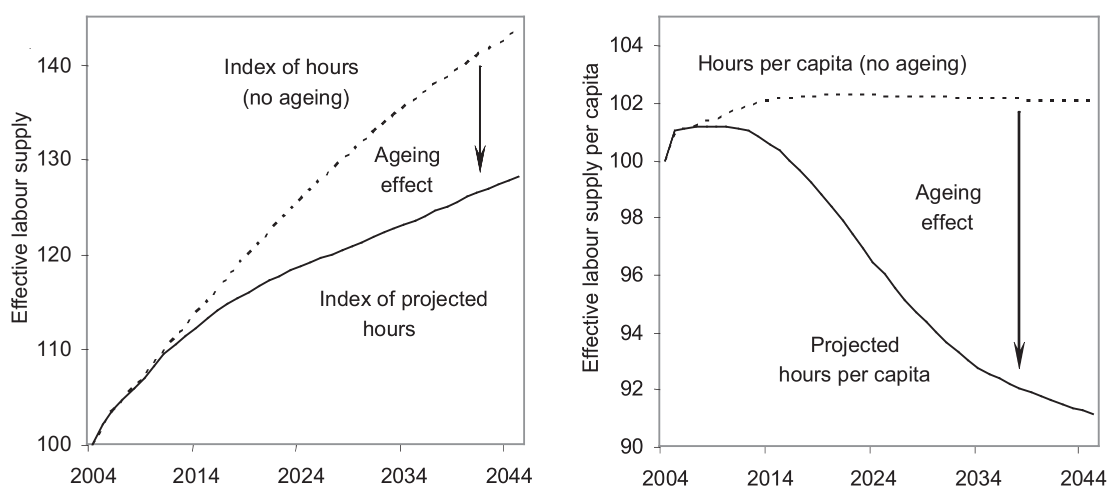
1970-71 to 2100-01



Source: Productivity Commission (2005)

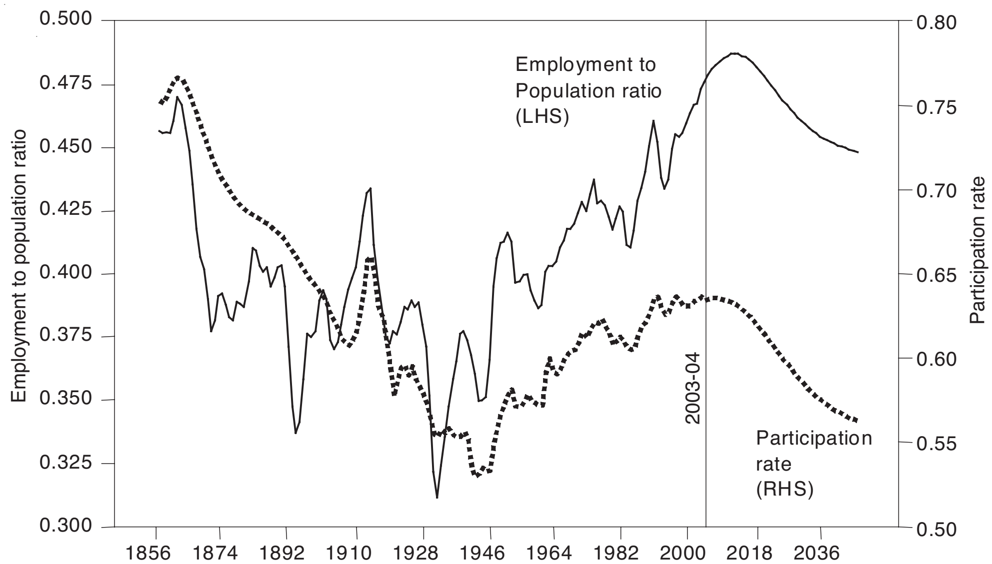
Figure 4. Aging and effective labour supply

Australia 2003-04 to 2044-45



Source: Productivity Commission (2005)

