

Superannuation Tax Reforms in a Life-Cycle Framework

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June 2009

Abstract

This paper numerically evaluates implications of different tax treatments of Australia's fully-funded retirement income pillar - superannuation. The primary objective is to assess the removal of superannuation benefit taxation that was implemented in July 2007. This policy is compared with the alternative policy of the shift towards the expenditure tax treatment that reflects industry demands to abolish taxes on contributions and fund earnings. The quantitative analysis is based on a computable, open economy OLG model, which features intra-generational heterogeneity and incorporates essential aspects of retirement income and personal income tax policy settings in Australia. Our simulation results indicate that the 2007 superannuation changes with the exit tax removal benefit the most in terms of remaining life-cycle consumption and welfare to older generations of high-income households approaching the superannuation payout age. On the other hand, low-income households with small superannuation balances experience welfare losses through the general equilibrium effect of a higher consumption tax rate that increases to offset the decline in the superannuation tax revenue. The small magnitude of the macroeconomic results suggests that both superannuation tax policy changes represent primarily a taxation switching issue as the real economy seems not to be greatly affected.

Keywords: Superannuation, pension and tax reforms, dynamic OLG model

JEL Classification: H55, H24, H30, C68,

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1 Introduction

In July 2007, the Australian federal government implemented significant superannuation changes to remove the complexity of the system, to increase retirement income and to encourage older individuals to postpone their retirement (Treasury, 2006). The major change was the abolition of the superannuation benefit taxation for people aged over 60 years that completed the shift towards the income tax treatment of superannuation with the “taxed-taxed-exempt” [TTE] regime. This superannuation tax policy change is in the very focus of this paper.

Prior to the 2007 superannuation changes, the taxation of Australia’s superannuation was very complex and unusual in the international context with taxes applied to contributions, fund earnings as well as benefits. In fact, Australia was the only OECD country with the “taxed-taxed-taxed” [TTT] regime. The recognised complexity and inefficiency of superannuation taxation has led a number of researchers to undertake investigations into possible superannuation tax reforms. However, as opposed to the benefit tax removal adopted in 2007, many retirement income commentators and industry experts urged for a move towards some sort of an expenditure tax treatment of superannuation with either the EET or ETT regimes. ASFA (1998) and Doyle et al. (1999) proposed to abolish the taxes on contributions and fund earnings and to replace the concessional tax on benefits with the marginal tax rates of personal income at the time of withdrawal. Clare (2006) examines the abolition of only the contribution tax and Knox (1998) suggests a gradual shift towards the ETT regime.

The methodology used in the studies above involves simple projections of the effects of their policy proposals on government revenues and net retirement benefits. For instance, Doyle et al. (1999) show a small net loss in tax revenues resulting from their proposal as the revenue loss from the abolition of contribution and fund earnings taxes will be partly offset by imposing the marginal tax rates on superannuation benefits. Their projections of net retirement benefits indicate that all cohorts gain when annuities are taken but most cohorts loose under the lump-sum payout option. In addition to the effects on the government budget and retirement savings, Atkinson et al. (1999) analyse the lifetime redistributive effects of the EET regime adopted by most OECD countries and of the Australian TTT tax regime at the time. Using a cohort micro-simulation model, they find that although the EET regimes scores better in terms of intra-generational equity and the overall progressivity of the tax and social security systems, it is the assumed behaviour at retirement (i.e. whether the superannuation savings are paid out as an annuity or a lump-sum) that has a much stronger effect on the redistributive measures than the superannuation tax structure.

More recent papers by the Institute of Actuaries Australia [IAA] (2007) and Davidson and Guest (2007) examined the fiscal implications of the 2007 superannuation policy reform. Both papers projected low fiscal costs of the implemented benefit tax abolition, reflecting already highly preferential tax treatment of superannuation benefits in the pre-existing system. However, critics of the 2007 superannuation reform such as Bateman and Kingston (2007) argue that because of concessional tax treatment of superannuation benefits in the pre-existing system, the implemented changes to superannuation would not achieve adequacy, efficiency and equity goals of the retirement income system and that the exit tax abolition would mainly benefit the affluent elderly.

Our paper examines the intergenerational, welfare and macroeconomic implications of the abolition of the superannuation benefit taxes, that is, the shift towards the TTE superannuation tax regime. We also study the effects of the alternative policy of the shift towards the expenditure tax treatment that is common in many other developed countries and that reflects superannuation industry demands to abolish taxes on contributions and fund earnings.

The quantitative analysis in our paper builds on computable overlapping generations [OLG] models, which are inter-temporal general equilibrium models that incorporate overlapping generations of households each of whom behave as predicted by the life-cycle theory. In contrast with the micro-simulation models and simple projections, general equilibrium OLG models are theoretically rigorous and consistent, and because they feature explicit modelling of preferences, they can generate welfare effects of policy changes. The first attempt to analyse Australia's superannuation tax policy changes in a life-cycle optimisation framework was carried out by Creedy and Guest (2008). They use a simple single-household model with the life-cycle of the household spanning over three periods to 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. Our model is a small open economy variant of Auerbach and Kotlikoff's (1987) model, that features inter- and intra-generational heterogeneity and incorporates essential aspects of retirement income and personal income tax rules in Australia. Hence, the model is capable of studying various reforms to Australia's retirement income policy.¹

Our simulation results indicate that the income tax treatment of superannuation with the exit tax removal benefits the most in terms of remaining life-cycle consumption and welfare to older generations of high-income households approaching the superannuation payout age. On the other hand, low-income households with small superannuation balances, that would not pay any tax on their benefits already in the pre-existing system, experience welfare losses through the general equilibrium effect of a higher consumption tax rate that increases to offset the decline in the superannuation tax revenue. This confirms the hypothesis of Bateman and Kingston (2007) that (i) the abolition of the benefit taxes as the major change in the 2007 superannuation reform package would have a minimal impact on many people as the pre-existing system was already highly tax concessional at the withdrawal phase and (ii) the winners of the adopted superannuation changes would be people with large superannuation asset holdings who are close to retirement. The alternative policy of the shift towards the expenditure tax treatment with the EET regime is more beneficial for future-born generations as they would receive the tax-free contributions and fund earnings for the entire period of the superannuation assets accumulation. The small magnitude of the macroeconomic implications suggests that both superannuation tax policy changes represent primarily a taxation switching issue where a fall in the superannuation tax revenue is compensated by an increase in the consumption tax receipts. The real economy apart from the macroeconomic effects on domestic and foreign assets seems not to be greatly affected by the two different tax treatments of superannuation.

¹A computable OLG model calibrated to the Australian economy was also applied by Kulish et al. (2006) to examine the macroeconomic implications of population ageing. Their model is a closed economy model with only household and production sectors.

In the next section, we provide a technical description of the simulation model, which is followed by the discussion on parameterisation of the model and the analysis of the benchmark long-run steady state. The behavioural, welfare and macroeconomics effects of the two superannuation tax policy changes are presented in section 5. Section 6 investigates the sensitivity of the superannuation tax policies to the choice of the key model parameters and section 7 offers some concluding remarks and suggestions for future research.

2 Simulation model

We apply an open economy version of Auerbach and Kotlikoff's [A-K] OLG model to simulate the two superannuation tax policy changes. Variants of the A-K model have been used worldwide by many researchers to analyse various policies, including social security, private pension and tax policy changes. A brief overview of the model and an algebraic description of the individual sectors of the model are provided below.

2.1 Theoretical overview

Our general equilibrium OLG model comprises the following five sectors: household, pension, production, government and foreign sectors. The household sector is populated with overlapping generations of heterogeneous households distinguished by age and lifetime earnings ability. Each generation is assumed to consist of low-, middle- and high-income households. Households face lifespan uncertainty. The assets of those who die, because of uncertain survival, are assumed to be equally redistributed to all surviving households as accidental bequests. Only the low-income households are assumed to be constrained from borrowing while the other two household types can borrow any time and as much as their wish provided that their terminal assets are non-negative.

The major novelty of our OLG model is that it incorporates essential features of the first two pillars of Australia's retirement income policy – the age pension and mandatory superannuation guarantee [SG]. Households aged 65 years and over receive the age pension only if they satisfy the means test. In addition to ordinary private assets, households accumulate superannuation assets through the mandatory SG contributions made by the representative producer. The superannuation savings are assumed to be paid out by the superannuation fund as a net lump-sum when households reach age 60.

The production sector contains one producer, which represents a large number of perfectly competitive firms. This aggregate producer produces a single all-purpose output good that can be consumed, invested in production capital or traded internationally. The production technology is given by a CES production function, in which output is produced using capital and labour. Capital formation is assumed to be subject to adjustment costs (Hayashi, 1982)

and investment decisions follow the Q theory of investment (Tobin, 1969), according to which firms invest whenever the market value of their assets exceeds the cost of replacement.

The government sector is represented by a public budget constraint, which includes government outlays and receipts. On the expenditure side of the public budget, there are government consumption and age pension expenditures. Revenues from consumption, personal income and superannuation taxation are on the income side of the budget. We assume that the government maintains a fixed government consumption-output ratio and balances its budget in every time period by adjusting the consumption tax rate.

The model is a small open economy model with the domestic interest rate pegged to the world interest rate and where international capital flows make sure that the balance of payment is in equilibrium. Whenever domestic savings fall short of domestic capital, foreign capital will be employed, which has negative effects on the current account. If output falls more than domestic demand, the trade balance deteriorates.

Finally, aggregation conditions ensure that labour, capital and output markets clear, that is, in every time period, (i) demand for labour for the representative producer must equal the labour supply aggregated across all households, (ii) the value of the capital stock must equal the domestic and foreign assets and (iii) output is equal to the sum of consumption, investment, government spending and the trade balance.

2.2 Demographic structure

The demographic structure of the model is stationary. The model economy is populated with 70 overlapping generations of heterogeneous households aged from 21 to 90 years ($a = 21, \dots, 90$) at any time t . Each generation consists of three income groups i - low-income ($i = 1$), middle-income ($i = 2$) and high-income ($i = 3$). The constant shares of i household types are denoted by ω_i . Every year, the oldest generation of households dies and a new generation is born. Generations are assumed to enter the model structure at age 21 and to face random survival with a maximum possible lifespan of 70 years. Lifespan uncertainty is described by s_a , the time-invariant exogenous conditional probability of survival from age a to $a + 1$. The total population grows at a constant rate, n , which together with the time-invariant survival probabilities, implies that the cohort shares, $\mu_a = [s_a / (1 + n)] \mu_{a-1}$, that add to one are constant over time.

2.3 Household sector

Household behaviour is modelled based on the life-cycle theory pioneered by Modigliani and Brumberg (1954), which says that people make rational choices about their consumption and saving over their finite lifespan. In our model, households optimally choose consumption, $c_{a,t}$, leisure, $l_{a,t}$ and the timing of retirement given their preference, budget and time constraints. The households' preferences are represented by the expected lifetime utility function, which

for a household of the type i who begins her economic life at time t can be expressed as

$$E(U_t^i) = 1/(1 - 1/\gamma) \sum_{a=21}^{90} S_a (1 + \beta^i)^{21-a} (u_{a,t+a-21}^i)^{(1-1/\gamma)} \quad (2.1)$$

where the CES instantaneous utility is

$$u_{a,t+a-21}^i = \left[(c_{a,t+a-21}^i)^{(1-1/\rho)} + \alpha (l_{a,t+a-21}^i)^{(1-1/\rho)} \right]^{1/(1-1/\rho)}.$$

The expected lifetime utility (2.1), that is the sum of current and discounted future utilities, comprises the following four taste parameters: the inter-temporal elasticity of substitution, γ , the intra-temporal elasticity of substitution, ρ , the leisure distribution parameter, α , and the rate of time preference, β^i , that differs across the three income types and which discounts any future utility due to time impatience of households. Future utility is also discounted by the unconditional survival probability, $S_a = \prod_{j=21}^a s_{j-1}$.

