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**Changes in the Taxation of Superannuation:
Macroeconomic and Welfare Effects**

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Changes in the Taxation of Superannuation:

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Abstract

This paper provides an applied general equilibrium analysis of several alternative taxation regimes applying to superannuation. It is motivated by the decision, announced by the Australian Government in its 2006 Budget, to exempt from tax all superannuation benefits received by recipients over 60 years of age. The analysis focuses on the implications of this and other superannuation tax regimes for intergenerational equity, national living standards, labour supply, saving and social welfare. The method of analysis is simulation of an open economy overlapping generations CGE model, calibrated to Australia.

JEL codes: H31, H32, J18, E21

1 Introduction

Superannuation tax structures can be broadly described in terms of the treatment during three separate stages. These concern the contributions to a superannuation fund from pre-tax income, the earnings obtained by the fund and the income withdrawn from the fund after retirement. The letters T and E are used respectively in turn to indicate whether the component is taxed or is exempt, so that, for example, a system is described as being of the TTT variety if tax is imposed in all three stages.

The aim in this paper is to examine, using an overlapping generations general equilibrium model, unanticipated shifts from a TTT structure to other tax systems: TTE, ETT and EET. The latter is the common model in OECD countries and Horne (2002) pointed out that Australia was the only OECD country to adopt the TTT system. In the analysis presented here, it is assumed that any change to superannuation taxation must be budget neutral, implying either increases in other taxation or cuts in government spending.

This paper is motivated by the changes to the taxation of superannuation announced in the 2006 Australian Government Budget. One important change was the decision to exempt from tax all superannuation benefits, whether taken in the form of a lump sum or annuity, for all people over 60 years of age and to apply from 1 July 2007. This was unanticipated and therefore has the potential to significantly affect saving plans, especially for middle-aged workers, with resulting implications for intergenerational equity. There are also several potential general equilibrium effects. Changes in tax rates can affect the relative price of leisure and present consumption relative to future consumption, thereby affecting labour supply and saving.

The budgetary implications for the government may be non-trivial given population ageing because the government has cut off a revenue stream that would otherwise have grown with the increasing proportion of households who are self-funded retirees. This is likely to be a bigger issue if superannuation contribution rates increase in response to the new tax incentives.[1] The government's budget constraint implies that other taxes must ultimately rise,

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[1] Davidson and Guest (2006) calculated the potential fiscal costs of the tax exemption of superannuation benefits in the future given alternative assumptions about increasing contribution rates. The fiscal costs of the superannuation changes, while small at current contribution rates, could escalate substantially for modest

or spending must fall, in response to superannuation tax concessions. These adjustments cause offsetting effects on labour supply, saving and equity.

It can be shown that under certain assumptions the various tax regimes are equivalent in the sense that a shift from a TTT to a TTE regime would have no effect on lifetime superannuation balances and therefore no behavioural effects for optimising agents. See the Appendix and, for a continuous time exposition, Kingston and Piggott (1993). However a critical assumption underlying this equivalence is neutrality with respect to superannuation revenue (in present value terms) which is unlikely to apply and could not be assumed by households to apply. This, and the fact that tax policy changes are almost always unanticipated by households, means that such changes have the potential to affect saving plans with resulting implications for intergenerational equity, macroeconomic variables and economic welfare. The initial effects are likely to be stronger than the long run effects because the unanticipated nature of the policy causes relatively large adjustments immediately following the shock as middle aged households, in particular, adjust their behaviour over a short time frame.

The simulations ignore the many complexities of the regulations governing the taxation of superannuation which take into account a range of circumstances of taxpayers. Rather, the simulation model is based on the behaviour of a single representative household of each generation. This means that it cannot reveal effects on within-generation income inequality which could be substantial given the variation of superannuation balances of individuals within generations.[2]

Although the model determines the optimal labour-leisure choice of workers it does not consider the portfolio allocation problem in terms of the decision about the proportion of financial wealth to allocate between superannuation and other financial assets.[3] Instead of endogenising the choice of portfolio mix the model assumes, in line with the Australian mandatory system, an exogenous and constant rate of superannuation contributions is initially

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increases in contribution rates. Their calculations were not based on optimising decisions and therefore did not attempt to model any general equilibrium effects, such as labour supply and saving responses, nor was there any consideration of intergenerational equity and social welfare.

[2] Atkinson, Creedy and Knox (1996) considered within-generation inequality in their analysis of alternative retirement income strategies using the LITES microsimulation model. But their model did not allow a general equilibrium analysis or an analysis of inequality between generations.

[3] The latter is analysed in a life-cycle model with endogenous leisure by, for example, Bodie, Merton and Samuelson (1992).

assumed in the base case. Later, simulations are reported for increasing contribution rates over time. The retirement age is also exogenous. However, households optimally vary their labour force participation rates over their lifetime, given initial rates according to data.[4]

The paper proceeds as follows. Section 2 describes the simulation model; Section 3 describes the data and parameter values; Section 4 discusses the results and Section 5 concludes.

2 The model

The simulation model is an open economy, overlapping generations model with four sectors: firms, households, government and an overseas sector.

2.1 Firms

A representative firm produces output of a single good according to a Cobb-Douglas production function. Output, Y, in period j is given by

$$Y_j = K_j^{\alpha} \left(AL_j \right)^{1-\alpha} \tag{1}$$

where A is an exogenous technology parameter[5], K_j is the capital stock in year j, and L_j is aggregate labour. The latter consists of the sum of the labour of all generations. Hence $L_j = \sum_{i=1}^{n} L_{i,j}$ where $L_{i,j}$ is the labour of generation i working in year j.

The optimal capital stock, K_j, is determined by the first-order condition that the net marginal product of capital (net of depreciation, δ) is equal to the cost of capital, r, which is assumed to be constant implying the small open economy case. That is, $\dfrac{dY_j}{dK_j} - \delta = r$, which gives:

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[4] See Kulish, Smith and Kent (2006) for a model of optimal retirement in response to population ageing in the Australian context. Their aim is to consider the effects of changes fertility and longevity on the retirement age rather than to consider policy shocks as here.

[5] The technology parameter is constant, implying zero technical progress. The reason, as also given in Kulish et al. (2006), is that the leisure to consumption ratio would eventually decline to zero with continual productivity-induced rises in real wages. See Auerbach and Kotlikoff (1987) for a further discussion. It would be possible to specify a non-standard utility function that could deal with this problem in the presence of technical progress, but this is not pursued here.

$$\frac{K_j}{L_j} = A\left(\frac{\alpha}{r+\delta}\right)^{1/(1-\alpha)} \tag{2}$$

Investment, I_j, is given by:

$$I_j = K_j - K_{j-1}(1-\delta) \tag{3}$$

The price, $w_{L,j}$, of labour is equal to the marginal product of labour:

$$w_{L,j} = (1-\alpha)\left(\frac{K_j}{L_j}\right)^{\alpha} = \frac{Y_j}{L_j} - (r+\delta)\frac{K_j}{L_j} \tag{4}$$

and it is a weighted average of the wages of all workers of age i in year j, $w_{L,i,j}$, which is achieved by calibration (see the section below on data and parameters).

