

Fiscal Studies (1999) vol. 20, no. 2, pp. 189–203

Some Implications of Changing the Tax Basis for Pension Funds

MARGARET E. ATKINSON, JOHN CREEDY and DAVID M. KNOX*

Abstract

Governments in many developed economies provide private pension plans with significant taxation incentives. However, as many retirement income systems are now being reviewed due to demographic, social and economic pressures, these taxation arrangements are also under scrutiny. This paper discusses some of the implications of the differences between the traditional taxation treatment adopted by most OECD nations and that adopted by Australia, where there is a tax on contributions, a tax on investment earnings and a tax on benefits. The results show that there are significant differences in the net value of the benefits received by individuals and the taxation revenue received by the government. On the other hand, it is shown that there is remarkably little to distinguish between the two tax structures in terms of summary measures of lifetime income, although the form in which the benefit is taken in retirement is significant in influencing intragenerational equity.

JEL classification: D31, E27.

I. INTRODUCTION

The provision of income to retired persons is subject to much debate and reform throughout the world, with governments of countries at all stages of economic development expressing considerable interest in the topic and, in some cases, making far-reaching decisions. These changes are affecting both national social security programmes and private (or occupational) pension plans. The reasons for this awakening of interest in the development of national retirement income systems vary among countries. Some factors that have been important are: an ageing population which has placed increased financial pressure on existing retirement income programmes; increasing longevity; lower saving rates;

*University of Melbourne.

changing employment patterns which have led to an increase in early retirements and greater flexibility in labour markets; international pressure (for example, in the European Union); and the decline of family and other informal support structures. For a comparative review, see Disney (1996).

For several decades, governments in many developed economies have provided private pension schemes with significant taxation incentives. The value of these incentives has been an important factor in the popularity of these pension schemes, particularly as personal income tax rates have risen during this century (World Bank, 1994).

However, one of the possible responses to the financial and social pressures besetting retirement income programmes could be to review the traditional taxation treatment of occupational pension plans. Yet very few developed countries have made any significant changes to the taxation treatment of occupational pension plans. Australia and New Zealand are two exceptions. Indeed, New Zealand is the only OECD nation to remove totally these taxation incentives and is now taxing occupational pensions in a similar manner to other forms of savings. Not surprisingly, this adjustment has reduced the popularity of pension plans (Davis, 1995). Australia has also made some fundamental changes to its taxation treatment of pension plans whilst maintaining some taxation support.

The objective of this paper is to discuss some of the implications of the revised taxation treatment adopted by Australia when compared with the traditional taxation treatment adopted by most other OECD nations. These results may then assist policymakers and governments in reviewing the tax treatment of private pension plans. Section II of the paper compares the tax treatment of pension plans in Australia with a typical OECD structure and outlines some of the reasons for, and effects of, the changes. Section III briefly describes the model used for the comparisons of intragenerational equity, while Section IV sets out the results obtained when the two approaches are compared. Section V sums up and presents some conclusions.

II. A COMPARISON OF THE TAX STRUCTURES

1. The Traditional Approach

The most common approach to the taxation of private or occupational pension plans has been to permit employers and employees to claim a tax deduction for their pension fund contributions and to exempt these contributions and the subsequent investment income of the pension fund from any immediate taxation. However, the benefits paid from the pension fund are subject to full taxation when received by the individual. This is often known as the EET approach — namely, tax-exempt contributions, tax-exempt investment income but taxable benefits; for example, see Knox (1990), Dilnot and Johnson (1993) and Dilnot et

al. (1994). The principal advantages to the taxpayer of this approach are that the tax is deferred and that the subsequent level of income tax is reduced (assuming a progressive income tax rate structure), as the level of income received is normally lower in retirement than during the working years.

This traditional tax treatment of pension plans stands in contrast to the normal tax treatment of savings, which arise from after-tax earnings where tax is also paid on the investment income. However, no tax is payable on the withdrawals (or benefits). This system is often known as the TTE approach — that is, tax on contributions (or savings), tax on the investment income but no tax on the benefits since they arise from previously taxed savings.

To limit the size of the possible tax incentives provided to pension plans, many countries limit the level of tax-deductible contributions, the size of benefits or the amount of surplus that can be maintained in occupational pension plans (World Bank, 1994).

