

A General Equilibrium Analysis of the Australian Means-Tested Age Pension

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Abstract

This paper develops a computable general equilibrium model with overlapping generations [OLG] to analyse the behavioural, welfare and macroeconomic implications of the following hypothetical age pension policy changes: (i) abolition of the means test and (ii) removal of the labour earnings from the income test. The model incorporates essential aspects of Australia's retirement income and personal income tax policy systems.

We show that under both hypothetical pension policy changes, generations work longer hours at older ages and postpone their full retirement. Thus, the model implies that the existing means-tested age pension represents a disincentive for older Australians to work. The more effective of these age pension policy changes to increase the labour supply of older Australians is the removal of labour earnings from the income test while the means test abolition delivers larger retirement consumption and welfare gains. The macroeconomic simulation results indicate that the means test abolition would raise the government costs on age pension substantially relative to the costs resulting from the removal of only labour earnings from the income test.

Keywords: Retirement, pension reform, dynamic OLG model

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1 Introduction

This paper explores the implications of the following two hypothetical policy changes to the means test of the Australian age pension: (i) the means test abolition and (ii) the removal of the labour earnings from the income test. The aim is to determine whether the age pension means test provides disincentives for older Australians to engage at some part-time work and brings forward retirement.

The age pension represents the first pillar of Australia's retirement income policy which, as opposed to the first pension pillars in many other countries is means tested against both claimant's income and assets. OECD (2005) shows that although 18 member countries have targeted pension programs, many of these countries also pay some minimum pension or flat-rate basic pension. In most countries, targeted public pensions are pension-income tested or broader-income tested, and not means-tested against both income and assets like in Australia. Arguments for the universal age pension are that it would simplify the public pension pillar, avoid very high marginal tax rates, thus removing disincentives to work and save for the elderly. On the other hand, government expenditures on targeted pensions are substantially lower than on universal pension payments.

The effects of means tests of social security benefits on labour supply and retirement in other countries have been studied by many researchers. Baker and Benjamin (1999) estimate the impact of the sequential removal of the earnings test in Canada in the mid-1970s and find an increase in weeks worked conditional on employment and strong evidence of the shift from part-time to full-time work. Disney and Smith (2002) examine the labour supply effects of the abolition of the earnings rule in the United Kingdom in 1989. Using the Family Expenditure Survey for the period of 1984-94, they show a significant effect on the number of hours worked by men, with a lesser impact on women as a result of the means test removal.

The earnings test of the US social security system has also undertaken several changes. For instance, in 2000 the earnings test was eliminated for those over the social security normal age of retirement, which is currently 65 years. Early studies such as the paper by Burtless and Moffitt (1985), who applied a joint model of retirement and post-retirement labour supply, concluded that the earnings test had a small impact on labour supply of the elderly. However, Friedberg (2000) points out that Burtless and Moffitt used the data over the period when the earnings test parameters were almost unchanged. Friedberg examines the changes in the US social security earnings test between 1978 and 1990 and finds significant impacts of the earnings test on labour supply of the affected population at or near the earnings test threshold. Her estimated labour supply model indicates that the means test removal for those aged 65-69 would have a strongly positive effect on hours and earnings.

Gruber and Wise (2005) document a relationship across several countries between social security incentives to retire and the proportion of older people out of the labour force. They show that the departure rates at the early retirement ages are around 60 percent in France and Germany, and only about 25 percent in the US. They argue that the differences are due to taxes on continued wage earnings that vary considerably in these countries. The effective tax rates are about 70 percent in France and 40 percent in Germany but approximately zero

in the US.¹ French (2005) and Benitez-Silva and Hetland (2007), using structural models of retirement, show positive effects of the earnings test removal on labour supply of those at and near the threshold of the earnings test. Hence, these studies provide evidence that the removal of the earnings test would have a significant effect on labour supply.

In Australia, the Institute of Actuaries of Australia [IAA] (1994) recommended the means test abolition and the universal pension paid to all people from age 65.² Evans and Kelley (2003) assessed the attitude of Australians to alternative age pension systems. Using the survey of 4,830 cases, they concluded that the most preferable would be the universal age pension, while the least popular was no government provision, followed by the means-tested pension. Other researchers suggested only partial and gradual adjustments to the Australian age pension means test to encourage pensioners to provide some part-time work and to avoid substantial costs that would result from the shift to the universal pension. Dunsford and Rise (2004) propose the removal of the labour earnings from the income test and a gradual removal of the means test starting with the reduction in the income taper rate is recommended by Ingles (2001).

Existing approaches to modelling the effects of adopted and proposed retirement income policy changes in Australia are left mainly to micro-simulation models that lack theoretical content and provide an incomplete picture of the pension policy effects because of limited behavioural responses to underlying policy changes. The welfare and redistributive implications of the IAA (1994) proposal are examined by Atkinson et al. (1996) using a lifetime simulation model. The paper finds that the IAA scheme would increase progressivity of the tax system and raise welfare relative to the policy at that time only if 100 percent of the superannuation savings are used to buy annuity. Rothman (1998) applies the cohort projection RIMGROUP model to project the costs of age and veteran pensions up to year 2049-50 assuming various pension scenarios. The paper shows that under the base case the pension costs will rise to about 4.5 percent of GDP by 2049-50 due to ageing population. The shift to the universal age pension would lift the costs to 6.45 percent of GDP by 2049-50 -44 percent increase in 2049-50 relative to the costs of the existing means-tested pension.

In this paper we develop a computable general equilibrium model with overlapping generation [OLG] for Australian to numerically examine inter-generational, welfare and macro-economic implications of the age pension policy changes. The model is a small open economy version of Auerbach and Kotlikoff's model and, to our best knowledge, it is the first large scale OLG model capable of staying retirement income policy issues in Australia. Kulish et al. (2006) analysed macroeconomic consequences of ageing using a computable OLG model calibrated to the Australian economy. Their model is a closed economy model that contains only household and production sectors. Our model, in addition to household and production sectors, incorporates essential aspects of Australia's retirement income policy and it includes the government sector. The examined age pension policy changes are revenue neutral as we

¹They point out that very low tax on wage earnings for those aged 62-64 years is due to significantly lower replacement rates, low actuarial adjustments for postponing social security benefits, smaller payroll taxes to finance social security benefits in the US.

²The IAA proposal also featured employer contributions of 6 percent, employee contribution of 6 percent and tax refund of 10 percent of approved annuity.

assume that the consumption tax rate adjusts to balance the government budget as a result of the pension policy change.

Based on the numerical simulations, it is shown that under both examined pension policy changes generations significantly increase their working hours at older ages and postpones their full retirement relative to the benchmark simulation with the means tested age pension. Hence, the model supports the argument that the means tested age pension represents a disincentive for older Australians to provide some work. The simulation results also indicate that the more effective of the two hypothetical policy changes to increase labour supply of older Australians is the removal of labour earnings from the income test. On the other hand, generations achieve higher welfare gains from the means test abolition. However, the government expenditures on the universal age pension are significantly higher compared to the costs arising from the labour earnings removal from the income test.

The rest of the paper is organised as follows. The next section documents high effective marginal tax rates that older Australians eligible for the age pension and with some private earnings may face. Section 3 describes the OLG model that is used to numerically evaluate the age pension policy changes. Section 4 discusses parameterisation of the model and provides the benchmark steady state analysis. Section 5 presents the inter-generational, welfare and macroeconomic results of the two hypothetical changes to the means test of the age pension. Finally, section 6 offers some concluding remarks and recommendations for further research.

2 Effective marginal tax rates

A number of retirement income commentators expressed concerns that the existing means test applied to the Australian age pension might discourage pensioners from taking up part-time work because of high effective marginal tax rates (Dunsford and Rise (2004), Ingles (2001) and Nielson, 2005). The effective marginal tax rate [EMTR] represents a tax rate applied to additional dollar of income and taking into consideration a reduction in welfare benefits (e.g. the age pension) due to the effective income test.

Insert Figure 1 here

Figure 1 shows the EMTRs in the financial year of 2007-08 for other workers and single senior Australians.³ The x-axis records either private income which excludes the age pension for seniors (Figure 1a) or taxable income which includes the age pension (Figure 1b). Taxable and private incomes for the other workers are identical as they are not assumed to be eligible for the age pension. As depicted, older Australians with some private income may face significantly higher EMTRs than other workers. In particular, as soon as private income of single senior Australians exceeds the free income area (i.e. income threshold) of the age pension income test, they pay an effective tax of 40 percent on additional dollar earned. The

³In addition of the income test of the age pension, the calculation of EMTRs for single seniors in Figure 1 accounts for the Medicare levy and tax offsets that the single pensioner may be eligible for. These tax offsets include senior Australian tax offset [SATO], low income tax offsets [LITO] and mature age worker tax offset [MAWTO]. Similar to the age pension, the Medicare levy and aforementioned the tax offsets are income tested and thus generate high EMTRs for some incomes.

EMTR of 40 percent is given by the taper rate of the income test at which the age pension declines for every dollar of private income earned above the income threshold of the age pension income test. The maximum EMTR for those eligible for the age pension was 73.9 percent in 2007-08, which, however, was applied only to a narrow range of income.⁴

3 Dynamic, open economy OLG model

3.1 Model overview

The model is a small-open economy version of Auerbach and Kotlikoff's (1987) OLG model. It consists of household, pension, production, government and foreign sectors. The household sector is populated with overlapping generations of single person households distinguished by age. Households face lifespan uncertainty. Although there are no bequest motives, the assets of those who die are assumed to be equally redistributed to all surviving households as accidental bequests. Labour supply and retirement are endogenous. Hence, households, in addition to their consumption choices, decide on how much work to supply and when to retire to maximise their lifetime utility. There are no borrowing constraints, so households can borrow any time and as much as their wish at the world interest rate provided that their terminal assets are non-negative.

The model incorporates essential aspects of the first two pillars of the Australian pension system – the means tested age pension and the fully funded superannuation guarantee [SG]. The age pension is paid to households from age 65 provided that 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 benefits are assumed to be paid out as a 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 is assumed to produce a single all-purpose output good that can be consumed, invested in production capital or traded internationally. The production technology is represented by CES production function, in which output is produced using capital and labour. 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 comprises government outlays and receipts, issues of new debt and the interest paid on accumulated debt. 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 exogenously fixed debt-output and government consumption-output ratios. The consumption tax rate is adjusted accordingly to balance the public budget.

