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# Progressive Tax Changes To Private Pensions in a Life-Cycle Framework*

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**Abstract**

Tax concessions are a common feature of private pension pillars around the world. Most countries exempt pension fund earnings from any taxation but tax either benefits (EET regime) or contributions (TEE regime) progressively as regular private income. By contrast, Australia's superannuation taxation features concessional flat tax rates on contributions and fund earnings, with benefits being generally tax free. Concerned with the vertical equity of the current superannuation tax concessions, this paper provides a quantitative analysis of hypothetical replacements of the existing superannuation tax treatment with the EET and TEE regimes commonly found in other countries. Using a general equilibrium OLG model calibrated for Australia, we find that these hypothetical tax reforms to superannuation improve the vertical equity in the short, medium and long run, as indicated by larger relative welfare gains and income improvements experienced by lower income households.

**Keywords:** Compulsory saving; pension and tax reforms; dynamic OLG model

**JEL Classification**: H55; E21; C68

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# 1 Introduction

Private pension pillars around the world benefit from concessional tax treatments that aim to increase private retirement incomes and household savings. Most countries tax their private pensions under either the "exempt-exempt-taxed" [EET] or "taxed-exempt-exempt" [TEE] regimes where fund investment earnings are exempt from any taxation but where either benefits or contributions are treated as ordinary private income and taxed progressively. By contrast, the existing tax treatment applied to Australia's superannuation (Australia's term for private pensions) features a flat tax rate on contributions and fund investment earnings, with benefits being generally tax free. As the statutory rate of this flat tax on contributions and fund earnings is 15 percent, the system is concessional for most income earners compared to progressive taxation of regular income. However, the tax concessions flow largely to high income earners, as demonstrated by Ingles (2009) and the Australian Future Tax Structure [AFTS] (2008, 2010). For instance, AFTS (2008, p.22) estimates that over 37 percent of concessional contributions go to only about 5 percent of Australians on very high incomes.

Concerned with the vertical equity of Australia's superannuation tax arrangements, this paper provides a quantitative analysis of hypothetical replacements of the existing superannuation tax regime with the EET and TEE tax regimes that are commonly found in other countries. Under both reforms, the existing flat tax rates on contributions and fund earnings that are currently paid by superannuation funds are abolished and either the withdrawals or the contributions are treated as ordinary income and taxed progressively at marginal income tax rates in hands of households. We also examine the effects of the recommended policy on superannuation taxation by AFTS (2010, pp. 84-85). This policy recommendation represents an alternative to the TEE regime, which, in addition to the progressive taxation of superannuation contributions, includes (i) a flat-rate tax offset to contributions set such that the majority of taxpayers do not pay more than 15 percent tax on their contributions and (ii) a reduction of the statutory tax on fund earnings to 7.5 percent.

It is well known that under certain conditions the EET and TEE approaches are equivalent, that is, a shift to either the EET or TEE regimes would have the same effects on the present value of superannuation tax revenues and the lifetime behaviour of utility maximising households (see Kingston and Piggott (1993) or Creedy and Guest, 2008a). However, there would be no general equivalence for a pension or tax policy change that would be unanticipated by households and where tax rates would differ over the lifecycle (i.e., progressive taxation), which are some of the aspects incorporated in our modeling framework.

Australia's superannuation and its taxation has undergone several changes over the last decade. Probably the most significant change to superannuation taxation was the abolition of the superannuation benefit taxation for people aged 60 years and over in July 2007. While this change made the superannuation taxation simpler, it has an adverse effect on the equity of the system (see Bateman and Kingston, 2007). In terms of fiscal implications, the Institute of Actuaries Australia [IAA] (2007) and Davidson and Guest (2007) project low fiscal costs of the implemented benefit tax abolition, reflecting already highly preferential tax treatment of superannuation benefits in the pre-existing system.

Interestingly, prior to the 2007 superannuation changes, many retirement income commentators and industry experts called for the move towards the traditional EET regime (see, for example, ASFA (1998) and Doyle *et al.*, 1999) and some proposed the abolition of only the flat tax on contributions (Clare (2006) and Knox, 1998). The assessment of the ASFA (1998) proposal is provided by Horne (2002) who argue that the proposal would improve saving incentives and vertical equity. The analysis of the shift to the EET regime by Doyle *et al.* (1999) show only a small net loss in tax revenues as the revenue loss from the abolition of contribution and fund earning taxes is partly offset by imposing the marginal income tax rates on superannuation benefits. Atkinson *et al.* (1999), using a cohort micro-simulation model, find that the traditional EET regimes scores better in terms of intra-generational equity and overall progressivity than the concessional TTT regime in Australia at that time. Their main finding, however, is that the assumed behaviour at retirement (i.e., whether the superannuation savings are paid out as an annuity or a lump-sum) has much stronger effects on the redistributive measures than the superannuation tax structure.

The theoretical basis for the analysis of a policy change to private pension taxation is provided by Creedy and Guest (2008a). Using a three period, single household model, they study behavioural effects of various superannuation tax policy changes on consumption, labour supply and savings and show that, for example, the benefit tax abolition would reduce saving while increase labour supply. Creedy and Guest (2008b) employ a computable OLG model calibrated to Australia to examine macroeconomic and welfare impacts of the 2007 abolition of the benefit taxation. Based on their simulations, this policy change favours middle-aged and older workers more than younger households, and reduces national savings. Their policy recommendations to (i) correct the first issue with the abolition of benefit taxation is to increase marginal tax rates on higher incomes that would fall more heavily on middle-aged cohorts and to (ii) deal with the second concern is to increase public saving through lower transfers or higher taxes to offset reduced household saving.

There is also a large body of international literature that uses computable OLG models to examine the economic effects of voluntary tax-deferred retirement saving accounts (see, for example, Imrohoroglu et al. (1998), Fehr et al. (2008) and Nishiyama, 2011). In general, these studies find positive effects on national wealth, capital stock and long run welfare, although these effects varies greatly due mainly to different assumptions about government budget balancing policy instruments. Fehr et al. (2008) not only assess the effects of tax-deferred or front-loaded accounts taxed under the EET regime but also the implications of tax-exempt or back-loaded accounts taxed under the TEE regime. They show that increases in national wealth are significantly greater with front-loaded accounts, which burden (benefit) elderly (young) rich households more than front-loaded accounts. However, poor households are clearly better off than rich ones with back-loaded accounts.

The quantitative analysis of the three reforms to superannuation taxation in our paper also builds on computable OLG models. We use an extended version of the small open economy OLG model developed by Kudrna and Woodland (2011). Compared to Creedy and Guest's (2008b) model, our model includes detailed intra-generational household heterogeneity linked to the ABS (2007) data, life-uncertainty, endogenous retirement and, most importantly, a richer structure of Australia's fiscal and retirement income systems. While Creedy and Guest (2008b) examine the effects of eliminating the concessional tax rates on either contributions or fund earnings or benefits, we evaluate the effects of the replacements of these concessional superannuation tax rates with the progressive income taxation applied to either benefits or contributions. Compared to Fehr et al. (2008) who assess the introduction of voluntary tax-preferred retirement accounts, we analyse the reforms to the concessional taxation of already established mandatory superannuation. The main goal of our paper is to assess how these hypothetical but radical reforms to superannuation taxation affect welfare and net incomes of households of different income classes (vertical equity) and of different ages (inter-generational equity). We also provide macroeconomic implications for the simulated superannuation tax reforms.