2. The Australian Approach

Prior to 1988, Australian pension (or superannuation) plans were taxed according to the traditional method of taxing pension plans — namely, the EET approach. As mentioned above, this meant that the receipt of any taxation was deferred until retirement, which involved a deferral of many years. In an environment where the levels of contributions and pension assets were growing and where the government's budget was under financial pressure, this long-term deferral of taxation revenue was considered to be inappropriate.

The government's primary motivation was to bring forward the revenue that it would otherwise receive in the future and thereby improve its immediate budgetary position. This objective is confirmed by Keating (1988, p. 5), who stated that 'By collecting tax now rather than on a deferred basis, the budgetary cost of the superannuation arrangements is greatly reduced, but the incentive to save through superannuation is unchanged'. A secondary incentive was to improve the allocation of resources within the capital markets. Again, Keating (1988, p. 5) highlighted the rationale, as follows:

by imposing a light tax on superannuation fund investment earnings, the Government is able to significantly improve the business tax system. Full [dividend] imputation credits will be granted ... [and] this will encourage fund managers to invest in Australian companies as well as to reduce the preference for debt financing over equity. A number of tax avoidance arrangements will also be largely overcome by this change.

The changes, introduced in 1988, can be summarised as follows:

- A 15 per cent tax is paid by the pension fund on the receipt of all employer contributions and tax-deductible contributions from the self-employed. Most employer contributions remain tax-deductible for employers as a business expense (subject to prescribed limits) but the pension fund receiving these contributions must pay a 15 per cent tax on them. In practice, the effective tax rate is slightly reduced by deductions for administration and insurance charges.
- A 15 per cent tax is paid by the pension fund on the investment income received. In practice, the effective tax rate may be significantly reduced by dividend imputation and other investment credits obtained by the fund. One of the reasons for this change was to bring the pension funds into the tax system so that they could receive the benefits of the dividend imputation system. It was argued that, without this involvement, the funds had an incentive to invest in ways that passed the imputation credits on to other investors which, in turn, resulted in inefficient capital markets.
- There is a reduction in the tax rate payable on retirement benefits of 15 percentage points to allow for the tax previously paid on tax-deductible contributions. However, employee contributions are not tax-deductible and these contributions are therefore excluded from the benefits ultimately subject to taxation. Nevertheless, some employees continue to contribute because of requirements by the employer or to receive the concessional tax rate on investment income.

These changes mean that the Australian occupational pension system is now subject to a tax on deductible contributions (from employers and the self-employed), a tax on the fund's investment income and a tax on the resulting benefits. However, as none of these taxes is at the full rate, the system may be described as the 'ttt' approach — that is, a limited tax on contributions, investment income and benefits. For most income earners, the pension (or superannuation) system remains a tax-advantaged option although the introduction of tax at the three stages has made it more complex such that the level of taxation support is much less transparent.

Table 1 outlines the major differences in the tax treatment for occupational pension plans between the Australian system and the assumed OECD style as modelled in this paper.

Once future government revenue has been brought forward (as occurred with the 1988 changes), it is difficult to return to the former arrangements because of the relative importance of this income item in the government's budget. This Australian experience should act as a salutary warning to other countries. The traditional deferred approach to the taxing of occupational pension benefits was removed in 1988 and replaced with immediate taxation on contributions and investment income and reduced taxation on future benefits. Whilst the government could argue that there was limited additional taxation, the shift was

TABLE 1
A Brief Summary of the Two Taxation Structures

<i>Item</i>	<i>Tax rate in Australia</i>	<i>Tax rate assumed in OECD</i>
Employer contributions	15%	Nil
Investment income	7.5% (net) ^a	Nil
Lump-sum benefits	0% up to \$77,796 ^b then at 16.4%	15% up to \$77,796 ^b then at 31.4%
Pension benefits	Marginal income tax rates less a rebate of 15 percentage points	Marginal income tax rates

^aThe effective tax rate on investment income has been assumed to be 7.5 per cent and not 15 per cent due to the presence of dividend imputation credits.

^bMany benefits in Australia are paid in the form of lump sums and the prevailing tax rates applying to these payments have been shown. The assumed rates for the OECD structure have been set to these rates and then increased by 15 percentage points. It is also noted that a limited tax-free lump-sum benefit is available in the UK.

very significant. Occupational superannuation and pension arrangements are no longer outside immediate government revenue considerations and have formed part of Budget announcements on a regular basis since 1988. This has been unsettling for investors in a long-term product and has caused a reduction in the community's confidence in their superannuation arrangements.

