THE ECONOMIC RECORD, VOL. 76, NO. 233, JUNE 2000, 139–51

Lifetime Net Average Tax Rates in Australia Since Federation—A Generational Accounting Study

JOHN ABLETT and ZAID TSEGGAI-BOCUREZION*
University of Western Sydney,
Macarthur, NSW 2560

This paper presents estimates of average net payments to government, as a per cent of average lifetime labour earnings, for generations born in Australia since Federation (1901), based on historical data combined with several reasonable future scenarios covering fiscal policy, growth and demographic change. The results shed light on whether certain generations have been treated more favourably by the public sector than others this century. The main conclusion is that the average lifetime net tax rate will, under reasonable assumptions, be of the order of 37-39 per cent for all currently living generations born since the mid-1930s.

I Introduction

In recent times there has been considerable interest in gauging how government policies may affect the intergenerational distribution of resources, in particular between currently living and future generations. Currently, the most commonly used methodology for examining this issue is generational accounting, which was originally devised by Auerbach *et al.* (1991).[1] This methodology is usually applied in a forward-looking sense, in that the past taxation and social security benefit histories of generations (distinguished by year of birth) alive in the base year are ignored.[2] However, it can also be applied in a retrospective way for those born before the base year to give estimates or projections of average lifetime net taxes for these generations, i.e. lifetime taxes paid less social security benefits expressed as a present value in the year of birth. Division of average lifetime net taxes by a corresponding estimate/projection of the average present value of lifetime income yields estimated average lifetime net tax rates.

This paper provides estimates of average lifetime net taxes and net tax rates for Australians born since 1901, and includes an approximate analysis of the net tax contributions of migrants belonging to these generations based on purely demographic effects. Up to now, estimates of average lifetime net tax rates have only been published for the United States (starting with Auerbach *et al.* 1993) where, for most scenarios envisaged, the results have generally indicated a gradual increase in average lifetime net tax rates from about 18 per cent for persons born in 1900 to 35 per cent for those born since 1990.[3] The main motivation for the current study is to determine whether or not there is any evidence of a similar gradual increase in Australia. Such infor-

* Funding support for the research reported in this paper came from a 1997/98 Foundation grant from the University of Western Sydney, Macarthur.

[1] Readily accessible introductions to the generational accounting methodology include Auerbach *et al.* (1994) and Kotlikoff and Raffelhüschen (1999). Notable critiques are given by Haveman (1994), Diamond (1996), Buiter (1997) and Robinson (1997). Auerbach *et al.* (1999) provide a comprehensive review of generational accounting results for numerous countries.

[2] Ablett (1997) gives a recent set of purely forward-looking generational accounts for Australia.

[3] These estimates assume that measures are not taken to eliminate generational imbalance between currently living and future generations. Generational imbalance is explained in Section II of this paper.

mation is of obvious relevance to the assessment of the generational equity implications of current and future fiscal policy. Thus, if it can be shown that under past and current fiscal policies certain generations appear to be faring significantly better than others, then proposed policy changes that affect these generations can be assessed in this light.

It would appear reasonable to expect that average lifetime net tax rates have also risen in Australia over the course of this century. The economic importance of government as a provider of infrastructure, services and social welfare has clearly grown significantly in this time and has necessitated higher tax revenues. Furthermore, since real lifetime incomes have generally increased over the long term, one could argue that the capacity of successive generations of Australians to contribute a higher proportion of their lifetime income in net taxes has also increased. Evidence of a relatively favourable fiscal treatment of certain generations born in the past would therefore take the form of departures from the expected gradual increase in lifetime net tax rates, at least before some eventual levelling off. In particular, a levelling off or more gradual increases in lifetime net tax rates for those born during a given period, followed by more rapid increases for some generations born subsequently, would constitute such evidence.

Some commentators have asserted the existence of generations that have had a significantly better deal from government than their predecessors or successors (e.g. Thomson and Tapper 1993), the so-called 'me generations', or 'selfish generations' as described in the New Zealand context by Thomson (1991).[4] These generations, roughly designated as being born during the 20-year period starting with the Great Depression, are thought to have benefited disproportionately (in relation to the taxes they have contributed) from expansion of the welfare state after World War II. The results presented here suggest there is no evidence for the existence of 'me generations' in Australia, in that under reasonable assumptions average lifetime net tax rates will be relatively stable for all currently living generations born since the mid-1930s. This reflects an historical trend in Australia of increases in lifetime net tax contributions being roughly matched by increases in real lifetime incomes. If anything, it could be argued that the baby boomer and subsequent generations are likely to receive relatively favourable treatment from government since they may enjoy higher average lifetime incomes and yet experience average lifetime net tax rates similar to those experienced by their parents.

An obvious limitation of this study is that the lifetime net tax rate results presented, with the exception of health care, refer only to taxes and cash benefits. They do not consider the value to different generations of in-kind benefits in areas such as public education, or general benefits stemming from government consumption expenditure. In terms of health care, the estimates include the value of all Medicare (national health scheme) and pharmaceutical benefits (i.e. not just cash rebates), but not the value of in-kind benefits derived from investment in public hospitals or other health care expenditure.[5] In so far as the distribution over generations of the omitted non-cash benefits is different from that of cash benefits, the results cannot be considered indicative of the distribution over generations of total net benefits from government. Furthermore, we ignore other historical factors that may have affected the relative welfare of different generations, such as periods of low interest rates or sustained economic prosperity, which may have been influenced by government actions. However the results could serve as a starting point for more detailed historical analysis of intergenerational welfare in Australia.

In the next section we present a discussion of the basic generational accounting methodology and its retrospective application. Section III summarizes the major features and limitations of the data and assumptions used in the study, whilst results are presented and discussed in Section IV. Concluding comments are provided in Section V.