⁴The maximum EMTR of 73.9 percent is calculated as follows: the taper rate of 40 percent of the age pension income test + (30 percent personal income tax rate + SATO taper rate of 12.5 percent + LITO taper rate of 4 percent + 10 percent reduction rate of the reduced Medicare levy) $\times$ 60 percent of marginal income.

The model is a small open economy model with the domestic interest rate pegged to the world interest rate 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.

3.2 Demographics

The model economy is populated with 70 overlapping generations of homogenous households aged from 21 to 90 years at any time period t . Every year, the oldest generation dies and a new generation is born. Generations are assumed to enter the model structure at age 21 and to face random survival up to a maximum possible lifespan of 70 years. Lifespan uncertainty is described by s_a , the exogenous conditional probability of survival from age a to $a + 1$. Following Hansen and Imrohoroglu (2006), the total population is assumed to grow at a constant rate, n , and is given by

$$POP_t = N_t \sum_{a=21}^{90} \frac{\prod_{j=21}^a s_{j-1}}{(1+n)^{a-1}}, \quad (3.1)$$

where N_t denotes the number of people born in period t . The cohort shares, μ_a , in the economy's total population are given by

$$\mu_a = \frac{s_a}{(1+n)} \mu_{a-1}, \text{ where } \sum_{a=21}^{90} \mu_a = 1. \quad (3.2)$$

Assumed stationary demographics with the constant population growth rate implies that the cohort shares expressed in (3.2) are constant over time.

3.3 Household behaviour

Household behaviour is modelled on the basis of the life-cycle theory pioneered by Modigliani and Brumberg (1954). According to this theory, people make rational choices about their consumption and saving over their finite lifespan. In this model, households optimally choose paths of consumption, leisure and the timing of retirement, given their preferences, lifetime budget and time constraints. The households' preferences are represented by the expected lifetime utility function, which is assumed to be time-separable and of the nested constant-elasticity-of-substitution [CES] form. The expected lifetime utility of a household who begins her economic life at time t , $E(U_t)$, can be expressed as

$$E(U_t) = 1/(1-1/\gamma) \sum_{a=21}^{90} S_a (1+\beta)^{21-a} u(c_{a,t+a+21}, l_{a,t+a+21})^{(1-1/\gamma)} \quad (3.3)$$

where $u(c_{a,t+a+21}, l_{a,t+a+21})$ is the instantaneous utility (i.e. felicity) that households in year t obtains from consumption, c , and leisure, l .

The expected lifetime utility (3.3) is the sum of current and future utilities, where any future utility is discounted by the rate of time preference, β , and the unconditional survival probability, $S_a = \prod_{j=21}^a s_{j-1}$. The greater is β the smaller the weight attached to future utility. Households also discount the future due to lifespan uncertainty. Thus, the effective discount rate at age a is equal to $S_a / (1 + \beta)^{a-21}$, meaning that households only care of their future utility as long as they stay alive. The parameter γ is the inter-temporal elasticity of substitution of utility at any two ages. It represents the percentage change in the ratio of utility at any two ages with respect to the change of relative prices of utility between the two ages. A large value of γ indicates a great degree of substitutability of current utility for any future utility in response to a change of the after tax interest rate.

The felicity function takes the CES form

$$u(c_{a,t+a+21}, l_{a,t+a+21}) = \left[c_{a,t+a+21}^{(1-1/\rho)} + \alpha l_{a,t+a+21}^{(1-1/\rho)} \right]^{1/(1-1/\rho)}, \quad (3.4)$$

where ρ is the intra-temporal elasticity of substitution and α is the leisure distribution parameter. The leisure distribution parameter, α , gives household's strength of the preferences for leisure relative to consumption. The greater α is the less labour households supply.

Denoting $A_{a,t}$ to be the stock of ordinary private assets at the end of age a and at time t , the within period budget constraint (or assets accumulation equation) is given by

$$\begin{aligned} A_{a,t} = & (1+r)A_{a-1,t-1} + w_t e_{a,t}(h - l_{a,t}) + AP_{a,t} + NSB_{60,t} + SP_{a,t} + B_t \\ & - T(y_{a,t}) - (1 - \tau_t^c) c_{a,t}, \end{aligned} \quad (3.5)$$

with $A_{90,t} = 0$ and where r is the exogenous world interest rate and h denotes the annual time endowment. The constraint (3.5) indicates that households earn investment income, $rA_{a-1,t-1}$, and labour earnings, $w_t e_{a,t}(h - l_{a,t})$, where $w_t e_{a,t}$ represents the hourly wage and $h - l_{a,t}$ is the labour supply. The term w_t is the wage rate of household with no work experience and $e_{a,t}$ is the efficiency variable that allows for different wages per hour over working lives. In addition to investment and labour incomes, households of qualifying age and satisfying the means test receives the age pension payments, $AP_{a,t}$, and at age 60 the households collect their net superannuation benefits denoted by $NSB_{60,t}$. The term $SP_{a,t}$ stands for the superannuation pension that amounts to post-superannuation-payout mandatory contributions made by employer and is received only by households aged 61 years and over provided that they are still working.

Households also pay the consumption tax at the rate of τ_t^c and the progressive income tax, $T(y_{a,t})$, from their taxable income, $y_{a,t}$. Taxable income, $y_{a,t} = w_t e_{a,t}(h - l_{a,t}) + rA_{a-1,t-1} + AP_{a,t}$, comprises labour earnings, investment income and the age pension. Although the model features no bequest motive (i.e. intended bequests), due to uncertain lifespan there are accidental bequests, B_t , which are assumed to be equally redistributed to all surviving households in each time period t .

The time constraint is

$$l_{a,t} \leq h. \quad (3.6)$$

This constraint implies that households, in addition to their consumption and leisure choices,

decide upon the allocation of time between work and leisure. The agent fully retires from workforce if leisure equals the total time endowment, i.e. $l_{a,t} = h$.

3.4 The pension sector

In the following description of the age pension and superannuation accumulation the subscript t for time period is omitted.

3.4.1 Age pension

The age pension is received by the households aged 65 years and over who satisfy the means test. The means test consists of income and asset tests. Under the income test, the legislated maximum age pension, p , is paid to the eligible households provided that their assessable income, $\hat{y}_a$, is not greater than the given income threshold, IT . If the assessable income exceeds the income threshold, the maximum age pension is reduced at the income taper rate, θ , for every additional dollar of assessable income earned, $\hat{y}_a - IT$. The age pension paid under the income test, APi_a , can be expressed as

$$APi_a = \begin{cases} \max \{ \min \{ p, p - \theta (\hat{y}_a - IT) \}, 0 \}, & \text{for } a \geq 65 \\ 0 & \text{for } a < 65 \end{cases}, \quad (3.7)$$

where the private assessable income, $\hat{y}_a$, comprises labour earnings and investment income, that is, $\hat{y}_a = we_a(h - l_a) + rA_{a-1}$.

Similar to the income test, households aged 65 years and over are paid the maximum age pension, p , under the asset test only if the stock of their private assets, A_a , 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, $A_a - AT$. The age pension paid under the asset test, APa_a , is computed as

$$APa_a = \begin{cases} \max \{ \min \{ p, p - \phi (A_a - AT) \}, 0 \}, & \text{for } a \geq 65 \\ 0 & \text{for } a < 65 \end{cases}, \quad (3.8)$$

Finally, only the binding test applies. The age pension actually paid to the eligible households is equal to the age pension payment under the test that results in the lower rate. The final payout of the age pension, AP_a , can be expressed as

$$AP_a = \begin{cases} \min \{ APi_a, APa_a \} & \text{for } a \geq 65 \\ 0 & \text{for } a < 65 \end{cases}. \quad (3.9)$$

As the age pension depends upon private income and assets, households have less incentive to work and save. Prior to age 65, households consider that supplying an additional hour of work and earning an additional dollar may reduce future age pension entitlements because of greater private assets (i.e. effective assets test) or higher investment income (i.e. effective income test). Similarly, for households aged 65 years and over higher labour supply and/or saving may reduce current age pension entitlements due to increased labour and investment

incomes or larger private assets. Lower lifetime labour supply and private saving may also arise from the publicly provided age pension acting as a substitute of private income.

3.4.2 Superannuation guarantee

The mandatory SG contributions are paid by the representative producer on behalf of households between ages 21 and 60 at the after-tax contribution rate, $(1 - \tau^{sc}) cr$, from their gross labour earnings, $we_a(h - l_a)$.⁵ The contributions are made into the superannuation fund and added to the stock of superannuation assets, SA_a , which is invested and earns fund's 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 households of that age, regardless of whether they work, receive the superannuation savings in the form of a lump-sum and the superannuation accumulation ceases to exist.⁶ The superannuation assets accumulation, as describe above, can be expressed as a sequence of period-by-period accumulations

$$SA_a = \begin{cases} [1 + (1 - \tau^r) r] SA_{a-1} + [(1 - \tau^{sc}) cr] we_a(h - l_a), & \text{for } a \leq 60 \\ 0 & \text{for } a > 60 \end{cases}, \quad (3.10)$$

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

The superannuation assets, SA_a , are paid only to households aged 60 years as an after-tax lump-sum . The superannuation fund deducts the tax imposed on the amount of the payout that exceeds the legislated tax free threshold. The net superannuation lump-sum payment, NSB_{60} , is computed as

$$NSB_{60} = \min \{ TFT + [(1 - \tau^{sb}) (SA_{60} - TFT)], SA_{60} \}, \quad (3.11)$$

where TFT denotes tax-free threshold, τ^{sb} represents the benefit tax rate. The expression (3.11) indicates that households aged 60 pay no tax from their superannuation savings provided that their superannuation assets do not exceed the tax free threshold. If the superannuation savings are greater than the tax free threshold, the excess, $SA_{60} - TFT$, is taxed at the rate of and the net superannuation payout becomes $NSB_{60} = TFT + (1 - \tau^{sb}) (SA_{60} - TFT)$.⁷

⁵In addition, the model assumes post-superannuation-payout mandatory contributions paid by firms as a superannuation pension directly into the ordinary private accounts of working household aged 61 years and over (discussed later in this sub-section).

⁶Currently, 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).

⁷The model assumes that superannuation taxes are applied to contributions, fund's investment earnings and benefits, with the tax on benefits reflecting the 2007 pre-July superannuation system.