The expected lifetime utility (2.1) is maximised subject to budget and time constraints. Denoting $A_{a,t}^i$ to be ordinary private assets at the end of age a in every time period t , the budget constraint can be expressed as a sequence of period-by-period accumulations:

$$\begin{aligned} A_{a,t}^i &= (1+r)A_{a-1,t-1}^i + w_t e_a^i (h - l_{a,t}^i) + AP_{a,t}^i + NSB_{60,t}^i + SP_{a,t}^i + B_t \\ &\quad - T(y_{a,t}^i) - (1 + \tau_t^c) c_{a,t}^i, \end{aligned} \quad (2.2)$$

where r is the exogenous world interest rate and h denotes the annual time endowment. There are other two conditions for ordinary private assets that $A_{90,t}^i = 0$ and the borrowing constrains, $A_{a,t}^1 \geq 0$, only for low-income households. Expression (2.2) indicates that households earn investment income, $rA_{a-1,t-1}^i$, and labour earnings, $w_t e_a^i (h - l_{a,t}^i)$, where $w_t e_a^i$ represents the age-specific hourly wage and $h - l_{a,t}^i$ is the labour supply. The term w_t is the aggregate wage rate and e_a^i is the exogenous age-specific earnings ability variable. Eligible households may receive some age pension, $AP_{a,t}^i$, that is means tested against both income and assets. At age 60, households collect their superannuation savings as a net lump-sum denoted by $NSB_{60,t}^i$. The term $SP_{a,t}^i$ stands for post-superannuation-payout mandatory contributions made by the producer only to households aged 61 years and over provided that they are still working. This is to ensure that all the working households are paid the same gross wage rate. Household consumption is taxed at a linear rate of τ_t^c , while the income tax, $T(y_{a,t}^i)$, imposed on taxable income, $y_{a,t}^i$, is progressive. The taxable income comprises labour earnings, investment income and the age pension, i.e., $y_{a,t}^i = w_t e_a^i (h - l_{a,t}^i) + rA_{a-1,t-1}^i + AP_{a,t}^i$. Due to life uncertainty, there are accidental bequests, B_t , that are assumed to be equally redistributed to all surviving households in every t .

The time constraint is

$$l_{a,t}^i \leq h. \quad (2.3)$$

This constraint implies that households also decide upon the allocation of time between work and leisure. If their leisure equals the total time endowment, $l_{a,t}^i = h$, households are fully retired from workforce.

2.4 Pension sector

The modelling of the pension sector in our OLG framework closely reflects the legislation on the first two pillars of the Australian retirement income policy - public age pension and mandatory superannuation.

Age pension

Eligible households aged 65 years and over are paid some age pension by the government provided that they satisfy the means test. The means test consists of both the income and asset tests. Under the income test, the legislated maximum age pension, p , is paid to the eligible households of i type if their assessable income, $\hat{y}_{a,t}^i$, is not greater than the given income threshold, IT . In the case that the assessable private income income that comprises labour earnings and investment income, $\hat{y}_{a,t}^i = w_t e_a^i (h - l_{a,t}^i) + r A_{a-1,t-1}^i$, exceeds the income threshold, the maximum age pension is reduced at the income taper rate, θ , for every additional dollar of assessable income earned, $\hat{y}_{a,t}^i - IT$. Similar to the income test, the eligible households of i type are paid the maximum age pension, p , under the asset test only if the stock of their private assets, $A_{a,t}^i$, does not exceed the given asset threshold, AT . If the private assets exceed the asset threshold, then the age pension is reduced at the asset taper rate, ϕ , for every dollar of private assets over the asset threshold, $A_{a,t}^i - AT$. Finally, only the binding test applies. The age pension actually paid to the eligible households of i type is equal to the age pension payment under the test that results in the lower rate. The means testing of the age pension can be algebraically expressed as

$$\begin{aligned}
 \text{Income test} \quad AP_{a,t}^i &= \begin{cases} \max \{ \min \{ p, p - \theta (\hat{y}_{a,t}^i - IT) \}, 0 \}, & \text{for } a \geq 65 \\ 0 & \text{for } a < 65 \end{cases} \\
 \text{Asset test} \quad AP_{a,t}^i &= \begin{cases} \max \{ \min \{ p, p - \phi (A_{a,t}^i - AT) \}, 0 \}, & \text{for } a \geq 65 \\ 0 & \text{for } a < 65 \end{cases} \\
 \text{Biniding test} \quad AP_{a,t}^i &= \begin{cases} \min \{ AP_{a,t}^i, AP_{a,t}^i \}, & \text{for } a \geq 65 \\ 0 & \text{for } a < 65 \end{cases}
 \end{aligned} \tag{2.4}$$

where $AP_{a,t}^i$ is the age pension calculated under the income test, $AP_{a,t}^i$ represents the age pension computed under the assets test and $AP_{a,t}^i$ denotes the age pension payments that finally enter household budget constraint (2.2).

The existing means testing defined in (2.4) indicates that households have less incentive to work and save. Prior to the age pension eligibility age, supplying an additional hour of work and earning an additional dollar may reduce future age pension entitlements because of greater accumulated private assets (i.e. effective asset test) or higher investment income derived from these larger assets (i.e. effective income test). Similarly, for households aged 65 years and over, higher labour supply and/or savings may reduce their current age pension entitlements. Furthermore, the public age pension acts as a substitute of private income, which has negative effects on lifetime labour supply and private savings.

Superannuation guarantee

The mandatory SG contributions are paid by the representative producer on behalf of households of type i between ages 21 and 60 at the after-tax contribution rate, $(1 - \tau^{sc}) cr$, from their gross labour earnings, $w_t e_a^i (h - l_{a,t}^i)$.² These contributions are made into the superannuation fund and added to the stock of superannuation assets, $SA_{a,t}^i$, which is invested and earns fund investment income at the given after-tax interest rate, $(1 - \tau^r) r$. The stock of superannuation assets is assumed to be vested in the fund until households reach age 60. The superannuation assets accumulation, as describe above, can be expressed as

$$SA_{a,t}^i = \begin{cases} [1 + (1 - \tau^r) r] SA_{a-1,t-1}^i + [(1 - \tau^{sc}) cr] w_t e_a^i (h - l_{a,t}^i), & \text{for } a \leq 60 \\ 0 & \text{for } a > 60 \end{cases}, \quad (2.5)$$

where r is the world interest rate, τ^r is the fund earnings tax rate, τ^{sc} denotes the contribution tax rate and cr is the mandatory SG contribution rate.

The households at age 60, regardless of whether they work, receive their superannuation savings as a lump-sum only and the superannuation assets accumulation ceases to exist.³ The superannuation lump-sum benefits are taxed as follows. The fund deducts the concessional tax imposed on the amount of the lump-sum payout that exceeds the legislated tax free threshold, TFT . If the superannuation benefits exceed the lump-sum reasonable benefit limit, RBL , then these excessive amounts are taxed at the top marginal tax rate of τ^{m5} . The net superannuation lump-sum payment, $NSB_{60,t}^i$, is

$$NSB_{60,t}^i = \begin{cases} SA_{60,t}^i, & \text{iff } SA_{60,t}^i \leq TFT \\ TFT + (1 - \tau^{sb}) (SA_{60,t}^i - TFT), & \text{iff } TFT < SA_{60,t}^i \leq RBL \\ TFT + (1 - \tau^{sb}) (RBL - TFT) + (1 - \tau^{m5}) (SA_{60,t}^i - RBL), & \text{iff } SA_{60,t}^i > RBL \end{cases}, \quad (2.6)$$

where τ^{sb} represents the concessional benefit tax rate.⁴

To make sure that the effective gross wage rate, $w_t(1 + cr)$, that includes the mandatory SG contribution rate, paid by the producer is the same across all working households at time t , we assume that working households after receiving superannuation lump-sum payments are paid the mandatory SG contributions directly into their ordinary private asset account.

²We do not model voluntary households' contributions. Allowing for these contributions would results in that the liquidity unconstrained middle- and high-income households would be borrowing greatly and accumulating significant private debt to make maximum permitted contributions as these voluntary contributions are tax preferred.

³Currently, superannuation benefits can be withdrawn as lump-sum payments or income streams upon reaching the superannuation preservation of 55 years and being retired from workforce. The model assumption of lump-sum payout of superannuation benefits seems reasonable as over a five year period ending in June 2005 about 75 percent of all superannuation benefits, on average, were paid as lump-sum payments (APRA, 2007). The assumed superannuation payout age of 60 years is based on the following: (i) average retirement age of recent retirees of 60.3 years and (ii) high proportion of people around that age taking superannuation lump-sum payments (ABS, 2008).

⁴This benchmark model assumes that superannuation taxes are applied to contributions, funds investment earnings and benefits, with the benefit taxation reflecting the 2007 pre-July superannuation system.

These mandatory contributions take the form of the superannuation pension, $SP_{a,t}^i$, that directly enters households' budget constraints. The pension that is taxed at the concessional benefit tax rate is given by

$$SP_{a,t}^i = \begin{cases} (1 - \tau^{sb}) [cr \times w_t e_a^i (h - l_{a,t}^i)], & \text{for } a > 61 \text{ and } l_a \neq h \\ 0 & \text{for } a \leq 60. \end{cases} \quad (2.7)$$

The justification of this model assumption that deals with post-payout SG contributions is that since July 2005, people who have reached the superannuation preservation age of 55 years can draw on their superannuation savings while still working. Thus, the assumed post-payout superannuation contributions in the model can be regarded as these so-called "transition to retirement" pensions.

2.5 Production sector

The production sector consists of a single aggregate producer, which in every time period t , produces a single all-purpose output, Y_t , using a CES production function given by

$$F(K_t, L_t) = \kappa \left[\varepsilon K_t^{(1-1/\sigma)} + (1 - \varepsilon) L_t^{(1-1/\sigma)} \right]^{1/(1-1/\sigma)}, \quad (2.8)$$

where K_t denotes the capital stock, L_t is the labour input, κ is a productivity constant, ε represents the capital share and σ is the elasticity of substitution in production.

Capital formation is subject to convex adjustment costs (Hayashi, 1982). Thus, the net output is the difference between the gross output and adjustment costs, i.e.,

$$Y_t = F(K_t, L_t) - 0.5\psi \left(\frac{I_t}{K_t} - (n + \delta) \right)^2 K_t, \quad (2.9)$$

where I_t represents investment, ψ is the adjustment cost coefficient, n is the population growth rate and δ denotes the capital depreciation rate.⁵

The aggregate producer maximises the present value of all future profit payments discounted at the interest rate, r , subject to the capital accumulation equation, $I_t = K_{t+1} - (1 - \delta) K_t$ and the adjustment costs function. Solving the producer's profit maximisation problem yields the following first order necessary conditions:

$$(1 + cr) w_t = F_{L_t} \quad (2.10a)$$

$$q_{t+1} = 1 + \psi \left(\frac{I_t}{K_t} - (n + \delta) \right) \quad (2.10b)$$

$$r q_t = F_{K_t} + 0.5\psi \left[\left(\frac{I_t}{K_t} \right)^2 - (n + \delta)^2 \right] + (1 - \delta) q_{t+1} - q_t. \quad (2.10c)$$

⁵Note that because of the adjustment cost function in (2.9) that was taken from Fehr (2000), the adjustment costs occur only during the transition path as the investment rate equals to the sum of the capital depreciation rate and the population growth rate in the steady state equilibrium.