3. The Effects of the Different Tax Arrangements

The effect of the different taxation treatments on the benefits received by members of the fund can be demonstrated as follows. Let C represent the contribution paid into the fund, I the annual pre-tax earnings yield of the fund, N the period in years from the contribution date to the retirement date, t_C the tax rate on contributions, t_I the tax rate on investment earnings, t_B the tax rate on benefits and NRB the net retirement benefit as at the date of retirement. Therefore, allowing for each of the terms,

$$NRB = C (1 - t_C) (1 + \{1 - t_I\}I)^N (1 - t_B).$$

It is apparent that if the tax rate on benefits (t_B) is replaced by a tax on contributions (t_C) at the same rate, there is no change in the value of the net retirement benefit. However, such a change is difficult to implement, as the actual tax rate on the gross retirement benefit is unknown in advance, since the benefit may be taken in a variety of forms, each of which is subject to differing tax treatments.

As indicated above, most arrangements in OECD countries have both the tax on contributions and the tax on investment income set at zero, so that the tax on benefits is the only relevant tax rate. By contrast, the Australian arrangements

TABLE 2
Net Retirement Benefits under Different Taxation Treatments

<i>Term in years (N)</i>	<i>Australia</i>	<i>OECD</i>	<i>Australia/OECD</i>
5	1.1411	1.1540	98.88%
10	1.7020	1.7755	95.86%
20	3.7865	4.2033	90.08%
30	8.4241	9.9508	84.66%
40	18.7417	23.5571	79.56%

impose a tax rate at each stage. To indicate the effects of these changes on the net retirement benefit (NRB), Table 2 sets out the value of the NRB for a single contribution assuming a 15 per cent tax on contributions, a 7.5 per cent tax on investment earnings and an average tax rate of 10 per cent on benefits in Australia, compared with a 25 per cent tax on benefits only for the OECD structure. A pre-tax investment yield of 9 per cent per annum is assumed.

Table 2 highlights the significant reduction in the benefits under the Australian arrangement that occurs over the longer term due to the compounding effect of a lower net investment yield. Whilst Table 2 is limited to a single investment, similar results occur when contributions are assumed to be made regularly over a lifetime. For instance, there is a 12 per cent reduction in the accumulated benefit if it is assumed that contributions are made for 40 years and salaries increase at 6 per cent per annum.

The effects are broadly similar for different tax mixes. For instance, if a 25 per cent tax is assumed on contributions with a zero tax on benefits instead of the Australian mix used in Table 2, the percentages in the final column range from 96.9 per cent to 78.0 per cent. Naturally, if a higher investment tax is assumed, there are greater effects over the longer term due to the compounding effects.

However, these changes also affect the value of the taxation revenue received by the government. The replacement of a tax on benefits with a similar tax rate on contributions will, in most circumstances, reduce the long-term value of the revenue received by the government. This result occurs if the discount rate used in valuing the government's future tax revenue is less than the investment yield earned by the pension fund. In essence, the present value of a tax on benefits exceeds the present value of a tax on contributions under these circumstances. Such a result raises the question as to the appropriate discount rate for a government to use. However, in most circumstances, the appropriate long-term rate is less than the long-term investment yield earned by a fund that invests in equities, properties and bonds. As Brown (1993, p. 17) suggests, 'the worth of the tax concessions is likely to be very sensitive to the government discount rate assumed. If we assume the Government discount rate is equal to the

Government's cost of funds, it is ... more likely that we will assess the tax concessions as "worthwhile".'

The major motive for the Australian change in 1988 was to improve the immediate budgetary position of the present government. The likely consequence has been to reduce the present value of future taxation revenue by a larger amount.

4. Other Australian Background

Before proceeding to discuss the model used in this research, it is useful to review briefly the two major components of the retirement income arrangements in Australia. They are the State-funded age pension and the mandatory superannuation system, which is funded, invested and administered in the private sector.

State-Funded Age Pension

Since early this century, the federal government has provided a means-tested age pension to Australians who meet certain residential and age requirements. The level of the full age pension is, for a single person, 25 per cent of male average earnings and, for a married couple, about 40 per cent of male average earnings. The pension is funded from general government revenue and not from a special tax or social security contribution.

The most controversial aspect of the age pension is the means tests. There are two means tests, one based on income and the other based on assets (excluding the primary residence). The income test affects most pensioners and reduces the value of the pension received by 50 cents for every dollar of income above a minimum level.