To ensure that the effective wage rate, $w(1 + cr)$, that includes the mandatory SG contribution rate, paid by the producer is the same across all working households at time t , the model assumes that if households after receiving superannuation lump-sum payments (i.e. those aged 60 years and over) work, they are paid the mandatory SG contributions directly into the ordinary private asset account. These mandatory contributions take the form of the superannuation pension labelled as SP_a in the private budget constraint (3.5). The superannuation pension is expressed as

$$SP_a = \begin{cases} [(1 - \tau^{sb}) cr] we_a(h - l_a) & \text{for } a \geq 61 \text{ and } l_a \neq h \\ 0 & \text{for } a \leq 60. \end{cases} \quad (3.12)$$

The justification of this model assumption dealing 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 this model could be regarded as these so-called ‘transitions to retirement’ superannuation pensions. This superannuation pension represents labour supply incentives for older households and it allows for direct interaction of superannuation with the age pension provided as long as households provide some labour supply.

3.5 The production sector

The production sector is represented by the aggregate producer, which produces a single output, Y_t , using the capital stock, K_t , and the labour input, L_t . The production technology is assumed to be described by the CES production function with the constant return to scale property. It takes the form

$$F(K_t, L_t) = \kappa \left[\varepsilon K_t^{(1-1/\sigma)} + (1 - \varepsilon) L_t^{(1-1/\sigma)} \right]^{1/(1-1/\sigma)}, \quad (3.13)$$

where κ is a productivity constant, ε represents the capital share and σ is the elasticity of substitution in production.

Following Hayashi (1982), capital formation is subject to adjustment costs. This implies that the net output is the difference between the gross output given by (3.13) and adjustment costs that are assumed to be quadratic in investment, that is,

$$Y_t = F(K_t, L_t) - 0.5\psi \left(\frac{I_t}{K_t} - (n + \delta) \right)^2 K_t, \quad (3.14)$$

where I_t represents investment, ψ is the adjustment cost coefficient, n is the population growth rate and δ denotes the capital depreciation rate. The adjustment cost function taken from Fehr (2000) indicates that adjustment costs occur only during the transition path to the other as the steady state investment rate equals to the sum of depreciation and population growth rates in the steady state equilibrium.

The aggregate producer maximises the present value of all future profit payments discounted at the world interest rate subject to the capital accumulation equation, $I_t =$

$K_{t+1} - (1 - \delta) K_t$. The first order necessary conditions for the producer's profit maximisation problem are:

$$(1 + cr) w_t = F_{L_t} \quad (3.15a)$$

$$q_{t+1} = 1 + \psi \left(\frac{I_t}{K_t} - (n + \delta) \right) \quad (3.15b)$$

$$rq_t = F_{K_t} + 0.5\psi \left[\left(\frac{I_t}{K_t} \right)^2 - (n + \delta)^2 \right] + (1 - \delta)q_{t+1} - q_t. \quad (3.15c)$$

According to (3.15a), the producer demands labour until the real wage rate inclusive of the SG contribution rate, $(1 + cr) w_t$, equals the marginal product of labour, F_{L_t} . Condition (3.15b) implies that 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 is also Tobin's q – capital price (Tobin, 1969). Equation (3.15c) represents the arbitrage condition that requires identical returns to financial and real investments. The left side of (3.15c) gives the return to financial investment of amount, q_t . The right side comprises the net return to capital and capital gains, $(1 - \delta)q_{t+1} - q_t$. The net return to capital includes the marginal product of capital, F_{K_t} , and reduction in marginal adjustment costs. The model abstracts from any taxation at the corporate level.

3.6 The government sector

The government sector is represented by an inter-temporal public budget constraint. The expenditure side of the public budget constraint consists of government consumption, G_t , age pension expenditures and interest payments on net government debt, rD_t . The government collects revenues from income, consumption and superannuation taxation denoted as TR_t and it can also issue debt, D_{t+1} , in order to pay for its outlays. The public budget constraint can be written as

$$D_{t+1} = (1 + r) D_t + G_t + \sum_a AP_{a,t} \mu_a - TR_t, \quad (3.16)$$

where $\sum_a AP_{a,t} \mu_a$ is the cohort weighted average of age pension expenditures. The issuance of new debt, $D_{t+1} - D_t$, represents the path of government deficits.

The model assumes that the government maintains exogenously fixed ratios of government consumption to output and debt to output. To balance the public budget (3.16) with these fixed ratios, the consumption tax rate, τ_t^c , is adjusted accordingly. This implies that, even though government consumption is unproductive and generates no utility to households in this model, any reduction in the public outlays (e.g. lower age pension expenditures) and any increase in government revenues (e.g. higher income tax revenue) are passed onto households in the form of a lower consumption tax rate. The total tax revenue collected from households consists of the revenues from personal income taxation, consumption taxation and superannuation taxation, i.e., $TR_t = TR_t^Y + TR_t^C + TR_t^S$.

3.6.1 Personal income taxation

The model incorporates progressive personal income taxation. Broadly, this means that high incomes are taxed at higher average income tax rates than low incomes. This is accomplished by applying different marginal tax rates to ranges of different income (tax) brackets. The Australian income tax system has five tax brackets and five marginal tax rates. The model implements the approximation function of the Australian personal income tax taken from Woodland (2005), to avoid the discontinuity of the actual tax function and thus to simplify the model computation. The approximation income tax, $T(y)$, that appears in the private budget constraint (3.5) as a function of the taxable income takes the form⁸

$$T(y) = t_5(y) - t_5(yt_1) \exp \left(\sum_{i=1}^{M-1} -(0.1)^i v_i y^{i-1} \right), \quad i = 1, \dots, M-1, \quad (3.17)$$

where

$$t_5(y) = m_5(y - yt_5) + tax_5,$$

where $v_i = (v_1, v_2, v_3, v_4)$ is a parameter vector, M denotes the number of tax brackets, yt_1 and yt_5 represent lowest and highest tax thresholds, m_5 is the top marginal tax rate and tax_5 is the tax payable at the top tax threshold.

The revenue from personal income taxation, TR_t^Y , is the average of income tax payments across households weighed by their cohort shares, μ_a , and it is calculated as

$$TR_t^Y = \sum_a T(y_{a,t}) \mu_a. \quad (3.18)$$

3.6.2 Superannuation taxation

Superannuation taxes in the benchmark steady state are imposed on contributions, fund investment earnings and benefits. In addition, the superannuation assets of those households who die – the so-called death superannuation benefits – are taxed at a rate of τ^{db} .⁹ The total revenue from superannuation taxation, TR_t^S , is then

$$TR_t^S = TR_t^{SC} + TR_t^{SFE} + TR_t^{SB} + TR_t^{SDB}, \quad (3.19)$$

where the contribution tax receipt is $TR_t^{SC} = \tau^{sc} \sum_a^{60} cr \times w_t e_{a,t} (h - l_{a,t}) \mu_a$ and the revenue from fund's earnings taxation is $TR_t^{SFE} = \tau^r \sum_a^{60} r \times SA_{a-1,t-1} \mu_a$. The revenue from benefit taxation, which comprises taxes on lump-sum payments and post-superannuation-payout contributions (i.e. superannuation pension), is $TR_t^{SB} = \tau^{sb} (SA_{60,t} - TFT) \mu_a + \tau^{sb} \sum_{a=61}^{90} cr \times w_t e_{a,t} (h - l_{a,t}) \mu_a$. The tax receipts from death superannuation benefits are

⁸Note that the subscripts for age, a , and time period, t , are omitted in the income tax function (3.17).

⁹According to the current superannuation legislation, taxation of death superannuation benefits depends on whether the death benefits are received by dependants or non-dependants. The death benefits to dependants are tax-free while death benefits to non-dependants are taxed at a concessional tax rate. The model treatment of death superannuation benefits to non-dependants is based on the fact that the death benefits in the model are equally redistributed to all surviving households.

given by $TR_t^{SDB} = \tau^{db} \sum_a^{59} (1 - s_a) SA_{a,t} \mu_a$, where $(1 - s_a)$ is the proportion of the deceased households at age a .

3.6.3 Consumption taxation

As opposed to progressive personal income taxation, the consumption tax is linear and aims to represent the Australian Goods and Services Tax [GST]. The consumption tax rate that adjusts endogenously to balance the public budget constraint (3.16) is computed as

$$\tau_t^c = \frac{G_t + \sum_{a=65}^{90} AP_{a,t} \mu_a + (r - n)D_t - (TR_t^Y + TR_t^S)}{\sum_a c_{a,t} \mu_a}. \quad (3.20)$$

3.7 The foreign sector

The model is a small open economy model with perfect capital mobility, implying that the domestic interest rate, r , is pegged to the exogenously given world interest rate. Denoting the foreign asset holding as FA_t at the beginning of time period t , the international budget constraint can be expressed as

$$FA_{t+1} - FA_t = TB_t + rFA_t, \quad (3.21)$$

where the left side of (3.21) represents capital flows and the right side is the current account comprising the trade balance, TB_t , and the interest receipts (payments) on foreign assets holdings (debt), rFA_t .

3.8 Competitive equilibrium

A competitive equilibrium in this stationary demographic environment consists of consumption tax rate, τ_t^c , balancing the government budget constraint, accidental bequests, B_t , optimal household allocations $\{c_{a,t}, l_{a,t}, A_{a,t}, y_{a,t}, AP_{a,t}, SA_{a,t}, NSB_{60,t}\}_{a=21}^{90}$, factor demands K_t and L_t , wage rate w_t and capital price q_t and clearing conditions for capital, labour and goods markets such that:

- Given the wage rate and interest rate, households solve their optimisation problem; i.e. maximisation of expected lifetime utility expressed in (3.3) subject to the budget constraint (3.5) and time constraint (3.6).
- The producer maximises the present value of the future profit streams discounted at the exogenously given world interest rate, r , subject to the capital accumulation equation. This yields the first order necessary conditions given by (3.15a), (3.15b) and (3.15c).
- The government budget constraint (3.16) is satisfied with the consumption tax rate, τ_t^c , computed as in (3.20) and with the fixed ratios of G_t/Y_t and D_t/Y_t .