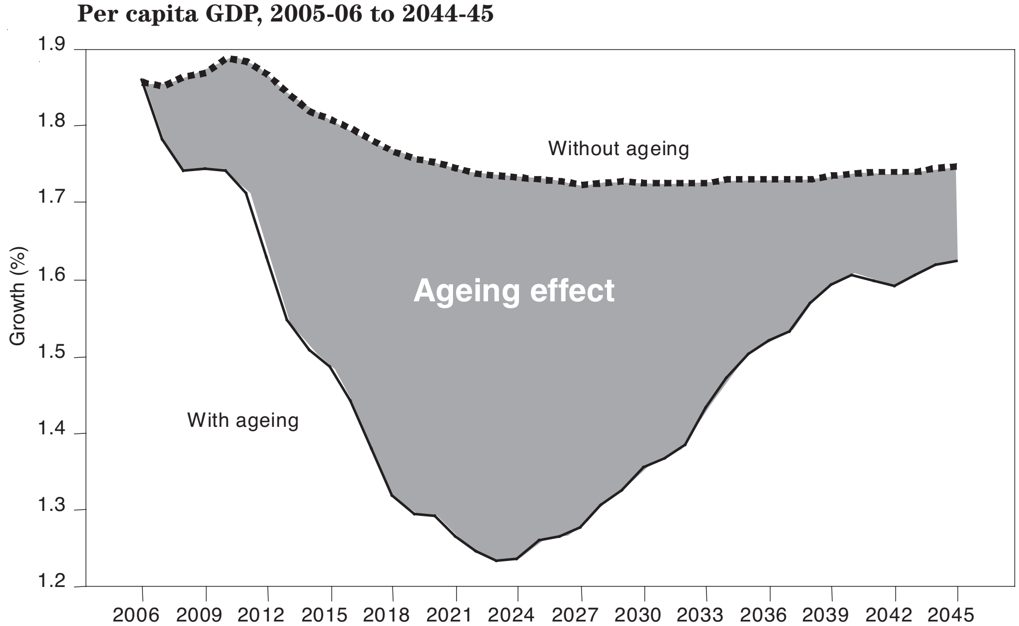
Figure 5. Taking a long view: 200 years of Australian labour supply



Source: Productivity Commission (2005)

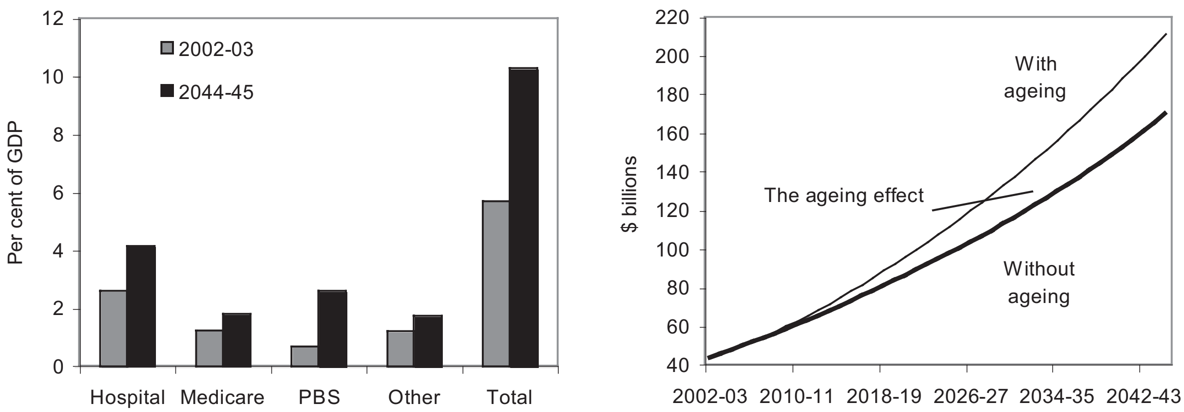
Figure 6. Economic growth in Australia — a 40 year projection

Per capita GDP, 2005-06 to 2044-45



Source: Productivity Commission (2005)