Our simulation results indicate that all three examined reforms to superannuation taxation improves the vertical equity in the short, medium and long term, as shown by larger (lower) relative gains (losses) in welfare and net incomes experienced by lower income households. These findings provide support for the proposal by ASFA (1998) to apply the progressive income taxation to superannuation benefits as well as for the proposals by AFTS (2010) and Ingles (2009) to tax the mandatory contributions as ordinary income. The comparison of the examined reforms reveals that while the welfare and macroeconomic effects of the TEE regime and the AFTS proposal are not largely different, these effects differ greatly from those generated by the shift to the EET tax regime. Under the EET tax regime, older generations suffer from large welfare losses as their private pensions are treated as regular income and taxed at marginal income tax rates. However, long run improvements in welfare for all income types are greater compared to the other two taxation reforms because of large increases in the income tax revenues that allow for a significant reduction in the budget balancing consumption tax rate. The examined reforms to superannuation taxation have also positive long run effects on household total assets, which are significantly larger especially under the shift towards the EET tax regime. Similar effects on national wealth were obtained by Fehr et al. (2008) for the introduction of voluntary front-loaded (EET) accounts.

In the next section, we provide a non-technical description of our economic model. Section 3 reports on the calibration of the model and also provides comparison of the benchmark steady state equilibrium solutions with actual Australian data. The simulation results for the three superannuation taxation reforms, concentrating on equity and efficiency implications are presented in Section 4. Finally, Section 5 offers some concluding remarks and suggestions for future research.

# 2 The economic model

We apply a general equilibrium OLG model that builds on Kudrna and Woodland (2011). The model is extended to include a detailed disaggregation of households by income type to quintiles linked to the ABS (2007) data and by allowing for gradual withdrawals of superannuation savings. The model is a small open economy type of Auerbach and Kotlikoff' (1987) OLG model, whose variants have been used worldwide by many researchers to analyse various tax and pension policy reforms. In Australia, Kulish *et al.* (2010) used a closed economy model to analyse macroeconomic consequences of population ageing and as already metioned, Creedy and Guest (2008b) applied an open economy model to simulate changes to the superannuation tax regime. Computable OLG models with stochastic incomes were employed by Tran and Woodland (2011) and Cho and Sane (2011) to study the effects of policy changes to the Australian means tested public pension. Compared to the aforementioned models, our model is specified to include major aspects of Australia's superannuation, means tested age pension and progressive income taxation, which, combined with household heterogeneity by both age and income types, is crucial to the analysis of distributional effects of the investigated superannuation tax reforms.

## 2.1 Demographic structure

The demographic structure of the model is assumed to be stationary. The model economy is populated with 70 overlapping generations of households aged from 21 to 90 years ($a =$ 21,...,90) at any time $t$. Each generation consists of five income quintiles $i$ - the lowest, second, third, fourth and highest income groups of households. The fraction of each income group $i$ in every generation is denoted by $\omega_i$. Each year, a new young generation aged 21 years enters the model structure and faces random survival with a maximum possible lifespan of 70 years, while the oldest generation aged 90 years dies. Lifespan uncertainty is described by $s_a$, the time-invariant exogenous conditional probability of survival from age $a$ to $a + 1$. The total population growths at a constant rate, $n$, which together with time-invariant survival probabilities, implies that cohort shares in the total population, $\mu_a = [s_a \diagup (1 + n)] \, \mu_{a-1}$ are constant over time.

## 2.2 Household behaviour

Households are assumed to optimally choose consumption, $c$, leisure, $l$, at each age and when to retire from workforce to maximise their expected lifetime utility function subject to their lifetime budget constraint. The expected lifetime utility function, which is of time separable, nested CES form, for each $i$-type generation who begins her economic life at time $t$ can be expressed as

$$E(U_t^i) = \frac{1}{1-1/\gamma}\sum_{a=21}^{90} S_a\,(1+\beta)^{21-a} \left[\left(c_{t+a-21}^i\right)^{(1-1/\rho)} + \alpha\left(l_{t+a-21}^i\right)^{(1-1/\rho)}\right]^{\frac{1-1/\gamma}{1-1/\rho}}, \quad (1)$$

where the parameters (assumed to be the same for all income types) are the inter-temporal elasticity of substitution, $\gamma$, the intra-temporal elasticity of substitution, $\rho$, the leisure distribution parameter, $\alpha$, and the rate of time preference, $\beta$. The term $S_a = \prod_{j=21}^{a} s_{j-1}$ denotes the unconditional survival probability.

The household's budget constraint can be expressed as period by period asset accumulations

$$A_{a,t}^i = (1+r)A_{a-1,t-1}^i + w_t e_a^i(1-l_{a,t}^i) + AP_{a,t}^i + SB_{a,t}^i + TR_a^i + B_{a,t}^i - T(y_{a,t}^i) - (1+\tau^c)\,c_{a,t}^i, \quad (2)$$

where $A_{a,t}^i$ demotes the stock of ordinary private assets for type $i$ household at the end of age $a$ and time $t$, which equals the assets at the beginning of the period, plus the sum of interest income, $rA_{a-1,t-1}^i$, labour earnings, $w_t e_a^i(1-l_{a,t}^i)$, age pension, $AP_{a,t}^i$, superannuation pension, $SB_{a,t}^i$, social transfer payment, $TR_a^i$, and bequest receipts, $B_{a,t}^i$, minus the sum of income taxes paid, $T(y_{a,t}^i)$, and consumption expenditures, $(1+\tau_t^c)\,c_{a,t}^i$.[1] Labour earnings are the product of labour supply, $h - l_{a,t}^i$, and the hourly wage, $w_t e_a^i$, where $w_t$ is the market wage rate for a person with unit efficiency and $e_a^i$ is the age- and income-specific earnings ability variable. The labour supply is required to be non-

[1] We assume the social transfer payment, $TR_a^i$, to be paid to households in the lowest to the fourth income quintile aged younger than 65 years. The reason for including this government benefit is to match the share of welfare payments in gross total income for each household income class. More on this exogenous benefit is provided in the next section on calibration.

negative, $1 - l^i_{a,t} \geq 0$, which implies that leisure, $l^i_{a,t}$, (expressed as a proportion of the total annual hours available) cannot exceed the available time, 1. Taxable income, $y^i_{a,t} = w_t e^i_a (1 - l^i_{a,t}) + r A^i_{a-1,t-1} + AP^i_{a,t}$, comprises labour earnings, investment income and the age pension. Due to uncertain lifespan there are accidental bequests, $B^i_{a,t}$, that are assumed to be aggregated within each income type and equally redistributed to the surviving households of the same type aged between 45 and 65 years. We also assume that households are liquidity constrained by imposing non-negative asset requirements ($A^i_{a,t} \geq 0$) to prevent young and middle-aged households from borrowing against their superannuation payouts.

## 2.3 Retirement income policy

Australia has a three pillar retirement income system. The first pillar is a mandatory, publically managed "safety net" pillar comprising the means tested age pension. The second pillar is also mandatory but is a privately managed superannuation guarantee scheme. The third pillar is voluntary and privately managed, and comprises private saving, including housing and voluntary superannuation. The model incorporates the two publically stipulated pillars. We begin with compulsory superannuation as the superannuation assets and the incomes these assets generate are subject to the means testing of the age pension for eligible households.