II Basic Methodology

The starting point of the forward-looking generational accounting framework as originally proposed by Auerbach *et al.* (1991) is a particular formulation of the public sector's intertemporal budget constraint. This identity states that the total present value of the net contributions to government by currently living and future generations (born after the base year) equals the public sector's net liabilities in the base year plus the present value of its current and future consumption expen-

[4] The authors are unaware of the originator of the term 'me generations'.

[5] In this regard, recent studies by Harding (1995) and Schofield (1998) suggest non-cash health benefits have significant effects on income distribution.

diture. Labelling the base year t (1995/96 in this paper) and assuming a constant discount rate r, this identity can be written as

$$\sum_{s=0}^{D} N_{t,t-s} + \sum_{s=1}^{\infty} N_{t,t+s} \equiv W_t^g + \sum_{s=t}^{\infty} G_s \frac{1}{(1+r)^{s-t}} \quad (1)$$

where $N_{t,k}$ is the present value in year t of the *remaining* lifetime net payments to all levels of government by the generation born in year k, W_t^g is government net debt in year t, and G_s is undiscounted government final consumption expenditure in year s. The maximum lifetime of a particular generation, D, is assumed here to be 100 years.

It is now common practice to include in the calculation of net payments to government non-transfer expenditures on education and health that can reasonably be allocated to generations, in addition to cash benefits. Due to historical data limitations, in this application net payments to government include only taxes, cash benefits and non-cash Medicare and pharmaceutical benefits.

The forward-looking generational account of a particular generation (distinguished by year of birth) is taken to be the remaining lifetime per capita net payment of a typical member of that cohort, expressed as a present value in the base year. However, in this paper retrospective and prospective calculations are combined to estimate average *lifetime* real net payments to government, expressed as a present value in the year of birth, for all generations born since 1900/01.[6] If we denote the corresponding present value in year k of the aggregate lifetime income of the generation born in year k as $L_{k,k}$, then the average lifetime net tax rate of this generation is simply $N_{k,k}/L_{k,k}$. In theory, $L_{k,k}$ should include inherited wealth and capital gains that differ from the normal return to saving. However as data on these variables are unavailable, an estimate of lifetime labour earnings is used as a proxy for lifetime income, in line with the approach taken in the US studies of lifetime net tax rates.[7]

The projected aggregate net contribution of future generations (the second sum in (1)) is obtained as the balancing item in identity (1) after projections have been used to estimate the other components. In most generational accounting applications, this net burden is distributed by assuming that all future generations face the same per capita generational account at birth, adjusted for an assumed growth rate. Imbalance in a generational accounting sense is then gauged by comparing the lifetime accounts of newborns in years t and $t+1$, the latter representing future generations, with equality indicating generational balance.[8]

There are a number of well-known and acknowledged shortcomings of generational accounting as currently practised. Most important amongst these are the exclusion of indirect general equilibrium feedback effects and the dependence of results on particular incidence assumptions. In the long term, the former could be quite significant, however simulation results presented by Fehr and Kotlikoff (1997) provide support for the view that empirically estimated generational accounts can be expected to give a reasonable indication of the intergenerational incidence of a broad range of fiscal policies.

A further difficulty is the determination of an appropriate discount rate. In theory the discount rate used could depend on whether the accounts are to be used mainly for cost-based calculations to examine the sustainability of fiscal policies, or for determining the degree of intergenerational redistribution implied by alternative fiscal policy

[6] For the purposes of the calculations, all monetary values were expressed in 1995/95 dollars.

[7] Although they represent income, normal returns to saving do not increase the present value of lifetime resources and therefore should not be included explicitly in the calculation of the latter. Whether certain generations in Australia have indeed enjoyed above average returns to their savings would be an interesting question for future research.

[8] There is an ongoing debate as to whether achievement of 'balance' in the generational accounting sense is an optimal rule for the conduct of fiscal policy. It is certainly possible to conceive of particular situations in which the generational balance rule would not lead to optimal social welfare over time. One such example is given by Raffelhüschen and Risa (1997), while interesting discussions of this issue are also given by Kotlikoff (1997) and Robinson (1997). We will not enter into this debate here, other than to note that even in situations where generational balance may not be strictly optimal, a general goal of approximate generational balance may still be a useful guide to governments in achieving a better outcome. In other words, approximate generational balance could lead to at least a potential Pareto improvement with respect to the welfare of current and future generations, compared to a situation that implies significant intergenerational redistribution.

scenarios.[9] Cost-based calculations would require an interest rate equal to the government's cost of borrowing, perhaps adjusted upwards for risk associated with future inflation. However, the existence of uncertainty and incomplete insurance markets would suggest the use of a higher interest rate when gauging intergenerational redistribution. Fortunately, in many cases qualitative results on the direction of generational imbalance are robust against a wide range of discount and per capita growth rate assumptions. In line with most recent empirical applications, this paper presents results with a preferred discount rate of 5 per cent per annum, together with some sensitivity analysis.

III Estimation Procedures and Assumptions

Three main stages were involved in the estimation process. First, retrospective calculations were made relating to the net contributions to government and labour income up to 1995/96 for each generation born between 1900/01 and 1995/96. Second, projections of remaining lifetime labour income and net payments to government for generations alive in 1995/96 were obtained using a uniform per capita growth rate assumption. Third, the usual forward-looking generational accounting methodology was used to calculate the implied net fiscal burden on future generations (born after 1995/96); a projection of average lifetime labour income for future generations was calculated using the second-stage uniform growth rate assumption. Each of these estimation stages is discussed below. Details of data sources and specific incidence assumptions are given in Appendix A.[10]

(i) Retrospective Calculations

Annual population and mortality data by single year of age and sex were obtained for all years since 1900/01 (including projections for years up to 2120). This allowed the estimation, for each year of birth and sex cohort, the number of surviving members in each successive year, both with and without the inclusion of migrants belonging to the cohort. Detailed death rate estimates were applied in the calculation of non-migrant annual survival numbers.