Figure 7. Projected government health expenditure



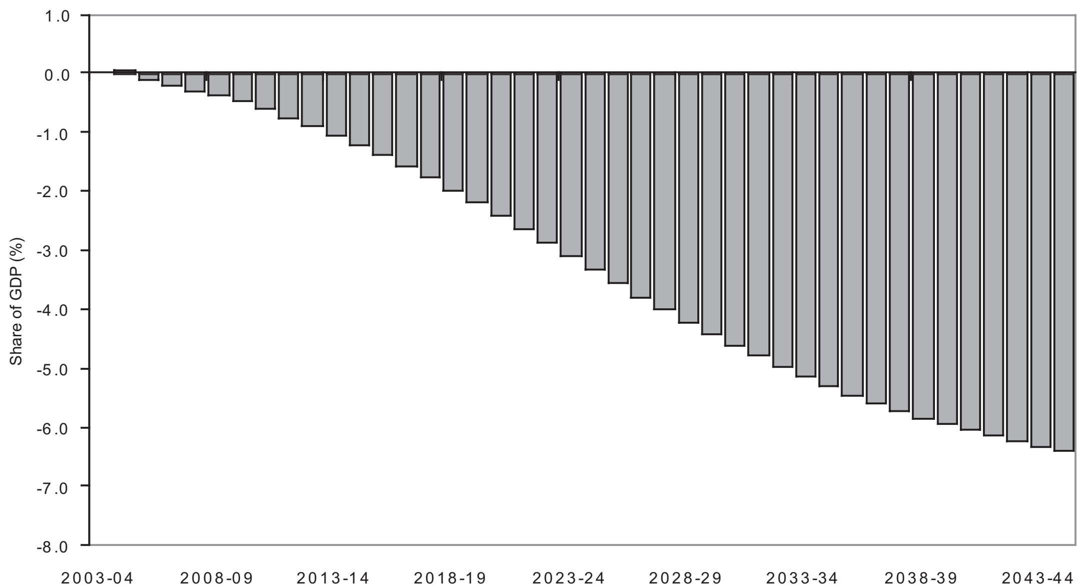
Source: Productivity Commission (2005)

Table 1. Age-related government spending to GDP ratios

All Government summary	*2003-04*	*2044-45*	*Difference*
	%	%	Percentage points
Health care	5.7	10.3	4.5
Aged care & carers	1.1	2.4	1.4
Age pensions	2.9	4.6	1.7
Other social safety net	3.8	3.1	-0.6
Education	5.2	4.7	-0.5
Total	**18.7**	**25.2**	**6.5**

Source: Productivity Commission (2005)

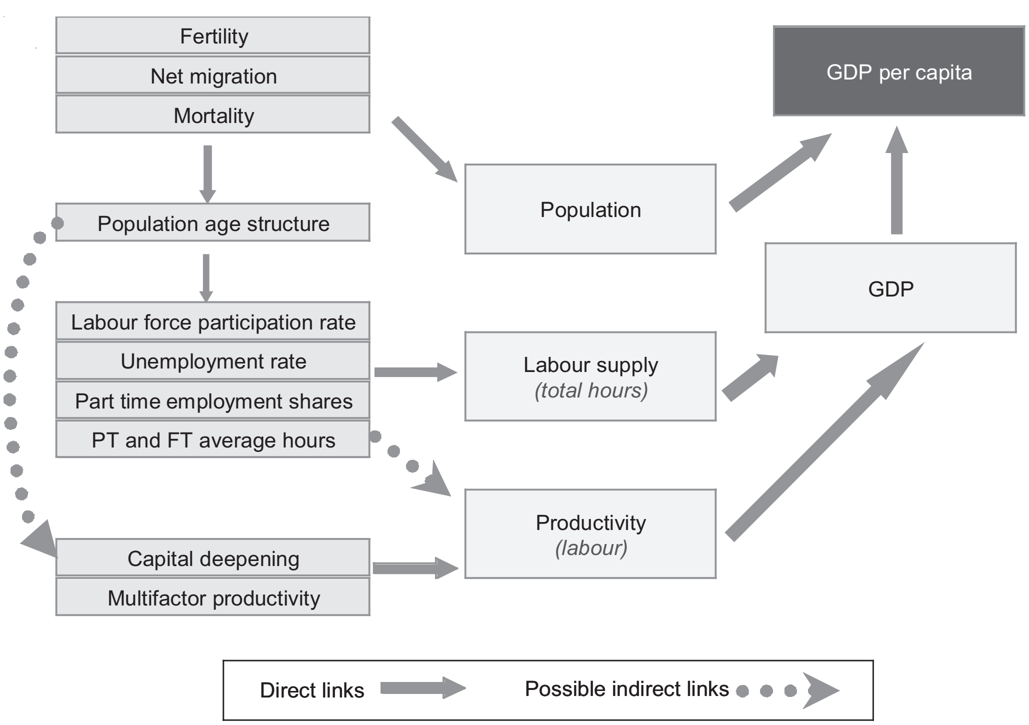
Figure 8. Net fiscal position to GDP relative to 2003-04