The superannuation guarantee mandates employers to contribute currently 9 percent of gross labour earnings into the employee's superannuation fund. We assume that mandatory contributions by the representative firm are made on behalf of all working households at the after-tax contribution rate, $(1 - \tau^s)\, cr$, from their gross labour earnings, $w_t e^i_a (1 - l^i_{a,t})$. These contributions are added to the stock of superannuation assets, $SA^i_{a,t}$, that earns investment income at the after-tax interest rate, $(1 - \tau^r)\, r$. Superannuation assets are assumed to be kept in the fund until households reach age 60. Households of that age and older can draw down their superannuation savings in the form of superannuation pensions, $SB^i_{a,t}$. The stock of superannuation assets accumulates in the fund according to

$$SA^i_{a,t} = [1 + (1 - \tau^r)\, r]\, SA^i_{a-1,t-1} + (1 - \tau^s)\, cr \cdot w_t e^i_a (1 - l^i_{a,t}) - SB^i_{a,t}, \qquad (3)$$

where $\tau^r$ is the effective earnings tax rate, $\tau^s$ denotes the statutory contribution tax rate and $cr$ is the mandatory superannuation rate. If eligible households decide to collect superannuation pensions, $SB^i_{a,t}$, these pensions are subject to the maximum and minimum withdrawal limits. The maximum limit of 10 percent of the superannuation balance applies only to working households. The minimum limits are aged based. These are 4 percent of the balance for households younger than 65 years, 5 percent for those aged 65-74, 6 percent for 75-79 years old, 7 percent for 80-84 years old, 9 percent for 85-89 years old and 11 percent for those 90 years old.

The age pension, $AP^i_{a,t}$, is paid to households aged 65 years and over provided that they satisfy the means test. The means test comprises the income test, $APi^i_{a,t}$, and the asset test, $APa^i_{a,t}$, with the test that results in lower age pension payments (i.e., binding test) applied. The means testing of the age pension can be expressed as

$$\begin{aligned} AP^i_{a,t} &= \min\left\{APi^i_{a,t}, APa^i_{a,t}\right\} \\ APi^i_{a,t} &= \max\left\{\min\left\{p, p - \theta\left(\widehat{y}^i_{a,t} - IT\right)\right\}, 0\right\} \\ APa^i_{a,t} &= \max\left\{\min\left\{p, p - \phi\left((A^i_{a,t} + SA^i_{a,t}) - AT\right)\right\}, 0\right\}, \end{aligned} \tag{4}$$

where $p$ is the legislated single rate of the maximum age pension, $\theta$ is the income taper rate, $\phi$ represents the annual asset taper rate, $IT$ denotes the income threshold and $AT$ is the asset taper rate. The income assessed under the pension income test, $\widehat{y}^i_{a,t} = r(A^i_{a-1,t-1} + SA^i_{a-1,t-1}) + 0.5 \times w_t e^i_a(1 - l^i_{a,t})$, consists of interest earnings generated from superannuation and non-superannuation assets and half of labour earnings.[2]

## 2.4 Firms and technology

Perfectly competitive firms, which are represented by a single producer, produce a single all purpose output, $Y_t$, using the capital stock, $K_t$, and the labour supply, $L_t$, according to the technology described by the standard CES production function

$$F(K_t, L_t) = \kappa\left[\varepsilon K_t^{(1-1/\sigma)} + (1-\varepsilon)L_t^{(1-1/\sigma)}\right]^{[1/(1-1/\sigma)]}, \tag{5}$$

[2] According to the current policy, half of labour earnings up to $13,000 per year are exempt from assessable income for the pension income test.

where $\kappa$ is the productivity constant, $\varepsilon$ denotes the capital intensity parameter and $\sigma$ is the elasticity of substitution in production. Following Fehr (2000), capital formation is subject to adjustment costs that are assumed to be quadratic in net investment, $I_t$, and given by

$$C(I_t, K_t) = 0.5\psi \left(I_t/K_t - (n+\delta)\right)^2 K_t, \tag{6}$$

where $\psi$ is the adjustment cost coefficient, $n$ is the population growth rate, $\delta$ denotes the capital depreciation rate.

The firm's optimisation problem is to maximise the present value of all future profits discounted at the world interest rate, $r$, subject to the (per capita) capital accumulation equation, as specified by

$$\begin{aligned} \max_{\{K_t,\ L_t,\ I_t\}} \quad & \sum_{t=0}^{\infty} D_t \left[\left(1-\tau^f\right)\left(F(K_t, L_t) - C(I_t, K_t) - I_t - (1+cr)w_t L_t\right)\right] \\ \text{s.t.} \quad & (1+n)K_{t+1} = I_t + (1-\delta)\, K_t, \end{aligned} \tag{7}$$

where $D_t = (1+n)^t/(1+r)^t$ accounts for discounting and population growth and $\tau^f$ stands for the corporation tax rate. Note that the total wage rate faced by the representative firm ($(1+cr)w_t$) also includes the mandatory SG rate and so the total wage bill is given by $(1+cr)w_t L_t$.

## 2.5 The government

The government is assumed to maintain a balanced budget, which includes the age pension expenditures, $AP_t$, the social transfer payments, $SB$, and public consumption, $G$ on the expenditure side and the tax revenues from household income, $TR_t^Y$, consumption, $TR_t^C$, and superannuation, $TR_t^S$, and firm's profits, $TR_t^F$ on the income side. The government budget can be expressed, in per capita terms, as

$$TR_t^Y + TR_t^C + TR_t^S + TR_t^F = G + SB + AP_t, \tag{8}$$

where $G$ and $SB$ are assumed to be constant and the per capita pension expenditures and tax receipts from households and firms in period $t$ are given by

$$
\begin{aligned}
AP_t &= \textstyle\sum_{i=1}^{5} \omega_i \sum_{a=65}^{90} \mu_a \; AP_{a,t}^i \\
TR_t^Y &= \textstyle\sum_{i=1}^{5} \omega_i \sum_{a=21}^{90} \mu_a \; T(y_{a,t}^i) \\
TR_t^C &= \textstyle\sum_{i=1}^{5} \omega_i \sum_{a=21}^{90} \mu_a \; \tau_t^c \; c_{a,t}^i \\
TR_t^S &= \textstyle\sum_{i=1}^{5} \omega_i \sum_{a=21}^{60} \mu_a \left[\tau^s \cdot cr \cdot w_t e_a^i (1 - l_{a,t}^i) + \tau^r \cdot rSA_{a-1,t-1}^i\right] \\
TR_t^F &= \tau^f (Y_t - \delta q_t K_t - (1 + cr) w_t L_t),
\end{aligned}
$$

which are the weighted averages of each component across households, with weights given by the intra-generational shares, $\omega_i$, and cohort shares, $\mu_a$, of the population.[3] In the per capita corporation tax revenue, $Y_t$ is output net of adjustment costs, $\delta q_t K_t$ represents depreciation of the value of the capital stock and $(1+cr)w_t L_t$ gives the total labour costs.

The government budget is assumed to be balanced through adjusting the consumption tax rate, $\tau_t^c$, according to

$$\tau_t^c = \frac{G + SB + AP_t - \left(TR_t^Y + TR_t^S + TR_t^F\right)}{\sum_{i=1}^{5} \omega_i \sum_{a=21}^{90} \mu_a \; c_{a,t}^i}. \tag{9}$$

## 2.6 International budget constraint

In this small open economy model, the domestic interest rate, $r$, is exogenous and equal to the world interest rate. Denoting $FD_t$ to be the per capita foreign debt holding at the begining of time period $t$, the international budget constraint, in per capita terms, can be written as

$$(1 + n)FD_{t+1} - FD_t = TB_t - rFD_t, \tag{10}$$

where $TB_t$ is the trade balance and $rFD_t$ represents the interest payments on net foreign debt. This constraint equates capital flows on the left-hand side with the current account on the right-hand side.

[3] The per capita social benefits are given by $SB = \sum_{i=1}^{4} \omega_i \sum_{a=21}^{64} \mu_a \; SB_a^i$.