2.2 Households

Firms produce a single good and households consume that good and leisure. A period of time is five years duration and a new generation of households is born each period.[6] Each household consists of one person who dies at age 90, implying that there are $h = 18$ overlapping generations of households alive at any time. The households supply labour for the $n = 11$ periods between the age of 15 and 70. Households pay tax on income from both capital and labour (discussed below). Future values of the demographic variables and the parameters are known with certainty, except for the policy shock which comes as a surprise at which time households must adjust their plans accordingly.

Households derive utility from consuming private goods, C, public goods, C_G (the price of which is normalised to one), and leisure, S. Following the approach in Foertsch (2004), C_G is exogenous and separable from both private consumption and leisure in generating utility. Therefore C_G does not affect the household's choice of private consumption or leisure. It is therefore ignored in the derivation of the household's optimisation problem. The assumption of separability between public and private consumption is a common assumption as noted in Foertsch (2004) because of lack of evidence about the substitutability between private and government consumption. The total resources available to the household from which to provide work effort are normalised to 1; see the discussion of work intensity below. These resources are time and a notional stock of 'effort'.

The composite index of consumption and leisure for a household of age i is:

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[6] The use of five-year periods was chosen for computational convenience.

$$M_i = \left[\mu_i^{1/\psi} C_i^{(\psi-1)/\psi} + (1-\mu_i)^{1/\psi} S_i^{(\psi-1)/\psi} \right]^{\psi/(\psi-1)} \qquad (5)$$

The preference for consumption relative to leisure, captured by the parameter μ_i, is assumed to vary over the lifecycle. It is assumed to rise up to middle age and then fall. This pattern is designed to reflect the observed life cycle pattern of consumption which tends to track the well-known observed hump-shaped pattern of income to some degree, rising during the household's working life and falling after retirement. Hence μ_i follows an inverted U-shape, given by the quadratic:

$$\mu_i = \xi_1 + \xi_2 i - \xi_3 i^2 \qquad (6)$$

where ξ_1, ξ_2, and ξ_3 are parameters determined by calibration.

Each one-person household of age i in year j earns a wage, $w_{i,j}$. This is less than the wage of each worker, $w_{L,i,j}$ in order to reflect a labour force participation rate of less than 1.[7] Hence $w_{i,j} = w_{L,i,j} L_{i,j} / N_{i,j}$. Superannuation is deducted from earnings at an exogenous and constant rate of x per cent, with the remainder of earnings subject to income tax at the rate, t_j. The tax rates $t_{s,j}$, $t_{y,j}$ and $t_{b,j}$ are the tax rates on, respectively, superannuation contributions, income on fund assets, $r_j B_{i,j}$, and end benefits, $B_{n,j}$, in period j.

Households maximise the following lifetime utility function:

$$U = \sum_{i=1}^{h} \frac{M_i^{1-\beta}}{1-\beta} (1+\theta)^{1-i} + vC_G \qquad (7)$$

where θ is the pure time preference rate. The price of private consumption goods is normalised to 1 in each period, and the 'price of leisure' at age i in period j is denoted $p_{i,j}$. Utility is maximised subject to a lifetime budget constraint which takes the following form:

$$\sum_{i=1}^{h} \left(C_i + S_i p_{i,j} \right) \left(\frac{1}{1+r(1-t_j)} \right)^{i-1}$$
$$= \sum_{i=1}^{h} \left(p_{i,j} + f_{i,j} \right) \left(\frac{1}{1+r(1-t_j)} \right)^{i-1} + Q \left(\frac{1}{1+r(1-t_j)} \right)^{h-6} \qquad (8)$$

The left hand side represents the present value of expenditure (on private consumption goods and leisure) and the right hand side is the present value of lifetime income. The latter is defined to include transfer payments, $f_{i,j}$, received by households aged i in year j and an

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[7] This is because the representative individuals must be workers, rather than non-participants.

inheritance, Q, which is assumed to be received when the household is aged $h-6=60$;[8] For simplicity, total transfer payments paid by the government in a given year are allocated evenly across all households alive in that year, rather than being allocated to certain generations. Hence total transfers in year j are $f_j = N_j f_{i,j}$. The tax rate, $t_{j,}$ is the tax rate in year j applying to income from both labour and financial assets other than superannuation.

In writing the lifetime budget constraint in the above form, it is possible to show that the effective price of leisure in each period can be expressed as $p_{i,j} = E_{i,j} w_{i,j}$ where $E_{i,j}$ is given by:[9]

$$E_{i,j} = \left(1-t_j\right) - x\left\{\left(1-t_j\right) - \left(\frac{1+r\left(1-t_y\right)}{1+r\left(1-t_j\right)}\right)^{n-i+1} \left(1-t_c\right)\left(1-t_b\left[1-\phi\right]\right)\right\} \tag{9}$$

where $n=11$ is the number of periods of superannuation contributions, t_y is the tax rate on superannuation fund earnings, t_c is the tax rate on superannuation contributions which are not otherwise subject to income tax, t_b is the tax rate on superannuation benefits, ϕ is the proportion of benefits which is tax-free, and x is the mandatory superannuation contribution rate equal to the proportion of gross earnings contributed to the superannuation fund.

The structure of $E_{i,j}$ reflects the nature of the tax regime applying to superannuation. For example, if there were no superannuation contributions, then $E_{i,j} = \left(1-t_j\right)$ and the relative price of leisure, $p_{i,j}$, is the familiar expression for the net wage, $w_{i,j}\left(1-t_j\right)$, that applies in standard single-period models of the work/leisure choice with an income tax.

It is instructive to consider the implications for $E_{i,j}$ under alternative tax regimes. Under a TTE regime, for which $t_b = 0$:

$$E_{i,j} = \left(1-t_j\right) - x\left\{\left(1-t_j\right) - \left(\frac{1+r\left(1-t_y\right)}{1+r\left(1-t_j\right)}\right)^{n-i+1} \left(1-t_c\right)\right\} \tag{10}$$

If, in addition, $t_y = t_c = t$, $E_{i,j}$ again reduces to the simple form $E_{i,j} = \left(1-t_j\right)$.