Currently, more than 80 per cent of the aged population receive a full or part pension from the government, with about two-thirds of recipients receiving the full pension. Notwithstanding the recent development of the compulsory superannuation system, it is expected that most Australian retirees will receive a part or full pension from the government for many decades.

Mandatory Superannuation

Traditionally, occupational pension (or superannuation) plans were provided by larger employers to attract and retain staff and/or to reward longer-serving employees. Superannuation coverage tended to be concentrated amongst full-time, male, white-collar employees. Indeed, in 1974, only 32 per cent of all employees were covered by superannuation; this coverage increased gradually to 40 per cent in the mid-1980s.

This lack of superannuation coverage amongst some sections of the workforce motivated the trade union movement to enter the superannuation debate

during the 1980s. The result was that, by January 1989, industrial awards required an employer contribution to superannuation of 3 per cent of wages. A major effect of these industrial award decisions was to increase superannuation coverage to 72 per cent of all employees by 1991.

The next extension occurred in July 1992 when the federal government introduced the Superannuation Guarantee Charge (SGC), which prescribed a minimum level of employer support of superannuation for employees. The minimum level commenced at 3 per cent or 4 per cent of earnings in July 1992 and is rising gradually to 9 per cent of earnings in July 2002. As may be expected, this legislation has further increased the level of superannuation coverage, to more than 90 per cent of full-time employees.

Although the SGC may be considered to be a quasi-national retirement benefits scheme, it operates, unlike many national schemes, on a funded basis and the administration and investment are carried out in the private sector. Hence there are tens of thousands of funds, ranging in value from a few thousand dollars to in excess of several billion dollars.

The planned minimum employer contribution rate of 9 per cent of earnings from July 2002 has been assumed in this research. An employee contribution of 3 per cent has also been assumed. Whilst this employee contribution is not compulsory, the previous Labor Government indicated that the 9 per cent goal was not sufficient in the long term and had suggested a minimum employee contribution rate of 3 per cent of earnings.

III. THE MODEL USED

The results in Section IV are based on the LITES (Lifetime Income, Taxation, Expenditure and Superannuation) model, which is a cohort microsimulation model where each individual receives a unique earnings profile during the pre-retirement years, based on Australian earnings data. Each individual's earnings profile contains an annual increase that is based on the assumed average increase for the community, the shape of the lifetime earnings profile plus a random variable designed to reflect the uncertainty of an individual's earnings. In effect, this means that individuals do not receive the same proportion of the average wage throughout their life but a more realistic lifetime earnings profile. Further details are outlined in Appendix A.

The model also allows for earnings, pension fund contributions, taxes throughout the person's life (both before and after retirement), receipt of the government-funded age pension (which may be subject to the means tests) and a range of alternatives in terms of expending the superannuation benefit at retirement. A full description of the model is found in Atkinson, Creedy and Knox (1997).

The model also requires a number of macroeconomic assumptions as it projects an individual's earnings, expenditures and savings over several decades.

The most important assumptions relate to the relative values of the various rates. For instance, it is assumed that the pre-tax rate of return for the pension funds is 3 percentage points per annum greater than the increase in the average wage. Further assumptions are listed in Appendix B.

For this paper, the cohort consists of 3,000 males in full-time work, each of whom commences earning at the age of 20 and retires at the age of 65. The LITES model produces a number of economic summary measures in respect of the cohort. The summary measures provide some insights into the relative equity or progressivity for a range of alternative retirement income structures and/or different behaviour decisions by the individuals.

One of the objectives of this paper is to assess the effects of alternative taxation structures for pension funds on the equity between members in the same cohort. Hence this paper reports summary measures based on net lifetime income, including the Gini coefficient and the Kakwani measure of progressivity. It is possible to produce others, but Creedy (1997) has shown that the general trends are the same for the major inequality and progressivity measures used in the economic literature. It should also be noted that the absolute values of these numbers are less important than the relative values and than changes that occur due to different structures and/or behaviours.

IV. RESULTS

Table 3 presents the results for the selected summary measures assuming a total contribution of 12 per cent of earnings, with a 3:1 split between the employer and employee. These results assume either uniform or differential mortality rates. The results also allow for five different behaviours by the individuals in the cohort at retirement. In each example, it is assumed that all individuals in the cohort behave in the same manner. The assumed annuity rate is the same under both the Australian and the OECD arrangements, as there is no tax paid in Australia on the investment income of assets that are used specifically to back the payment of complying annuities.