Average annual labour income and net payments to government by age and sex for each year from 1900/01 to 1995/96 were estimated by applying profiles of average labour income, taxes paid to government and benefits received from government derived from survey data and other sources. These profiles were benchmarked against corresponding national aggregate estimates using the demographic data for each year (including migrants).[11] Taxes were divided into labour income taxes, capital income taxes, property taxes and indirect taxes, whilst cash benefits were categorized as age pensions, unemployment benefits, family benefits, hospital benefits, non-hospital health benefits, benefits related to school, higher and other tertiary education, and other social security cash benefits (maternity and disability allowances, carer pensions, etc.). The national benchmarking aggregates for these components relate to all levels of government.

Unfortunately the earliest suitable survey data available refers to 1975, and this is clearly a shortcoming of this study. In effect, it was necessary to apply quite recent relative age/sex profiles to distribute aggregate taxes and benefits in earlier years, and it is not known how much these profiles varied in the years before survey data was collected. An examination of the available data from the past two decades does indeed reveal some changes in the estimated relative age profiles (for persons) of taxes, benefits and labour income over this period. These changes are evident in Table 1, which summarizes the age profile data estimated for 1975/76 and 1995/96 for payments to government, benefits from government and labour income. The figures in the table show, for each indicated age, year and component, the ratio of the average payment or receipt to that of the corresponding average for 40-year-olds.

The main feature of Table 1 is an apparent shift over the past 20 years in the age distribution of government benefits (and net payments) relative to 40-year-olds in favour of younger people. For example, the figures suggest that in 1975/76 30 and 40-year-olds made almost equal average net payments to government, whilst in 1995/96 the average net payment by 30-year-olds was about 20 per cent less than that of 40-year-olds. Some

[9] The estimation of intergenerational redistribution by changes in generational accounts is described by Diamond (1996) as a utility-based calculation since such changes can be considered approximations of the corresponding changes in the various cohorts' respective expected utilities, measured as wealth equivalents.

[10] Data files are available on request from the authors.

[11] The general benchmarking procedure is described in Appendix A.

TABLE 1

Tax Payments, Benefits, Net Tax Payments and Labour Income Relative to those Aged 40 Years (Persons), 1975/76 and 1995/96

	Tax Payments		Benefits		Net Tax Payments		Labour Income	
Age	1975/76	1995/96	1975/76	1995/96	1975/76	1995/96	1975/76	1995/96
20	0.776	0.710	1.091	1.248	0.728	0.602	0.895	0.642
30	0.996	0.897	0.951	1.453	1.004	0.790	0.994	0.907
40	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
50	1.001	1.097	1.247	1.262	0.963	1.064	0.913	0.962
60	0.775	0.865	3.171	2.729	0.409	0.491	0.423	0.298
70	0.582	0.569	5.499	3.971	−0.171	−0.113	0.014	0.019
80	0.479	0.587	6.134	4.781	−0.386	−0.255	0.003	0.002

TABLE 2

*Average Lifetime Net Taxes and Labour Income (Persons)**

Year of Birth	Average Lifetime Net Tax Payment (Thousands of 1995/96 dollars)	Average Lifetime Labour Income (Thousands of 1995/96 dollars)	Average Lifetime Net Tax Rate (per cent)
1900/01	9.5	38.9	24.3
1910/11	15.0	51.0	29.4
1920/21	23.3	68.9	33.9
1930/31	34.4	90.5	38.0
1940/41	45.1	116.9	38.5
1950/51	58.9	153.5	38.4
1960/61	64.3	166.5	38.6
1970/71	64.6	171.0	37.8
1980/81	70.2	186.8	37.6
1990/91	77.9	207.8	37.5
1995/96	81.6	220.1	37.1
1996/97 (future generations)	82.2	222.4	37.0

* The figures presented in this table assume a discount rate of 5 per cent per annum, and a uniform per capita growth rate of 1 per cent per annum after 1995/96 for all taxes and benefits paid and received by those alive in 1995/96, labour income (by age and sex) and government consumption expenditure. The figures in the second and third columns are present values in the year of birth.

factors contributing to this shift include higher unemployment levels and longer periods of full-time education, which affect disproportionately benefits going to younger age groups. Such factors have also affected the age distribution of labour income in recent decades.

Although it is not possible to rule out large changes in the relative age profiles of net tax payments and labour income before 1975/76, it seems reasonable to suppose that many of the major variables driving the changes revealed in Table 1 were more stable in earlier years. For example, mass participation in tertiary education and significant reductions in the average age of retirement have been fairly recent phenomena over a time line covering this century. Furthermore, the introduction and/or growth in importance of a number of cash benefits, such as

those relating to education and health, did not occur until well after World War II, so in these instances the use of recent profiles is likely to be less of a problem. Thus it is felt that, for the earlier years of this century, changes in the levels of taxes and benefits over time dominate any changes in the relative age/sex profiles of these components in the determination of the average lifetime net taxes and net tax rates of generations.