Under an ETT regime, for which $t_c = 0$:

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[8] Households leave a bequest equal to 10 per cent of their total lifetime pre-tax income. The bequest is received by the generation 30 years younger, which is a simplification for the purpose of generating lifetime budgets because the demographic data used for the simulations reflects the actual patterns of age-specific fertility.
[9] For details of the derivation of this term in a three-period framework, see Creedy and Guest (2007).

$$E_{i,j} = (1-t_j) - x \left\{ (1-t_j) - \left(\frac{1+r(1-t_y)}{1+r(1-t_j)} \right)^{n-i+1} (1-t_b[1-\phi]) \right\} \qquad (11)$$

and again if $t_y = t_b = t$, $E_{i,j}$ reduces to $E_{i,j} = (1-t_j)$. Finally, if in the TTT regime all tax rates on superannuation are the same and equal to t then it can be seen that:

$$E_{i,j} = (1-t_j)(1-xt_j) \qquad (12)$$

in which case superannuation taxation reduces the relative price of leisure in the standard model by a factor xt_j, reflecting the size of the contribution, x, and the tax on superannuation at all stages, t_j.

The household's superannuation fund balance at age i in period j is

$$B_{i,j} = \left(\begin{array}{cc} B_{i-1,j-1}(1+r(1-t_y)) + (1-t_c)xw_{i,j} & i=4,..,13 \\ B_{i-1,j-1}(1+r(1-t_y))(1-t_b[1-\phi]) & i=14 \end{array} \right) \qquad (13)$$

which assumes that workers retire at age $h-4=14$, at which time superannuation is withdrawn and absorbed into other financial assets.[10] The balance of other financial assets at age i in year j is given by:

$$B_{F,i,j} = \left(\begin{array}{l} B_{F,i-1,j-1}(1+r(1-t_j)) + w_{i,j}(1-x)(1-t_j) - C_{i,j} + f_{i,j} \quad i=1,..,11,14,..,18 \\ B_{F,i-1,j-1}(1+r(1-t_j)) + w_{i,j}(1-x)(1-t_j) - C_{i,j} + f_{i,j} + Q \quad i=12 \\ (B_{F,i-1,j-1} + B_{i-1,j-1})(1+r(1-t_j)) + w_{i,j}(1-x)(1-t_j) - C_{i,j} + f_{i,j} \quad i=15 \end{array} \right) \qquad (14)$$

Given the (intertemporally) additive nature of the household's lifetime utility function, the optimisation problem can be solved in two stages. First, the profile of the consumption index, M, over the life cycle must be determined.

The household's intertemporal problem is solved by maximising the utility function in (7) subject to the budget constraint (8). It can be shown that the first-order condition for this problem yields the following Euler equation for the evolution of the consumption index over the life cycle:

$$\frac{M_{i,j} - M_{i-1,j-1}}{M_{i-1,j-1}} = \frac{1}{\beta} \left(r(1-t_j) - \left(\frac{P_{i,j} - P_{i-1,j-1}}{P_{i-1,j-1}} \right) - \theta \right) \qquad (15)$$

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[10] This is a simplification. The alternative would be to allow funds to be retained in superannuation accounts during retirement and thereby attract the concessional tax rate, t_y. This is not modelled here because it would require a determination of the division of financial assets between superannuation and other assets in each period during retirement.

where $P_{i,j}$ is defined as the price of the consumption index, $M_{i,j}$.

Given the value of $M_{i,j}$, it is then possible to solve for the terms $C_{i,j}$ and $S_{i,j}$. The solution to the household's optimisation problem yields the following relation between consumption of goods and leisure as a function of the relative price of leisure:

$$\frac{\mu_i S_{i,j}}{(1-\mu_i)C_{i,j}} = p_{i,j}^{-\psi} \tag{16}$$

Define total expenditure in each age as $Z_{i,j} = C_{i,j} + p_{i,j}S_{i,j}$. Rearranging this and substituting into (16) yields:

$$C_{i,j} = \frac{\mu_i Z}{\mu_i + (1-\mu_i)\, p_{i,j}^{1-\psi}} \tag{17}$$

and:

$$S_{i,j} = \frac{p_{i,j}^{-\psi}(1-\mu_i)Z}{\mu_i + (1-\mu_i)\, p_{i,j}^{1-\psi}} \tag{18}$$

Using the definition of $P_{i,j}$ as the price of the consumption index, we can write $Z_{i,j} = P_{i,j}M_{i,j}$. Substituting this into (17) and (18) and then into the expression for M_i in (5) yields:

$$P_{i,j} = \left[\mu_i + (1-\mu_i)\, p_{i,j}^{1-\psi} \right]^{1/(1-\psi)} \tag{19}$$

Substituting (19) back into $Z_{i,j} = P_{i,j}M_{i,j}$ and then into (17) and (18) yields:

$$C_{i,j} = \mu_i \left(\frac{1}{P_{i,j}} \right)^{-\psi} M_{i,j} \tag{20}$$

$$S_{i,j} = (1-\mu_i) \left(\frac{p}{P} \right)_{i,j}^{-\psi} M_{i,j} \tag{21}$$

The solution to the optimisation problem can be obtained numerically as follows. Specify a trial value of $M_{i,j}$ for $i=1$, then solve forward for $M_{i,j}$ for $i = 1,...,h$ according to the Euler equation (15). For $i = 1,...,h$ calculate $C_{i,j}$ and $S_{i,j}$ according to (20) and (21). Then calculate $B_{F,h,j}$; if it does not equal the target bequest, then adjust $M_{i,j}$ for $i = 1$ and repeat the algorithm iteratively until the target bequest is met within a degree of tolerance.

The labour supply of households aged i in year j, $L_{i,j}$, is given by $L_{i,j} = e_{i,j}\bar{L}_{i,j}$ where $\bar{L}_{i,j}$ is the exogenously given size of the labour force of age i in year j and $e_{i,j}$ is work intensity defined as $e_{i,j} = 1/S_{i,j}$. The notion of work intensity here follows that in Barro and Sala-i-Martin (1995, p.322) where no distinction is drawn between an increase in $e_{i,j}$ that reflects a rise in effort from one that reflects a rise in hours worked. Both amount to an increase in labour supply. The present model implies, for example, that a 1 per cent increase in demand

for leisure gives rise to a 1 per cent decline in labour supply in terms of either effort or hours worked. The total resources available to the household from which to provide work effort are therefore normalised to $e_{i,j}S_{i,j} = 1$.

The labour market is assumed to clear in each period. Competitive firms demand labour up to the point where the marginal product of labour is equal to the real wage, according to (4). Labour supply depends on the real wage via the demand for leisure of each household. The real wage adjusts instantaneously to equate labour demand to labour supply. Firms then adjust their demand for capital in response to the level of employment in order to maintain the desired capital-labour ratio, which is determined by (2).