The selected behaviours range between the extremes of converting the total accumulated benefit at retirement into a lifetime annuity and of immediately spending the total benefit and relying only on the government age pension to provide retirement income. The bank option allows the retiree to invest the benefit in the bank and gradually withdraw the benefit over 15 years. Although these assumed behaviours may appear rather restrictive, Atkinson and Creedy (1996) have shown that these behaviour assumptions do not distort the results when alternative schemes are compared. They are also a reasonable representation of realistic options.

One other variation should be noted. As previously discussed, the government age pension in Australia is means-tested. The last two options in Table 3 vary this assumption and allow for the removal of the means tests and the introduction

TABLE 3
A Comparison of the Summary Measures for the Two Tax Systems

Standard mortality						
<i>Option</i>	Kakwani		Gini inequality		Total tax ratio	
	<i>Australia</i>	<i>OECD</i>	<i>Australia</i>	<i>OECD</i>	<i>Australia</i>	<i>OECD</i>
i. 100% annuity	0.3897	0.3794	0.2122	0.2147	0.1593	0.1583
ii. 50% annuity, 50% bank	0.4374	0.4417	0.2091	0.2100	0.1497	0.1470
iii. 50% annuity, 50% spent	0.5082	0.5301	0.2100	0.2096	0.1302	0.1260
iv. 100% bank	0.4592	0.4877	0.2064	0.2040	0.1479	0.1441
v. 100% spent	0.5710	0.6340	0.2115	0.2082	0.1154	0.1093
Option (i) + universal pension	0.4874	0.5187	0.2118	0.2108	0.1322	0.1267
Option (v) + universal pension	0.5328	0.5908	0.2128	0.2095	0.1208	0.1147

Differential mortality						
<i>Option</i>	Kakwani		Gini inequality		Total tax ratio	
	<i>Australia</i>	<i>OECD</i>	<i>Australia</i>	<i>OECD</i>	<i>Australia</i>	<i>OECD</i>
i. 100% annuity	0.2579	0.2468	0.2425	0.2449	0.1557	0.1542
ii. 50% annuity, 50% bank	0.3369	0.3419	0.2291	0.2293	0.1491	0.1465
iii. 50% annuity, 50% spent	0.3821	0.3996	0.2315	0.2309	0.1297	0.1257
iv. 100% bank	0.3915	0.4190	0.2171	0.2145	0.1510	0.1470
v. 100% spent	0.4738	0.5306	0.2242	0.2208	0.1170	0.1109
Option (i) + universal pension	0.3105	0.3284	0.2459	0.2458	0.1272	0.1219
Option (v) + universal pension	0.4478	0.5006	0.2244	0.2210	0.1223	0.1162

Note: Pre-tax Gini inequality value = 0.2860.

of a universal age pension from age 65. The major reason for presenting this option is to explore the effect of removing the means tests in terms of the overall equity of the system. After all, one of the arguments for a means-tested age pension is that it concentrates the payment of the age pension to those in greatest need, thereby improving poverty alleviation and the overall progressivity of the taxation and social security systems.

The most notable result from Table 3 is that the summary measures are much more affected by the assumed behaviour at retirement than by the different tax

structures. In addition, the progressivity tends to be lower (as shown by lower Kakwani and higher Gini measures) when option (i) is used, and greater when option (v) is used, under both structures. The introduction of a universal pension and the corresponding abolition of the means tests reduce the range of values under both systems. In comparing the two tax structures, the range of values of summary measures for the assumed OECD case is greater, indicating that the progressivity of the system is more sensitive to retirement behaviour than it is in the Australian system.

However, the values provided by the two systems are comparable, and it therefore appears that the value of the higher rate of taxes on benefits under the assumed OECD structure is broadly comparable in effect (in terms of equality and progressivity) to the value of a measure of tax exemption for contributions before retirement.

In fact, not all of the behaviour options are available to retirees under typical OECD conditions. For example, option (v) — the immediate consumption of the total accumulated benefit — is commonly not permitted. To take the comparison out of the theoretical framework, actual cohort behaviour might be expected to resemble option (iii) for Australia and option (i) with the universal pension for many OECD nations. If the summary measures for these two cohort behaviours are compared, they are found to be remarkably similar.