(ii) Prospective Calculations for Those Born 1900/01–1995/96

For all generations alive in 1995/96, all components of estimated average (per capita) net payments and labour income by age and sex in 1995/96 were assumed to grow at a uniform per capita annual rate (1 per cent, unless otherwise specified) over their remaining lifetimes. Thus no attempt was made to predict changes in average taxes and benefits by age and sex brought about by fiscal policy initiatives or changes in economic behaviour after 1995/96. A major aim of the uniform growth rate assumption is to give a scenario that would appear reasonable for those alive in the base year. Nevertheless, it ignores the effects of superannuation and expected increases in the prices of medical services that may change the generational impact of fiscal policies in the future.[12]

Estimates from the first two stages together with an assumed uniform discount rate (5 per cent in the base case) and the detailed population data then permitted the calculation of aggregate and per capita lifetime net payments to government and labour income, as a present value in the year of birth, for each generation born between 1900/01 and 1995/96. In arriving at these estimates, the net fiscal contributions and labour income of migrants were excluded.

It is clear that a cohort's aggregate net fiscal contribution (and aggregate lifetime labour income) will be affected by migration. Therefore, as explained in Ablett (1997), if a cohort's average net fiscal contribution is to be estimated by dividing its aggregate net contribution by the number of domestic-born cohort members, then this aggregate net contribution should exclude the net contribution of migrants belonging to the same age cohort. The net contributions of migrants should, however, have been taken into account when calculating the implied aggregate net fiscal burden on future generations (see below). Section IV provides some discussion of the effects of migration on aggregate cohort net fiscal contributions.

(iii) Calculation of the Implied Net Fiscal Burden on Future Generations

Following the usual forward-looking generational accounting methodology, the projections from the second stage were combined with assumptions about demographic change and the future growth of government consumption expenditures to obtain a figure for the implied net fiscal burden to be borne by future generations (i.e. born after 1995/96). Per capita government consumption was assumed to grow at the same uniform rate as the other generational account components, and general government net debt as at 30 June 1995 was used as the estimate of total government net liabilities in the base year. The total implied net fiscal burden on future generations was determined taking account of the contributions of post-base year migrants and their effect on growth in government consumption expenditure that is not allocated to generations. Migration affects future government consumption directly and also by increasing the number of future births.

To clarify our calculation of the generational accounts of future generations in the presence of migration, we can decompose the total generational accounts of future generations in the following way

$$\sum_{s=1}^{\infty} N_{t,t+s} = \sum_{s=1}^{\infty} N^{d}_{t,t+s} + \sum_{s=1}^{\infty} N^{m}_{t,t+s}. \qquad (2)$$

In (2), $N^{d}_{t,t+s}$ is the aggregate generational account of domestically born members of the future generation born s years after the base year t (1995/96), while $N^{m}_{t,t+s}$ is the present value in t of the aggregate net fiscal contribution of future migrants belonging to the same future generation. Commonly it is assumed implicitly that the net fiscal burden on a given future generation falls

[12] The impact of compulsory superannuation on Australian generational accounts is examined in Bateman and Ablett (1998). These authors note that the effects of current superannuation provisions on age pension payouts will not be significant over the next 15 to 20 years, which implies the effects of these provisions on 1995/96 base year Australian generational accounts are not significant. Walker *et al.* (1998) provide interesting microsimulation results on the effects of increasing drug prices on the costs of the Pharmaceutical Benefits Scheme in Australia.

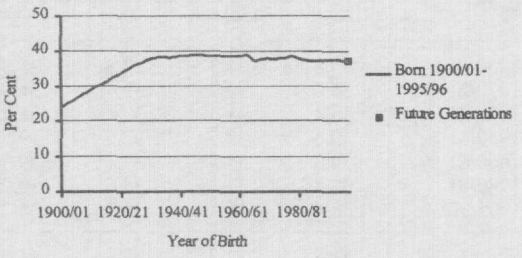
solely on the domestic-born members of that generation, i.e. it is assumed that $N^m_{t,t+s}$ $(s \geq 1)$ is zero. The existence of significant migration necessitates an alternative assumption. In this paper we make the assumption that migrants born in the future make the same age-specific generational account contributions as domestic-born members of their generations. This assumption seems reasonable, but could be considered somewhat conservative given the historical age composition of arriving migrants, which suggests migrants on average make greater lifetime net fiscal contributions than domestic-born members of their age cohorts.[13] It is applied in addition to the assumption that all future generations face the same per capita generational account at birth, adjusted for the assumed uniform growth rate. The average lifetime net tax rates for future generations presented in the next section represent the implied per capita generational account of those born in $t + 1$(1996/97) divided by this generation's estimated present value of per capita lifetime labour earnings. Thus, given our assumptions, the generation born in the year following the base year is treated as representative of all future generations.

IV Results

The results of this section refer to persons, i.e. they can be interpreted as weighted averages of the corresponding male and female results.[14] Table 2 presents the preferred base case net tax rate results for selected years of birth, assuming a uniform 5 per cent annual discount rate and a uniform 1 per cent per capita annual growth rate after 1995/96 for the net payment components of all generations alive in this year and average labour income. A relatively low future migration scenario was used (see Appendix A). The net tax rate results for this case are also shown graphically in Figure 1, which reveals a steady increase in lifetime net tax rates for those born between the turn of the century and 1930 from 24.3 to 38 per cent. Perhaps surprisingly, for those born after 1930, the lifetime net tax rate remains fairly flat at about 37 to 39 per cent. Thus whilst the results reveal a steady increase in average lifetime net tax payments as shown in the second column of Table 2, after 1930 this is matched, or more than matched, by increases in average lifetime labour income.