2.3 Government

Government spending is denoted, G, and, other than transfer payments, is assumed for simplicity to be government consumption spending. Hence:

$$G_j = C_{G,j} + f_j \tag{22}$$

An assumption maintained throughout the simulations is that the government runs balanced budgets every period, so that:

$$G_j = T_j \tag{23}$$

where T_j denotes total tax revenue, given by

$$T_j = T_{W,j} + T_{K,j} + T_{S,j} \tag{24}$$

and where T_W is tax levied on wage income, T_K is tax levied on income from financial assets other than superannuation, T_S is tax levied on superannuation at rates t_c, t_y and t_b as defined above. These can therefore be expressed as:

$$T_{W,j} = \sum_{i=1}^{h} w_{i,j}L_{i,j}\left(1-x\right)t_j$$

$$T_{K,j} = \sum_{i=1}^{h} B_{i,j}rt_j \tag{25}$$

$$T_{S,j} = xt_{c,j}\sum_{i=1}^{h} w_{i,j}L_{i,j} + t_{y,j}r\sum_{i=1}^{h} B_{i,j}N_{i,j} + t_{b,j}\left(1-\phi\right)B_{14,j}N_{14,j}$$

Substituting (25) into (24), then into the balanced budget condition (23), gives an expression for t_j of the form:

$$t_j = \frac{T_j - T_{S,j}}{\sum_{i=1}^{h} B_{i,j}r + \sum_{i=1}^{h} w_{i,j}L_{i,j}\left(1-x\right)} \tag{26}$$

However, this expression is actually highly nonlinear in t_j because several terms on the right hand side are functions of this and other tax rates. Hence the budget constraint must be solved

numerically, which is achieved through the iterative procedure of solving the life-cycle plans of households, as follows. Households are assumed to have perfect foresight and therefore know the future values of all variables that affect their plans, one of which is the tax rate, t_j. Their plans are solved iteratively starting with a trial vector of values of all future variables; each new plan uses the updated vector until the values stabilise.

The balanced budget condition implies that a reduction in taxation on superannuation must be budget neutral and therefore must be accompanied by either raising the tax rate applying to non-superannuation income, or reducing government spending. In the simulations it is assumed that the adjustment falls on government spending in the form of transfer payments, f_j.[11] Therefore f_j is reduced to match any reduction in superannuation revenue. This implies a reduction in the household budget which therefore affects consumption of goods and leisure.

Finally, the standard national accounting identity gives the evolution of foreign liabilities:

$$D_j = D_{j-1}(1+r) + \sum_{i=1}^{T} C_{i,j} + C_{G,j} + I_j - Y_j \qquad (27)$$

2.4 Value Judgements

An evaluation of the path of aggregate consumption over time requires the use of a social welfare function, which makes value judgements about consumption in the future relative to present consumption explicit. Here it is assumed that an independent judge evaluates only the consumption that occurs in the present and the future. This implies that there is no regard for past consumption even by generations still alive, on the grounds that past consumption cannot be influenced by current and future policy.

The social welfare function applied here is:

$$V = \sum_{j=1}^{H} N_j \left[\frac{M_j}{1-\beta_s} \right]^{1-\beta_s} (1+\theta_s)^{1-j} \qquad (28)$$

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[11] This is done for expediency. The alternative – adjusting the tax rates applying to non-superannuation income – introduces more complicated feedback effects which are harder to disentangle.

where $M_j = \sum_{i=1}^{h} M_{i,j}$ is the aggregate value of the consumption index of all households alive in period j; $j = 1$ in 2005; H is an arbitrarily long time in the future. The parameter θ_s is the pure rate of time preference of the judge and β_s reflects the constant relative aversion to variability of the judge: it is the (absolute value of the) elasticity of marginal valuation. The form of the social welfare function also assumes that the judge takes the view that the appropriate unit of analysis is the individual, so that values are weighted by N_j in each period.

3 Empirical Application

The aim of this section is to compare the various tax regimes for superannuation – TTT, TTE, ETT and EET - in terms of their implications for intergenerational equity, national living standards, labour supply, national saving and social welfare.

3.1 Data and Parameters

In the TTT case, the three superannuation tax rates are set equal to 15 per cent. An exemption of income from any of the three taxes implies setting the relevant tax rate equal to zero from 2005 onwards.

Government spending as a share of GDP is set equal to 0.3 for the period up to 2002 after which it increases according to the increase in age-related spending of the Australian Government in Productivity Commission (2005). The categories of age-related government consumption spending are given in Productivity Commission (2005) and consist of health, aged care, carers and education; and the categories of f_j are age and service pensions, family tax benefits, disability support benefit, unemployment allowances and parenting payments. Age-related spending of the Australian Government is projected to increase by 5.7 per cent between 2004 and 2045 according to the Productivity Commission (2005).

The calibration is such that the size of superannuation tax revenue as a proportion of GDP in 2005 is equal to that reported by the Institute of Actuaries of Australia (IAA) (2006). The IAA calculates the following superannuation tax revenues as percentages of GDP for 2004: contributions tax of 0.5 per cent, income tax on fund income of 0.2 per cent, and benefits tax of 0.05 per cent. For the contributions tax, the value of x is set at that giving the total of 0.5 per cent of GDP in 2005. This figure turns out to be 5 per cent which is less than the 9 per cent compulsory contribution rate currently applying in Australia. This is at least

partly because the 5 per cent is assumed to apply to all labour income in the economy whereas in reality some self-employed and casual workers would not contribute to superannuation at 9 per cent (although some workers would contribute more than 9 per cent). The IAA points out that a small proportion of superannuation benefits attract the benefits tax, due to the tax-free proportion, and there are ways in which the tax can be avoided. A value of the tax-free proportion, ϕ, equal to 0.8 generates the IAA figure of 0.05 per cent of GDP for the benefits tax. The interest rate on superannuation fund income is assumed to be equal to the constant interest rate, r, which applies to all forms of saving and borrowing. This generates tax revenue from super fund income equal to 0.12 per cent of GDP which is less than the IAA figure of 0.2 per cent but close enough to avoid the complication of setting a return on super fund income higher than r.

It is also necessary to allow for the likely growing popularity of superannuation as a saving vehicle. In Australia superannuation assets have been projected to more than double between 2005 and 2020 (IFSA, 2007), compared with an increase in GDP in the order of 60 per cent (at 3 per cent compound growth). Hence superannuation assets to GDP could nearly double over this period. There are several reasons for this growth. The Investment and Financial Services Association (IFSA) (2007) reports a study suggesting that 23 per cent of this growth can be attributed to the changes introduced in the 2006 Australian Government Budget. Other factors include: the cumulative effect of the 9 per cent compulsory contribution rate that has applied since July 2002; the growing awareness of the benefits of superannuation and its increasing flexibility; and an older workforce implying a higher average propensity for superannuation saving across the workforce.