## 2.7 Market clearing conditions

The following market clearing conditions for labour, capital and output markets must be satisfied in every time period $t$:

$$\begin{aligned} L_t &= \textstyle\sum_{i=1}^{5} \omega_i \sum_{a=21}^{90} e_{a,t}^i (1 - l_{a,t}^i) \mu_a \\ q_t K_t &= \textstyle\sum_{i=1}^{5} \omega_i \sum_{a=21}^{90} \left( A_{a,t}^i + SA_{a,t}^i \right) \mu_a - FD_t \\ Y_t &= \textstyle\sum_{i=1}^{5} \omega_i \sum_{a=21}^{90} c_{a,t}^i \mu_a + I_t + G_t + TB_t, \end{aligned} \tag{11}$$

where $q_t$ is the price of capital (i.e., Tobin's $q$) that is obtained by solving the firm's profit maximisation problem defined in (7).

# 3 The model calibration

The model is calibrated to the key Australian aggregates averaged over the five-year period ending in June 2010. The benchmark economy is assumed to be in a steady state equilibrium. In this section, we report on some of the details of the calibration procedure, present the resulting parameter choices and provide a brief comparison of the model generated solutions with Australian data for some variables.

## 3.1 Income heterogeneity among households

We consider five income types of households in each generation that differ by their exogenously given earnings ability and social transfer payments (excluding the age pension).

The earnings ability is full or potential wage earned with all time endowment allocated to work. Using the estimated lifetime wage function for males with completed high school education taken from Reilly *et al.* (2005) and the income distribution shift parameter, $\zeta^i$, the earnings ability variable, $e_a^i$, is constructed as

$$e_a^i = \zeta^i \times e^{2.235+0.04(a-17)-0.00067(a-17)^2}, \tag{12}$$

where $\zeta^i$ is set to 0.26 for the lowest quintile, 0.55 for the second quintile, one for the third quintile, 1.52 for the fourth quintile and 2.63 for the highest quintile. These values are the ratios of the private incomes of lower and higher quintiles to the private income of the third quintile, calculated from ABS (2007) - Table 7, p.22. Hence, the earnings ability profile for the middle income households (those in the third quintile) is taken from Reilly *et al.* (2005) and the profiles for lower and higher income quintiles are shifted down and up to approximate the private income distribution in Australia.[4]

In order to approximately match not only private earnings but also welfare payments and gross total incomes for each income quintile, we assume that households are paid the government transfer payments. These payments, which are assumed to be constant at each age and received by households (except for those in the highest quintile) aged younger than 65 years, are calculated as follows. First, we use the ABS (2007) data to derive the share of social welfare transfers in gross total income for each eligible income quintile. These shares are 0.44 for the lowest quintile, 0.3 for the second quintile, 0.15 for the third quintile and 0.06 for the fourth quintile. Then, we calculate the value of social benefits for the eligible households in the benchmark steady state simulation such that these payments together with the endogenous age pension yield the aforementioned shares in their lifetime gross income.

## 3.2 Demographic, utility, technology and policy parameters

The values of the demographic, utility and technology parameters of the model are reported in Tables 1. The demographic structure of the model is stationary, where the constant annual population growth rate, $n$, is calibrated together with the male survival probabilities taken from the 2007-09 life tables (ABS, 2010a) to generate the current old aged dependency ratio of 0.2. The intra-generational shares, $\omega_i$, are based on ABS (2007) that divides households into income quintiles; that is, each income type of households has an equal share of 20 percent in every generation.

Insert Table 1 here

The values of utility and technology parameters are standard in the literature. The utility function parameters are the same across all income types of households. The subjective rate of time preference, $\beta$, is chosen to generate the capital output ratio of 3

[4]Note that the earnings ability after age 65 is assumed to decline at a constant rate such that it reaches zero at age 90 for each income class as Reilly *et al.* considered only workers aged 15-65 years.

(ABS, 2010b). The technology constant, $\kappa$, is calibrated to reproduce the market wage rate that is normalised to one in the benchmark steady state equilibrium. The capital depreciation rate, $\delta$, is set to target the investment capital ratio of 0.09 (ABS, 2010b). The elasticity of substitution in production, $\sigma$, and the capital intensity parameter, $\varepsilon$, are calibrated via the producer's first order conditions to match the interest rate and national account data for factor shares. Following Creedy and Guest (2008b), the exogenous interest rate is set to 4 percent and the adjustment cost parameter is taken from Auerbach and Kotlikoff (1987). We also target the ratio of net foreign debt to capital stock of 0.195, reflecting net foreign ownership of about 19.5 per cent of Australia's capital stock (ABS, 2010b).

The values of the age pension and superannuation parameters are those applicable in September 2009. The age pension eligibility age is 65 years. The consumption tax rates is set to its statutory GST rate of 10 percent. We then compute the "tax base" parameter to replicate the average ratio of this tax revenues to GDP, which was 0.0389 over the five-year period ending in June 2010 (Commonwealth of Australia, 2011). The product of the statutory tax rate and the computed tax base parameter give the effective rates on consumption, $\tau^c = 7.04\%$. The corporation tax rate is set to its statutory rate of 30 percent and we assume balanced government budget with no government debt.

The model incorporates the differentiable approximation function of the Australian progressive personal income tax schedule in 2009-10. The approximation income tax, $T(y)$, is a function of taxable income, and it takes the following form:

$$\begin{aligned} T(y) &= t_5(y) - t_5(yt_1) \exp\left( \sum_{z=1}^{M-1} - (0.1)^z \nu_z \times \frac{y^z}{z} \right), \ z = 1, ..., M-1, \qquad (13) \\ t_5(y) &= m_5(y - yt_5) + tax_5, \end{aligned}$$

where $\nu_z = (\nu_1, \nu_2, \nu_3, \nu_4)$ is a parameter vector, $M$ denotes the number of tax brackets ($M = 5$), $yt_1$ and $yt_5$ are the lowest and highest tax thresholds ($yt_1 = 0$ and $yt_5 = 180$, expressed in \$1,000), $m_5$ is the top marginal tax rate ($m_5 = 0.45$) and $tax_5$ is the tax payable at the highest threshold ($t = 54.55$, expressed in \$1,000). The parameter vector $\nu_z = (\nu_1, \nu_2, \nu_3, \nu_4)$ is estimated by nonlinear least squares using the Stata software. We construct a grid of equally spaced incomes in the range [0, 200.5] and the corresponding income taxes payable based on the 2009-10 Australian tax schedule, with both variables expressed in units of $1,000. The obtained parameter estimates are $\nu_z$ = ( 0.1446, 0.0160, -0.0049, 0.0003).

## 3.3 Computation and benchmark steady state solution

After specifying the parameter values, we compute the solution to the benchmark steady state equilibrium, using the GAMS software.[5] Our algorithm applies the iterative Gauss-Seidel computational method that was suggested by Auerbach and Kotlikoff (1987). The steps carried out to solve for the steady states and the transition paths are listed in Kudrna and Woodland (2011). In this subsection, we only outline the way of dealing with the non-convexity of the household budget set that is caused by the age pension means test. We follow Altig *et al.* (2001) to deal with the kinked households' budget constraints and identify households that choose to locate at the kinks in particular periods by evaluating their income assessable under the pension income test. If the assessable incomes are close (rounded to 6 decimal places) to the income threshold of the pension income test, we set these incomes exactly to that threshold. By doing that we put such households exactly at kinks in each period in which being at a kink is optimal.

Insert Table 2 here

The results for the key macroeconomic ratios and household net income variables generated by the benchmark steady state solution of the model are presented in Table 2. The distribution of net incomes across the household quintiles and the Gini coefficient match very closely the actual data. Note that the actual data for net income shares and the Gini coefficient for net income were obtained from ABS (2011) as averages over the five-year period ending in June 2010.