Source: Productivity Commission (2005)

Figure 9. The '3 Ps' of economic growth

Population, participation and productivity



Source: Productivity Commission (2005)

APPENDIX A

This Appendix derives a decomposition of demographic change on living standards based on (5), which is reproduced here:

$$\frac{C}{N}=\frac{L}{N}\left(\frac{Y}{L}+\left(r-n\right)\frac{F}{L}-n\frac{K}{L}-\Delta\frac{W}{L}\right) \qquad \text{(A1)}$$

Let c=C/N, a (assets)=W/L and γ=L/N. Then (A1) can be written (as in Elmendorf and Sheiner, 2000, p.8 where assume a steady state in which $\Delta a = 0$):

$$c=\gamma\left(y(k)-nk+\left(r-n\right)f-\Delta a\right) \qquad \text{(A2)}$$

where lower case letters y,k and f denote, respectively, Y, K and F per worker in efficiency units. Totally differentiating (A2) and ignoring second order terms[12] gives:

$$dc \approx d\gamma\left(\frac{c}{\gamma}\right)-\gamma\left(dn(k+f)-dr(k+f)-\left[y'\left(k\right)-n\right]dk-\left(r-n\right)df\right) \qquad \text{(A3)}$$

Dividing through by c and noting a=k+f:

$$\frac{dc}{c}\approx\frac{d\gamma}{\gamma}-\frac{\gamma}{c}\left(\left[y'\left(k\right)-n\right]dk-\left[r-n\right]df-a.dr+a.dn\right) \qquad \text{(A4)}$$

Equation (A4) indicates several effects of population aging. The dependency effect is $\frac{d\gamma}{\gamma}$; the open economy Solow effect is $-\left(\frac{\gamma}{c}\right)a.dn$; and the saving (wealth deepening) effect is $-\frac{\gamma}{c}\left(\left[y'\left(k\right)-n\right]dk-\left[r-n\right]df-a.dr\right)$.

In the calculations reported in the text, we assume for simplicity that the interest rate, and therefore the capital-labour ratio, are constant in a steady state, in which case the saving effect becomes $\frac{\gamma}{c}\left(\left[r-n\right]df\right)$. Cutler et al (1990, p 17) also adopt this assumption in their closed economy version of (A4), where the wealth-labour ratio is replaced by a constant steady state capital-labour ratio. In their model, however, there are no foreign assets by dint of the closed economy assumption and therefore df=0 and the saving effect is zero.

The remaining dividend reported in the text is what we have called the imperfect substitutability dividend. It increases labour in efficiency units by increasing total factor productivity, A. In other words it is a source of technical progress. This is not directly captured in (A4) because y, k, and f are measured in units of efficiency labour. This is discussed further in Appendix B.

[12] Hence the approximation sign is used in (A3).

APPENDIX B

This Appendix provides technical detail on the calculation of the dividend through imperfect substitutability of labour among different age groups. Further detail is given in Guest (2005).

Effective labour is assumed to be a CRESH function of labour inputs in natural units:

$$\sum_{i=1}^{k} \alpha_i \left[\frac{L_i}{f(L^*)} \right]^{\rho_i} = 1 \qquad \text{(B1)}$$

where α_i is the productivity weight of labour of age i,k is the number of age groups, L_i is the number of workers of age i, L* effective labour, and ρ_i is a parameter that represents the flexibility, or versatility, of L_i, meaning the degree to which L_i can substitute for any other input, L_j. We assume here that all labour inputs are substitutes to some degree, which restricts ρ_i such that $-\infty<\rho_i<1$. The larger the absolute value of ρ_i, the more easily L_i is substitutable for any other labour input with a given value of ρ_j. This implies that two labour inputs with high absolute values of ρ_i will be good substitutes and two inputs with low absolute values of ρ_i will be poor substitutes.

Note that if ρ in (B1) is equal to 1, we have the additive function for which the elasticity of substitution is infinite:

$$L^* = \sum_{i=1}^{k} \alpha_i L_i \qquad \text{(B2)}$$

The elasticity of substitution[13] (ES) between L_i and L_j, which we will define as σ_{ij}, is given by Hanock (1971, p 699):

$$\sigma_{ij} = \frac{a_i a_j}{\sum_{m=1}^{k} s_m a_m} \qquad \text{(B3)}$$

where $a_i = \frac{1}{1-\rho_i}$ and s_m is the factor share of L_i.