Hence, an alternative set of simulations allow x to increase gradually over time from its base case rate of 5 per cent, increasing by 1 per cent every 5 year period after 2005 implying that, by 2050, 14 per cent of labour income is being contributed to superannuation. This is plausible given the growth in popularity of superannuation which will be accentuated in Australia by the incentives introduced in the 2006 Budget. However, this does not apply to the base case simulations, for which x is fixed at 5 per cent.

The demographic data consist of actual historical population levels, and projected future population levels, for each age group. These data are given in the following Australian Bureau of Statistics (ABS) Catalogues: historic population, Catalogue 320109.1; projected population, Catalogue 3222.0; labour force participation rates by age, Catalogue 6291.0; and wage rates by age, Catalogue 6310.0. The data source for government expenditure is Productivity Commission (2005) as described above.

The wage of each worker by age in year j, $w_{L,i,j}$, is calibrated such that the weighted average of $w_{L,i,j}$ over all workers of age i in year j is equal to the price of labour, $w_{L,j}$; that is:

$$\sum_i w_{L,i,j} L_{i,j} = w_{L,j} L_j \tag{29}$$

This is achieved by first normalising exogenous data on wages by age, $\bar{w}_{L,i,j}$, such that $\sum_i \bar{w}_{L,i,j} = 1$. The $\bar{w}_{L,i,j}$ are then weighted by:

$$\gamma_j = \frac{w_{L,j} L_j}{\sum_i \bar{w}_{L,i,j} L_{i,j}} \tag{30}$$

giving

$$w_{L,i,j} = \bar{w}_{L,i,j} \gamma_j \tag{31}$$

Table 1 presents other parameter values. The interest rate of 4 per cent is a typical value of the world interest rate used in CGE simulations: the assumption is that Australia is a small open economy. Households' rate of time preference, θ, is the rate that would, if both the tax rate and the parameter μ_i were constant, ensure that a household's consumption grows at the long run rate of growth of output, g, implying $\theta = r - \beta g$.

Table 1 Base Case Parameters and Initial Values

Parameter	
Interest rate, r	0.04
Rate of time preference of households, θ	0.028
Capital elasticity of output: $\alpha = \left(\dfrac{\bar{K}}{\bar{Y}}\right)_0 (r+\delta)$	0.27
Depreciation, δ	0.05
Initial capital to output ratio $\left(\dfrac{\bar{K}}{\bar{Y}}\right)$	3.0
Initial tax rate on all income, t	0.3
Foreign liabilities to GDP ratio, D/Y, in 2003	0.6
Elasticity of marginal valuation, β	2.0
Elasticity of substitution between consumption and leisure, ψ	0.8
Bequest as a proportion of household's lifetime income	0.1

The capital elasticity of output is calibrated such that the initial capital to output ratio is equal to 3.0, the approximate actual value for Australia in 2002. The initial tax to GDP ratio is set equal to 0.3 the actual value for Australia in 2002. The ratio of foreign liabilities to GDP, *D/Y*, in 2005 is calibrated so that it equals 0.6 (which is approximately the actual value) by finding the ratio of *D/Y* in 1920 that gives $D/Y = 0.6$ in 2005, where 1920 is the year in which household aged 85 in 2005 was born. The values of the elasticities, β and ψ, are set equal to common values used in related studies in the literature, see for example Foertsch (2004).

A sensitivity analysis with respect to these parameter values indicated that the effects of the superannuation tax concessions were robust with respect to a reasonable range of values for each parameter. In all of the sensitivity simulations conducted, the effect of the tax concession on any endogenous variable in any given period was within 15 percent of the effect under the base case parameter value. For example, if the effect of a tax concession were to boost lifetime consumption for a particular generation by 0.5 percent, then no variation in a single parameter produced an effect outside plus or minus 15 per cent of 0.5 per cent, which is a range of 0.42 to 0.58 percent.

There is no assumption that the economy is in a steady state prior to the tax smoothing policy shock, nor that the economy converges to a steady state. Nevertheless, the overlapping generations feature of the model generates fairly well-behaved state variables. In particular, debt and the capital stock do not take extreme values at any point in the optimal path.
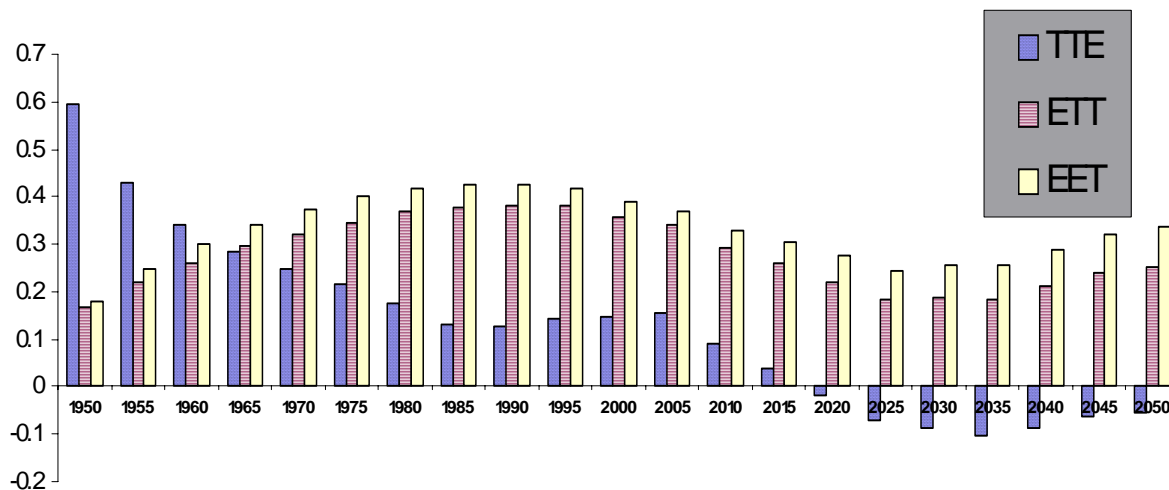
4 Simulation Results

4.1 Consumption

Consider first the effect of alternative tax regimes on lifetime consumption of successive generations. Unless otherwise stated, 'consumption' refers to the value of the consumption index, M.[12] The effect of a change in tax regime on lifetime consumption depends on its effect on lifetime income, as reflected in the budget constraint, (8). The elimination of a superannuation tax implies an increase in the after-tax wage or relative price of leisure, $p_{i,j}$.

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[12] An alternative would have been to consider the effects on goods consumption, *C*, only, thereby ignoring leisure. Inspection of the simulation results showed the effects on goods consumption, *C*, were not qualitatively different to the effects on the consumption index, *M*.