Table 3 also shows the results when differential mortality is assumed. As mortality is linked to socio-economic conditions (see Carney and Hanks (1994)), it is appropriate to consider mortality rates that are related to lifetime income. In this model, each individual's age at death is assumed to depend on his annual average real income in relation to the cohort as a whole, with the addition of a further stochastic component. The survival curve of the simulated population closely replicates the curve for the Australian male population. Many of the similarities between the two taxation arrangements, noted above, also hold true for this assumption.

Perhaps the most interesting result here is that, under both mortality assumptions, and under both tax structures, the removal of the means test on the age pension increases the progressivity of option (i) (as shown by a higher Kakwani measure) and narrows the range of the summary values spanned by the two extreme behaviours. Thus the removal of the means tests improves the relative progressivity of the 100 per cent annuity option and dampens the extent of the fluctuation that is dependent upon behaviour after retirement.

Under differential mortality, the level of progressivity is lower and the inequality index higher, for both the Australian and OECD tax structures. Not surprisingly, this result is caused by the additional pension payments received by those who live longer and who, on average, received higher incomes during their working years. These additional pension payments would be received from both the public pension and private annuity arrangements.

The above results assumed no additional saving outside the pension fund. However, many individuals have savings both within and outside their pension fund. Hence comparative summary measures were calculated for both mortality assumptions assuming an additional saving of 5 per cent of disposable income during the working years, outside the pension system. The additional savings element reduces progressivity in all cases, with a reduction in the Kakwani measure ranging from 0.0380 to 0.0561 for the Australian arrangement and from 0.0379 to 0.0608 for the OECD example, assuming standard mortality. As would be expected, the total tax ratio increased in all cases. Otherwise the comparisons between the OECD and Australian structures, and between the different retirement behaviours, are as reported for the case of no additional savings.

V. CONCLUSIONS

This paper set out to discuss and investigate some of the implications of fundamental changes to the taxation system for pension funds. In particular, it has compared the existing taxation arrangements in Australia, where there exist taxes on contributions, fund investment income and benefits, with the standard approach adopted in many OECD countries, where the contributions and investment income are tax-exempt but the resulting benefits are subject to full taxation.

The results in this paper indicate that there is remarkably little to distinguish between the OECD and Australian tax structures for pension funds when summary measures of lifetime income are used to assess intragenerational equity. Under both tax structures, it is apparent that behaviour choices at retirement are very significant in influencing equity. Also, the progressivity measures indicate that the effects on progressivity of the OECD structure are more sensitive to retirement behaviour choice than the effects under the Australian system. If it is considered desirable to encourage the use of income streams, the Australian structure compares favourably in that it provides a slightly more progressive result than the OECD system. On these two considerations, the Australian scheme seems to be fulfilling the desired requirements a little better than the OECD structure, since it is more independent of retirement behaviour. However, the regulations in most OECD nations do not permit the range of behaviours that is permitted in Australia, so the actual range of effects is smaller for the OECD than the theoretical comparative figures suggest.

A striking general result is that the introduction of a universal pension into either structure has three impacts: the range of the effect of progressivity covered by the extreme behaviours is narrowed, the annuity option is associated with higher progressivity and the consumption option is associated with reduced progressivity. This would seem to support the two aims of progressivity and the encouragement of income streams as opposed to lump-sum benefits. This finding

supports the conclusions in Atkinson, Creedy and Knox (1996) which show that the removal of means testing results in a more consistent overall effect across the range of behaviours.

The major differences between the tax structures arise as a result of the 15 per cent tax on contributions and investment income under the Australian structure. The tax on contributions brings forward revenue (in terms of the government's immediate budgetary position) but is likely to reduce the value of total taxation revenue over the longer term.

The introduction of a tax on investment earnings reduces the investment return achieved by the fund which, in turn, must reduce the accumulated benefit. In certain circumstances, this may result in individuals choosing to defer retirement because of the smaller benefit available. It is difficult to assess the impact of this tax on behaviour at or near retirement as there are many factors that affect the age of retirement, including existing economic conditions, availability of employment, taxation policy and the availability of social security. A reduced net benefit is also likely to cause increases in future social security benefits, particularly in a means-tested environment. Atkinson and Creedy (1997) considered the optimum combination of retirement age and behaviour under a number of different utility evaluation methods. The results, in short, suggest that if differential mortality is taken into account, those who have sufficient funds to be affected by the means tests tend to purchase as much annuity as possible without losing their right to the age pension, and then spend the remaining benefit. If the means testing is removed, these individuals are inclined to retire later and to purchase larger annuities.