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

$$B_t = \sum_a (1 - s_a) [A_{a,t} + (1 - \tau^{db}) SA_{a,t}] \mu_a. \quad (3.22)$$

- The labour market clears in every time period t ; that is, the demand for labour by the representative producer (i.e. labour input in production) equals the cohort weighted average of effective labour supply across households:

$$L_t = \sum_a e_{a,t}(h - l_{a,t})\mu_a. \quad (3.23)$$

- The capital market clears in every time period t , which implies that the market value of the capital stock plus public debt equals the sum of domestic total assets and foreign assets, that is

$$q_t K_t + D_t = \sum_a (A_{a,t} + SA_{a,t}) \mu_a + FA_t. \quad (3.24)$$

- The goods market clears – the following resource constraint for the model small open economy is satisfied in every time period t (i.e. output equal to the sum of consumption, investment, government spending and trade balance):

$$Y_t = \sum_a c_{a,t} \mu_a + I_t + G_t + TB_t. \quad (3.25)$$

As the model features no growth rate of technological progress, the subscript t above can be omitted as in the competitive, steady state equilibrium, all the macro variables that are expressed as cohort weighted averages (i.e. per model capita) are constant in every time period.

4 Parameterisation and benchmark SS simulations

To solve the model, numerical values have to be assigned to the model parameters. The values for these parameters are chosen to generate the benchmark steady state [SS] equilibrium of the model that aims to correspond with the actual macroeconomic data for the Australian economy in the financial year of 2004-05.

4.1 Parameterisation and scaling

The model is scaled such that the values of all the monetary variables are expressed in units of \$100,000. The scaling makes the model computation easier as the differences in the values amongst model variables are reduced.

Insert Table 1 here

The targets to which some model parameters (mainly production function parameters) are calibrated are reported in Table 1. The targeted capital-output, investment-output and government consumption-output ratios are based on the Australian National Accounts [ANA] data in June 2005 (ABS, 2006). 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). The ratio of $D/Y = 0$ assumed in the model that implies the balance government budget can be justified by future fiscal projections that suggest the complete elimination of the net government debt and budget surpluses of around one percent of GDP.

Net foreign assets are set to zero in the benchmark SS equilibrium. The zero foreign assets imply a zero current account and a balanced trade account. This deviates from reality as foreigners owned about 25 percent of Australia's capital stock in June 2005 (ABS, 2006). The reason behind this assumption is that in the economy on a dynamic efficient growth path (i.e. $r > n$) assumed in our model, foreign debt implies a positive trade balance, i.e., $TB = (n - r)FA$, while the Australian trade balance is negative.

The wage rate of $w = 0.8736$ represents the wage expressed in units of \$100,000 that households aged 20 years with no work experience would receive if they allocate all their time endowment to work. The actual time endowment is assumed to be 5,460 hours per year (i.e. 15 non-sleeping hours per day). We normalised this time endowment labelled as h to unity, i.e., $h = 1$. The implied wage rate for a 20 year old is \$16 per hour, which is based on Gruen and Garbutt's (2003) age patterns of average hourly wages for Australian males. The target wage rate is then obtained as $w = \$16 * 5460 \text{ hours} / \$100,000$. The value for the target interest rate of $r = 0.05$ is based on empirical observations of the historical real rate of return on bonds and the historical real rate of return on equities in Australia.

Insert Table 2 here

Table 2 presents the chosen values of the main parameters of the model. Some parameters are taken from related literature (e.g. utility function parameters), some exactly match actual values in 2004-05 (e.g. pension sector parameters) and some are calibrated to the calibrations targets (e.g. production function parameters). The population growth rate of $n = 0.012$ is approximately the annual growth rate of the Australian population in the five year period ending in June 2005. Conditional survival probabilities, s_a , are taken from ABS (2005) life tables for males and the number of people born in the first time period, N_t , is set to one.

The values of the utility function parameters are within the estimated ranges obtained from relevant empirical studies. The parameter value of $\beta = 0.01$ is set to reproduce the target capital-output ratio. Most of the production function parameters are calibrated to replicate the target variables in the benchmark SS equilibrium. The technology parameter, κ , is a scaling parameter and is chosen to reproduce the target wage rate. The elasticity of substitution in production, σ , is calibrated to the exogenous interest rate. The depreciation rate of the capital stock, δ , is set to target the investment-output ratio. The capital share, ε , is derived as follows. Using data from ANA in June 2005, the labour share of output was 0.55, capital share 0.33 and indirect taxes less subsidies 0.12. Assuming the last component of the income method of calculating GDP is zero, the capital share equals 0.375. The adjustment cost parameter of $\psi = 10$ is taken from Auerbach and Kotlikoff (1987).

The efficiency variable, e_a , is based on the estimates of the wage function for Australian male workers taken from Reilly et al. (2005) and is equal to

$$e_a = \exp \left(2.235 + 0.04 (a - S - 5) - 0.00067 (a - S - 5)^2 \right), \quad (4.1)$$

where S represents years of schooling, which is equal to 12 years. To account for the fact that the wage function was estimated for year 1999, the function (4.1) is normalised in the model such that the adjustment factor equals one for the households with no work experience. As Reilly et al. (2005) estimates are related only to male workers aged 15-65, the model assumes that the efficiency profile for the households from age 65 onwards declines at a constant rate and reaches zero at age 90.

The income tax function (3.17) taken from Woodland (2005) is approximated to the 2004-05 Australian personal income tax schedule. The values of the parameter vector are $v_i = (0.3174, 0.0877, -0.0784, 0.0167)$, the top marginal tax rate, $m_5 = 0.47$, the lowest income threshold, $yt_1 = 0$, the highest income tax threshold, $yt_5 = 70$, and the tax payable at the highest income threshold was $tax_5 = 18.612$.¹⁰

4.2 The computational method

Solving for the SS equilibrium of this open economy model is relatively simple. The iterative computational technique – the Gauss-Seidel method – used to solve many OLG models in this open economy framework 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 initial guesses for B and combined with w and r , the household optimisation problem can be solved.

The household optimisation problem – maximisation of the lifetime utility function (3.3) subject to budget constraint (3.5) and leisure constraint (3.6) – 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 (3.22) and (3.20), 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 (3.23). 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 (3.24) and the trade balance is derived from (3.25).

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 alive at the time the policy change is adopted must be treated differently from the SS simulation. At the time of the policy change, existing generations solve their optimisation problems again but over shorter lifetimes given their ordinary private and superannuation assets accumulated prior to the policy change. The initial assets for these generations are obtained from the

¹⁰The parameter vector, v_i , is estimated by nonlinear least squares. Following the description in Woodland (2005), a grid of equally spaced incomes in the range $[0, 100.5]$ and the corresponding income taxes in 2004-05 were generated. There are 202 observations for both variables income and income tax, both expressed in units of \$1,000. The income tax, $T(y)$, is rescaled in the model to be expressed in units of \$100,000.

benchmark SS simulation. The model economy is given 200 years to reach a new steady state.

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 (3.14), capital accumulation equation and the three first order necessary conditions defined in (3.15a-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 a single household’s optimisation problem, in this transition path program with the economy spanning over 150 years and 70 years of the household’s maximum life horizon there are 220 generations whose optimisation problems have to be solved. This includes 69 generations 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 220 generations 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, which requires about six iterations for a reasonable policy change.

4.3 Steady state analysis

The benchmark SS solutions for the main variables are presented at the disaggregate household level as well as at the macroeconomic level.

4.3.1 Disaggregate household results

In a SS equilibrium, households of different ages behave exactly same as the single household over the entire life-cycle of 70 years. As mentioned, households at every age choose how much to consume and how much time to devote to leisure and work. Resulting labour supply and the wage determine labour earnings, which together with investment income and the age pension represent total taxable income. The excess of after-tax income over consumption is saved and added to the stock of ordinary private assets. Households also accumulate superannuation assets that must be kept in the superannuation fund until age 60. At this age, superannuation benefits are paid out and the superannuation accumulation ceases to exist.

Insert Figure 2 here

Figure 2a shows a hump-shaped life-cycle consumption profile generated by the SS simulation. The increasing part of the consumption profile is due to (i) the interest rate greater

than the effective rate of discount and (ii) substitutability between consumption and leisure. At younger ages, high survival probabilities result in a low effective discount rate, which is below the exogenous interest rate. This implies an increasing instantaneous utility derived from consumption and leisure. Either consumption or leisure or both must increase for the utility to grow. However, declining survival probabilities mean that households discount future utility more heavily at older ages. Eventually, the effective discount rate exceeds the interest rate, leading to a falling instantaneous utility. In addition, the substitutability between consumption and leisure implies that households work and consume more (less) when leisure is relatively expensive (cheap). Given the hump-shaped efficiency profile, the labour supply and consumption profiles are also hump-shaped while the leisure profile is U-shaped.

As depicted by Figure 2b, the household at age 21 allocates about 29 percent of the time endowment to work (i.e. about 1,584 hours worked per year or 30 hours worked per week) and the remaining time is devoted to leisure.¹¹ Labour supply (leisure) increases (decreases) until age 37, at which the fraction of time spent working is about 0.34 (i.e. 36 hours worked per week). Then, labour supply starts decreasing mainly due to the falling efficiency at older ages. Full retirement occurs at age 65 when the household supplies no labour and the whole time endowment is allocated to leisure. As leisure remains constant in retirement, consumption must decline for the annual utility to fall, explaining declining consumption at older ages.

The kink in the consumption, leisure and labour supply profiles at age 65 arises from the commencement of means-tested age pension entitlements. The age pension means test combined with progressive income taxation may lead to high effective taxation of additional private income earned. The prospect of high effective marginal tax rates makes consumption and labour supply relatively expensive compared to leisure. Consequently, household reduce consumption and labour supply while leisure goes up to raise instantaneous utility.

Lifetime total income and its components (i.e. labour earnings, investment income and the age pension) are displayed in Figure 2c. The profile of gross labour earnings determined by labour supply and the hourly wage is hump-shaped similar to the labour supply profile. Investment income is derived from ordinary private assets holdings, and so the shape of lifetime investment income follows the shape of the ordinary private assets profile. The household aged 65 years and over receives some age pension, which is lower at the early age pension ages due to the effective income test. The age pension increases with age as private income assessed under the age pension means test declines, and it becomes the major source of total income towards the end of life-cycle.