This is offset by a decrease in transfer payments, $f_{i,j}$, according to the assumption that the government balances its budget in each period by offsetting any change in superannuation revenue by a dollar for dollar change in transfer payments. However, the offset is not exact for several reasons. The main reason is that the tax change is unanticipated, the effect of which is discussed further below; and there are other minor factors at work meaning that even if the tax change were entirely anticipated there would still be small net effects on lifetime income which would differ among generations.[13]

Figure 1 plots the difference between lifetime consumption under three alternative tax regimes: TTE, ETT and EET, compared with the base case: TTT.

Figure 1 . Percentage change in lifetime consumption by generation

Exempting benefits in the TTE system boosts the after-tax superannuation balances of older generations more than it does for younger generations because older generations have larger balances at the time the exemption is introduced and hence receive a relatively large windfall, yet they have not had to pay for the cost of this windfall through lower transfer payments during their lives. However, younger generations however pay for the tax

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[13] In any given year the budgetary cost of the tax exemption, which is met by a reduction in transfer payments, is spread evenly across all households, whereas the boost in after-tax income accrues more to households at a higher income stage of their lifecycle. Also, the cost in lost transfer payments relative to the gain in after-tax labour income in a given year also depends on the support ratio.
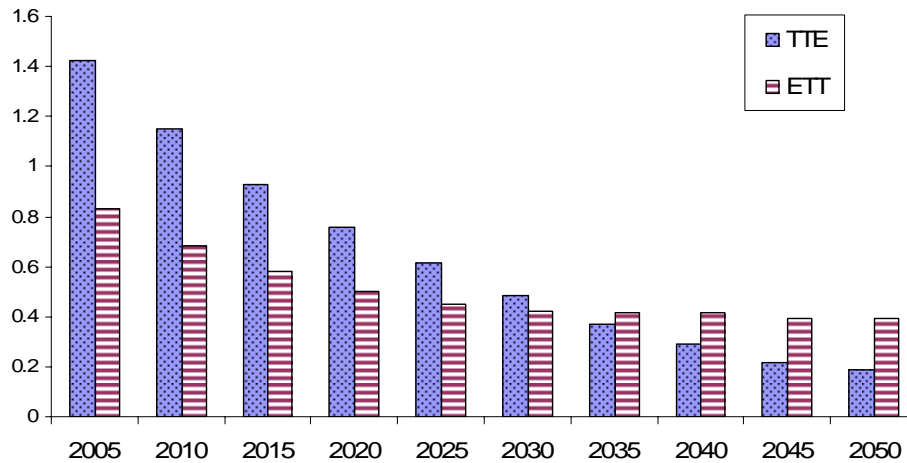
exemption enjoyed by older generations before they in turn receive the tax exemption. Hence the net lifetime gain to older generations is greater than for younger generations. This is reflected in the declining size of the bars in Figure 1 for the TTE case.

Exempting super contributions (ETT) generates the opposite pattern on lifetime consumption of successive generations. It boosts the after-tax superannuation balances of younger generations more than that of older generations for the simple reason that younger generations have more years from which to benefit from higher after tax contributions than older generations. Hence, Figure 1 displays a rise in the size of the bars for successive generations from the 1950 generation to generations born recently. For subsequent generations the ETT series follows a slight cyclical pattern. This can be explained by the cyclical pattern of the support ratio.[14]

The EET case turns out to be little different from the ETT case in its effect on lifetime consumption (see Figure 1) and other variables of interest. This implies that exempting from tax superannuation fund income as well as contributions makes little difference. This can be verified by differentiating (9) with respect to each of the tax rates which shows that the impact of t_y is smaller than for the other tax rates. For this reason we do not report results for the EET case beyond the result given in Figure 1.

Figure 2 shows the effect of the ETT and TTE regimes on average consumption per capita, or living standards, in each period from 2005 to 2050. In the initial few periods from 2005 the impact on living standards is greater in the TTE case than the ETT case. This is because of the large adjustment of older generations as described above. However, over time this relationship is reversed - the ETT effect becomes greater. In the long term the effect of removing the benefits tax is relatively small because the tax free threshold on benefits implies that only 20 per cent of benefits are subject to tax, whereas 100 per cent of contributions are subject to tax. The absolute size of the effect on consumption per capita declines from 1.4 to 0.2 per cent in the TTE case and from 0.8 to 0.4 per cent in the ETT case.
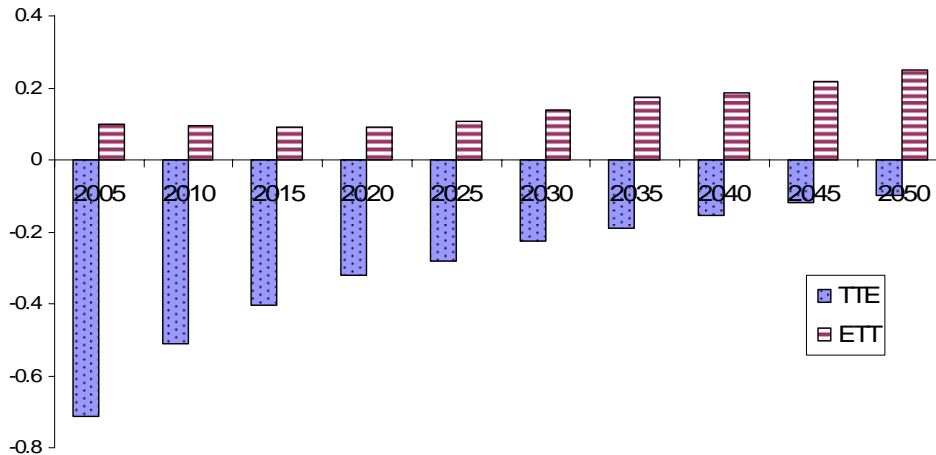
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[14] The support ratio at a given time determines the superannuation contributions for all workers alive at that time. Hence when the support ratio is falling, the size of super contributions is falling and the benefit of a tax exemption on contributions is therefore smaller. This explains the relatively smaller gain for generations born around 2025 because the support ratio falls quite steeply at that time.

Figure 2 . Percentage boost to living standards

4.2 Labour Supply

The effect on labour supply depends on the difference between the income effect and the substitution effect. More precisely, the labour supply effect is measured by the elasticity of demand for leisure with respect to the tax rate which equals the difference between the elasticity of future full income with respect to the tax rate and the elasticity of the price of leisure with respect to the tax rate (see Creedy and Guest, 2007).

In the TTE case, the elasticity of future full income is relatively large for older generations because the reduction in benefits tax applies to all of their past accrued benefits, and is therefore a relatively large proportion of their remaining lifetime full income compared with the case for younger generations. Hence the income effect for older generations is relatively strong and outweighs the substitution effect resulting in a larger decline in labour supply for older households. See Figure 3. A way of interpreting this is that older households have, in hindsight, overworked during their lives in aiming for their target bequest. They immediately adjust by buying more leisure and hence reducing their labour supply. As the effect on the labour supply of older generations falls, the aggregate effect on labour supply diminishes over time, as shown in Figure 3.