The comparison of model generated and actual macroeconomic indicators also indicates that the model replicates the Australian economy fairly well. The components of domestic aggregate demand are close to their actual values expressed in percent of GDP, except for the trade balance, whose positive value is implied by the calibration target for the net foreign debt to capital ratio. Similar conclusions can be drawn for the displayed government indicators, apart from the government revenues from the superannuation taxes. The difference between the model and actual revenues from the superannuation

[5] We use GAMS software also to compute the transition paths of the superannuation taxation reforms.

taxation is due to the full maturity of the superannuation system that we assume in the model.[6]

# 4 Dynamic simulations of superannuation tax reforms

In this section we numerically evaluate the following three hypothetical reforms to superannuation taxation: (i) shift to the EET taxation regime, (ii) shift to the TEE taxation regime and (ii) implementing the AFTS proposal. Under the shift to the EET regime, the existing concessional tax rates on superannuation contributions and fund earnings paid by the superannuation fund are abolished, with the superannuation withdrawals being added to ordinary taxable income and taxed progressively at marginal income tax rates. The second simulated reform - the shift to the TEE regime - also eliminates the existing concessional superannuation taxes, but it is the mandatory superannuation contributions that are included in ordinary taxable income and taxed progressively at marginal income tax rates. The third examined superannuation tax reform - the AFTS proposal - follows the TEE regime by treating superannuation contributions as ordinary taxable income. In addition, the proposal includes a 15 percent tax offset to contributions for all households and a reduction of the statutory tax on fund earnings to 7.5 percent.

The following discussion on the simulation results of the three examined superannuation taxation reforms concentrates on the equity and macroeconomic implications of the superannuation taxation reforms. We first provide an overview of the key results and then we discuss the results in more detail.

## 4.1 Overview

All three examined reforms to superannuation taxation basically consist of two parts. The first part is to abolish the concessional 15 percent tax rate on mandatory contributions and to either fully eliminate the effective fund earnings tax of 7.1 percent for the EET and

[6]Note that compulsory superannuation (i.e., superannuation guarantee) was introduced in 1992 with initial 3 percent contributions, which were gradually increased to the existing rate of 9 percent in 2001. The 9 percent mandatory contributions paid to households over their whole working lives that we assume in the model also generates higher ratios of superannuation assets to GDP and to total assets than they currently are. Thus, it should be emphasised that the superannuation taxation reforms whose results are presented in the next section are examined in the environment of a fully mature superannuation system.

TEE regimes or to partially eliminated this tax for the AFTS proposal. These changes favour greatly the superannuation assets that households can draw down from the age of 60 onwards. The resulting increases in national wealth, saving and interest incomes upon reaching the eligibility age of 60 years for the age pension mean that the income and/or assets tests become more binding for potential age pension recipients and hence that the government expenditures on the age pension decline. In that sense, there has been a substitution between the age pension and superannuation as retirement supports, which is significant especially under the shift towards the EET taxation regime.[7]

The second part of the simulated reforms is to treat either the withdrawals (for the EET regime) or the contributions (for the TEE regime and the AFTS proposal) as ordinary taxable income. This generates larger revenues from personal income taxation, which allows for a reduction in the budget-balancing consumption tax rate. Under the EET regime, the consumption tax rate is lower over the entire transition path, supported also by increased labour supply of young and middle-aged cohorts, which has positive effects on their ordinary non-superannuation assets accumulations. As for the other two taxation reforms, the decline in the consumption tax rate is only temporary, with the tax rate being higher in the long run compared to its benchmark value. The extra government expenditure on the refundable superannuation tax offset under the AFTS proposal implies a higher consumption tax rate ralative to the other two taxation reforms.

The progressive income taxation applied to either superannuation benefits or contributions is behind improvements in vertical (intra-generational) equity of the superannuation system. The equity improvements are demonstrated by greater gains (or smaller losses) in welfare, the increases in net income shares for lower income types and by lower values for the Gini coefficient under all the examined reforms. The implications for intergenerational equity, however, differ across the three reforms. Under the EET regime, older generations experience large welfare losses as their withdrawals from the superannuation funds are now taxed at marginal income tax rates. On the other hand, older cohorts gain slightly or attain minimal welfare losses with the TEE regime and the AFTS proposal as they are affected only indirectly through initially lower consumption taxes.

[7] Note that the policy simulations of eliminating concessional tax rates on either contributions or fund earnings or benefits by Creedy and Guest (2008b) assume universal age pension benefits and thus are incapable of capturing the effects of the given superannuation tax policy on the publically-provided age pension.

In the long run, the shift to the EET regime generates larger average welfare compared to the other policy reforms, which is due primarily to lower consumption taxes.

## 4.2 Equity effects

To examine the equity effects of the superannuation taxation reforms, we use the concepts of equivalent variation, net income shares for household quintiles and of the Gini coefficient that is calculated using net incomes. The first equity measure - equivalent variation - provides the distributional welfare effects across the five income types of households (i.e., measuring the effects on vertical equity) and across different generations (i.e., measuring the effects on inter-generational equity). In particular, equivalent variation for the given generation measures the percentage increase in this generation's wealth, which brings about the proportional increase in consumption and leisure in each year of remaining life needed in the benchmark scenario to produce the realised remaining lifetime utility in the reform scenario (see Auerbach and Kotlikoff, 1987, p. 87).

Insert Table 3 here

The distributional welfare effects of the examined superannuation taxation reforms are reported in Table 3. These effects are presented as percentage changes in remaining utility for generations of different ages at the time of the reform and for the five income types of households.[8] The key result is that all the three reforms improve intra-generational or vertical equity, depicted by larger (smaller) gains (losses) in welfare for lower income types of households relative to those for higher income households. For instance, the shift to the EET tax regime generates the welfare loss of only 0.15 percent for the lowest income households aged 80 years at the time of the reform, but the welfare loss for the highest income quintile of the same age is 6.84 percent. In the long run, the lowest income type gains in welfare about 0.55 percent from that reform, which is more than double of the gain experienced by the highest income quintile. Under the shift to the TEE regime, future born generations of the lowest income quintile gain in welfare 0.27 percent, while the highest income quintile attains the welfare loss of about 0.2 percent. Similarly, the simulation of the AFTS proposal leads to the long run welfare gain of about 0.3

[8] Note that the youngest generation at the time of the reforms is aged 21 years, which is the assumed entry age in the model. All the generations aged 20 years and younger are those born in the succeeding transitional years. The results for the generation aged -80 in year 2010 (i.e., generation born in 2110) represent the long run welfare effects.

percent for the lowest income quintile and of 0.11 percent for the highest quintile. These improvements in vertical equity are driven by the progressive taxation of superannuation benefits or contributions, which outweighs the elimination of the concessional tax on fund earnings that favours higher income types.