Figure 2d shows the life-cycle profiles of ordinary private, superannuation and total (private plus superannuation) assets. The stock of ordinary private assets (i.e. the accumulated excess of after-tax income over consumption) is initially negative, implying that at early ages, households borrow against future superannuation payout to fund the consumption excess. In contrast, the stock of superannuation assets grows exponentially over its accumulation period of 40 years. At age 60, the superannuation fund pays out the superannuation benefits

¹¹The actual hours worked per year are obtained by multiplying the displayed fraction of time spent working should with 5,460 non-sleeping hours of the actual annual time endowment.

as a net lump sum into household's private assets account and after that age, households draw down their ordinary private assets holdings to finance retirement consumption.

4.3.2 Real life-cycle data comparison

At the disaggregate level, to check whether the model and the chosen parameter are appropriate in the Australian context, the age-profiles of labour supply and assets generated by the benchmark SS simulation are compared with real life-cycle data.¹²

Insert Figure 3 here

Figure 3a shows that the model and real average labour supply profiles are very similar with both being hump-shaped and reaching maximum for the same age group. A small difference arises for older age groups as households in the model fully retire from workforce at age 65 while the real labour supply is still slightly positive for group aged over 70. Both total assets profiles in Figure 3b have also similar shapes with the peak for the age group of 55-64 years. The difference occurs again for older cohorts. The model total assets for age groups aged over 64 years falls rapidly while the real average household net worth declines only slightly, suggesting bequest motives in the real world household behaviour. The assumed 'pure' life-cycle model with no bequest motives is based on Kelly and Harding's (2003) estimates of small amounts bequeathed in Australia, namely \$18,000 in 2002.

4.3.3 Macroeconomic results

The main macroeconomic solutions to the benchmark SS and the comparison with the actual values in the financial year of 2004-05 are presented in Table 3. It is shown that the model with the chosen parameter replicates the Australian economy fairly well. The components of domestic aggregate demand are almost identical to their actual values expressed in percent of GDP. The zero trade balance (i.e. external demand) in the model is implied by the assumed zero foreign assets in the calibration of the benchmark SS. The government indicators presented in percent of GDP are slightly greater than the actual data apart from the assumed zero government surplus in the model. The significant difference between the model and actual revenues from superannuation taxation can be, again, explained by the full maturity of the superannuation system in the OLG model. The consumption tax rate, τ^c , generated by the model – balancing the public budget with the government consumption fixed at 18 percent of GDP – is almost identical to the Australian Goods and Services tax of 10 percent. The capital-output ratio (K/Y) and investment rate (I/K) are also very close to the actual values of these ratios in Australia.

Insert Table 3 here

¹²Given the availability of the actual life-cycle profiles only over age groups, the model life-cycle labour supply and total assets displayed below are shown as averages within each age group.

4.3.4 Sensitivity analysis

It is important to point out that none of the taste and production parameters presented in Table 2 was econometrically estimated using Australian data. As mentioned, some of the parameters are taken from relevant literature and some are calibrated to the calibrations targets. For this reason, this subsection explores implications of alternative parameterisations of the model for the steady state equilibrium. The values of the main parameters are changed individually and the simulation results for the major model variables and ratios in the steady state are displayed in Table 4.

Insert Table 4 here

In sum, the sensitivity analysis indicates that the open economy OLG model solution is driven mainly by changes in effective labour supply across households. The resulting labour input determines long-run changes in the capital stock and output. Provided that a policy shift or a shock does not alter the wage rate, the capital stock in the long-run steady state equilibrium must exactly follow the resulting change in the labour input to hold the capital-labour ratio constant.

Table 4 shows that the variations in all parameters deliver different values of the foreign assets and the trade balance. A positive value of the foreign assets implies a negative trade balance in the steady state equilibrium with the world interest rate greater than the population growth rate, i.e., $TB = (n-r)FA$, where $n \times FA$ represents the current account in the steady state.¹³ A higher value of the inter-temporal elasticity of substitution, γ , means a greater substitutability of the current utility for any future utility, leading to a larger accumulation of domestic total assets. The overall impact on labour supply is negative as a decline in older households' labour supply more than offsets longer working hours supplied by young cohorts. Some of the capital stock is exported abroad, the foreign assets holding increases ($FA/K > 0$) and the trade balance deteriorates ($TB/Y < 0$). The consumption tax rate, τ^c , falls because of higher revenues from personal income and superannuation taxation. On the other hand, a higher value for the subjective time preference parameter, β , lowers the domestic total assets as households become more time impatient, wanting to have more consumption and leisure at early ages rather than later on. Higher labour input implies larger capital stock, part of which is now owned by foreigners ($FA/K < 0$). The consumption tax rate goes up to balance the government budget with lower income tax revenues.¹⁴

Higher elasticity of substitution in production, σ , leads to capital deepening (greater K/L) and a higher wage rate. Domestic total assets are also up but by less than the increase in the capital stock (see high K/Y), which results in capital imports, foreign debt and positive trade balance. The consumption tax rate increases due to higher government consumption even though the revenues from personal income and superannuation taxation have gone up. Similar implications are caused by a higher value for the capital share, ε . The capital depreciation rate, δ , calibrated to reproduce the ratio of $I/Y = 0.25$ in the

¹³In the steady state, the international budget constraint (3.21) becomes $nFA = TB + rFA$ because of the steady state requirement for foreign assets, $\Delta FA = 0$.

¹⁴Note also that the utility function parameters have no impact on the wage rate as its value is implied by the exogenous interest rate and production function parameters.

benchmark steady state is quite high. Using $\delta = 0.052$ that corresponds to the depreciation rate of the Australia's aggregate capital stock has a similar effect on the displayed variables as the changes in σ and ε . However, here the consumption tax rate falls because the increase in income and superannuation tax revenues and as the decline in age pension expenditures outweigh the increase in government consumption.

A higher value for the world interest rate, r , increases domestic total assets and leads to foreign exports and negative trade balance. K/Y falls as the capital stock declines more than output. Any increase in the population growth rate, n , implies a higher steady state investment rate, which is $I/K = n + \delta$. Labour, capital stock, output and foreign debt are also higher while the consumption tax rate falls slightly as a result of higher n .

5 Dynamic simulations of pension policy changes

In this section we present the simulation findings of the following policy changes to the existing means test of the Australian age pension: (i) the complete abolition of the means test and (ii) the removal of the age pension from the income test. The simulated age pension policy changes are hypothetical but both have been debated amongst policy makers, academics and industry experts. The intergenerational, welfare and macroeconomic implications of these parametric pension policy changes on impact, during the transition and in the long-run are discussed below.

5.1 The means test abolition

This policy simulation aims to demonstrate the implications of eliminating both the income and assets tests of the age pension. In this policy scenario, households aged 65 years and over receive the universal age pension (i.e. the maximum age pension, p) regardless of their private incomes and assets.

5.1.1 Intergenerational implications

Intergenerational implications refer to policy effects on households of different ages (i.e. different cohorts of households) over their remaining life-cycle. For ease of exposition, the intergenerational implications of the means test abolition are plotted only for three cohorts – aged 21 years (representing young people), 65 and 70 years (representing older people) at the time of the reform.

Insert Figure 4 here

The simulation results support the argument that the existing means-tested age pension provides a disincentive for the elderly to supply labour. It is clearly shown that the labour supply incentives of the means test removal outweigh the income effect of higher age pension payments as the cohorts of households aged 21 and 65 provide some work at age pension ages and significantly postpone their retirement (Figure 4a). In particular, the young cohort still works about 820 hours per year at age 65 (i.e. 15 percent of time endowment) and

postpones full retirement by about seven years relative to the benchmark SS simulation with the means tested age pension. The positive labour supply effect of the means test removal on the already retired cohort aged 70 years indicates that some age pensioners (e.g. those affected by the existing means test) may return to workforce as they would no longer face high effective marginal tax rates.

The universal age pension policy has positive implications for retirement consumption with the cohorts aged 65 and 70 years increasing their consumption spending (Figure 4b). The means test removal makes leisure more expensive, which generates higher consumption and labour supply. The young cohort also consumes significantly more after the commencement of the universal age pension but before age 65, its net consumption falls relative to the benchmark SS simulation. This is because of the tax neutrality of this policy change with higher age pension expenditures financed by an increase in the consumption tax rate.

The policy impacts on consumption and labour supply vary across cohorts due to different accumulated assets. For instance, the cohort aged 65 consumes more and works less relative to the young cohort from age 65 onwards because it has accumulated larger assets prior to the policy change while the young household spreads the benefits of higher age pension payments (e.g. in terms of lower labour supply before age 65) over a longer period.

5.1.2 Welfare implications

The welfare implications are assessed on the basis of equivalent variations for generations born at date g . The equivalent variation for a particular generation is defined as the percentage increase in this generation's wealth needed in the benchmark scenario to produce the realised remaining lifetime utility in the reform scenario. Given the homogenous property of the utility function (see Auerbach and Kotlikoff, 1987, p.87), these increases in generations' wealth are identical to the proportional increases in consumption and leisure, which would make them in the benchmark scenario as well off as in the reformed scenario. The needed increase or decrease in percent of initial resources for generation g is computed as

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

where $\hat{U}_g$ is the value of the remaining lifetime utility after the policy change and $\bar{U}_g$ is the value of the remaining lifetime utility in the benchmark scenario.

Insert Figure 5 here

Figure 5 depicts that old cohorts already receiving the full age pension before the period of the means test abolition suffer from welfare losses as the increases in the consumption tax rate reduce their net consumption. On the other hand, younger cohorts and future born generations gain in remaining welfare because of significantly higher consumption at age pension ages, even though these generations work longer hours at older ages. The winner of this pension policy change in terms of remaining welfare is the cohort aged 65 years at time of the policy change, achieving an almost two percent rise in its remaining utility. The long-run gains in welfare (i.e. welfare gains of future born generations) are only about 0.2

percent of lifetime resources, mainly reflecting high discounting in retirement consumption by future generations.

5.1.3 Macroeconomic implications

The macroeconomic implications of the means test removal are presented in Table 5 as percentage changes from the benchmark steady state labelled as ‘Initial SS’. The following discussion involves the impacts of this policy change on the labour market, capital accumulations, output market and government indicators.