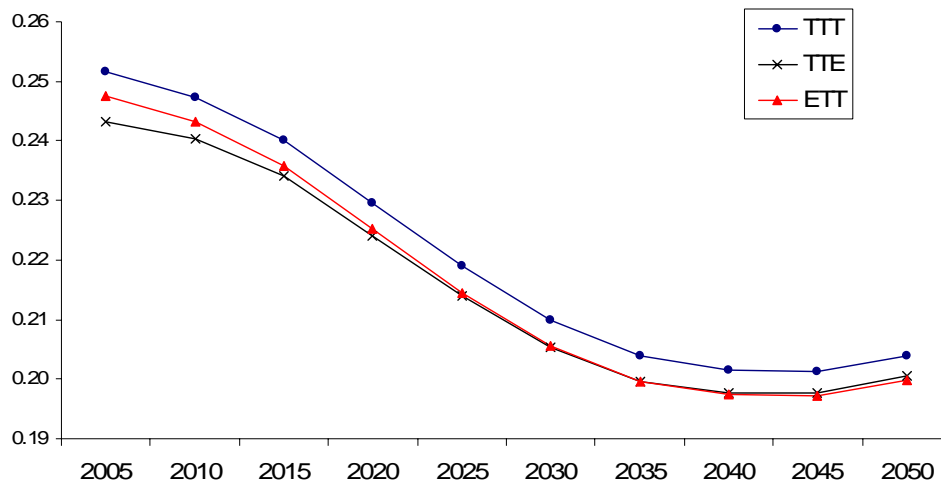**Figure 3 . Percentage change in aggregate labour supply**

4.3 National Savings

The effects on national savings are reported because the desire to boost savings is a motive not just for superannuation reform in Australia but more generally for pension reform in OECD countries. The aim is to shift the funding of retirement incomes from the public to the private sector. This requires an increase in private saving so that the present generation of workers can fund the retirement incomes of two generations of workers – themselves and the current generation of retirees who still rely heavily on the public pension. However, the effect on private saving would be diminished to the extent that workers shift savings from other saving vehicles to superannuation. It has been estimated with respect to Australia for example that compulsory allocations of saving into superannuation results in up to a 50 per cent leakage from other saving vehicles (Freebairn, 1998). The question of interest here is whether such a leakage occurs in response to tax concessions on superannuation.

The assumptions of the model call for a qualified response to this question. For instance the portfolio allocation problem is ignored – the superannuation contribution rate is exogenous and constant. Households' bequests are also fixed as a proportion of lifetime income. Furthermore, the government's budget is balanced by reducing transfer payments dollar for dollar with any tax concession on superannuation. Given these assumptions and drawing on the earlier discussion, a lower tax rate on superannuation raises the price of leisure

which calls for a substitution of consumption for leisure thereby reducing saving. This can be seen from (21) after substituting $E_{i,j}$ into $p_{i,j}$ and $P_{i,j}$. The income effect is close to zero because every dollar of superannuation tax concession is offset by a dollar reduction in transfer payments in terms of the effect on the government's budget. This is reflected in the lifetime budget constraint, (8), by an increase in $p_{i,j}$ offset by a decrease in $f_{i,j}$. The net outcome of a neutral income effect and a negative substitution effect on saving is a lower saving rate. This is illustrated in Figure 4.

Figure 4 . The national saving rate (ratio to GDP)

Under all tax regimes the saving rate falls over time as the standard consequence of population ageing in models such as this – the reason being that the proportion of households at the high income, high saving age declines. The tax concessions do not alter this effect qualitatively, but they reduce saving in all periods - in the ETT case by a constant 0.4 per cent in all years, and in the TTE case by 0.8 per cent initially and falling to 0.4 per cent by 2050.

4.4 Social Welfare

The measure of social welfare, *V*, is cardinal and therefore the effect on *V* can be calculated directly. The effect could in principle be sensitive to the choice of parameters βs and θs. Hence we report results for various combinations of values of these parameters. Except in the extreme case where βs, the effects on *V* are within 5 percent of the base case values.

The results are given in Table 2. Under the base case parameter values:βs=2 and θs=3 per cent, the effect of the TTE, ETT and EET regimes compared with the TTT regime is to

increase social welfare by 0.38, 0.42 and 0.46 percent, respectively. The ranking by size of the effects is consistent with the results discussed above. One source of the welfare gain is the reduction in the distortionary effects of taxation since the elimination of a tax which distorts the price of leisure ($p_{i,j}$) is funded by a reduction transfer payments ($f_{i,j}$) which are in lump-sum form and therefore non-distortionary.

Table 2 Effect on social welfare, V

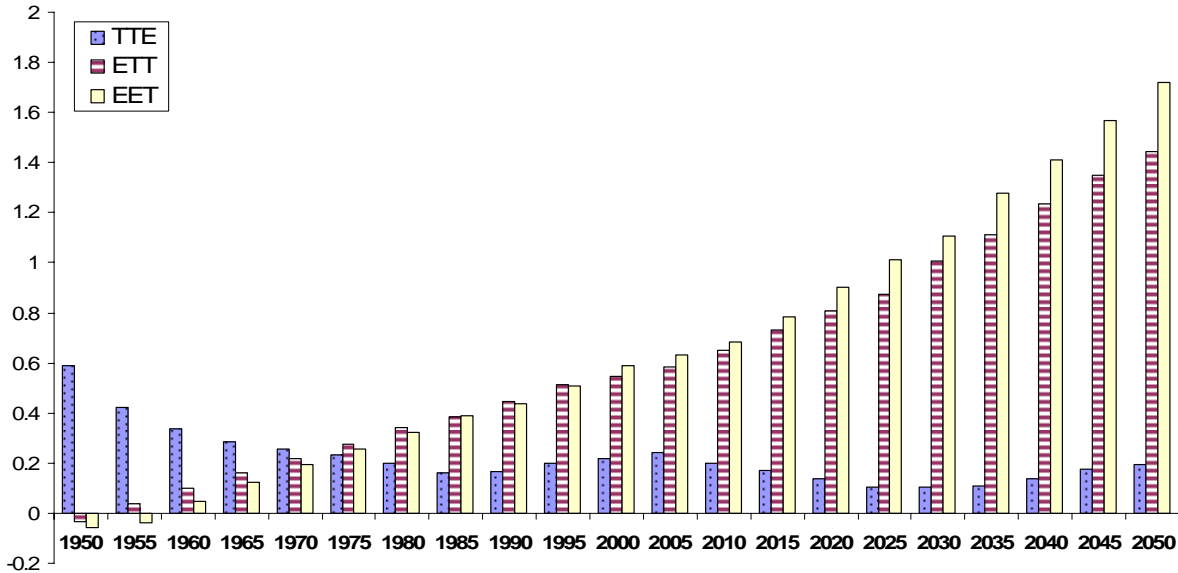| θ_s %	β_s	TTE % gain	ETT % gain	EET % gain
0.0	2.0	0.33	0.41	0.45
2.8	2.0	0.38	0.42	0.46
8.0	2.0	0.43	0.44	0.47
4.0	0.2	0.31	0.34	0.37
4.0	1.0	0.00	0.00	0.00
4.0	10.0	3.34	3.76	4.09