Equation (2.10a) is the first order condition for equilibrium wages that equates the real wage rate inclusive of the SG contribution rate and the marginal product of labour, F_{L_t} . According to (2.10b), the producer will invest until the marginal benefits, q_{t+1} , from an additional unit of capital in the next period amount to the marginal cost of acquisition and installation. The term q_t in this formulation also equals Tobin's q – capital price (Tobin, 1969). Equation (2.10c) represents the arbitrage condition for the rate of returns on financial and real investment. The left side of (2.10c) gives the return to financial investment of amount, q_t . The right side comprises (i) the net return to capital that includes the marginal product of capital, F_{K_t} , and reduction in marginal adjustment costs and (ii) capital gains, $(1 - \delta)q_{t+1} - q_t$.⁶

2.6 Government sector

The government collects revenues from taxing household income, consumption and superannuation, $TR_t = TR_t^Y + TR_t^C + TR_t^S$, in order to fund its consumption, G_t , and the expenditures on the age pension, $\overline{AP}_t = \sum_{i=1}^3 \omega_i \sum_{a=65}^{90} AP_{a,t}^i \mu_a$. As mentioned, superannuation taxes are applied to SG contributions, fund investment earnings and superannuation benefits and the income tax is progressive. The model implements the approximation function of the Australian personal income tax schedule taken from Woodland (2005), to avoid the discontinuity of the actual tax function and thus to simplify the model computation. The consumption tax rate, τ_t^c , is assumed to adjust endogenously to ensure that the government budget is balanced in every t :

$$TR_t^Y + TR_t^S + \tau_t^c \cdot \sum_{i=1}^3 \omega_i \sum_{a=21}^{90} c_{a,t}^i \mu_a = G_t + \overline{AP}_t. \quad (2.11)$$

The government maintains a fixed ratio of government consumption to output. Although G_t is unproductive and generates no direct utility to households in our model, any reduction in the public outlays such as, for example, lower government expenditures on the age pension and any increase in tax revenues are passed onto households in terms of a lower consumption tax rate.

2.7 Foreign sector

In this small open economy model with perfect capital mobility, the domestic interest rate, r , is fixed to the exogenously given world interest rate and international capital flows make sure that the balance of payment is in equilibrium. Denoting FA_t to be the foreign asset holding at the beginning of time period t , the international budget constraint is

$$FA_{t+1} - FA_t = TB_t + rFA_t, \quad (2.12)$$

where the left side of (2.12) represents capital flows and the right side gives the current account that consists of the trade balance, TB_t , and the interest receipts (payments) on

⁶Note that if the adjustment cost coefficient, ψ , was set to one, then $q_t = 1$ and condition (2.10c) would reduce to $r = F_k - \delta$.

foreign assets (debt), rFA_t . The domestic and foreign assets are assumed to be perfect substitutes, implying that only the trade balance can be determined with indeterminate imports and exports.

2.8 Aggregation conditions

Given the household structure, the following feasibility conditions that ensure that labour, capital and output markets clear must be satisfied:

$$L_t = \sum_{i=1}^3 \omega_i \sum_{a=21}^{90} e_a^i (h - l_{a,t}^i) \mu_a \quad (2.13a)$$

$$q_t K_t = \sum_{i=1}^3 \omega_i \sum_{a=21}^{90} (A_{a,t}^i + SA_{a,t}^i) \mu_a + FA_t \quad (2.13b)$$

$$Y_t = \sum_{i=1}^3 \omega_i \sum_{a=21}^{90} c_{a,t}^i \mu_a + I_t + G_t + TB_t. \quad (2.13c)$$

The accidental bequest assumed to be equally redistributed to all surviving households is calculated as

$$B_t = \sum_{i=1}^3 \omega_i \sum_{a=21}^{90} (1 - s_a) [A_{a,t}^i + SA_{a,t}^i] \mu_a. \quad (2.14)$$

3 Parameterisation of the model

To simulate the two superannuation tax policy changes, we have to assign numerical values to the model parameters. The values of these parameters that are recorded in Table 1 are chosen to generate the benchmark steady state equilibrium that approximately corresponds with the actual macroeconomic data for the Australian economy in the financial year of 2004-05. In this subsection, we briefly discuss the choice of the key parameter values.⁷

Insert Table 1 here

This model features stationary demographics with a constant population growth rate of $n = 0.012$ taken from Kulish et al. (2006) and the conditional survival probabilities for males, s_a , from the ABS (2005a) life tables. Regarding the choice of the shares of i household types, ω_i , we follow Fehr et al. (2008) by assuming that 30 percent of each generation belong to low-income type, 60 percent to middle-income type and 10 percent to high-income type.

The values of the utility function parameters are within the estimated ranges obtained from relevant empirical studies.⁸ These parameters are the same for all income types except for the subjective rate of time preference, β^i , which differs across the household types. High-income households are assumed to have a lower value of this parameter compared to middle- and low-income households, reflecting the fact that richer households tend to be more time patience and discount the future less than poorer households (Hurd, 1990).

⁷In section 5, we check the sensitivity of superannuation tax policy results to the alternative parameterisation of the model.

⁸The choice of the values of the utility function parameters is discussed in more detail in Kudrna and Woodland (2009) who applied the same model except for superannuation taxation to evaluate various policy changes to the age pension means test.

As opposed to the utility function parameters, most of the production function parameters are endogenised to reproduce calibration targets. The technology parameter, κ , is calibrated to reproduce the aggregate wage rate of $w = 1$ in the initial steady state. The elasticity of substitution in production, σ , is calibrated to the exogenous interest rate of $r = 0.05$ and the capital depreciation rate, δ , is set to target the investment-output ratio of $I/Y = 0.258$. The capital share of $\varepsilon = 0.36$ is derived using data from ANA in June 2005 and the adjustment cost parameter of $\psi = 10$ is taken from Auerbach and Kotlikoff (1987).

The three types of households in every generation differ by their age-specific earnings ability. The earnings ability, which is the full wage earned with all the time endowment allocated to work for each income class, e_a^i , is then given as $e_a^i = \xi^i \times \bar{e}_a^i \times \bar{w}$, where $\bar{e}_a^i$ is the normalised efficiency variable for each income group i at age a that is derived from the estimates from Reilly et al. (2005).⁹ The term $\bar{w}$ is the wage earned by a 20 year old average earner with full time endowment spent at work. This parameter is based on Gruen and Garbutt's (2003) age pattern of average hourly wages for Australian males (i.e. \$16 for middle income male aged 20 years) and the full time endowment assumed to be 5460 hours per year, which corresponds to about 15 non-sleeping hours per day. We normalise the time endowment to unity and scale all the monetary variables and parameters such that they are expressed in units of \$100,000. The shift parameter ξ^i is set to 0.3 for low-income households, one for middle-income households and three for high-income households.

The government consumption to output ratio is endogenised in the benchmark steady state to produce the consumption tax rate of $\tau^c = 0.1$, which corresponds to the Australian goods and services tax [GST] rate. We assume the balance government budget with no government debt. This assumption seems reasonable in Australia as the actual net government debt-output ratio was 0.014 with the government surplus of 1.5 percent of GDP in 2004-05 (Commonwealth of Australia, 2006) and the future fiscal projections in 2005 that suggested a complete elimination of net government debt. The income tax function taken from Woodland (2005) is approximated to the 2004-05 Australian personal income tax schedule (see Kudrna and Woodland, 2009).

The values of the age pension parameters were applicable in November 2004. In the benchmark steady state, the superannuation taxes are imposed on contributions, fund earnings as well as the benefits, the so-called TTT superannuation tax regime applicable in Australia prior to 1 July 2007.

⁹Their estimated wage function is normalised such that the wage for a 20 year old middle-income household with no experience in the model is equal to one, that is, $\bar{e}_a^i = \exp\left(2.235 + 0.04(a - S^i - 5) - 0.00067(a - S^i - 5)^2\right) / \exp(\bar{e}_{20}^i)$, where S denotes years of schooling and a represents age. Normalisation of the wage function is performed to account for the fact that the estimates by Reilly et al. were obtained for year 1999. The three income types of households are assumed to attend different years of schooling. Low-income households have 10 years of schooling ($S^1 = 10$), middle-income households 12 years ($S^2 = 12$) and high-income households 15 years of schooling ($S^3 = 15$). As Reilly et al. consider only workers aged 15 to 65, we assume that the wages after age 65 decline at a constant rate and reach zero at age 90 for low- and middle-income households and at age 80 for high-income households. This assumption is made in order to avoid positive labour supply at very old ages.

4 Benchmark steady state equilibrium

We use the GAMS software and apply the Gauss-Seidel method to solve for the steady state equilibrium as well as the transition path.¹⁰ In this section, the benchmark steady state [SS] equilibrium solutions at disaggregate household and macroeconomic levels are presented. At the disaggregate level, the age-profiles of average labour supply, labour earnings and assets generated by the benchmark SS simulation are compared with real life-cycle data from HILDA surveys (Figure 1). The figure also displays model-generated life-cycle superannuation assets of the three income types of households.

Insert Figure 1 here

The model-generated age profile of average labour supply is hump-shaped, peaking at age 37 (Figure 1a). Comparison of model and HILDA profiles of average labour supply indicates that the model matches quite well the average age-specific labour supply across both males and females from HILDA but it underestimates average age-specific labour supply of males especially for the middle aged males. The model also underestimates average labour supply of the elderly. In fact, only high-income households in the benchmark SS provide some labour beyond age 65. Middle-income households having their pension reduced due to the binding income test fully retire from the workforce at age 65 to avoid a penalty of high effective marginal tax rates. Similarly to the average labour supply profiles, the model generates average labour earnings profile which is lower than HILDA labour earnings profile for males for most of the life cycle and higher than the combined HILDA profile because of lower labour supply and wages of females (Figure 1b).

Figure 1c depicts the model assumption of superannuation assets being accumulated in the fund through producer's mandatory contributions and fund investment earnings over the first 40 years. At age 60, all three income types of households collect their lump-sum superannuation benefits and the superannuation assets accumulation ceases to exist. The average superannuation assets profile from HILDA is significantly lower than the average age-specific superannuation assets generated by the model over the assumed accumulation period. This is because the model assumes a full maturity of the superannuation system with the 40 years of mandatory nine percent contributions while the superannuation guarantee commenced in 1992 with only three percent contributions initially. High-income (low-income) households accumulate approximately three times larger (smaller) superannuation assets compared to superannuation assets of middle-income households, which is almost identical to the average superannuation assets.¹¹ As for the superannuation benefit taxes in the benchmark SS simulation, high-income households holding large superannuation assets at age 60 have their excessive lump-sum benefits (i.e. amount of lump-sum benefits exceeding the RBL) taxed at the top marginal income tax rate reasonable benefit limit. Middle-income pays only the concessional 15 percent tax on their benefits over the tax free threshold while low-income households with small superannuation assets pay no superannuation benefit taxes.

¹⁰The computational procedure is described in Appendix A.

¹¹This is given by the exogenous age-specific earnings ability (productivity) across the three income types and the shift parameter, as discussed in the section on parameterisation of the model.

The model age profile of average total assets in Figure 1d consists of average ordinary private assets and superannuation assets (solid line in Figure 1c). The stock of ordinary private assets that is the accumulated excess of disposable income over consumption expenditures is initially negative as the liquidity unconstrained middle- and high-income households borrow at early ages against their future superannuation lump-sum payouts to fund their consumption excess. This is known as superannuation offset. At age 60, the accumulated superannuation savings net of the benefit tax are paid into households' ordinary private assets accounts and after that age, households draw down their private assets to pay for their retirement consumption. The data points of average financial assets derived from HILDA are below the average age-specific total assets simulated by the model due to the aforementioned model assumption of the full maturity of the superannuation system.