Insert Table 5 here

Labour market The means test abolition has a positive impact on employment, which on impact increases by 1.061 percent compared to the benchmark SS. This indicates that the increase in labour supply of some older generations outweighs the decrease in labour supply of the generation younger than 65 at the time of the policy change. In the subsequent years, aggregate labour supply starts declining and reaches its lowest value in 2011, which is still 2.8 percent greater than the benchmark aggregate labour supply. Initially, employment declines modestly relative to the immediate impact as a result of lower hours worked by the new generations, which replace the old generations with unchanged (zero) labour supply. In the subsequent periods, the labour input goes up gradually and converges to a new SS value, which is almost 1.7 percent higher than in the benchmark SS. The changes in aggregate labour supply determine the effect on the wage rate, which is negative during the transition. 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. Because of no change in the exogenous world interest rate and production parameters, the wage rate returns to its initial SS value in the long run.

Assets and capital accumulations As a result of the means test abolition, domestic assets (i.e. sum of private and superannuation assets) are initially up due to higher labour earnings and age pension payments received by older generations at the age pension ages. In the medium term, domestic assets fall below its benchmark SS value because of the decrease in total assets of generations younger than 65 years, which outweighs the increase in older generation’s total assets. In the long run, domestic assets decline only negligibly by 0.324 percent. On the other hand, the capital stock increases over the entire transition path as the capital price (i.e. marginal benefits of a purchase of addition capital) is positively affected by the means test removal. The increased capital stock is financed partly from abroad by capital imports, which leads to foreign debt accumulation.

Goods market The impact of the means test abolition on output (i.e. GDP) is positive and output increases over the entire transition path because of higher labour and capital. The largest component of domestic demand, consumption goes up as generations aged 65 years and over consume more. Long-term consumption is 1.311 percent higher than benchmark SS consumption. Investment demand expands as investors expect a positive net return

on capital and government consumption (not displayed) increases, exactly following the percentage changes in output. In the long run, the trade account improves because output exceeds domestic demand.

Government indicators The government budget expands with age pension expenditures up by 21.553 percent when the means test is abolished. In other words, age pension expenditures increase from the benchmark 3.82 percent to 4.645 percent of GDP. In the long-run, total government expenditures are up by 5.166 percent due to higher government consumption and larger age pension expenditures. On the income side of the government budget, the revenue from income taxation increases gradually due to a higher (universal) age pension that is a component of the taxable income. The impact on superannuation taxation is negligible while consumption tax receipts are up by 11.538 percent in the long run. The two sources of the higher consumption tax revenue are greater consumption spending and the consumption tax rate that has to rise to fund the increased age pension expenditures. In particular, the consumption tax rate increases by 11.011 percent on impact and by 10.094 percent in the long-run (i.e. from 9.9 percent in the benchmark SS to 10.9 percent in the new SS).

5.2 Labour earnings removal from the income test

The simulation of the second, hypothetical age pension policy change examines the intergenerational, welfare and macroeconomic impacts of the removal of labour earnings from the income test of the age pension. In this age policy change, labour earnings of households aged 65 years and over are no longer assessed under the means test but households are still means tested with respect to their investment income or accumulated assets.

5.2.1 Inter-generational implications

The intergenerational implications for labour supply and consumption (i.e. labour supply and consumption impacts on cohorts aged 21, 65 and 70 years at the time of the reform over their remaining lives) are plotted in Figure 6.

Insert Figure 6 here

Similarly to the means test removal, this policy change is expected to increase labour supply of age pensioners affected by the existing income test, as they would no longer be penalised by high effective marginal tax rates for working beyond the age pension age. This expectation is supported by the simulation results that indicate that all three cohorts supply some labour at the age pension ages as a result of the labour earnings removal from the income test of the age pension (Figure 6a). Moreover, cohorts work longer hours and retire later than in the policy simulation of the means test abolition. The young cohort postpones full retirement by 10 years and the cohort 65 years at the time of the reform by about 8 years relative to the benchmark SS scenario. The results not only confirm that the means test of the age pension discourages some age pensioners from part-time work but also suggest that this policy change provides a greater incentive for older people to supply part-time work than

if the means test was removed completely. A possible explanation is that under the labour earnings removal policy households are still means-tested with respect to their investment income, implying a lower age pension compared to the means test removal. Therefore, the means test removal with higher age pension payments has a relatively stronger income effect on labour supply.

Figure 6b shows positive impacts on consumption for all three cohorts at older ages as the labour earnings removal from the income test makes consumption a cheaper way relative to leisure to attain higher utility. In contrast to the means test removal, consumption of the young cohort prior to age 65 is hardly changed as the impact on the consumption tax rate is minimal. Although consumption is higher at some age pension ages, the consumption increases are of lower magnitude relative to the means test removal policy with higher age pension payments.

5.2.2 Welfare implications

The welfare implications graphically illustrated in Figure 7 reveal that older cohorts are positively affected by this hypothetical policy change while some younger cohorts and all future generations lose in welfare. The very old cohorts already receiving the full age pension spend more on consumption because of a lower consumption tax rate (discussed with respect of macroeconomic implications). The cohorts aged 65 years and over that re-enter the workforce as their labour earnings are no longer income tested and some cohorts younger than 65 years of age at the time of the reform benefit from the increase in consumption at age pension ages. However, welfare of the future born generations decline slightly as the fall in discounted leisure exceeds in absolute terms the increase in discounted consumption contributing to lifetime utility. Some future born generations also faces a higher consumption tax rate. As in the case of the means test abolition, the biggest increase in remaining utility is experienced by the generation aged 65 at the time of this policy change. The welfare of this generation is up only by about 0.3 percent compared to the 1.8 percent increase in the means test removal simulation. The removal of only labour earnings from the income test results in smaller consumption increases and higher labour supply due to lower age pension payments to age pensioners relative to the means test removal.

Insert Figure 7 here

5.2.3 Macroeconomic implications

The macroeconomics implications for the labour market, capital accumulations, output market and government indicators of the labour earnings removal from the income test are reported in Table 6.

Insert Table 6 here

Labour market The implications of this policy change for labour supply are positive, with labour increasing over the entire transition path. On impact, employment is up by 0.366 percent. Labour supply of generations at early age pension ages increases significantly as

their labour income no longer directly reduces their age pension payments. Labour-supply incentives of this policy change are even higher than in the means test removal scenario as households at older ages are still income tested against their investment income and, therefore, receive a lower age pension – supplement of private income. Higher working hours of older households outweigh the decline in labour supply of the households younger than 65 years, leading to greater overall employment. In the subsequent years, employment continues to grow and in the long run it reaches a new SS value which is 2.293 percent above the initial SS labour supply. Given the positive impact on overall labour supply, the wage rate (i.e. the price of labour) falls below the initial SS wage rate and the effect of this policy change on the wage rate is negative during the entire transition. As in the simulation of the means test abolition, the wage rate returns to its initial SS value in the long-run.

Assets and capital accumulations In contrast with the means test abolition policy, the impacts of this policy change on domestic assets are largely negative as both superannuation and ordinary private assets decline. The long-run stock of aggregate domestic assets falls by 6.86 percent, indicating lower household saving in the long term. The decline in superannuation assets is caused by the lower wage rate and labour supply of households aged 60 and younger (i.e. those households accumulating superannuation assets). Ordinary private assets fall as households earn less income and have higher consumption expenditures prior to age 65. On the other hand, the impacts on the capital stock are positive, with the long-term capital up by 2.293 percent. The negative difference between domestic assets and the value of capital implies negative foreign assets. The level of foreign assets declines over the entire transition, indicating capital imports from abroad.

Goods market As a result of the labour earnings removal from the income test, output increases by 0.236 percent on impact. As both labour and capital inputs keeps on rising, output grows over the entire transition and converges to the new SS value of 2.293 percent higher than the initial SS output. Private consumption initially jumps by 1.688 percent, caused by higher consumption of the generations of age pension ages. In the subsequent years of the transition, overall consumption declines relatively to the immediate impact because of a rising consumption tax rate and its negative impact on disaggregate household consumption. The long-run consumption is still about 0.568 percent greater than in the initial SS. The second largest component of domestic demand, investment goes up due to the positive impact of this policy change on the capital price. As domestic demand initially increases more than output, the trade balance deteriorates. This reverses after 20 years when output exceeds domestic demand due to declining private consumption, implying improvement in the trade balance.

Government indicators Probably the most significant difference between the two age pension policy changes simulated in this paper is the impact on overall costs of the age pension to the government. While the means test abolition policy increased the age pension costs by 21.553 percent, the labour earnings removal from the income test initially reduces the age pension expenditures because of higher assessable income (i.e. investment income

of households aged 65 years and over assessed under the income test). Because assessable investment income falls over the transition period, government spending on the age pension goes up and in the long run it is 1.388 percent higher than in the initial SS. The total government expenditures increase by 2.134 percent in the long-term, reflecting also higher government consumption. The impacts on tax receipts from income and superannuation taxation are minimal. The revenue from consumption taxation goes up initially due to higher private consumption and later on also because of a higher consumption tax rate. The consumption tax rate declines by 1.101 percent on impact but the long-run consumption tax rate is up by 5.622 percent. Put it differently, as a result of the labour earnings removal from the income test the consumption tax rate increases from 9.9 percent in the initial SS to 10.05 percent in the new SS.

6 Concluding remarks

This paper applies a computable OLG model to simulate policies that reflex the Australian pension rules. The model demonstrates that the existing means-tested age pension represents a strong disincentive for older Australians to work. The numerical simulations of the both pension policy changes (i.e. the means test abolition and the labour earnings removal from the income test) show that generations work longer hours at older ages and delayed their retirement as they no longer face the penalty of higher effective marginal tax rates for working beyond the age pension age.

The more effective of the two simulated age pension policy changes to increase labour supply of older Australians is the removal of labour earnings from the income test while the means test abolition delivers larger retirement consumption and welfare gains. This is because the means test abolition results in higher age pension payments relative to age pension payments received under the policy change of the labour earnings removal from the income test where eligible households are still means tested against their investment income or assets. However, the costs of the complete means test removal to the government are significantly greater than the age pension expenditures resulting from the removal of only labour earnings from the age pension income test. In reality, government expenditures on age pensioners would be higher than simulated by the model because many supplementary payments, services and concessions (e.g. pensioner concession card) are paid only to recipients of the age pension or a similar age-related payment.