FIGURE 1

Lifetime Net Tax Rates
(5 per cent p.a. discount rate, 1 per cent p.a. uniform growth rate after 1995/96)



The Table 2 results also reveal approximate generational balance in that the average net payment to government (generational account) of those born in 1995/96 is almost the same as the implied average net payment of those born in 1996/97, the latter representing future generations as explained in Section II. It can be seen that the average net payment to government of future generations is slightly higher than that of the 1995/96 cohort, however a larger calculated average lifetime labour income for the former results in them having a slightly lower lifetime net tax rate. Although it should be remembered that these net payment results only consider taxes, cash benefits and Medicare non-cash benefits, they are in line with previous generational accounting results for Australia (Ablett 1997) that do not indicate significant generational imbalance in contemporary fiscal policy.

Table 3 provides results from sensitivity analysis using three different discount rates (3, 5 and 7 per cent per annum) and three different uniform per capita growth rates (0.5, one and 1.5 per cent per annum) after 1995/96 for the net payment components of all generations alive in this year and average labour income. It is felt that these cases cover the ranges of reasonable assumptions for the two parameters considered. Apart from the preferred base case, most cases generally show falls in the lifetime net tax rates for successive generations born over the period from the mid-1930s up to 1995/96, with the most significant falls occurring with the high 7 per cent discount rate assumption. One explanation for the latter phenomenon is the significant increases in cash benefits related to education in recent times,

[13] Ablett (1997) provides some support for this view.
[14] Results distinguished by gender are available from the authors on request.

TABLE 3

Average Lifetime Net Tax Rates (Persons) under Various Discount (r) and Growth (g) Rates

Year of Birth	g = 0.5%			g = 1%			g = 1.5%		
	r=3%	r=5%	r=7%	r=3%	r=5%	r=7%	r=3%	r=5%	r=7%
1900/01	25.8	24.3	22.7	25.8	24.3	22.7	25.8	24.3	22.7
1920/21	34.0	33.9	33.4	34.0	33.9	33.4	33.9	33.9	33.4
1930/31	38.3	38.0	37.8	38.2	38.0	37.7	38.1	37.9	37.7
1940/41	39.6	38.6	37.5	39.5	38.5	37.5	39.3	38.5	37.5
1960/61	39.3	38.5	37.3	39.3	38.6	37.4	39.3	38.7	37.5
1980/81	38.8	37.2	34.6	39.0	37.6	35.2	39.1	37.9	35.8
1995/96	38.4	36.4	33.2	38.7	37.1	34.2	38.9	37.6	35.1
Future Gen.	41.5	37.2	38.3	44.0	37.0	36.4	49.1	37.3	35.2

TABLE 4

Average Lifetime Net Taxes (Persons) under Various Discount and Growth Rates (thousands of 1995/96 dollars)

Growth Rate (%)		0.5			1			1.5	
Discount Rate (%)	3	5	7	3	5	7	3	5	7
Born 1995/96	141.5	67.5	32.8	171.7	81.6	39.6	208.3	98.6	47.9
Future Generations	153.7	69.3	38.0	197.0	82.2	42.6	266.7	99.3	48.9
Imbalance (%)	8.6	2.7	15.9	14.7	0.7	7.6	28.0	0.7	2.1

which in this study are distributed to the younger generations, boosting the present value (at birth) of their lifetime cash benefits. Generally speaking, a higher discount rate will imply a lower present value of lifetime net payments to government if a higher proportion of benefits is received earlier in life. Recent increases in higher education contribution scheme (HECS) charges would of course reduce the net cash benefits going to young people. The estimates presented do not explicitly take into account future increases in tax payments required to repay accumulated HECS debts, however this omission is unlikely to bias the results given the uniform growth rate assumption.

Sensitivity analysis results relating to generational imbalance are given in Table 4, where it can be seen that the imbalance in favour of generations alive in the base year (1995/96) compared to future generations is relatively minor, except perhaps for the extreme case with a low discount rate (3 per cent per annum) and high uniform growth rate (1.5 per cent per annum).[15]

It is also of interest to examine the changing composition of lifetime taxes and cash benefits over this century. This is revealed in Tables 5 and 6 below, both of which are based on the preferred base case scenario. Two major conclusions can be drawn from these results. First, over time the importance of indirect and property taxes has fallen as a proportion of total average lifetime taxes, whilst the importance of labour income taxes has generally increased. This appears to coincide with popular belief, although most of this change occurred early enough to affect all generations born after World War II. One can point to the changes in Federal and State taxing powers during World War II as possibly giving impetus to the observed changing composition of lifetime net taxes.[16]

[15] Given the simulation nature of generational accounting exercises it is not possible to make an objective judgement as to the significance of any generational imbalance revealed. The generational imbalances implied here are, however, not large compared with those commonly revealed in other generational accounting studies (e.g. Auerbach *et al.* 1999).

[16] The Commonwealth Government assumed the sole power to levy income taxes in 1942.

TABLE 5

Composition of Average Lifetime Taxes (for persons as a per cent of total tax payments)
(5 per cent p.a. discount rate, 1 per cent p.a. uniform growth rate after 1995/96)

Year of Birth	1900/01	1920/21	1940/41	1960/61	1980/81	1995/96
Labour Income Taxes	28.1	37.4	39.7	44.5	43.1	43.1
Capital Income Taxes	16.8	17.0	17.0	13.8	15.6	15.7
Property Taxes	14.2	9.7	9.7	6.9	6.9	6.9
Indirect Taxes	40.4	35.9	35.9	34.8	34.4	34.3

TABLE 6

Composition of Average Lifetime Cash Benefits (for persons as a per cent of total cash benefits)
(5 per cent p.a. discount rate, 1 per cent p.a. uniform growth rate after 1995/96)

Year of Birth	1900/01	1920/21	1940/41	1960/61	1980/81	1995/96
Age Pension	78.3	49.9	32.5	19.4	17.2	16.9
Family Benefits	8.9	20.8	16.0	16.8	17.1	16.6
Education Benefits	0.0	0.1	1.7	6.7	10.7	9.5
Health Benefits	7.7	12.3	19.2	20.9	24.4	27.1
Other Cash Benefits	5.1	16.9	30.6	36.2	30.6	29.9