Insert Table 2 here

Table 2 compares the main macroeconomic solutions of the benchmark SS simulation with the actual values in June 2005. As shown, our model with the chosen parameter values replicates the Australian economy fairly well. Apart from the trade balance, the components of domestic demand are close to their actual values expressed in percent of GDP. The positive trade balance in the model is implied by the negative foreign assets, which is a calibration target in the benchmark SS simulation. The foreign assets (i.e. net international investment position) were largely negative with foreigners holding about 19 percent of the Australian capital stock in June 2005 (ABS, 2006). Negative net foreign assets generate a positive trade balance in the economy that is assumed to be on a dynamic efficient growth path where the interest rate is greater than the population growth rate ($r > n$), i.e., $TB = (n - r)FA$. However, the Australian trade balance was negative in June 2005, which indicates that the Australian economy could not be in a steady state.

The model assumes the balanced government budget and abstracts from taxation at a corporate level. The model generated components of tax revenue are greater than the actual data. Especially, superannuation tax revenues differ significantly, which again can be explained by the full maturity of the superannuation system in the simulation model. The government consumption to output ratio (G/Y) that is endogenised to target the consumption tax rate of $\tau^c = 0.1$ in the benchmark SS is very close to the actual G/Y in June 2005. The benchmark SS simulation of the model also matches the capital-output ratio (K/Y) and investment rate (I/K).

5 Simulation results

This section presents the simulation results of the following two superannuation tax policy changes: (i) the shift to the TTE regime with the abolition of the benefit taxation (labelled "income tax treatment of superannuation") and (ii) the shift to the EET regime with the removal of the contribution and earnings taxes (labelled "expenditure tax treatment of superannuation"). The first simulated superannuation policy reform was implemented by the July-2007 superannuation changes which made superannuation benefits withdrawn from taxed funds by people aged 60 years and over tax free. The motivation for examining the alternative policy change to the superannuation tax system is that the superannuation

industry and retirement income commentators have long been calling for the shift towards the expenditure tax treatment with the removals of contribution and/or fund earnings taxes which is common in the private pension pillars of other developed countries. The simulation results consist of the behavioural, welfare and macroeconomic implications of the two policies and are discussed below.

5.1 Behavioural implications

The behavioural implications relate to both the inter-generational and intra-generational effects of the investigated superannuation policy changes on households' life-cycle behaviour. The inter-generational effects reflect the behavioural responses of different cohorts to a policy change over their remaining life. At the time of the policy change, households are of different ages and with different amounts of accumulated assets, and so their behaviour over the remaining lifetime is likely to vary. Consider, for example, the generation that just reaches age 55 years when a policy change comes into effect. Prior to the policy change, this generation behaves exactly as in the benchmark SS simulation. However, at the beginning of age 55, this generation solves the second optimisation problem over the shorter remaining life-cycle of 36 years and with the stocks of private and superannuation assets accumulated by age 54. This retirement-approaching generation will spend different amounts on consumption and work a different number of hours than any younger generation at and above age 55. This is because the older generation's accumulated total assets before the policy change vary from the assets of younger generations at age 54 as these cohorts already adjusted their consumption and leisure choices to the policy reform. The older generation at the time of a policy change is likely to consume more over the remaining lifetime if the accumulated stock of total assets at age 54 is greater than the total assets of younger cohorts at that age.

For ease of exposition, the behavioural implications of the superannuation tax policy changes are plotted for consumption and labour supply of each household type (intra-generational effects) but only of the following two cohorts (inter-generational effects) - one aged 21 years (representing young people) and the other aged 55 years (representing older people approaching the superannuation payout age) at the time of a superannuation reform. The behavioural effects on these two generations of three household types are compared with the life-cycle profiles of consumption and labour supply generated by the benchmark steady state scenario at which the superannuation taxes are imposed on contributions, fund earnings and benefits.

Income tax treatment of superannuation

The abolition of the superannuation benefit taxes for people aged 60 years and over adopted in Australia in July 2007 completed the shift toward the income tax treatment with the TTE regime. The effects of this policy on consumption and labour supply of the two cohorts of low-, middle- and high-income households are illustrated in Figure 2.

Insert Figure 2 here

Low-income households in the benchmark SS simulation receive their superannuation payouts that do not exceed the legislated tax-free threshold, meaning that these households pay no tax on their superannuation benefits. Thus, this superannuation tax policy change has no direct impact on their life-cycle behaviour. However, because of the consumption tax rate that increases to offset the loss in the superannuation tax revenues, life-cycle consumption of the two displayed cohorts of low-income households declines. As opposed to low-income households, middle- and high-income households are explicitly affected by this policy change as they pay benefit taxes in the benchmark scenario. The young middle-income cohort consumes less over the entire life-cycle as the benefits from a larger, tax-free superannuation payout are outweighed by the increased consumption tax rate. The older middle-income cohort, however, consumes more relative to the benchmark consumption and the young cohort's consumption over the remaining lifetime. Relative differences in consumption of young and older generations arise from different total asset holding of the two generations.¹² The older middle-income generation accumulates larger total assets prior to the benefit tax removal compared to the young generation's total assets at the same ages. This is because the young generation spends some of the benefits of the higher superannuation payout on pre-retirement consumption. Therefore, the older generation can afford to consume more over its remaining lifespan. The superannuation payouts of high-income households are even greater than the reasonable benefit limits, implying that the excessive amounts of their superannuation savings are taxed at the top marginal tax rate. Hence, the abolition of the benefit taxation has a significantly positive impact on their lifetime consumption. The older high-income cohort gains more in terms of remaining life-cycle consumption as the main benefit of this policy change is experienced when the tax-free benefits are paid out, which is at age 60.

Life-cycle labour supply of low-income households is hardly affected. The young middle-income cohort works slightly longer hours because of the labour supply incentives of superannuation. The working hours of the older middle-income cohort decline compared the benchmark SS simulation and the young cohort's labour supply. As this older generation accumulated larger total assets prior to the benefit tax removal, it chooses higher leisure (and consumption) in the following years of the policy shift than the young cohort over that period. The behavioural implications for labour supply of high-income households are more significant as the superannuation benefit taxes are considerably higher prior to this policy change. Based on the same reasons as for middle-income households, the young high-income cohort works longer hours prior to the superannuation payout while the older high-income cohort supplies less labour over the remaining lifetime.

Expenditure tax treatment of superannuation

In contrast to the shift to the TTE regime, the alternative policy change of the shift towards the expenditure tax treatment of superannuation with the EET regime has direct implications for life-cycle behaviour of all three income classes as they all no longer pay any

¹²The graphs of age-specific private, superannuation and total assets are not presented due to the space constraint. They can be provided upon request.

tax on superannuation contributions and fund earnings. The inter- and intra-generational implications of the removal of contribution and fund earnings taxes for consumption and labour supply are plotted in Figure 3.

Insert Figure 3 here

Figure 3a shows that the young low-income cohort consumes less prior to the superannuation payout but significantly more after it receives a larger superannuation payout. Recall that these households are restricted from borrowing but at the same time they face a higher consumption tax rate, which causes lower net consumption of the young middle-income cohort prior to age 60. The older low-income cohort consumes less over the remaining lifetime as only the five years of tax-free contributions and fund earnings are not enough to offset the negative effect of the increased consumption tax rate on net consumption. Middle- and high-income households can borrow and the young cohorts do so to finance higher consumption prior to the superannuation payout age. However, the older cohorts of these two income classes consume less as, similar to the older low-income households, they face the increased consumption tax rate and receive tax-free superannuation contributions and fund earnings only for five years.

The effects of the shift to the EET regime on labour supply are positive for all three household types early in life when their productivity is increasing as the substitution effect of greater superannuation savings dominates. Later on, working hours of young cohorts of all three income types fall below their benchmark labour supply as a result of the stronger income effects of high superannuation. Similarly to the shift towards the TTE regime, this policy change has no influence on the retirement age. However, labour supply of the young low-income cohort declines considerably after the payout of larger superannuation savings.

5.2 Welfare implications

The welfare effects of the superannuation tax policy changes are determined by computing the equivalent variations for generations of type i households born at date g . The equivalent variation is defined as the percentage increase in the generation's wealth needed in the benchmark scenario to produce the realised remaining lifetime utility under the policy change. Because the lifetime utility is homothetic, these increases in generations' wealth bring about the proportional increases in consumption and leisure that would make generations in the benchmark steady state scenario as well off as in the reformed scenario (see Auerbach and Kotlikoff, 1987, p.87). The needed percentage increase or decrease in initial resources is computed as

$$W_g^i = \left[\left(\widehat{U}_g^i / \widetilde{U}_g^i \right)^{1/(1-1/\gamma)} - 1 \right] \times 100, \quad (5.1)$$

where $\widehat{U}_g^i$ is the value of remaining lifetime utility after the policy change for generation g of type i and $\widetilde{U}_g^i$ is the value of remaining lifetime utility in the benchmark SS scenario.

Income tax treatment of superannuation

The welfare effects of the benefit tax removal for generations of low-, middle- and high-income households are depicted by Figure 4a. All generations of low-income households are not directly affected by this policy change but lose in terms of welfare because of the negative impact of the higher consumption tax rate and the lower wage rate on their net consumption. Middle- and high-income households are affected directly only if they have not yet received the superannuation payout or they have already received the payout but still work and thus receive the post-superannuation payout contributions as the superannuation pension.¹³

Insert Figure 4 here

Figure 4a indicates that the winner of the shift to the income tax system of superannuation with the TTE regime is the cohort of the high-income households born 39 years prior the reform, gaining about 3.5 percent in welfare. This high-income cohort just reaches age 60 when the benefit taxation is abolished and is paid tax-free benefits while, in the benchmark scenario, this generation would pay the 15 percent concessional tax rate on benefits greater than the tax-free threshold and the top marginal tax rate of 47 percent (i.e. the top tax rate applicable in 2004-05) on the amount over the RBL. Because of the considerably larger superannuation payout that rises the life-cycle total assets, this generation experiences the largest consumption increases over the remaining lifetime. Similarly, the middle-income cohort that is born 39 years prior to the policy change attains the largest welfare gains relative to other middle-income generations, thus reflecting the fact that the main benefits of the exit tax removal are delivered at the time of the superannuation payout. The long-run welfare effects (i.e., welfare effects on future-born generations in the new steady state) of the shift to the TTE regime are positive for high-income households but slightly negative for middle-income households as the benefits of not paying the exit tax for high-income households with large superannuation savings are considerably greater than for middle-income households.¹⁴

Expenditure tax treatment of superannuation

The alternative policy of the shift to the EET regime generates very different welfare effects in comparison with the shift to the TTE regime discussed above. As shown in Figure 4b, the unaffected generations that already receive their superannuation payouts and no longer accumulate superannuation savings lose in welfare. The losses are almost twice as larger as under the TTE regime. This is because this policy change with the removal of the contribution and fund earnings taxes leads to a significantly greater fall in the superannuation tax revenue, which has to be compensated by a larger increase in the consumption tax rate, thus reducing net consumption.

The welfare effects start to improve for the cohorts aged 60 years and younger at the time of the reform as all three household types benefit from the tax-free superannuation

¹³These superannuation pensions are assumed to be taxed at the concessional tax rate of 15 percent in the benchmark scenario.

¹⁴Figure 4 presents long-run welfare effects as those for generations born 20 years after the policy change. Their welfare changes are approximately the same as the welfare impacts on generations born in the new steady state because of a relatively stable consumption tax rate over the transition.

contributions and fund earnings. In contrast with the TTE regime simulation, the winners of the shift to the TTE regime are the future born generations with the long-run gains of 0.45 percent for middle-income households, 0.25 percent for high-income household and 0.18 percent for low-income households. The welfare of all three income classes goes up over the entire transition path due to the consumption tax rate that declines relative to the first year of the transition. The changes in the consumption tax rate are mainly caused by smaller losses in the superannuation tax revenue arising from larger superannuation assets accumulation and thus the significantly greater collection of superannuation benefit taxes. The long-run welfare gains for middle-income households are higher than those for the other two income classes as high-income households face larger superannuation benefit taxes and low-income households restricted from borrowing cannot bring their higher consumption forward. In fact, because of the increased consumption tax rate, pre-superannuation payout consumption of low-income households declines, as depicted in Figure 3a.