Restrictions exist on the range of values of the σ_{ij} that yield a unique solution for the CRESH function (Hanoch, 1971). The binding restriction in the present application is that $\alpha_i\rho_i$ must be of the same sign for all i, assuming that all $a_i>0$, which implies that all labour inputs are substitutes to some degree. Given all $\alpha_i>0$ by definition, we must have, for all i, either $0<\rho_i<1$ ($a_i>1$) or $\rho_i<0$ ($0<a_i<1$).

In applying the CRESH function we assume that the degree of flexibility of workers varies with their age. In particular, we assume that middle age workers are more flexible than either young workers or older workers. The degree of flexibility is a hump shape function of age, rising to middle age then falling to old age. The intuition for this is that middle age workers, defined here as workers in the 35 to 54 age group, will be more substitutable for young workers than will older workers; and will also be more substitutable for older workers than will younger workers.

[13] ES refers here to the Allen-Uzawa pairwise elasticity of substitution, which is the n-factor analogue of the two-factor Hicks ES of substitution.

The particular values for a_i are:

i	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74
a_i	1.0	1.5	2.0	2.0	3.0	3.0	3.0	3.0	2.0	1.5	1.0	1.0

Table 1. Employment to population ratios

	(1) Working age pop share[1]		(2) LFPR[5] age 15-74[2]		(3) base case Weighted LFPR age 15-74[3]		(4) Weighted LFPR age 15-74[4]		(5) Weighted LFPR (later ret.)[6] age 15-74[3]
	2006	**2050**	**2006**	**2050**	**2006**	**2050**	**2006**	**2050**	**2050**
Australia	0.746	0.707	0.477	0.421	0.519	0.456	0.522	0.455	0.492
Canada	0.765	0.697	0.510	0.428	0.559	0.462	0.560	0.460	0.500
France	0.734	0.682	0.407	0.349	0.458	0.392	0.459	0.392	0.433
Germany	0.777	0.679	0.446	0.367	0.497	0.404	0.499	0.404	0.448
Ireland	0.751	0.715	0.463	0.394	0.510	0.431	0.523	0.429	0.464
Italy	0.765	0.642	0.384	0.287	0.433	0.320	0.439	0.319	0.354
Japan	0.768	0.640	0.484	0.382	0.522	0.406	0.516	0.400	0.434
New Z.	0.731	0.704	0.495	0.454	0.538	0.490	0.535	0.483	0.525
Sweden	0.741	0.693	0.477	0.434	0.524	0.474	0.517	0.468	0.509
United K.	0.746	0.705	0.485	0.441	0.528	0.476	0.529	0.475	0.512
United S.	0.733	0.717	0.475	0.448	0.516	0.482	0.517	0.481	0.508
average	*0.751*	*0.689*	*0.464*	*0.400*	*0.509*	*0.436*	*0.511*	*0.433*	*0.471*

Notes:

1. $\frac{\sum_{i=15-19}^{70-74} N_i}{\sum_{i=0-4}^{100+} N_i}$ 2. $\frac{\sum_{i=15-19}^{70-74} LFPR_i N_i}{\sum_{i=0-4}^{100+} N_i}$ 3. $\frac{\sum_{i=15-19}^{70-74} \alpha_{1,i} LFPR_i N_i}{\sum_{i=0-4}^{100+} N_i}$ 4. $\frac{\sum_{i=15-19}^{70-74} \alpha_{2,i} LFPR_i N_i}{\sum_{i=0-4}^{100+} N_i}$

$\alpha_{1,i}$ and $\alpha_{2,i}$ are the productivity weights in, respectively, Miles (1999) and Skirbeck (2004)

$LFPR_i$ are the labour force participation rates in OECD Labour Market Statistics
available at http://www1.oecd.org/scripts/cde/DoQuery.asp

N_i are the population projections for age i from United Nations, World Population Prospects:
The 2004 Revision, available at http://esa.un.org/unpp/

5. All LFPRs are assumed to be constant at their 2004 levels
6. "Later retirement" means that the LFPRs for age groups from 55-60 and above are increased over the period 2004 to 2050 to equal those for the next lowest age group that were observed at 2004. See text for further discussion.