Second, there appears to have been a dramatic fall in the importance of the age pension in lifetime cash benefits, counterbalanced by increases in the importance of education, health and other social security benefits (which in Table 6 includes unemployment benefits). These changes are not hard to understand. Apart from maternity allowances, the age pension (including benefits to war veterans) was the only major cash benefit paid by the Australian government before World War II. After this time numerous benefits going to younger age groups, or all age groups, were successively introduced and expanded. Benefits going mainly to young people included numerous education benefits such as Commonwealth education scholarships, the tertiary education assistance scheme and the more generalized Austudy allowance for high school and tertiary students. On the other hand, hospital and other health benefits are distributed over people of all ages, although they generally go to the elderly more than other age groups.[17]

The results presented so far for generations with surviving members in the base year (1995/96) have excluded the aggregate net payments to government of migrants belonging to these cohorts, according to the rationale given in Section III. A rough indication of the net contribution to government by a particular (year of birth) cohort of migrants can be obtained by comparing the cohort's aggregate net contribution to government with and without the net contribution of migrants. It is also of interest to calculate how the inclusion of these migrant net contributions changes the cohort's per capita net payment to government calculated in the usual way, i.e. the cohort's aggregate net payment divided by the number of domestic-born cohort members. The summary results of this exercise for the preferred base case are presented in Table 7.[18]

A shortcoming of the calculations behind Table 7 is that they ignore whatever differences exist in average payment/benefit levels between migrants and non-migrants belonging to the same cohort. Ideally these would be taken into account in the calculation of lifetime net tax payments and rates,

[17] The generational imbalance results presented in this paper could conceivably be changed significantly by rapidly increasing public health care benefits, as acknowledged in Ablett (1998).

[18] In arriving at the net tax rates in the second column of Table 6 the labour incomes of migrants were also included in the aggregate labour incomes of the cohorts.

but the unavailability of adequate data precludes this. Thus at best Table 7 only reveals the purely demographic effects of migration on total cohort net contributions to government. Ablett (1997) provides some discussion of this issue in the context of purely forward-looking generational accounts and concludes this may not be a major problem. However, in a retrospective study where it is clear that the ethnic composition of the Australian population has changed significantly over the century, the problem is likely to be more significant.

Given these caveats, the magnitude of the results presented in Table 7 nevertheless adds weight to the view that migrants generally have contributed and will continue to contribute significant positive net tax payments to government in Australia.[19] This can be partly explained by the fact that historically many migrants have come to Australia at a relatively young age, but after being reared and educated elsewhere. Such migrants thus did not receive the education and public health benefits going to younger age groups, but generally started paying positive net taxation shortly after arrival. The differing increases in total cohort net tax payments over cohorts due to migration (up to about 50 per cent) are also partly attributable to the varying sizes of migrant intakes according to year of birth cohort. For example, there were relatively large intakes of migrants born during and shortly after World War II.

[19] The calculated lifetime net tax rates (not shown) for cohorts born between 1900/01 and 1995/96 generally increase slightly following the inclusion of migrant net payments to government and labour income earned after arrival. This would suggest that migrants belonging to each of these cohorts will pay a slightly higher net tax rate on their labour earnings in Australia than domestically born cohort members.

V Concluding Remarks

The results presented in this paper suggest that the average lifetime net tax rate will, under reasonable assumptions, be of the order of 37–39 per cent for all currently living generations born since the mid-1930s. As such, they do not support the view that certain generations born in the 1930s and 1940s will over their lifetimes enjoy relatively favourable treatment at the hands of the Australian welfare state. It is our contention that anecdotal evidence asserting the existence of such generations with reference to, for example, changing official tax rates and cash benefit levels, is deceiving because at best it represents only a partial analysis. In particular, reference should also be made to movements in average lifetime earnings, which have generally shown an upward trend this century. The approach presented here takes account of this trend as well as all lifetime tax payments, cash benefits, and Medicare benefits/rebates, and covers all levels of government. It does, however, have shortcomings, including the

TABLE 7

Lifetime Net Taxes with and without Migrant Contribution (Persons)
(5 per cent p.a. discount rate, 1 per cent p.a. uniform growth rate after 1995/96)

Year of Birth	Average Net Tax Payment Excluding Migrant Contribution (Thousands of 1995/96 dollars)	Average Net Tax Payment Including Migrant Contribution (Thousands of 1995/96 dollars)	Per Cent Increase in Total Cohort Net Payments Due to Migration
1900/01	9.5	12.7	34.1
1910/11	15.0	18.1	21.1
1920/21	23.3	29.6	27.0
1930/31	34.4	46.8	36.1
1940/41	45.1	67.7	50.2
1950/51	58.9	81.8	39.0
1960/61	64.3	84.1	30.7
1970/71	64.6	77.0	19.2
1980/81	70.2	87.9	25.3
1990/91	77.9	93.6	20.1
1995/96	81.6	100.9	21.1

omission of numerous in-kind benefits from the estimates, and an inability to take account of changes in age profiles of benefits, etc., which may have occurred before the 1970s.

One aspect of the findings that deserves future analysis is the implicit assumption that certain generations have not earned above average returns on savings over their lifetimes. If it can be shown that generations born during particular periods have indeed benefited from significantly higher lifetime returns to savings than others, then our general conclusions could be changed. In this case, the average lifetime incomes (proxied in this paper by lifetime labour earnings) of these generations would be higher and their lifetime net tax rates accordingly lower. It is conceivable that such phenomena exist. For example, it is quite reasonable to suppose that certain generations benefited disproportionately from the 1980s property price boom in Australia. The question is whether such phenomena are sufficiently significant to modify our general conclusion. Any answer to this question must also consider the degree to which any above normal returns to savings are passed on to younger generations, in turn increasing their lifetime resources.