Table 3 also shows the inter-generational equity implications that differ among the superannuation taxation reforms. Under the EET tax regime, older generations receiving (or close to the age of receiving) the superannuation benefits experience welfare losses, with the average welfare loss for generations aged 80 years at the time of the reforms being almost 3.18 percent because of the progressive income taxation imposed on their superannuation benefits. In contrast, future born generations gain in welfare, with the long run welfare gain of about 0.39 percent. The long run gains indicate that the resulting decreases in the consumption tax rate and significantly higher asset accumulations offset the negative effects of income taxations imposed on superannuation withdrawals. On the other hand, the shift to the TEE regime benefits more in terms of welfare to older generations, which is due to the initial decline in the consumption tax rate. In the long term, the average welfare gain is smaller, being reduced by lower welfare for higher income households that bear most of the burden of the progressive income taxation applied to their superannuation contributions.[9]

Insert Table 4 here

The other two equity measures for which we provide results are the net income shares for five household types and the Gini coefficient. The percentage changes in net income shares and in the Gini coefficient for the three superannuation taxation reforms are presented in Table 4. Similar to the distributional welfare implications, all three reforms increase (reduce) net income shares for lower (higher) income types, thus reducing the Gini coefficient. Under the shift to the EET regime, the Gini coefficient falls by 0.96 on impacts and by about 1.13 percent in the long term. The improvements in vertical equity during the transition path result from the transitional increases in the net income shares for lower income types that outweigh smaller net income decreases experienced by

[9]Similar inter-generational welfare effects are obtained by Fehr at al. (2008) for the policy introducing voluntary front-loaded and back-loaded accounts. The differences in their results between the two types of tax-preferred accounts come mainly from the general equilibrium effects on the assumed budget balancing policy instrument rather than through direct effects on households from the taxation applied to these voluntary accounts.

higher income types. The opposite transitional effects on vertical equity apply for the shift to the TEE regime and adopting the AFTS proposal, with these effects being more positive in the short term than in the long run. For example, the Gini coefficient falls by about 1.9 percent on impact and by 1.39 percent in the long run as a result of the shift to the TEE regime. Although the net income shares for lower income types are higher in the long run, they fall relative to the impact effect, while the decrease in the net income shares of higher income types are reduced in the long term, causing the Gini coefficient to increase over the transition.

## 4.3 Macroeconomic effects

Macroeconomic or aggregate variables are obtained as weighted averages of optimal household behaviour, where the weights are the constant cohort and income type shares. The macroeconomic effects of the superannuation tax reforms are displayed in Table 5 as percentage changes in the selected per capita variables in the selected years of the transition from the benchmark steady state solution. Note that the reforms are assumed to be implemented in 2010, with the results for that year depicting the impact effect of the reforms. We also present the results for two transitional years of 2015 and 2030 and for year 2150, which represents the long run effects of the policy reforms. In the discussion of the macroeconomic results we concentrate on the implications for the asset accumulation and capital, the goods market, the labour market and for the main government indicators.

Insert Table 5 here

The removal of the superannuation contribution tax rate, combined with the full elimination (under both the EET and TEE regimes) or the partial elimination (under the AFTS proposal) of fund earning tax implies larger superannuation assets, which generate the reported increases in total domestic assets. The magnitude of these increases, however, is largely different among the three reforms. Similar differences in the effects on national wealth arising from introduction of voluntary front- and back-loaded retirement accounts are derived by Fehr at al. (2008). Under the EET regime, the long run increase in total wealth is over 20 percent, which is due to not only greater superannuation assets but also because of increased private non-superannuation assets, as depicted by the falling share of superannuation assets in Table 5. The higher private assets are due to significantly lower consumption expenditures (as the consumption tax rate falls) and by higher labour earnings initially. As for the TEE regime and the AFTS proposal, the increases in total domestic assets are moderated by private assets whose decreases are driven by higher income taxes on younger generations.[10] While the total wealth increases, the effects of the superannuation taxation reforms for the capital stock per capita are negative. In the short and medium term, the capital decreases are caused by lower capital prices (not displayed) but in the long term, these negative effects are entirely driven by lower labour input. Hence, the increases in household saving are not invested in the domestic capital stock but exported abroad, leading to substantial reductions in net foreign debt.

The examined radical changes to superannuation taxation have significant implications for household labour supply. As shown in Table 5, the effects of the TEE regime and the AFTS proposal on per capita labour supply are negative over the entire transition paths. The lower average labour supply is due to reduced working hours of middle-age and older working households that face increased income tax rates as contributions are treated under the progressive income taxation. The relatively more favourable outcome for per capita labour supply arising from the AFTS proposal is caused by the uniform 15 percent tax offset to superannuation contributions that effectively reduces income tax rates (relative to the rates under the TEE regime). On the other hand, the shift to the EET regime leads initially to higher per capita labour supply, which increases by about 1.74 percent on impact. This is because the current middle-age and older working households supply more labour in order to boost the superannuation savings. In the succeeding years of the transition, the increases in average labour supply disappear, with the average labour supply falling by almost 2.24 percent in the long term, which is due mainly to the dominating income effect of significantly larger asset holdings.[11]

The output (or GDP) is produced, using the capital stock and labour supply, and so the effects of the reforms on output follow the changes in these two inputs to production.

[10] Recall that we impose borrowing constrains on all households so they cannot borrow against their superannuation assets. Removing the borrowing constraints would generate a larger superannuation offset (i.e., reduction in private non-superannuation assets) and smaller increases in total wealth for all three examined reforms. Creedy and Guest (2008b) allow for borrowing, which partly explains lower saving generated by their policy simulation of removing the concessional tax rate on benefits.

[11] The wage rate (not displayed) is unchanged in the long term in this small open economy model but during the transition it moves in the opposite direction to the changes in average labour supply (i.e., higher labour supply by households leads to a lower wage rate paid by firms).

Table 5 indicates that only under the shift to the EET regime in the short and medium terms, output increases because of higher average labour supply. The effects on national income (or GNP) that equals the output less the interest payments on foreign debt are more favourable because of lower foreign debt. In fact, the national income is higher over the entire transition and in the long term as a result of the shift to the EET regime. The largest component of output is consumption, which is measured in per capita terms as all the other macroeconomic variables. As shown, all three reforms have negative effects on per capita consumption. Under the EET regime, average consumption decreases significantly by about 3.66 percent on impact, caused by lower consumption of the current elderly that now have their superannuation benefits taxed as ordinary income. However, there are improvements in per capita consumption during the transition due to greater accumulated assets. By contrast, the shift to the TEE regime and the AFTS proposal generate relatively higher consumption in the short run than in the long run, which is driven mainly by the increases in the consumption tax rate over the transition.[12]

The simulation results also show that all three reforms reduce reliance of the elderly on publicly provided age pension. This is because of larger accumulated assets and asset incomes in retirement that are subject to the age pension means test. The decline in the age pension expenditures is especially significant for the shift to the EET regime, generating the long run fall of about 4.52 percent in public pension costs. As expected, the receipts from the income taxation increase under all three reforms as either benefits or contributions are treated as ordinary taxable income. These effects are quite similar for both the EET and TEE regimes in the short run, but over the transition, the shift to the TEE regime leads to greater decreases in income tax revenues. The decreases are caused by the higher income tax rates faced by middle aged households that lower their labour supply, private assets and asset incomes. The increased income tax revenues allow for a lower consumption tax rate that is assumed to balance government expenditures and tax revenues. In the short term, the consumption tax rate declines under all three examined reforms. However, relative to the impact effects, the consumption tax rate increases and it is 1.62 percent and 8.88 percent higher for the TEE regime and the AFST proposal,

[12]The effects on the other components of aggregate demand are not displayed. In brief, government or public consumption is kept constant over the entire transition and the policy effects on investment demand are similar to those in the capital stock. The external demand or net export balances output supply with domestic demand and under all three reforms, it decreases in the long run as the output falls more than domestic demand.

respectively. These increases are caused partly by declining intakes from personal income taxation, corporation taxation (that largely follows the effects on output) and declining average consumption that affects overall consumption tax revenues. The relatively higher consumption taxes for the AFTS proposal comes from the extra government expenditure on the uniform 15 percent contribution tax offset.