5.3 Macroeconomic implications

The macroeconomic or aggregate analysis examines the effects of each of the two simulated superannuation policy changes on the model economy as a whole at the time of the policy change, in the subsequent years as well as in the long run. As mentioned, the household sector comprises 70 overlapping generations of the three income classes alive in any time period. Each year the oldest generation dies and a new generation takes its place. The macroeconomic implications for any time period t are obtained by aggregating the solution values of the disaggregate household variables across generations of the three income households taking into consideration (i) the generation (cohort) share in the total population, which is given by the survival probabilities and the population growth rate and (ii) the share of each income class in every generation. The macroeconomic implications of the shift to the TTE regime in Table 3 and the effect of the shift to the EET regime in Table 4 are presented as the percentage changes in the main model variables from the benchmark steady state labelled as ‘Initial SS’. The level values for monetary variables are expressed in units of \$100,000 and in per capita. The discussion in this subsection involves the impacts of the two superannuation tax policy changes on the labour market, capital accumulations, output market and government indicators.

Income tax treatment of superannuation

Insert Table 3 here

Labour market The open economy OLG model solutions are driven mainly by changes in effective labour supply across households. This holds entirely in the long-run, steady state equilibrium. The resulting labour input determines long-run changes in the capital stock, output, government consumption and investment. No superannuation tax policy change alters the wage rate in the long run and so the long-run capital stock must exactly follow the resulting change in the labour input to hold the capital-labour ratio constant. As a result of the shift to the TTE regime, the labour input increases on impact by about 0.51

percent. In the short run, labour supply declines slightly relative to the impact effect but in the long-term, it exceeds the benchmark labour supply by 1.26 percent. The increases in employment come from higher labour supply of middle-and high-income households that have not yet received their superannuation savings. These households work longer hours in order to boost their superannuation savings. Positive effects of this policy change on labour supply are experienced also by the working households aged over 60 years because of the assumption of post-payout superannuation contributions paid as the superannuation pension that are taxed at the concessional benefit tax rate in the benchmark scenario. The removal of the benefit tax alleviates the dominating income effects of substantially larger superannuation tax-free payouts on their labour supply. The positive impact on aggregate labour supply causes the gross wage rate to fall below its value in the initial SS. However, in the long-run, the wage rate is determined by the world interest rate and the parameters of the CES production function in this open economy model. As none of the production function parameters and the interest rate were changed, the wage rate returns to its initial SS value in the long run.

Assets and capital accumulations Domestic total assets decline over the entire transition path mainly because of the falling ordinary private assets. The aggregate stock of ordinary private assets decreases partly due to increased borrowing against larger superannuation payouts but also due to a higher consumption tax rate that increases households' gross consumption expenditures. The superannuation assets grow modestly as higher labour supply of middle- and high-income households accumulating superannuation assets more than offsets the small decline in the wage rate. In the long-term, the domestic total assets are down by 3.35 percent, implying negative impact of this superannuation tax policy change on household savings. In contrast with domestic total assets, the capital stock increases gradually because of the positive effect on the capital price. Investors anticipate higher net return on capital and, therefore, investment demand expands. As a consequence, capital goes up. However, more of the capital stock is now owned by foreigners. Foreign assets (debt) decline (increases) and the current account worsens as a result of the shift to the TTE regime.

Goods market The impact effect on output is positive as employment falls and the capital stock is fixed at the time of the policy change. In the subsequent years of the transition, output continues on rising as both inputs in production are higher. Initially, domestic demand exceeds output, implying negative external demand or the trade account deficit. In the long-run, output increases more than domestic demand and, therefore, the trade balance improves. Note that in the long-run, the changes in the trade account are of the same percentage value with the opposite sign as the changes in the foreign assets because of $TB = (n - r)FA$. The largest component of domestic demand, aggregate consumption increases by 0.638 percent on impact because of higher consumption of high-income cohorts accumulating superannuation assets and older middle-income households approaching the superannuation payout age. In the new steady state, aggregate consumption is still up by 0.47 percent relative to the benchmark steady state. The long-run effects on consumption that are smaller than the impact effect can be explained by the increasing consumption tax rate that the future generations face and also by the fact that the benefits of this policy

received in the form of larger tax-free superannuation payout are spread over the entire life-cycle while the older cohorts benefit from higher payouts only over their remaining lifetimes. Investment demand goes up as the investors anticipate a greater net return on capital. In the long turn, the percentage changes in investment exactly follow the percentage changes in the capital stock. The public demand or government consumption is also higher in the long-term because of the positive long-term effect on output.¹⁵

Government indicators This superannuation tax policy change reduces age pension expenditures because private income of middle-income households and assets of high-income households assessed under the means test increase. However, total government expenditures that include also government spending are higher over the entire transition path. In the long run, the total government expenditures are about 0.4 percent higher than those in the benchmark steady state due to higher government consumption. The revenue from personal income taxation increases modestly while there is a significant immediate decline of around 36.2 percent in the superannuation tax receipts, reflecting the abolition of superannuation benefit taxes. The consumption tax rate has to increase to bring more into the government budget. The consumption tax rate goes up immediately by 16.2 percent. In the subsequent years, the rate keeps on rising and in reaches almost 12 percent in the new steady state, which represents the long-run increase of about 19.34 percent. The increases in the consumption tax rate during the transition path are caused by falling net consumption and rising total government expenditures.

Expenditure tax treatment of superannuation

Insert Table 4 here

Labour market The shift towards the expenditure tax treatment of superannuation (i.e., the EET regime) with the tax-free contributions and fund earnings has initially a positive effect on the labour input as mainly younger cohorts of all three income types work more hours because of labour supply incentives from superannuation. In the subsequent years of the transition, the income effect of larger superannuation account balances becomes stronger and aggregate labour supply starts to decline. The long-run effect on labour input is slightly negative as longer working hours of younger households are not enough to offset the decline in labour supply of older generations. The implications for the gross wage rate are given by the policy effects on the marginal product of labour. The short-run impacts on the wage rate are negative as the labour input increases but later on when the overall labour supply falls, the wage rate slightly increases before it returns to its initial steady state value in the long run.

Assets and capital accumulations As opposed to the TTE policy change, under the shift to the EET regime, domestic total assets grow over the entire transition path due to the

¹⁵Government consumption is fixed at the benchmark steady state ratio to output over the entire transition path.

rapidly increasing superannuation assets that by far outweigh falling ordinary private assets. Because of the abolition of the contribution and fund earnings taxes, the long-term domestic total assets are up by 9.35 percent, which means positive impacts of this superannuation tax policy change on household savings. The capital stock also increases in the short and medium run as the capital price (i.e. marginal benefits of a purchase of additional capital) is positively affected by this policy change. However, the long-run percentage changes in the capital stock that are determined by the overall labour supply are negative, falling slightly by about 0.37 percent. The foreign assets decline on impact because of the increase in the capital price while domestic assets are fixed in the first period of the transition. In the subsequent years, the foreign assets position improves as most of the increases in the domestic assets are exported abroad. The long-run foreign assets improve by about 40.66 percent.

Goods market The already discussed positive short- and medium-run effects of the shift to the EET regime on employment and the capital stock generates greater output. The long-run effect on output is slightly negative. Aggregate consumption declines by almost one percent on impact as the only generations with higher consumption are younger high-income households, which is not enough to offset lower consumption by all other generations. In the subsequent years of the transition, overall consumption improves and exceeds the benchmark steady state consumption. This is because younger and future-born generations benefit from a longer period of tax-free contributions and fund earnings. In addition, these generations also pay a lower consumption tax rate relative to the first year of the policy change. The long-run overall consumption is higher by 1.31 percent compared to that in the benchmark steady state. The second largest component of aggregate demand, investment demand expands initially but it falls below its initial steady state value because of a decline in the capital price. The trade account increases by 38.2 percent on impact as the lower aggregate consumption causes domestic demand that consists of consumption, investment and government spending to fall while output increases. In the subsequent years of the transition, the trade balance declines relative to the immediate impact. The long-run effect on trade balance is largely negative, falling by 40.66 percent as domestic demand increases while output decreases.

Government indicators As a result of the shift to the EET superannuation tax regime, the government budget expands slightly due to greater government consumption but later on, the total government expenditures decline relative to those in the benchmark steady state because of lower costs on the age pension. The age pension expenditures decline over the most of the transition path mainly because the middle-income households at older ages receive larger investment income that is assessed under the age pension income test. For high-income households, the assets test is binding. They accumulate larger total assets and thus they qualify for some age pension only at very old ages. The long-run age pension expenditures fall by 1.18 percent - the fall more than twice as large as the age pension cost decline under the TTE regime. On the other hand, the consumption tax rate increases by 32.38 percent on impact - from the rate of 10 percent to 13.3 percent, which is twice as much as under the TTE regime. This increase is needed to offset a considerable loss in the superannuation tax revenue of over 63 percent in the first year of the transition. In the subsequent years,

the superannuation tax revenue losses are alleviated by larger superannuation assets and the resulting revenue from the benefit taxation. The falling losses in the superannuation tax revenue cause the consumption tax rate to decline relative to that in the first year of this policy change. In the long run, the consumption tax rate is 12.2 percent, which still represents a considerable increase of about 22 percent relative to the initial steady state.

6 Sensitivity analysis

It is important to point out that none of the taste and production parameters in Table 1 was econometrically estimated using Australian data. There is no "correct" value for any of these parameters in this type of models (Rasmussen, 2003). As mentioned, we take some of the parameters used in the benchmark SS simulation from relevant literature, some exactly match the real values and some are calibrated to the calibration targets. In this subsection we explore the long-run, steady state macroeconomic effects of the two superannuation tax policies with alternative parameterisation of the model. The sensitivity results are reported in Table 5. The 'baseline' case shows the values of the calibrated parameters and the long-run policy effects on aggregate labour supply, domestic assets, consumption and the consumption tax rate with the benchmark parameters presented in Table 1.¹⁶ Under the alternative parameterisation scenarios of the model, the values of the key parameters are changed individually and the initial SS equilibrium is re-calibrated to generate the calibration targets such as the gross wage rate, the investment-output ratio, the interest rate and the foreign assets to capital ratio. Then, we compute the new SS equilibrium arising from (i) the benefit tax removal and (ii) the abolition of the contribution and fund earnings taxes. The percentage changes for overall labour supply, domestic total assets and consumption between the two steady states and the new steady state values of the consumption tax rate are recorded in the table below.

Insert Table 5 here

The sensitivity analysis reveals that the alternative choice of the values of the key model parameters in the superannuation tax policy simulations has a little long-run steady state impact on the displayed variables. In other words, the long-run effects of both superannuation tax policy changes under different parameterisation of the model do not vary greatly from the policy effects under the baseline case. None of the alternative parameterisation scenarios generate results that would have the opposite sign to the results arising from the baseline case. This is mainly because when the individual parameters are set to alternatives values then the parameters calibrated to generate the initial steady state approximately replicating the Australian economy change in such a way that it partially eliminates the effects of the change in the original parameter. For example, the increase in the capital share parameter from 0.36 to 0.45, (i.e. this higher value was used in the OLG model calibrated to Australia by Kulish et al., 2006), leads to a significant fall in the calibrated production parameter of the elasticity of substitution in production to 0.83 and the superannuation tax policy impacts that are almost identical to those in the baseline case.

¹⁶Recall that the long-run effect on aggregate labour supply determines the percentage changes in the long-run capital stock and output in this open economy model.