Table 2. Percentage change in labour force ratios, 2006 to 2050

	(1) Working age pop share[1] %	(2) LFPR[5] age 15-74[2] %	(3) base case Weighted LFPR age 15-74[3] %	(4) Weighted LFPR age 15-74[4] %	(5) Weighted LFPR (later ret.)[6] age 15-74[3] %
Australia	-5.20	-11.63	-12.12	-12.75	-5.23
Canada	-8.84	-16.18	-17.23	-17.75	-10.58
France	-7.10	-14.21	-14.45	-14.54	-5.48
Germany	-12.59	-17.58	-18.64	-19.01	-9.81
Ireland	-4.84	-15.04	-15.49	-17.96	-9.00
Italy	-16.04	-25.27	-26.12	-27.34	-18.31
Japan	-16.70	-21.13	-22.22	-22.61	-16.82
New Z.	-3.65	-8.21	-8.85	-9.79	-2.30
Sweden	-6.39	-9.03	-9.49	-9.48	-2.76
United K.	-5.50	-9.13	-9.85	-10.08	-3.04
United S.	-2.25	-5.77	-6.65	-6.89	-1.61
average	*-8.10*	*-13.93*	*-14.65*	*-15.29*	*-7.72*

Notes:

1. $\dfrac{\sum_{i=15-19}^{70-74} N_i}{\sum_{i=0-4}^{100+} N_i}$ 2. $\dfrac{\sum_{i=15-19}^{70-74} LFPR_i N_i}{\sum_{i=0-4}^{100+} N_i}$ 3. $\dfrac{\sum_{i=15-19}^{70-74} \alpha_{1,i} LFPR_i N_i}{\sum_{i=0-4}^{100+} N_i}$ 4. $\dfrac{\sum_{i=15-19}^{70-74} \alpha_{2,i} LFPR_i N_i}{\sum_{i=0-4}^{100+} N_i}$

where $\alpha_{1,i}$ and $\alpha_{2,i}$ are the productivity weights in, respectively, Miles (1999) and Skirbeck (2004)

5. All LFPRs are assumed to be constant at their 2004 levels

6. "Later retirement" means that the LFPRs for age groups from 55-60 and above are increased over the period 2004 to 2050 to equal those for the next lowest age group that were observed at 2004. See text for further discussion.

Table 3. Effect of potential dividends from population aging,2006 to 2050

	Solow dividend[1]	Saving[2]	Imperfect subst. of L[3]		Net effect of ageing on C/N		Equivalent effect on annual growth[6]	
			High	Low	Worst case[4]	Best case[5]	Worst case	Best case
	%	%	%	%	%	%	%	%
Australia	2.27	0.66	0.90	46.23	-12.12	-1.40	-0.134	-0.015
Canada	2.19	0.89	0.62	45.86	-17.23	-6.88	-0.193	-0.075
France	0.46	0.76	0.78	35.77	-14.45	-3.48	-0.161	-0.038
Germany	1.56	0.62	-0.16	22.57	-18.64	-7.79	-0.210	-0.086
Ireland	4.15	1.57	3.05	53.47	-15.49	-0.23	-0.173	-0.002
Italy	1.51	1.11	1.46	39.17	-26.12	-14.23	-0.300	-0.159
Japan	1.46	1.12	0.53	16.83	-22.22	-13.71	-0.253	-0.153
New Z.	2.93	0.71	0.52	32.23	-8.85	1.85	-0.097	0.020
Sweden	0.38	0.30	-0.16	17.27	-9.49	-2.23	-0.105	-0.024
United K.	0.90	0.40	-0.03	19.92	-9.85	-1.76	-0.109	-0.019
United S.	1.53	0.54	0.53	24.43	-6.65	0.99	-0.073	0.011
average	*1.76*	*0.79*	*0.73*	*32.16*	*-14.65*	*-4.44*	*-0.16*	*-0.05*

Notes:

1. The open economy Solow dividend applies for a given W/L ratio
2. The saving dividend is due to wealth deepening. It assumes a particular age-wealth profile for each country.
3. Imperfect substitutability of workers by age implies that a shift in the age composition of the labour force can affect labour productivity. Two cases are reported: (i) high and (ii) low elasticity of substitution. The high elasticity case is more realistic. It is closer to the standard assumption of perfect substitutability and is incorporated into the "best case scenario". The low elasticity case is included here only as a theoretical possibility.
4. The worst case assumes zero potential dividends and that all LFPRs remain at their 2004 levels (with Miles (1999) productivity weights). Hence this column is the same as column 3 in Table 2.
5. The best case takes the potential dividends as reported in this table and adopts the higher LFPRs in the later retirement scenario. The best case scenario is based on the high elasticity version of the dividend from imperfect elasticity of substitution of workers by age.
6. The reduction in the annual growth of wealth per capita from an assumed rate of 1.75 percent in the absence of demographic change.