# 5 Concluding remarks

In this paper we have examined hypothetical but radical reforms to superannuation taxation by using a computable OLG model that incorporates essential features of the Australian retirement income and taxation policy settings. These reforms include (i) the shift to the EET taxation regime; (ii) the shift to the TEE regime and (iii) adopting the AFTS proposal on the taxation of superannuation. The first two reforms represent the replacements of the existing concessional superannuation taxation with the taxation regimes commonly applied to private pension pillars in other countries, where either benefits or contributions are treated as ordinary incomes and tax progressively. The third reform is a variant of the shift to the TEE regime, which includes a 15 percent refundable "superannuation contribution" tax offset and halving (but not fully eliminating) the effective tax rate on investment earnings by the superannuation fund.

The major objective of the paper was to assess whether and to what extent the reforms improve vertical (or intra-generational) equity of the superannuation system, which currently provides tax concessions mainly to wealthy households, with lower income households deriving little or no benefits (AFTS, 2010). Our simulation results indicate that all three reforms generate positive effects on vertical equity in the short, medium and long terms, supporting the proposals to impose progressive income taxes on either superannuation contributions or benefits (see ASFA (1998), Ingles (2009) and AFTS, 2010). The welfare gains (losses) are greater (smaller) for lower income households relative to those experienced by higher income households. The net income shares for lower income households also improve, while the shares for higher income household are smaller and the Gini coefficient decrease under all the examined reforms. To rank the policy reforms based on the values obtained for the Gini coefficient, the most effective policy to reduce income inequality would be the shift towards the TEE regime, followed by the

AFTS proposal and the EET regime.

The model is also capable of evaluating the inter-generational implications of the reforms. It is shown that the effects on inter-generational equity obtained from the shift to the EET taxation regime are very different from those caused by the TEE regime and the AFTS proposal. Under the shift to the EET regime, older generations suffer from large welfare losses as their private pensions are treated as regular income and taxed at marginal income tax rates. However, long run improvements in welfare arising from the shift to the EET regime are higher for all income classes of households compared to the other two taxation reforms, driven by significant increases in the income tax revenue that leads to lower consumption taxes.

The removal of the existing concessional taxes paid by superannuation funds on mandatory contributions and interest earnings (i.e., part of each of the examined reforms) implies larger superannuation assets accumulations, which cause the national assets and household saving to increase. The implied larger assets and asset incomes in retirement are assessed under the age pension means test, reducing age pension payments for some households and the overall pension expenditure to the government. Hence, the reforms increase self-funding and reduce reliance on the age pension for many pensioners. The effects on average labour supply, however, are negative, arising from the income effect of increased life-cycle assets for the EET regime and from higher income tax rates faced by young and middle-age generations for the TEE regime and the AFTS proposal.

Any modeling analysis such as that employed here is subject to limitations. First, it should be empahsised that the simulation of the examined reforms to superannuation taxation were undertaken in the environment of the fully mature superannuation system, while the existing system is still in the transition, with the mandatory superannuation being introduced in 1992 with initial three percent contributions. And so, if we targeted the current values for superannuation assets and superannuation taxation revenues in the benchmark simulation, the effects generated by the reform would change from those presented. For example, eliminating the concessional tax rates on superannuation would require smaller increases in other taxes to balance the government budget, given the overestimated intakes from superannuation taxes generated by our benchmark steady state solution. Similarly, the shift to the EET regime is likely to lead to smaller increases in income tax revenues in the short and medium run than those presented, as the current superannuation balances are not as large as predicted by the model. Second, the present model features stationary demographics with a constant annual growth rate of total population and a time-invariant population age distribution. Implementing population ageing that si projected to accelerate in the next few decade would also change the obtained results. For instance, the increases in the income taxation revenues resulting from the shift to the TEE regime would not be as large because of the projected decreases in the shares of younger cohorts in the total population whose contributions would be taxed under the income taxation. On the other hand, the shift to the EET regime would lead to larger income tax revenues in the longer run due to expected increases in the older cohort shares. Hence, it would be more realistic if the model incorporates non-stationary demographics with the increasing share of older cohorts in future years.

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**Table 1**: Parameter Values of Benchmark Steady State Model

| Symbol | Description | Value | Source |
|---|---|---|---|
| | *Demographics* | | |
| $n$ | Population growth rate | 0.018 | Calibrated[a] |
| $\omega_i$ | Fraction of households of income group $i$ | All 0.2 | Data[b] |
| $s_a$ | Conditional survival probabilities | ABS (2010a) | Data |
| | *Utility function* | | |
| $\gamma$ | Inter-temporal elasticity of substitution | 0.4 | Literature[c] |
| $\rho$ | Intra-temporal elasticity of substitution | 0.9 | Literature[c] |
| $\beta$ | Subjective rate of time preference | 0.0093 | Calibrated |
| $\alpha$ | Leisure intensity parameter | 1.4 | Literature[c] |
| | *Production function* | | |
| $\kappa$ | Production constant | 0.866 | Calibrated |
| $\sigma$ | Elasticity of substitution in production | 0.866 | Calibrated |
| $\varepsilon$ | Capital share | 0.450 | Calibrated |
| $\delta$ | Depreciation rate | 0.072 | Calibrated |
| $\psi$ | Adjustment cost parameter | 10 | Literature[d] |
| | *Tax and retirement income policy* | | |
| $\bar{\tau}^c$ | Statutory consumption tax rate [GST] | 0.1 | Data |
| $\tau^f$ | Statutory corporation tax rate | 0.3 | Data |
| $\upsilon^c$ | Consumption tax base parameter | 0.694 | Calibrated[e] |
| $p$ | Maximum pension per year (in $100,000) | 0.174694 | Data |
| $IT$ | Income test threshold (in $100,000) | 0.03976 | Data |
| $\theta$ | Assets test threshold (in $100,000) | 3.07 | Data |
| $AT$ | Income reduction (taper) rate | 0.5 | Data |
| $\phi$ | Assets reduction (taper) rate | 0.039 | Data |
| $cr$ | Mandatory superannuation contribution rate | 0.09 | Data |
| $\tau^s$ | Superannuation contribution tax rate | 0.15 | Data |
| $\tau^r$ | Superannuation earnings tax rate | 0.071 | Data[f] |

*Notes*: [a] The population growth rate is calibrated such that it together with survival probabilities generates the old age dependency ratio of 0.2;[b] Each generation is divided into income quintiles based on ABS (2007); [c] The values of these parameters are similar to those in Auerbach and Kotlikoff (1987); [d] This value is taken from Auerbach and Kotlikoff (1987); [e] The product of this tax base parameter and the statutory GST rate of 10 percent gives the effective consumption tax rate of 6.94 percent that appears in the households' budget constraint; [f] This is roughly a value for the effective tax rate on superannuation earnings.

**Table 2**: Benchmark Steady State Solution and Key Australian Data Comparison

| Variable | Benchmark model | Australia [a] |
|---|---|---|
| *Expenditures on GDP (percent of GDP)* | | |
| - Private consumption | 56.12 | 56.22 |
| - Investment | 27.01 | 27.38 |
| - Government consumption | 15.58 | 17.88 |
| - Trade balance | 1.29 | -1.3 |
| *Government indicators (percent of GDP)* | | |
| - Age pension expenditure | 2.89 | 2.7 |
| - Personal income taxes | 12.31 | 11.49 |
| - Corporation taxes | 5.08 | 5.27 |
| - Consumption taxes (GST revenue) | 3.85 | 3.89 |
| - Superannuation taxes | 1.05 | 0.8 |
| *Targeted calibration ratios* | | |
| - Capital-output ($K/Y$) | 3 | 3 |
| - Investment-capital ($I/K$) | 0.09 | 0.09 |
| - Foreign debt-capital ($FD/K$) | 0.195 | 0.195 |
| *Net income share* | | |
| - Lowest quintile | 0.069 | 0.075 |
| - Second quintile | 0.121 | 0.125 |
| - Third quintile | 0.184 | 0.171 |
| - Fourth quintile | 0.243 | 0.229 |
| - Highest quintile | 0.384 | 0.401 |
| Gini coefficient | 0.336 | 0.326 |

*Source*: Our simulations and ABS (2010b), Commonwealth of Australia (2011) and ABS (2011).
*Notes*: [a] The data for Australia are five year averages over the period ending in June 2010.