The only significantly different results from the baseline case are delivered by the alternative values of the shift parameter that determines the heights of the lifetime earnings ability profiles of the three income classes. In the baseline case, similarly to Fehr et al. (2008), this parameter is set to 0.3 for low-income households, one for middle-income households and three for high-income households. Under the alternative parameterisation scenario, the shift parameter is set to 0.7 for low-income households and two for high-income households, representing a more equal income distribution calculated from ABS (2005b). Relative to the baseline case, this alternative scenario has greater negative long-term impacts on the labour input (and thus capital and output) and overall consumption but stronger positive effects on long-run domestic assets under both superannuation tax policy changes. Under the policy change to the TTE regime with the benefit tax removal, the consumption tax rate increases less than in the baseline case because high-income households with lower lifetime earnings ability (i.e. shift parameter equal to two) accumulate smaller superannuation assets and thus pay lower benefits taxes. When the benefit taxation is removed, the loss in the budget revenue is not as large as in the baseline case. The lower consumption tax rate, however, does not deliver higher consumption relative to the baseline case because the benefits of the exit tax removal to high-income households are significantly lower. Positive effects on long-run labour supply are smaller than in the baseline case because of less labour supply incentives of the superannuation benefit tax removal for high-income households. However, as these high-income households receive smaller tax-free superannuation payouts compared to the baseline case, they cannot borrow as much, which has smaller negative impacts on long-run domestic assets.

7 Concluding remarks

This paper numerically evaluates superannuation tax reforms by using a computable OLG model that incorporates essential features of Australia's retirement income policy. The major objective of the paper is to assess behavioural, welfare and macroeconomic implications of the benefit tax abolition implemented by the Australian government in July 2007. This policy is compared with the alternative policy change of the shift towards the expenditure tax treatment of superannuation with the EET regime where the superannuation contributions and fund earnings are tax-free while benefits remain to be subject to taxation. This second hypothetical policy change was proposed by the superannuation industry and a number of retirement income researchers.

The simulations of the two superannuation tax policy changes produce very different results. Under the TTE regime with the benefit taxation abolition, it is the older generations of high-income earners nearing the superannuation payout age that benefit the most in terms of remaining consumption and welfare. These generations that would have to pay large taxes on their superannuation benefits receive the tax-free lump-sum, which represents a very generous gift from the government. Low-income households that pay no benefit taxes prior to the reform experience consumption and welfare losses through the general equilibrium effect of a lower wage rate initially and of the increased consumption tax rate. On the other hand, the shift to the EET regime with the abolition of the contribution and fund earnings

taxes has the most positive impact on future-born, middle-income generations. Compared to cohorts alive before this policy is implemented, the new-born generations receive the tax-free contributions and fund earnings over the entire period of the superannuation assets accumulation. In addition, generations born in the later periods of the transition face a slightly higher wage rate and a declining consumption tax rate relative to these rates in the first period of the policy change. In comparison with the other two income types, low-income households cannot borrow against their larger superannuation payout to increase the pre-superannuation consumption and high-income households pay considerably higher benefit taxes because of a larger, tax-free superannuation accumulation.

The macroeconomic implications of the shift to TTE regime show positive effects on employment, capital stock, output and consumption both in the short run as well as in the long run. However, the domestic total assets decline over the entire transition path, implying that the capital increases are funded from abroad by capital imports, which worsen the current account. The shift to the EET regime generates also higher labour supply, capital and output but only in the short- and medium-run. In the long term, the labour input that determines long-run changes in the capital stock and output in this open economy model declines slightly as lower labour supply of older generations in the new steady state offsets the labour supply increases experienced by younger generations. The removal of the contribution and fund earnings taxes costs the government almost twice as much on impact as the shift to the TTE regime in terms of superannuation tax losses. This requires a significantly larger increase in the consumption tax rate to offset the revenue losses. However, the superannuation tax losses arising from the EET regime are alleviated during the transition due to a greater superannuation assets accumulation and the resulting larger benefit tax collection. In the long run, the gaps between superannuation tax losses and the consumption tax rate increases under both investigated policy changes are almost entirely eliminated.

Although the two policy's results vary significantly, the small magnitude of the results suggests that both superannuation policy changes represent primarily a taxation switching issue – a decline in superannuation tax revenues compensated by an increase in consumption tax receipts. The real economy except for the impacts on domestic and foreign assets seems not to be greatly affected by any of these simulated superannuation policies.

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A Appendix - Computational method

Solving for the SS equilibrium uses the Gauss-Seidel method which in this open economy model involves initial guesses for the accidental bequest, B , and the consumption tax rate, τ^c . The market clearing wage rate, w , and capital-labour ratio, K/L , are implied by the exogenous world interest rate, r , and the CES production function. Given the guesses for B and τ^c , combined with w and r , the household optimisation problem can be solved.

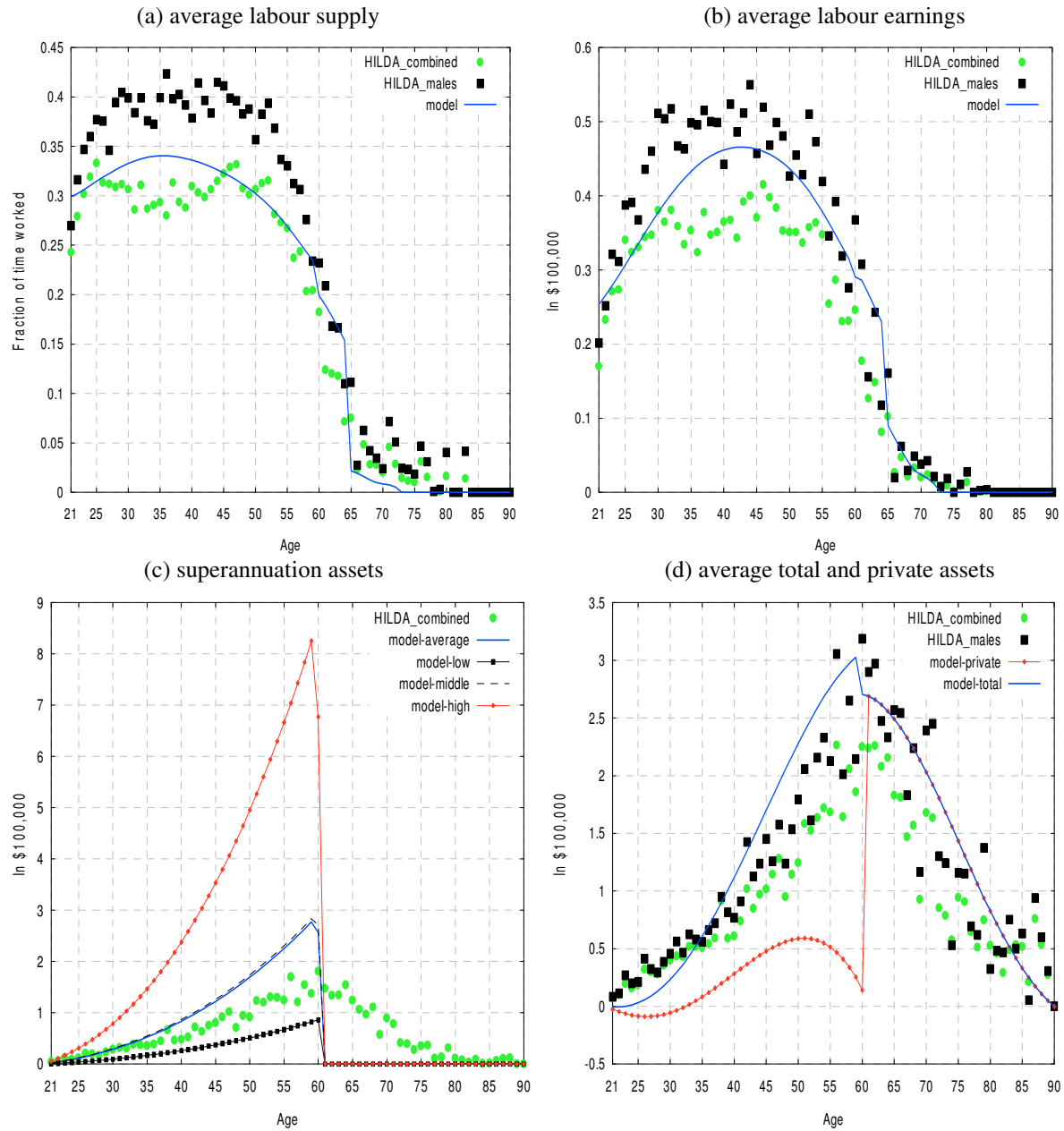
The household optimisation problem – maximisation of the lifetime utility function (2.1) subject to budget constraint (2.2) and leisure constraint (2.3) – is solved directly in GAMS using a DNLP solver called CONOPT. Solving this problem yields optimal values for household variables such as consumption and leisure. The solution for the household sector allows us to update B and τ^c using expressions (2.14) and (2.11), respectively. The iterations stop when the solution for the guessed variables equals their solution from the previous iteration. Then, we calculate the labour input using (2.13a). The capital stock is equal to the product of the implied capital-labour ratio and the labour input. The difference between the value of the capital stock and domestic assets implies presence of foreign assets calculated by (2.13b) and the trade balance is derived from (2.13c).

It is a bit more complicated to solve for the transition path from one steady state to another. First, capital adjustment costs can occur during the transition path. This implies that the capital price (Tobin's q), the wage rate as well as the capital-labour ratio can differ from their benchmark SS values. Second, on the household side, the generations of the three income groups alive at the time the policy change is adopted must be treated differently from the SS simulation.

Programming the transition path involves two sub-programs – one for the production sector and the other for the household sector. The production sector sub-program includes the net output function (2.9), capital accumulation equation and the three first order necessary conditions defined in (2.10a-c). The solution for the production sector is obtained using the mixed complementarity problem [MCP] solver called PATH. The household sector sub-program computes the households' optimisation problem using the DNLP CONOPT solver. In contrast to the steady state computation, which solves the optimisation problems of three income types of households, in this transition path program with the economy spanning over 150 years, three income groups and 70 years of the maximum life-cycle there are 660 households whose optimisation problems have to be solved. This includes 207 households (69 generations of 3 income types) born prior to year when the policy was adopted.

The two sub-programs are combined using an 'outer' loop. In this outer loop, the production sector sub-program is solved first with the labour input, L_t , guessed initially – set to its benchmark SS value. Solving the production sector determines the wage rate, w_t . Given w_t and the guesses for the bequest, B_t , and the consumption tax rate, τ_t^c , the household sector sub-program is computed. In particular, the household sector sub-program uses an 'inner' loop, in which the optimisation problem for each of the 660 households is computed separately. With the solutions to the household and production sectors, the guesses of L_t , B_t and τ_t^c are updated. The iterations stop when the solution for these guessed variables equals their solution from the previous iteration.

Figure 1: Life-cycle household profiles generated by the benchmark steady state model simulation and using HILDA data surveys



Notes: HILDA combined profiles are averages over both males and females. Model profiles are life-cycle profiles averaged across the three income types of model single-person households. (a) HILDA profiles of labour supply are derived using individual's data set of survey wave 5 conducted in 2005. The provided average weekly hours worked are converted to average annual labour supply and then divided by the assumed annual time endowment of 5460 hours. (c) To obtain HILDA profiles of average labour earnings, the derived variable of annual gross wages and salaries in individual's data set of survey wave 5 is used. (c) HILDA profile of average superannuation assets are derived from survey wave 6 with special topic on wealth. (d) HILDA profiles of average financial assets are also derived from survey wave 6. The individual's data set contain only information on superannuation and bank accounts. The plotted HILDA data points are obtained as follows: (i) using the individual's data set, average age-specific sum of superannuation and bank account holdings is calculated, (ii) using household data set, the average age-specific share of superannuation and bank account assets in total financial assets is calculated, (iii) to obtain total individual's financial assets, division of (i) by (ii) is performed and (iv) the obtained average age-specific assets are deflated at the three percent rate to 2005.