The present OLG model assumes that each generation consists of a single household representing behaviour of an average Australian of that age. A realistic extension of the model would be to consider several types of households in every generation distinguished, for instance, by different productivity levels. Low productivity households with low lifetime income that would be eligible for the full age pension under the existing means test would suffer from consumption and welfare losses indirectly because of the changes in the consumption tax rate as a result of the means test removal. On the other hand, the impact of the means test abolition on high productivity households ineligible for any pension under the existing means test would be positive in terms of welfare and consumption because of

payments of the universal age pension but negative in terms of labour supply at age pension ages.

The second desirable extension of the model would be to implement non-stationary demographics with the increasing share of older households in the total population in future years. The present model assumes stationary demographics with the model population growing at a constant annual growth rate and with constant population age distribution. However, because of population ageing, the growth rate of population is expected to decline and the proportion of those aged 65 years and over is projected to increase significantly in the next 50 years. The macroeconomic implications of population ageing if implemented in the model for the two simulated age pension policies are likely to be positive in terms of higher labour supply, consumption and output. The negative effects of the labour earnings removal on domestic assets and saving would also get reduced due to a higher share of older households with larger assets relative to the simulation with the existing means test. On the other hand, population ageing would significantly increase the government expenditures on the age pension as a result of the means test abolition.

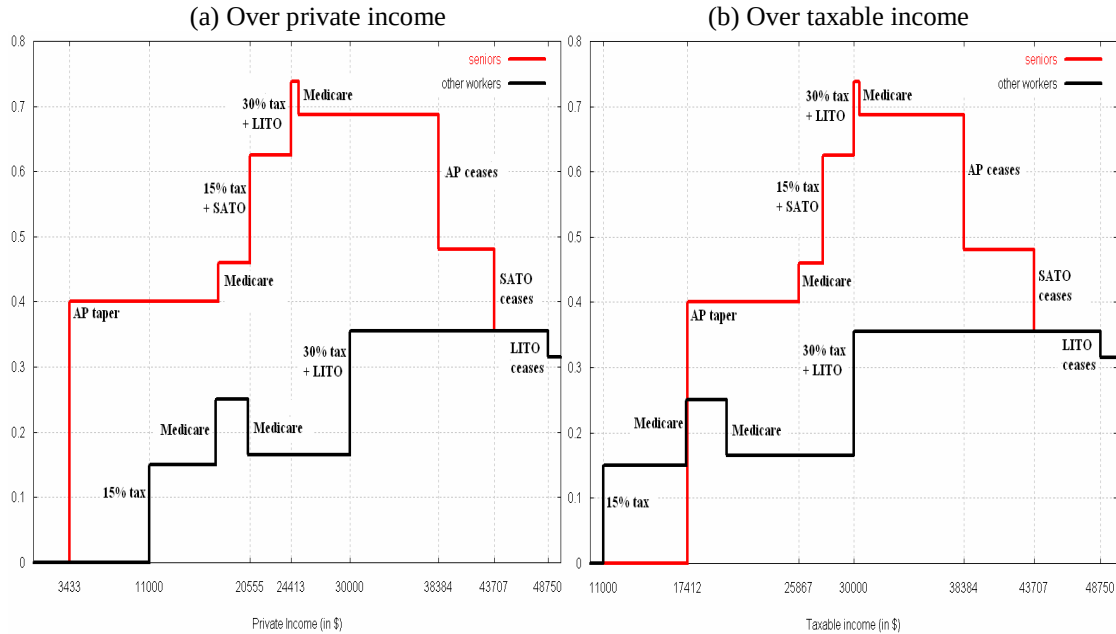
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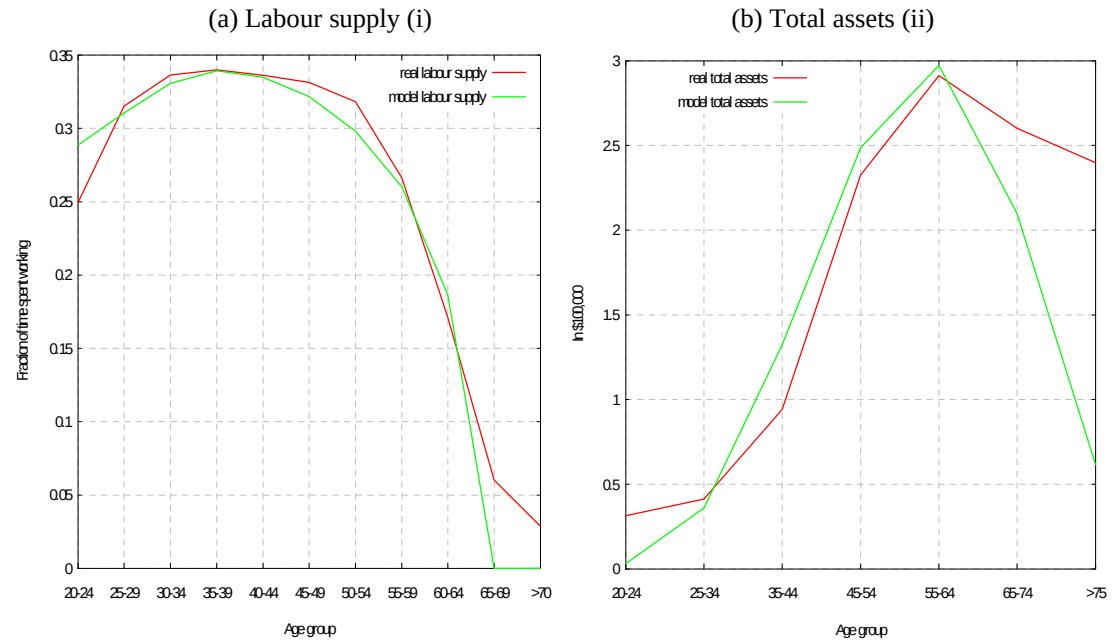
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Figure 1: Effective marginal tax rates for seniors and other workers in 2007-08



Notes: The calculation of the EMTR for seniors includes the age pension (and its income test), senior Australian tax offset [SATO], low income tax offset [LITO], mature age worker tax offset [MAWTO] and the Medicare levy.

Figure 3: Benchmark SS and real age-profiles of labour supply and total assets



Notes: (i) The real average labour supply is presented as hours worked by Australian males working full-time or part-time in 2005 (Productivity Commission, 2005) divided the annual time endowment of 5460 non-sleeping hours assumed in the model; (ii) The real household net assets (wealth) represents the total average net wealth less average owner-occupied dwelling assets in 2000 and is inflated by three percent inflation rate to year 2005 (Northwood et al., 2002).