The broader issue of the relative total welfare of different generations, taking account of, for example, periods of relative economic prosperity, would appear very difficult to approach in anything other than terms involving casual empiricism. As interesting as this issue may be, it is hard to imagine how an all-encompassing study of generational welfare could be undertaken.

Appendix A

Description of the Benchmarking Procedure and Data Sources

(i) The Benchmarking Procedure

The first main stage of the estimation process described in Section III involved the calculation of average annual labour income and net payments to government by age and sex for each year from 1900/01 to 1995/96 using a procedure common to most generational accounting studies. To understand the procedure employed, consider the age/sex profile of a particular tax in year k. First, a profile of average amounts of the tax paid by age and sex in a given year (not necessarily year k) was obtained from survey or other data. Then the ratio of each age/sex category's average tax payment to that of a reference age/sex category (in most cases 40-year-old males) was calculated. Denote the values of this ratio for males and females by R_n^m and R_n^f, respectively, where n represents age. Also denote total taxes of the type considered in year k by T_k (the benchmarking aggregate), the average amount of the tax paid by a member of the reference group in year k by h, and the number of males and females aged n years in the year k by P_n^m and P_n^f, respectively. Then the following equation holds:

$$T_k = h \sum_{n=0}^{100} (R_n^m P_n^m + R_n^f P_n^f) \qquad (3)$$

Equation (3) was used to find h. The complete age/sex profile for the tax considered in year k was then simply obtained by multiplying each R_n^m and R_n^f ($n = 0,...,100$) by h.

(ii) Population Data

Detailed population and deaths data for the period 1921–76 were obtained from Brown (1978 and 1979). For years before 1921 various sources of population statistics were used including the 1901 and 1911 censuses, the 'Australian Demography Bulletin' and the 'Yearbook Australia'. For some years detailed population and deaths data were simply unavailable and therefore some interpolation was required. Detailed population data for years after 1976 were derived from both published and unpublished data obtained from the Australian Bureau of Statistics.

Population projections for years up to 2120 were based on an extension of the Australian Bureau of Statistics' projections to 2051. The main features and assumptions related to these projections are described in Australian Bureau of Statistics (1996). The particular set of projections used in this paper assumes a moderate migration scenario involving net annual migration of 70 000 post-1998/99, a constant fertility rate of 1.85 children per woman and improvements in mortality to 2051. It was assumed that no further improvements in mortality would occur after 2051.

(iii) Benchmarking Aggregates

The establishment of benchmarking aggregates for the tax and benefit categories listed in Section III and labour income was based on numerous data sources. For many taxes and benefits the 'Yearbook Australia' yielded suitable aggregates. This information was supplemented with data from the Australian national accounts and other publications given in the reference list. For some items during certain years, notably for local council rates during World War II, some interpolation was necessary due to the absence of official estimates. Estimates of aggregate wages, salaries and supplements were used to represent labour income. As official estimates of this national aggregate were not available for years before 1948/49, it was approximated for earlier years by multiplying national income figures by estimates of labour's share of national income (Department of Labour and Immigration, 1975); since the latter was only available for years back to 1938/39,

the figure for that year (69 per cent) was applied to all earlier years covered by the study.

Aggregate payroll and income taxes for each year were divided between labour and capital income taxes by equating labour's share of these taxes with the share of wages, salaries and supplements in domestic factor income. Property taxes were taken to include land taxes, council and shire rates, Commonwealth estate duty, State probate and succession duties and other stamp duties. All other taxes were included as indirect taxes. Benefits to ex-servicemen were included in aggregate age pensions. The annual national aggregates obtained for all the various benefits over the course of this century were readily attributed to the benefit categories considered in the study (i.e. family benefits, unemployment benefits, other benefits, etc.)

In order to obtain projections of future government consumption expenditure, all of its components, with the exception of subsidies to industry, were assumed to increase at the general per capita uniform growth rate. Subsidies to industry were assumed to remain constant at their real 1995/96 level, as these have remained fairly constant over the last half-decade and the general trend has been towards reducing industry protection. Net transfers to government from public trading enterprises in the base year were treated as negative government consumption expenditure.

(iv) Age/Sex Profile Data

Profiles of relative taxes and benefits by age and sex to be benchmarked were mainly derived from survey data made available from the Australian Bureau of Statistics' 1975, 1988 and 1993 household expenditure surveys, 1981, 1986 and 1990 household income surveys, 1994/95 survey of income and housing costs, and 1977/78, 1989 and 1995 national health surveys. Indirect taxes were distributed using profiles of average consumption expenditure by age and sex derived from the household expenditure surveys, whilst property taxes were distributed using profiles of average property rates by age and sex derived from the household income surveys. In both these cases, the absence of suitable survey data relating to individuals necessitated the use of household level data classified by age, sex and marital status of the reference person. Estimated averages for individuals by age and sex were then derived under the assumption that half the household amount could be attributed to household reference persons who were married, with the full household amount attributed to unmarried reference persons.

The profiles used to distribute hospital and non-hospital health benefits were based on data showing numbers of hospital episodes and consultations with a doctor in given periods. The profiles used to distribute school, tertiary and further education, and higher education cash benefits were based on published participation rates for various years. Apart from education and health benefits, all other taxes and cash benefits were assumed to be paid or received by persons over the age of 15 years. This was necessary due to data limitations.