Figure1. Alternative age-specific productivity weights

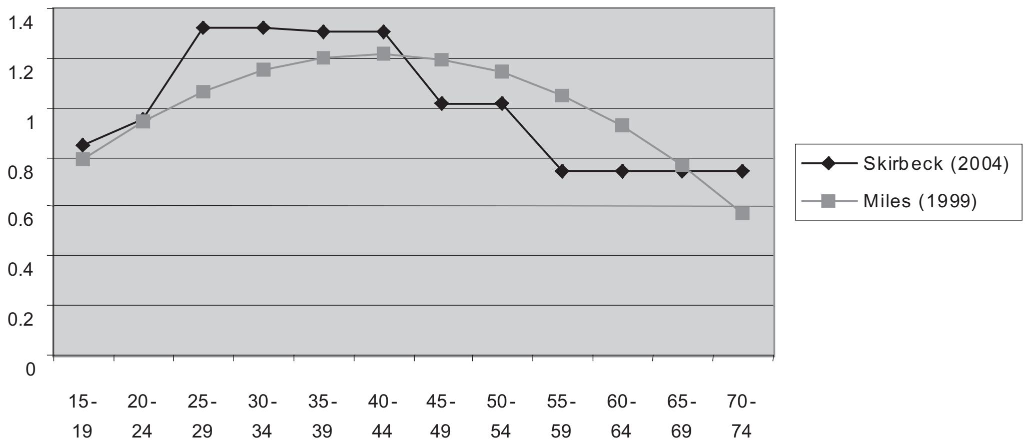
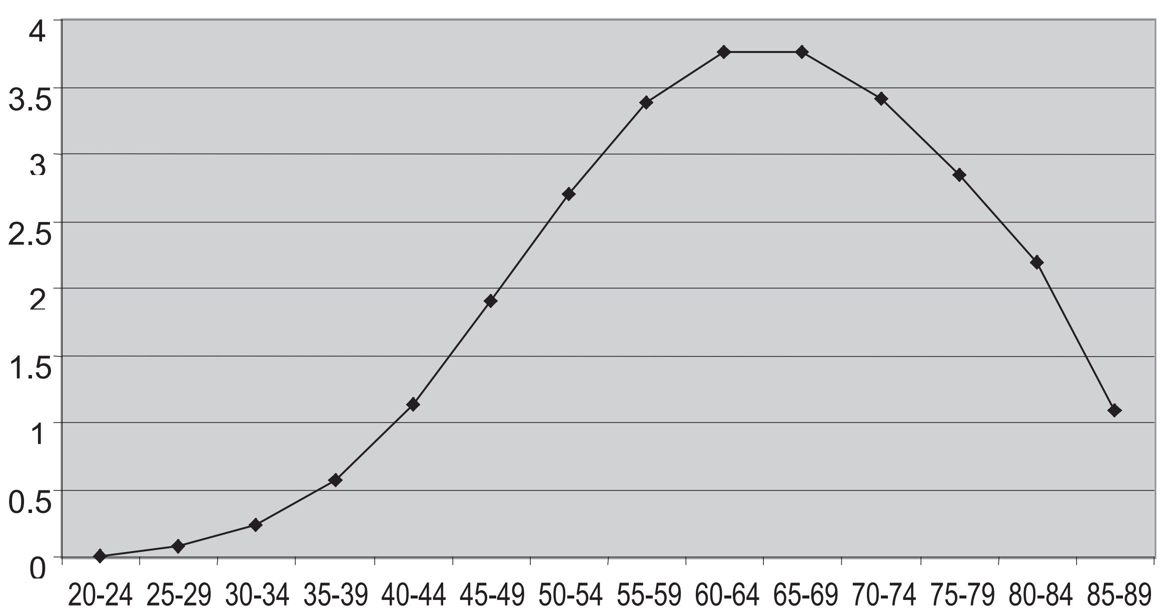


Figure2. Stylised lifecycle wealth



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