The overall results in this paper show that there are minimal differences between the two tax structures when assessed in terms of the summary measures of lifetime income used to assess progressivity within a cohort of full-time male workers. However, there are significant differences in the net value of the retirement benefits received as well as in the timing and size of the taxation revenue received by the government. These important conclusions are relevant internationally, as many governments are now reviewing the taxation and financial arrangements of private pension programmes.

APPENDIX A. DETAILS OF THE EARNINGS PROFILES

A salary stream $X(t)$ is constructed to represent the working life of the individual, using a stochastic model. Earnings in the first year are obtained by taking a random drawing from a log-normal earnings distribution with mean and variance of logarithms μ_1 and σ_1^2 . Mean log earnings at time t , $\mu(t)$, are a quadratic function of age and are given by

$$\mu(t) = \mu_1 + \theta t - \delta t^2.$$

The nominal growth rate of earnings is added to the parameter θ . The simulation process used to produce the profile $X(t)$ is given by

$$X(t) = X(t-1) \exp\{\mu(t) - \mu(t-1) + u(t)\}$$

where $u(t)$ is a random normal variable with mean 0 and variance σ_u^2 . The parameters of the model, using Australian income distribution data, are $\mu_1 = 9.98064$, $\theta = 0.0385$, $\delta = 0.00086$, $\sigma_1^2 = 0.1817$ and $\sigma_u^2 = 0.00575$.

APPENDIX B. ASSUMPTIONS USED IN THE MODELLING

The major assumptions used in the simulations are given below.

1. Both Structures

Contribution rates	Employer	9% of earnings
	Employee	3% of earnings
Ages of fund membership	Entry	20
	Retirement	65
Annual increase in average wages		6%
Annual increase in income tax thresholds		5.5%
Annual inflation rate		5%
Gross annual investment rate of return on fund accumulation		9%
Gross annual investment rate of return on savings accumulation		7%
Gross annual rate of return on bank account during retirement		5%
Tax on savings fund investment income		25%
Purchase price of retirement annuities		12.5
Annuities purchased escalate in payment at		5%

2. Australian Assumptions

Tax on employer contributions	15%
Tax on superannuation fund investment income	7.5%

REFERENCES

- Atkinson, M. E. and Creedy, J. (1996), 'Measuring optimal retirement decisions in Australia', *Australian Economic Papers*, vol. 35, pp. 39–59.
- and — (1997), 'The choice of early retirement age and the Australian superannuation system', *Australian Journal of Labour Economics*, vol. 1, pp. 1–24.

Changing the Tax Basis for Pension Funds

- , — and Knox, D. M. (1996), 'Alternative retirement income strategies: a cohort analysis of lifetime distribution', *Economic Record*, vol. 72, pp. 97–106.
- , — and — (1997), 'Simplifying superannuation taxation: the implications for lifetime equity', in J. G. Head and R. Krever (eds), *Taxation towards 2000*, Australian Tax Research Foundation.
- Brown, C. L. (1993), 'Tax expenditures and measuring the long term costs and benefits of retirement income policy', Conference Paper no. 93/1, Canberra: Retirement Income Modelling Task Force.
- Carney, T. and Hanks, P. (1994), *Social Security in Australia*, Melbourne: Oxford University Press.
- Creedy, J. (1997), 'Lifetime inequality and tax progressivity with alternative income concepts', *Review of Income and Wealth*, vol. 43, pp. 283–95.
- Davis, E. P. (1995), *Pension Funds Retirement-Income Security, and Capital Markets: An International Perspective*, Oxford: Clarendon Press.
- Dilnot, A., Disney, R., Johnson, P. and Whitehouse, E. (1994), *Pensions Policy in the UK: An Economic Analysis*, London: Institute for Fiscal Studies.
- and Johnson, P. (1993), *The Taxation of Private Pensions*, London: Institute for Fiscal Studies.
- Disney, R. (1996), *Can We Afford to Grow Older?*, Cambridge, Mass.: MIT Press.
- Keating, P. J. (1988), *Reform of the Taxation of Superannuation*, Canberra: Australian Government Publishing Service.
- Knox, D. M. (1990), *A Review of the Options for Taxing Superannuation*, Sydney: Australian Tax Research Foundation.
- World Bank (1994), *Averting the Old Age Crisis*, Oxford: Oxford University Press.