Figure 2: Behavioural implications of the shift to the TTE regime for life-cycle consumption and labour supply of the three income classes

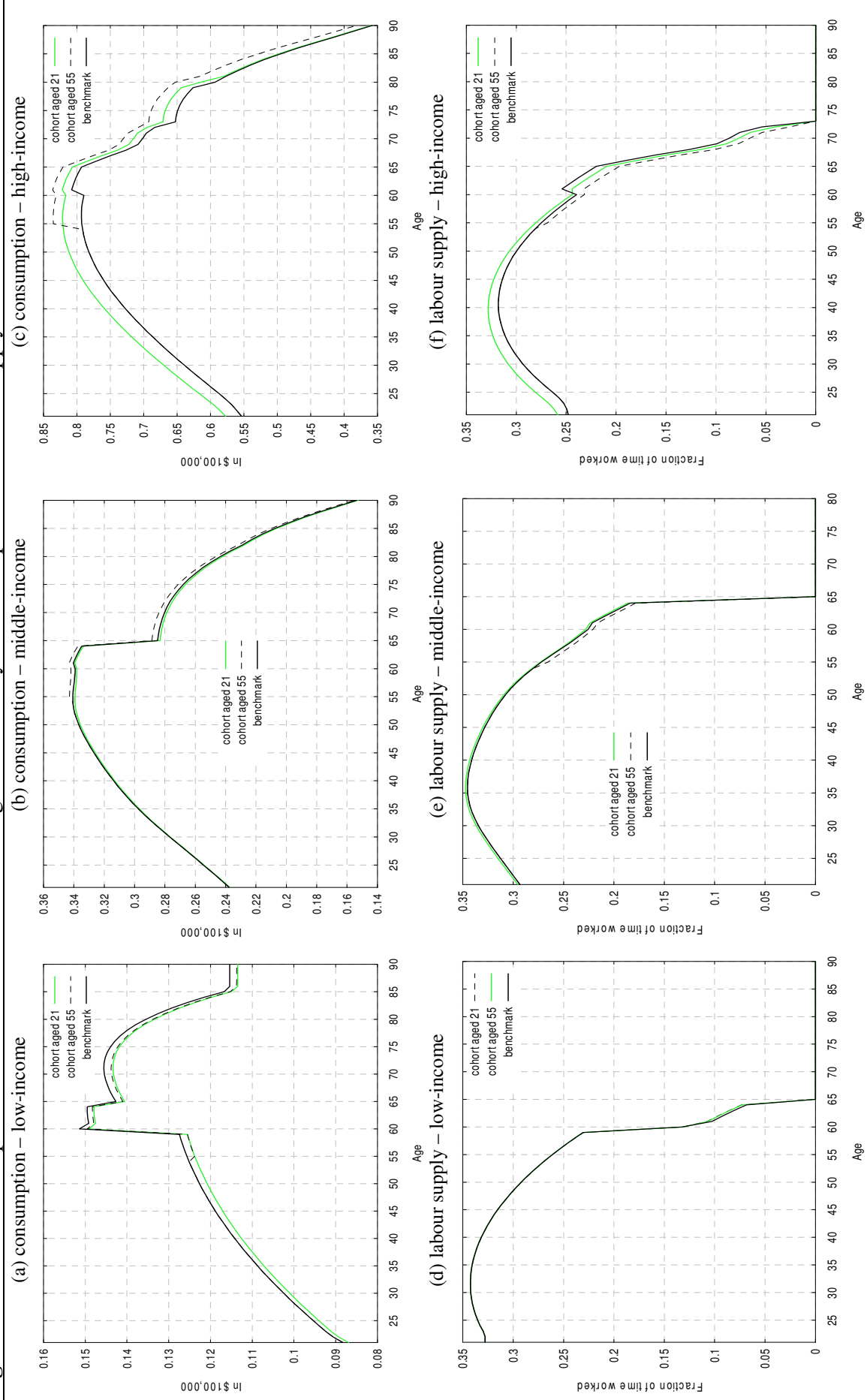


Figure 3: Behavioural implications of the shift to the EET regime for life-cycle consumption and labour supply of the three income classes

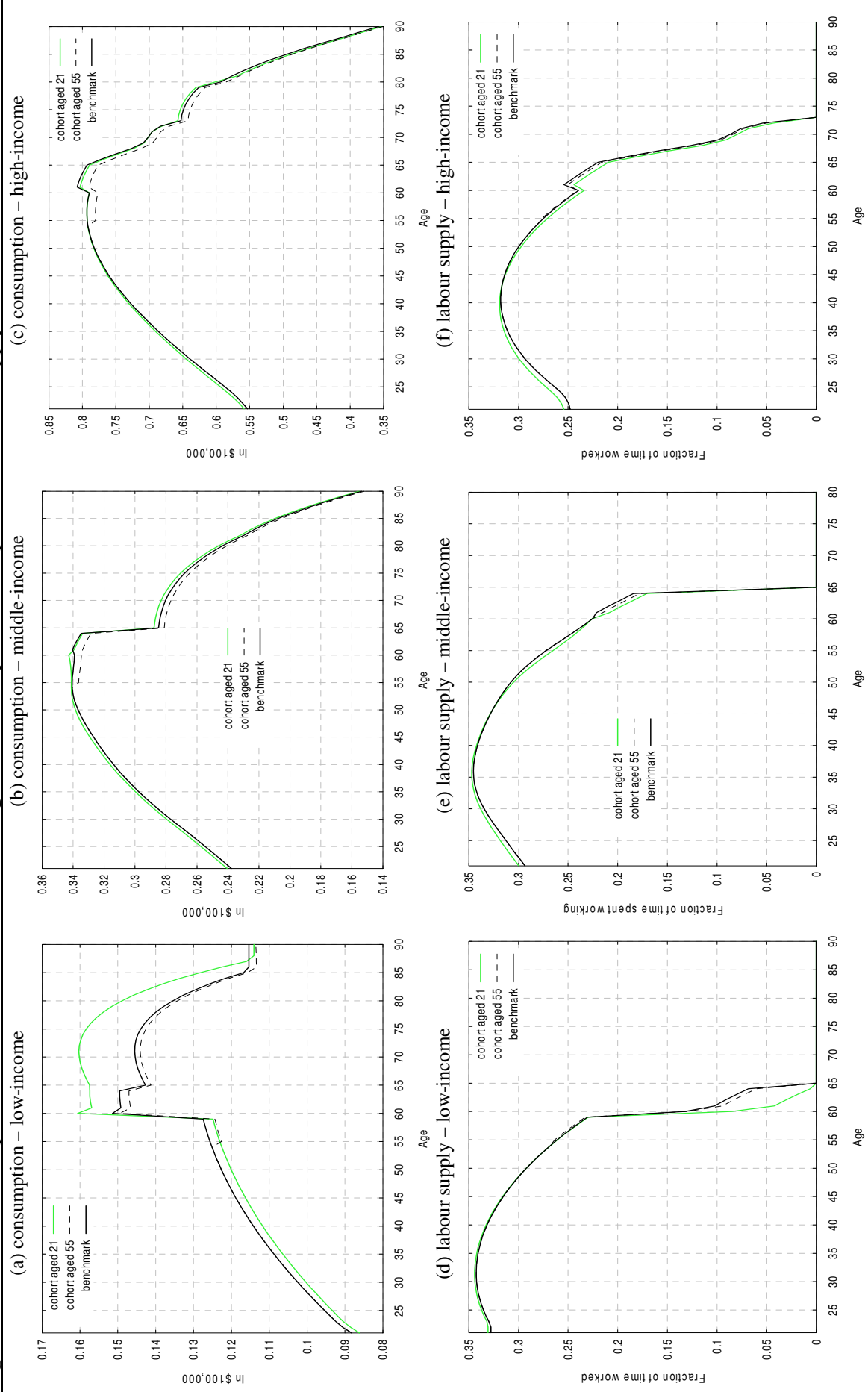
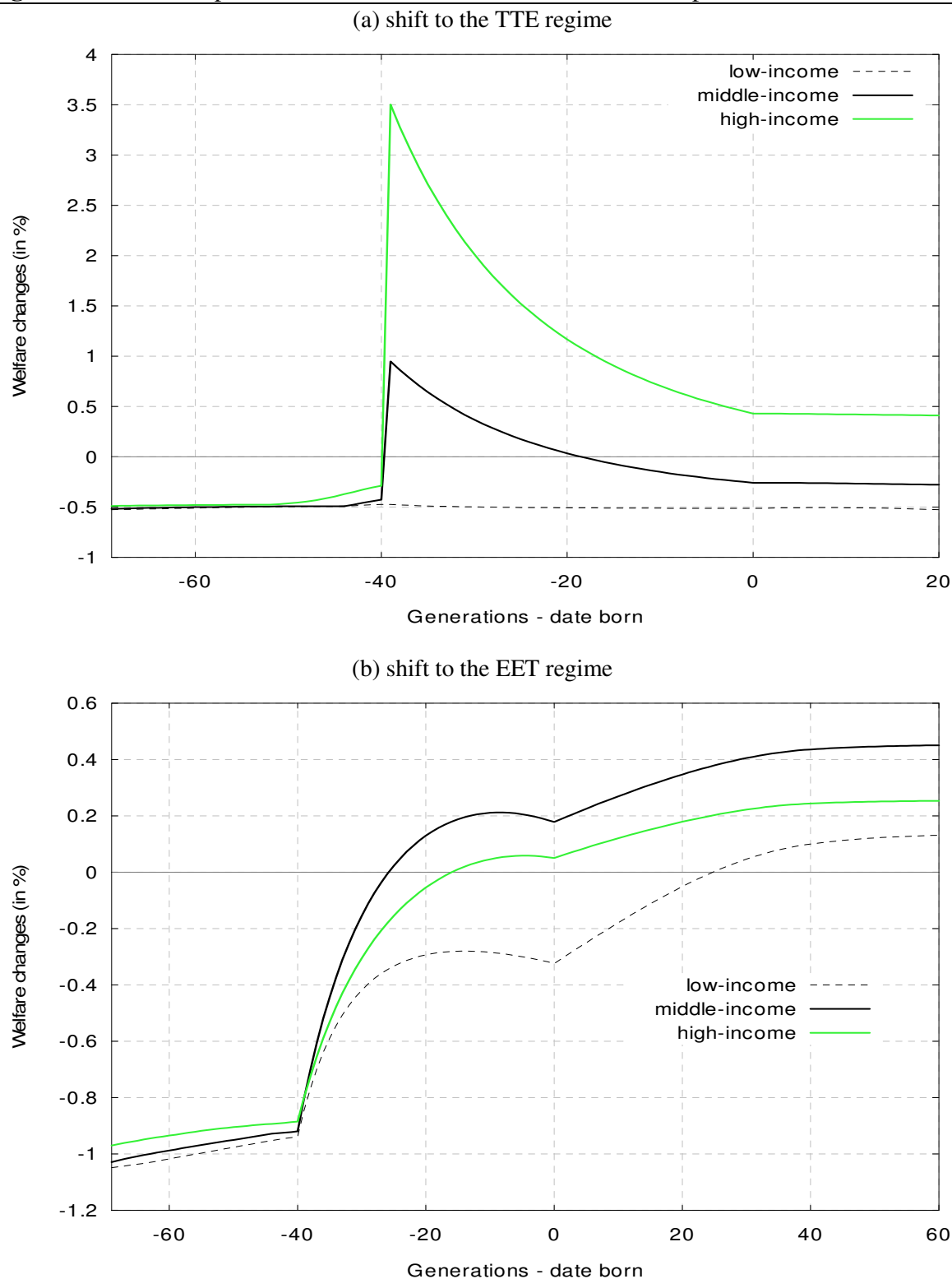


Figure 4: Welfare implications of two different tax treatment of superannuation



Notes: The horizontal axis records the periods when generation enters the model relative to the period of the policy change which is assumed to be period 0. A generation's age at the time of the policy shift can be obtained by subtracting the number on the horizontal axis from the assumed entry age of 21. For example, the generation born 40 years (-40) prior to the policy change is 61 years old at the time of reform.