The welfare effect is also a result of the social evaluation of the intertemporal consumption effect of the change in taxation, which depends on the form and parameters of the social welfare function. In particular, consumption gains near to the present are "worth" more than the same gains further in the future. This explains why the elimination of the benefits tax (TTE) yields a large welfare gain relative to the amount of tax revenue generated. It also explains why the welfare gains for smaller values of *ßs* tend to produce smaller welfare gains than for higher values of *ßs*, given that the annual gains in aggregate consumption tend to be greater in the short term following the shock. For example, the extremely high value of *ßs* =10.0 produces a much greater welfare gain from the tax concessions because the relatively large gains in the short term are given much greater weight than the smaller gains in the long term.

4.5 Higher Superannuation Contribution Rates

For reasons discussed above, simulations were run where the superannuation contribution rate is gradually increased by 1 per cent every 5 year period after 2005 up to 2050 by which time 14 per cent of labour income is being contributed to superannuation compared with the constant base case rate of 5 per cent. Concern is not so much with the effect of higher

contributions per se but the effect of the various tax exemptions, given higher contribution rates.

Figure 5 . Higher super contribution rate

The higher contribution rate magnifies the effect of tax exemptions on lifetime consumption of successive generations, national living standards, aggregate labour supply and national saving. It generally does not alter the patterns described for these variables, perhaps with one exception – the effect on lifetime consumption of successive generations, which is illustrated in Figure 5. The difference in the pattern compared with the base case (Figure 1) is that because the contribution rate steadily increases, so does the lifetime gain from exempting contributions from tax. By 2050 exempting contributions from tax would increase the lifetime consumption of the generation born in 2050 by 1.7 per cent compared with 0.25 per cent in the base case.

The effect on national living standards is very slightly higher than in the base case which was illustrated in Figure 2 – but the effect of the various tax exemptions on living standards remains less than 1 per cent in any year. The boost to labour supply from exempting contributions from taxation rises to 1 per cent by 2050 compared with 0.2 per cent in the base case, and the effect in the case of the benefits tax exemption is slightly higher (which means a smaller negative effect than that shown in Figure 3 – it is zero by 2050.) The national saving effect is virtually unchanged as is the effect on social welfare.

5 Conclusion

This paper has shown that changes in the taxation of superannuation changes the lifetime consumption plans of households. The effect occurs through the after-tax wage which is the relative price of leisure and therefore affects the work-leisure choice. The income effect of the change in the after-tax wage is muted, in the model applied here, by offsetting reductions in government spending in order to balance the government's budget. The unanticipated nature of the effect causes a stronger response in the short term because households make corrections to plans that have become inconsistent with their target bequest. The biggest short term adjustment occurs in the case of an unanticipated tax exemption on superannuation benefits because middle aged working households derive a windfall which causes relatively large adjustments to their labour supply and consumption.

The simulation results show that the intergenerational effects differ for a benefits tax exemption compared with a contributions tax exemption. The former confers a larger windfall on middle aged households than on young or post-retirement households. The contribution tax exemption benefits younger households more than older households.

The positive outcome for social welfare of tax exemptions under all of the tax regimes modelled suggests that the reduction in taxation of superannuation is an unambiguous welfare improvement. However, as always simulation results reflect the assumptions of the model. Some of these assumptions have already been emphasised – the balanced budget assumption, the exogenous contribution rate, the exogenous bequest as a proportion of lifetime income. But also important is the representative agent assumption – that is, all households of a given generation are represented by a single household, so that there is no allowance for inequality within generations. This acts to qualify the results because changes in taxation and transfer payments do not in reality affect all households of a given generation equally. Accounting for within-generation equality would require a more complex microsimulation model.

Subject to these qualifications, the results have demonstrated the potential effects of superannuation tax exemptions on intergenerational equity, national accounting aggregates, and social welfare. Whether these effects are large enough to warrant further policy responses is a matter of judgement.

Appendix A. Equivalence of TTT, TTE and ETT Regimes

This Appendix shows that the TTT, TTE and ETT models are equivalent under certain assumptions. See Kingston and Piggott (1993) for a continuous time exposition that also includes equivalence of EET. Let $xw_{i,j}$ be the pre-tax superannuation contribution in period i in year j; r_j be the return on the superannuation assets held in the fund in period j; $t_{s,j}$, $t_{y,j}$ and $t_{b,j}$ be the tax rates on contributions, income on fund assets, and end benefits respectively in period j; B_n the value of superannuation assets when withdrawn at the end of n number of periods of superannuation contributions. Assume that there are no tax-free thresholds, that contributions net of contributions tax are made at the start of each period and that the earnings tax is calculated on end of period values. The expression for B_n is

$$B_n = \left(\sum_{i=1}^{n} xw_{i,j}\left(1-t_{s,i}\right)\prod_{j=i}^{n}\left[1+r_j\left(1-t_{y,j}\right)\right]\right)\left(1-t_{b,n}\right) \tag{32}$$

If it is assumed that the tax rates on contributions and benefits are constant over time, then B_n becomes

$$\begin{aligned}B_n &= \left(\sum_{i=1}^{n} xw_{i,j}\prod_{j=i}^{n}\left[1+r_j\left(1-t_{y,j}\right)\right]\right)\left(1-\left[t_c+t_b\left(1-t_c\right)\right]\right)\\ &= \left(\sum_{i=1}^{n} xw_{i,j}\prod_{j=i}^{n}\left[1+r_j\left(1-t_{y,j}\right)\right]\right)-T_{CB,j}\end{aligned} \tag{33}$$

where $T_{CB,j}$ is the sum of taxes paid on superannuation contributions and benefits over n periods. If a switch between the TTT, ETT and TTE regimes is both fully anticipated and neutral in its effect on $T_{CB,j}$ then B_n is unchanged, implying that the switch is Ricardian equivalent. In that case it would make no difference to forward looking governments and investors whether tax is levied on the way into the fund or on the way out. However the assumptions of neutrality with respect to $T_{CB,j}$ and full anticipation of changes in tax policy are unrealistic. Hence an unanticipated shift from one regime to another can be expected to affect the lifecycle plans of households.

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