REFERENCES

Ablett, J. R. (1997), 'A Set of Generational Accounts for Australia: Base Year 1994/95', *Economic and Labour Relations Review* **8**, 1, 90–109.

—— (1998), 'Intergenerational Redistribution and Fiscal Policy', *Australian Economic Review* **31**, 1, 73–79.

Auerbach, A. J., Gokhale, J. and Kotlikoff, L. J. (1991), 'Generational Accounts: A Meaningful Alternative to Deficit Accounting', in D. Bradford (ed.), *Tax Policy and the Economy* **5**, 55–110, NBER and MIT Press, Cambridge, Massachusetts.

—— —— and —— (1993), 'Generational Accounts and Lifetime Tax Rates, 1900-1991', *Federal Reserve Bank of Cleveland Economic Review* **29**, 1, 2–13.

—— —— and —— (1994), 'Generational Accounting: A Meaningful Way to Evaluate Fiscal Policy', *Journal of Economic Perspectives* **8**, 2, 73–94.

Auerbach, A. J., Kotlikoff, L. J. and Leibfritz W. (eds.) (1999), *Generational Accounting Around the World*, NBER, Cambridge, Massachesetts.

Australian Bureau of Statistics, *Australian Demographic Statistics*, Cat. no. 3101.0, Canberra, various issues.

—— *Commonwealth Government Finance, Australia*, Cat. no. 5502.0, Canberra, various issues.

—— *Expenditure on Education Australia*, Ref. no. 5.44 and Cat. no. 5510.0, Canberra, various issues.

—— *Government Finance Statistics*, Cat. no. 5512.0, Canberra, various issues.

—— (1996), *Projections of the Populations of Australia, States and Territories, 1995–2051*, Cat. no. 3222.0, Canberra.

—— *Public Authority Finance*, Ref. no. 5.30, Canberra, various issues.

—— *Taxation Revenue Australia*, Cat. no. 5506.0, Canberra, various issues.

—— (1986), *Tertiary Education Australia* 1984, Cat. no. 4218.0, Canberra.

—— *Yearbook Australia*, Cat. no. 1301.0, Canberra, various issues.

Australian Department of Labour and Immigration (1975), *Labour's Share of the National Product—The Post-war Australian Experience*, AGPS, Canberra.

Bateman, H. and Ablett, J. (1998), *Compulsory Superannuation and Australian Generational Accounts*, Department of Economics and Finance Discussion Paper No. 1/98, University of Western Sydney, Macarthur.

Brown, H.P. (1978), *Australian Demographic Databank Volume 1: Recorded Vital Statistics 1921–1976*, Research School of Social Sciences, Australian National University, Canberra.

—— (1979), *Australian Demographic Databank*

Volume 2: Population Estimates and Demographic Rates, Research School of Social Sciences, Australian National University, Canberra.

Buiter, W. H. (1997), 'Generational Accounts, Aggregate Saving and Intergenerational Distribution', *Economica* **64**, 256, 605–26.

Butlin, N. G. (1962), *Australian Domestic Product, Investment and Foreign Borrowing 1861–1938/39*, Cambridge University Press, Cambridge.

Clark, C. and Crawford, J. G. (1938), *The National Income of Australia*, Angus & Robertson, Sydney.

Commonwealth Bureau of Census and Statistics, *Australian Demography Bulletin*, Canberra, various issues.

—— (1911), *Census of the Commonwealth of Australia 1911 Volume 2: Detailed Tables*, Canberra.

—— *Commonwealth Finance*, Canberra, various issues.

—— *Commonwealth of Australia Finance Bulletin*, Canberra, various issues.

—— *Public Authority Finance—Federal Authorities*, Ref. no. 5.12, Canberra, various issues.

—— (1965), *University Statistics 1964*, Canberra.

Diamond, P. (1996), 'Generational Accounts and Generational Balance: An Assessment', *National Tax Journal* **49**, 4, 597–607.

Fehr, H. and Kotlikoff, L. J. (1997), 'Generational Accounting in General Equilibrium', *FinanzArchiv* **53**, 1, 1–27.

Harding, A. (1995), 'The Impact of Health, Education and Housing Outlays Upon Income Distribution in Australia in the 1990s', *Australian Economic Review*, 3, 71–86.

Haveman, R. (1994), 'Should Generational Accounts Replace Budgets and Deficits?', *Journal of Economic Perspectives* **8**, 2, 95–111.

Kotlikoff, L. J. (1997), 'Reply to Diamond's and Cutler's Reviews of Generational Accounting', *National Tax Journal* **50**, 2, 303–14.

—— and Raffelhüschen, B. (1999), 'Generational Accounting Around the Globe', *American Economic Review* **89**, 2, 161–6.

Raffelhüschen, B. and Risa, A. E. (1997), 'Generational Accounting and Intergenerational Welfare', *Public Choice* **93**, 1–2, 149–63.

Robinson, M. (1997), *Intergenerational Equity, Deficits and Generational Accounting*, School of Economics and Finance Discussion Paper No. 45, Queensland University of Technology.

Schofield, D. (1998), *Public Expenditure on Hospitals: Measuring the Distributional Impact*, National Centre for Social and Economic Modelling Discussion Paper No. 37, University of Canberra.

Thomson, D. (1991), *Selfish Generations—The Ageing of New Zealand' Welfare State*, Bridget Williams Books, Wellington.

—— and Tapper, A. (1993), 'Meet the Luckies. . .', *The Independent Monthly*, April, 20–23.

Walker, A., Percival, R. and Harding, A. (1998), *The Impact of Demographic and other Changes on Expenditure on Pharmaceutical Benefits in 2020 in Australia*, National Centre for Social and Economic Modelling Discussion Paper No. 31, University of Canberra.