Table 1: Parameter values of the model in the benchmark steady state

Symbol	Description	Value
<i>Demographics</i>		
n	Population growth rate	0.012
ω_i	Fraction of households of income group i	0.3, 0.6, 0.1
s_a	Conditional survival probabilities	ABS (2005a)
<i>Utility function</i>		
γ	Inter-temporal elasticity of substitution	0.3
ρ	Intra-temporal elasticity of substitution	0.9
β^i	Subjective rate of time preference	0.017, 0.012, 0.007
α	Leisure parameter	1.6
<i>Production function</i>		
κ	Production constant	0.956
σ	Elasticity of substitution in production	1.026
ε	Capital share	0.36
δ	Depreciation rate	0.076
ψ	Adjustment cost parameter	10
<i>Age pension [a]</i>		
p	Maximum single-rate age pension per year	0.12238
IT	Income threshold to which p is payable	0.03172
θ	Income reduction (taper) rate	0.4
AT	Assets threshold to which p is payable	2.635
ϕ	Assets reduction (taper) rate	0.078
AP_age	Age pension eligibility age	65
<i>Superannuation guarantee [b]</i>		
cr	Mandatory superannuation contribution rate	0.09
τ^{sc}, τ^r	Concessional tax rates on contributions and earnings	0.15, 0.15
τ^{sb}	Concessional tax rate on benefits	0.15
τ^{m_5}	Top marginal tax rate on excessive lump-sums	0.47
TFT	Superannuation tax free threshold	1.23808
RBL	Lump-sum reasonable benefit limit	6.19223
SG_age	Assumed superannuation eligibility age	60

Notes:[a] The age pension parameters are those applicable in November 2004 (Dale, 2004) and the monetary values are expressed in units of \$100,000; [b] Superannuation parameters are those applicable in 2004/05 and the monetary parameters are expressed in units of \$100,000.

Table 2: Benchmark steady state and actual macroeconomic data

Variable	Benchmark steady state	Australia 2004-05 [a]
<i>Expenditures on GDP (Per cent of GDP)</i>		
- Private consumption	52.47	58.04
- Investment	25.82	25.82
- Government consumption	19.55	18.10
- Trade balance	2.16	-2.52
<i>Government indicators (Per cent of GDP)</i>		
- Age pension expenditures	3.66	2.89
- Government surplus	0.00	1.50
Current revenues		
- Personal income tax	15.36	12.10
- Corporation tax	-	4.97
- Consumption tax (GST)	5.25	4.12
- Superannuation taxes	2.60	0.71
Capital-output ratio	2.93	2.92
Foreign assets-capital ratio	-0.19	-0.19
Investment-capital ratio	0.09	0.09
Consumption tax rate	0.10	0.10

Source: [a] ABS (2006) and Commonwealth of Australia (2006).

Table 3: Macroeconomic implications of the shift to the TTE regime with the benefit tax removal

Variable	Initial SS [a]	Time period [b]								New SS [a]	
		0	5	10	20	30	40	50	200		
Labour supply	0.3106	%	0.513	0.491	0.640	0.978	1.137	1.211	1.238	1.260	0.3145
Wage rate	1.0000	%	-0.184	-0.103	-0.090	-0.097	-0.073	-0.048	-0.028	0.000	1.0000
Capital stock	1.5763	%	0.000	0.204	0.388	0.707	0.934	1.076	1.160	1.260	1.5961
Domestic assets	1.2703	%	0.000	-0.447	-0.960	-1.942	-2.702	-3.121	-3.306	-3.353	1.2277
Foreign assets	-0.3060	%	-2.395	-4.921	-7.839	-13.170	-16.994	-19.087	-20.040	-20.417	-0.3684
Capital price (Tobin's q)	1.0000	%	0.465	0.390	0.359	0.282	0.185	0.112	0.065	0.000	1.0000
Output [c]	0.5371	%	0.323	0.385	0.547	0.878	1.062	1.161	1.209	1.260	0.5439
- Consumption	0.2818	%	0.638	0.703	0.766	0.804	0.683	0.556	0.480	0.470	0.2831
- Investment	0.1387	%	0.503	0.640	0.791	1.018	1.137	1.198	1.230	1.260	0.1404
- Trade balance	0.0116	%	-9.470	-10.388	-7.680	0.986	9.360	15.374	18.643	20.417	0.0140
Government expenditures [d]	0.1247	%	0.259	0.295	0.355	0.573	0.756	0.863	0.933	0.980	0.1259
- Age pension expenditures	0.0196	%	-0.080	-0.184	-0.669	-1.059	-0.883	-0.731	-0.547	-0.523	0.0195
Total government revenues	0.1247	%	0.259	0.295	0.355	0.573	0.756	0.863	0.933	0.980	0.1259
- Income tax revenues	0.0825	%	0.726	0.608	0.556	0.593	0.554	0.558	0.588	0.629	0.0830
- Consumption tax revenues	0.0282	%	16.946	17.355	17.695	18.424	19.240	19.657	19.871	19.934	0.0338
- Superannuation taxation	0.0140	%	-36.147	-35.954	-35.804	-35.547	-35.335	-35.243	-35.224	-35.176	0.0091
Consumption tax rate (=GST)	0.1000	%	16.204	16.535	16.801	17.480	18.431	18.995	19.298	19.373	0.1194

Notes: [a] SS values for the monetary variables are expressed per average household and in units of \$100,000. Labour supply is presented as a fraction of time spent working per average household. [b] Values for all the displayed variables over the transition path are presented as percentage changes from the initial SS. [c] Output consists of consumption, investment, government consumption and trade balance with government consumption, G, not displayed as it is fixed as a ratio of output and thus percentage changes in G are identical to those in output. [d] Government expenditures include government consumption and age pension expenditures.

Table 4: Macroeconomic implications of the shift to the EET regime with the abolition of the contribution and fund earnings taxes

Variable	Initial SS [a]	Time period [b]								New SS [a]	
		0	5	10	20	30	40	50	200		
Labour supply	0.3106	%	0.793	0.545	0.330	0.051	-0.100	-0.163	-0.245	-0.357	0.3095
Wage rate	1.0000	%	-0.284	-0.161	-0.077	0.003	0.024	0.016	0.019	0.000	1.0000
Capital stock	1.5763	%	0.000	0.096	0.117	0.058	-0.035	-0.118	-0.191	-0.357	1.5707
Domestic assets	1.2703	%	0.000	1.479	2.879	5.297	7.096	8.218	8.797	9.347	1.3890
Foreign assets	-0.3060	%	-1.667	5.026	11.343	22.151	30.115	35.137	37.866	40.645	-0.1816
Capital price (Tobin's q)	1.0000	%	0.324	0.120	0.001	-0.089	-0.092	-0.080	-0.069	0.000	1.0000
Output [c]	0.5371	%	0.499	0.379	0.251	0.053	-0.076	-0.146	-0.225	-0.357	0.5352
- Consumption	0.2818	%	-0.964	-0.741	-0.510	-0.001	0.499	0.941	1.140	1.305	0.2855
- Investment	0.1387	%	0.313	0.199	0.100	-0.046	-0.137	-0.207	-0.268	-0.357	0.1382
- Trade balance	0.0116	%	38.180	29.651	20.500	2.562	-13.295	-25.771	-32.806	-40.645	0.0069
Government expenditures [d]	0.1247	%	0.420	0.320	0.189	-0.046	-0.196	-0.274	-0.352	-0.486	0.1240
- Age pension expenditures	0.0196	%	0.000	0.008	-0.146	-0.580	-0.837	-0.956	-1.031	-1.181	0.0194
Total government revenues	0.1247	%	0.420	0.320	0.189	-0.046	-0.196	-0.274	-0.352	-0.486	0.1240
- Income tax revenues	0.0825	%	0.720	0.086	-0.562	-1.688	-2.395	-2.542	-2.521	-2.558	0.0804
- Consumption tax revenues	0.0282	%	31.099	31.018	30.741	29.525	27.315	24.478	24.054	23.594	0.0348
- Superannuation taxation	0.0140	%	-63.220	-60.204	-56.994	-49.995	-42.700	-36.803	-36.772	-36.822	0.0088
Consumption tax rate (=GST)	0.1000	%	32.375	31.995	31.410	29.526	26.683	23.317	22.656	22.002	0.1220

Notes: [a] SS values for the monetary variables are expressed per average household and in units of \$100,000. Labour supply is presented as a fraction of time spent working per average household. [b] Values for all the displayed variables over the transition path are presented as percentage changes from the initial SS. [c] Output consists of consumption, investment, government consumption and trade balance with government consumption, G, not displayed as it is fixed as a ratio of output and thus percentage changes in G are identical to those in output. [d] Government expenditures include government consumption and age pension expenditures.

Table 5: Sensitivity analysis

Scenario	Calibrated parameters [a]			Shift to the TTE regime [b]				Shift to the EET regime [b]			
	σ	δ	G/Y	L (%)	DA (%)	C (%)	τ^c (Δ)	L (%)	DA (%)	C (%)	τ^c (Δ)
Baseline case [c]	1.026	0.076	0.196	1.26	-3.353	0.47	0.119	-0.357	9.347	1.305	0.122
Income distribution shift parameter ($\xi^1 = 0.7, \xi^2 = 1, \xi^3 = 2$)	1.028	0.076	0.179	0.602	-1.918	0.182	0.114	-1.12	10.74	0.856	0.123
Inter-temporal elasticity of substitution ($\gamma = 0.4$)	1.081	0.061	0.199	1.258	-1.674	0.645	0.119	-0.398	9.262	1.622	0.119
Subjective rate of time preference for middle-income ($\beta^2 = 0.015$)	1.001	0.084	0.195	1.284	-3.421	0.552	0.119	-0.381	10.463	1.307	0.122
Leisure distribution parameter ($\alpha = 2$)	1.089	0.072	0.178	1.526	-2.153	0.889	0.114	-0.356	9.342	1.304	0.122
Capital share ($\varepsilon = 0.45$)	0.829	0.076	0.195	1.26	-3.352	0.47	0.119	-0.356	9.342	1.304	0.122
Interest rate ($r = 0.055$)	1.098	0.068	0.198	1.213	-3.033	0.294	0.123	-0.561	9.447	1.605	0.122
Population growth rate ($n = 0.02$)	0.944	0.775	0.2054	1.329	-3.434	0.729	0.117	-0.117	9.705	1.119	0.125

Notes: [a] The elasticity of substitution in production, σ , is calibrated to reproduce $r = 0.05$, the depreciation rate, δ , to reproduce $I/Y = 0.2582$ and G/Y to obtain $\tau^c = 0.1$ in the initial SS equilibrium; [b] Displayed per-capita variables - labour supply, L , domestic total assets, DA , and consumption, C , are presented as the long-run percentage change from the initial SS under each parameterisation scenario and the consumption tax rate, τ^c , as the rate in the new SS; [c] The parameter values in the baseline case are: $\xi^1 = 0.3, \xi^2 = 1, \xi^3 = 3, \gamma = 0.3, \beta^2 = 0.012, \alpha = 1.6, r = 0.05, n = 0.012$.