**Table 3**: Welfare Implications of Superannuation Policy Changes
(Percentage changes in remaining utility)

| Superannuation tax reform | Age in 2010 | Household Income Type [a] | | | | | Average [a] |
|---|---|---|---|---|---|---|---|
| | | Lowest | Second | Third | Fourth | Highest | |
| (i) Shift to the EET regime | 80 | -0.147 | -1.641 | -3.039 | -4.208 | -6.838 | -3.175 |
| | 60 | -0.666 | -1.478 | -2.422 | -3.455 | -4.879 | -2.580 |
| | 40 | 0.188 | -0.093 | -0.331 | -0.628 | -1.067 | -0.386 |
| | 20 | 0.460 | 0.349 | 0.309 | 0.222 | 0.060 | 0.280 |
| | -20 | 0.555 | 0.431 | 0.410 | 0.334 | 0.207 | 0.387 |
| | -80 | 0.554 | 0.430 | 0.408 | 0.331 | 0.203 | 0.385 |
| (ii) Shift to the TEE regime | 80 | 0.231 | 0.225 | 0.220 | 0.216 | 0.209 | 0.220 |
| | 60 | 0.179 | 0.170 | 0.134 | 0.082 | -0.016 | 0.110 |
| | 40 | 0.368 | 0.309 | 0.161 | 0.030 | -0.019 | 0.170 |
| | 20 | 0.360 | 0.274 | 0.101 | -0.063 | -0.140 | 0.107 |
| | -20 | 0.280 | 0.164 | 0.009 | -0.145 | -0.193 | 0.023 |
| | -80 | 0.274 | 0.158 | 0.003 | -0.151 | -0.199 | 0.017 |
| (iii) Adopting the AFTS proposal | 80 | -0.007 | -0.071 | -0.117 | -0.142 | -0.179 | -0.103 |
| | 60 | -0.124 | -0.243 | -0.343 | -0.437 | -0.574 | -0.344 |
| | 40 | 0.225 | 0.132 | -0.013 | -0.140 | -0.189 | 0.003 |
| | 20 | 0.356 | 0.274 | 0.124 | -0.016 | -0.074 | 0.133 |
| | -20 | 0.305 | 0.203 | 0.064 | -0.065 | -0.103 | 0.081 |
| | -80 | 0.299 | 0.197 | 0.059 | -0.071 | -0.109 | 0.075 |

*Notes:* [a] Standard equivalent variations measures;

**Table 4**: The Implications of the Reforms on Net income and Gini Coefficient

| Superannuation tax reform | Period | Household Income Type | | | | | Gini Coefficient |
|---|---|---|---|---|---|---|---|
| | | Lowest | Second | Third | Fourth | Highest | |
| (i) Shift to the EET regime | 2010 | 0.259 | 0.240 | 0.233 | -0.305 | -0.432 | -0.960 |
| | 2015 | 0.746 | 0.435 | 0.217 | -0.285 | -0.423 | -0.984 |
| | 2030 | 1.349 | 0.995 | 0.461 | -0.242 | -0.623 | -1.304 |
| | 2150 | 1.225 | 0.750 | 0.414 | -0.198 | -0.542 | -1.126 |
| (ii) Shift to the TEE regime | 2010 | 2.644 | 1.611 | 0.187 | -0.633 | -0.672 | -1.899 |
| | 2015 | 2.739 | 1.572 | 0.145 | -0.595 | -0.680 | -1.908 |
| | 2030 | 2.491 | 1.239 | -0.026 | -0.328 | -0.618 | -1.618 |
| | 2150 | 2.428 | 1.005 | -0.042 | -0.487 | -0.424 | -1.390 |
| (iii) Adopting the AFTS proposal | 2010 | 2.116 | 1.257 | 0.066 | -0.569 | -0.448 | -1.431 |
| | 2015 | 2.182 | 1.245 | 0.050 | -0.531 | -0.473 | -1.457 |
| | 2030 | 2.238 | 1.136 | -0.017 | -0.348 | -0.532 | -1.450 |
| | 2150 | 2.047 | 0.864 | -0.096 | -0.446 | -0.311 | -1.133 |

*Notes:* The values gives the percentage changes from the benchmark steady sate values.

**Table 5**: Macroeconomic Implications of Superannuation Policy Changes
(Percentage Changes in the Selected Macroeconomic Variables from the Benchmark Steady State Solution)

| Period | Domestic Assets | Super Assets [a] | Capital Stock | Foreign Debt | Output (GDP) | National Income (GNP) | Consum-ption | Labour Supply | Age Pension | Income Taxation | Tax Rate [b] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***1.** Shift to the EET tax regime* | | | | | | | | | | | |
| 2010 | 0.000 | 0.807 | 0.000 | 1.021 | 1.123 | 1.126 | -3.661 | 1.841 | 0.800 | 13.708 | -16.255 |
| 2015 | 5.320 | 0.784 | -0.074 | -24.689 | 0.437 | 1.019 | -3.069 | 0.762 | 0.597 | 13.017 | -13.172 |
| 2030 | 19.048 | 0.791 | -1.574 | -91.983 | -1.722 | 0.368 | -1.229 | -1.815 | -2.846 | 11.299 | -7.646 |
| 2150 | 21.791 | 0.805 | -2.236 | -105.614 | -2.236 | 0.157 | -0.568 | -2.236 | -4.517 | 12.157 | -11.332 |
| ***2.** Shift to the TEE tax regime* | | | | | | | | | | | |
| 2010 | 0.000 | 0.807 | 0.000 | -2.262 | -0.326 | -0.281 | -0.481 | -0.530 | 0.022 | 12.327 | -11.137 |
| 2015 | 0.220 | 0.826 | -0.238 | -3.743 | -0.431 | -0.354 | -0.750 | -0.552 | 0.014 | 11.662 | -8.701 |
| 2030 | 3.033 | 0.899 | -0.810 | -17.958 | -0.810 | -0.413 | -1.151 | -0.810 | -0.488 | 9.321 | -0.836 |
| 2150 | 4.367 | 0.908 | -1.105 | -24.646 | -1.105 | -0.560 | -0.891 | -1.105 | -0.928 | 8.767 | 0.928 |
| ***3.** Shift to the AFTS proposal* | | | | | | | | | | | |
| 2010 | 0.000 | 0.807 | 0.000 | -1.010 | -0.065 | -0.043 | -0.440 | -0.106 | 0.034 | 6.904 | -1.657 |
| 2015 | 0.489 | 0.819 | -0.122 | -3.623 | -0.157 | -0.077 | -0.616 | -0.179 | 0.161 | 6.457 | -0.009 |
| 2030 | 3.635 | 0.878 | -0.581 | -19.276 | -0.613 | -0.181 | -0.830 | -0.633 | 0.014 | 4.437 | 6.460 |
| 2150 | 4.850 | 0.889 | -0.843 | -25.337 | -0.843 | -0.276 | -0.535 | -0.843 | -0.667 | 3.904 | 7.550 |

*Notes:* [a] Only the displayed values for superannuation assets are given as shares in the total domestic assets (the values for all other variables represent the percentage changes from the benchmark steady state); [b] This column shows the effects on the consumption tax rate that we assume to balance the government budget.