Figure 2: Benchmark SS profiles of disaggregate household variables

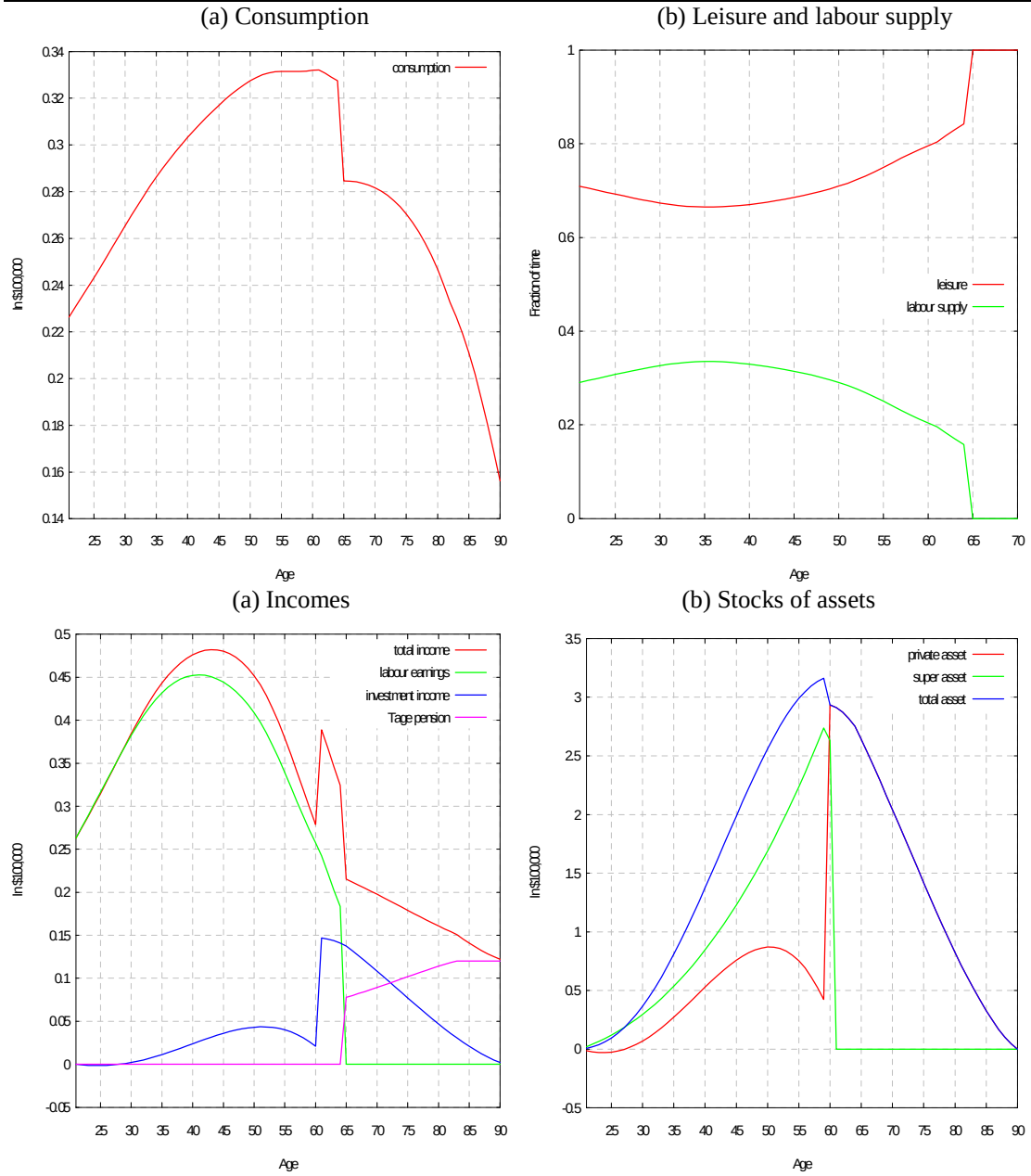
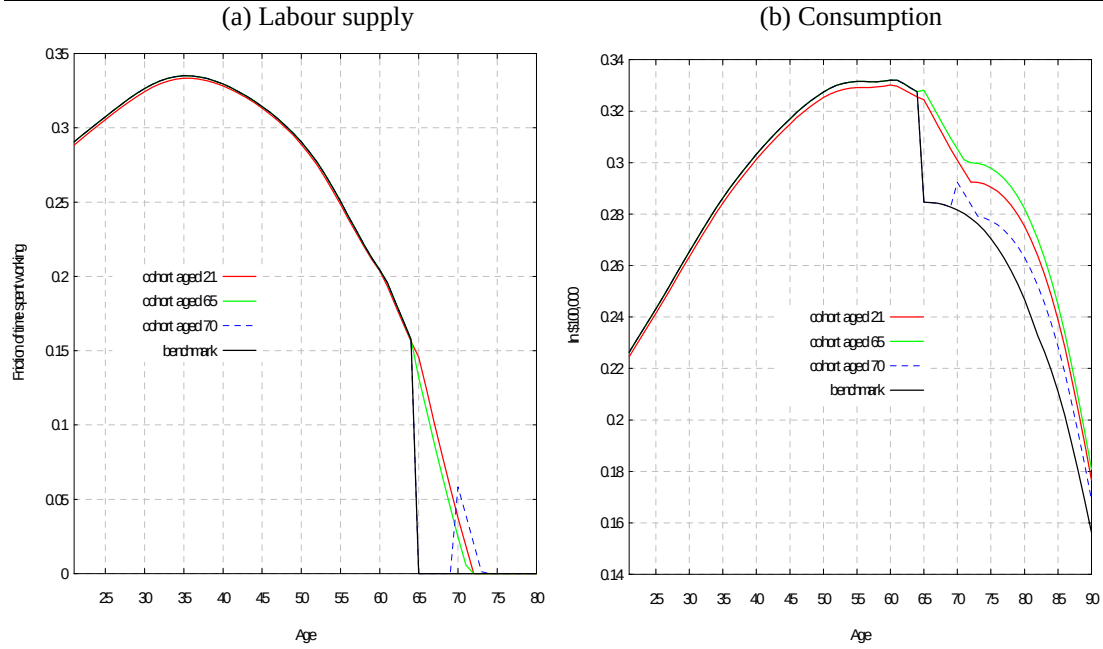
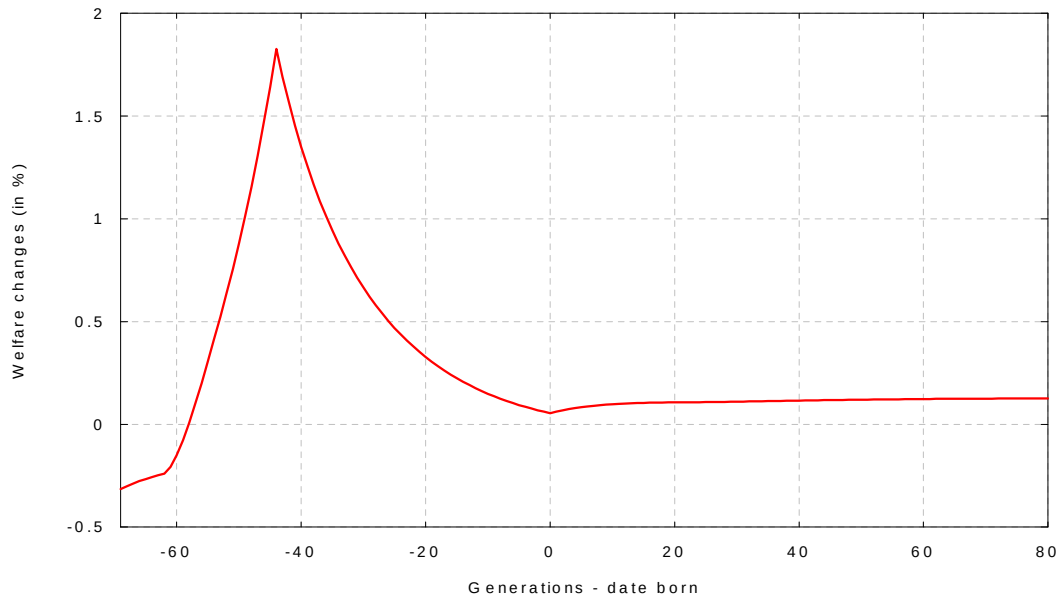


Figure 4: Intergenerational implications of the age pension means test removal



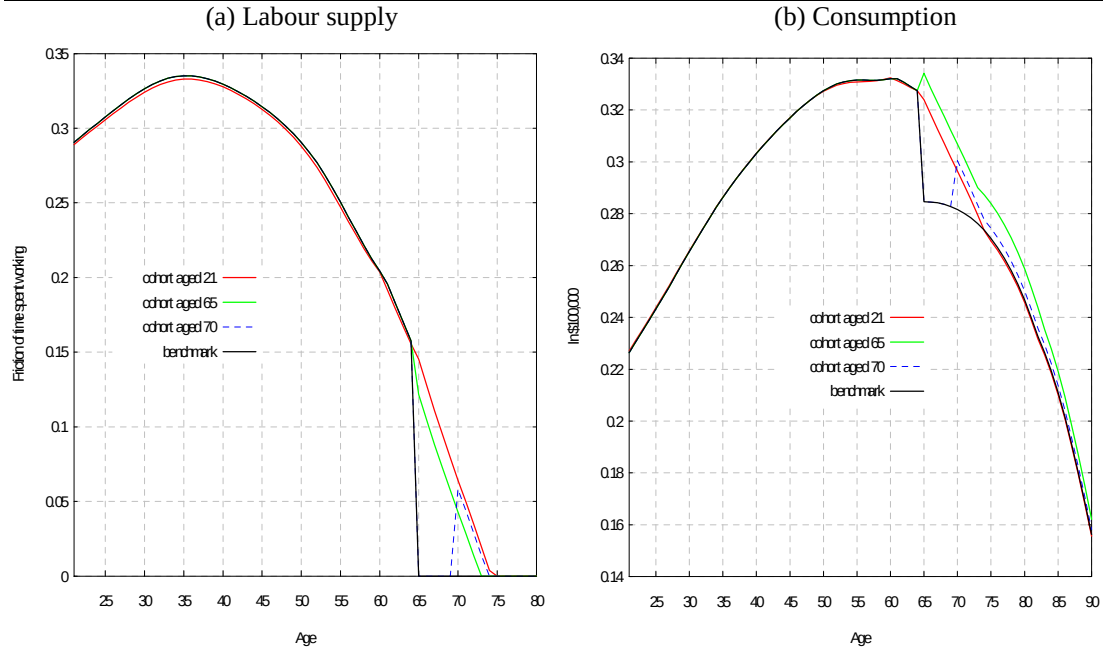
Notes: This figure shows household, life-cycle behaviour in the benchmark SS (i.e. prior to the means test removal) labelled as benchmark and the impacts on the selected cohorts at the time of the means test removal.

Figure 5: Welfare implications of the age pension means test removal (i.e. remaining lifetime utility)



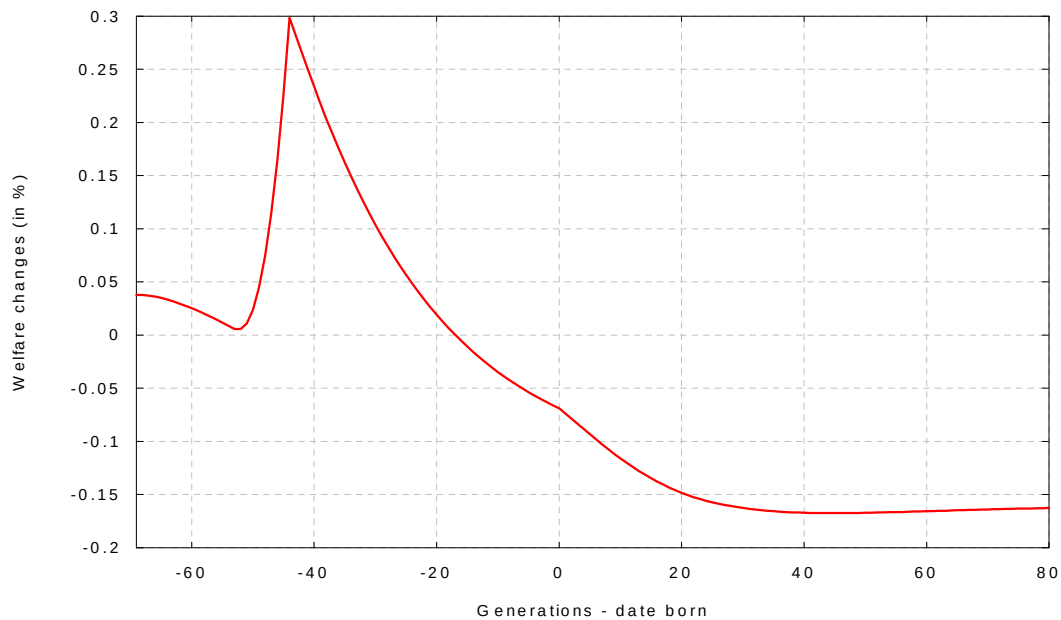
Notes: The horizontal axis records the periods when generation enters the model relative to the period of the policy change which is assumed to be period 0. A generation's age at the time of the policy shift can be obtained by subtracting the number on the horizontal axis from the assumed entry age of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

Figure 6: Intergenerational implications of the removal of labour earnings from the age pension income test



Notes: This figure shows household, life-cycle behaviour in the benchmark SS (i.e. prior to the means test removal) labelled as benchmark and the impacts on the selected cohorts at the time of the means test removal.

Figure 7: Welfare implications of the removal of labour earnings from the age pension income test (i.e. remaining lifetime utility)



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: Calibration targets and fixed ratios in the benchmark SS

Symbol	Description	Value
<i>Calibrations targets</i>		
K/Y	Capital-output ratio	2.9
I/Y	Investment-output ratio	0.25
FA/K	Foreign assets-capital ratio	0
w	Wage rate	0.87
r	Interest rate	0.05
<i>Fixed ratios</i>		
G/Y	Government consumption-output ratio	0.18
D/Y	Government debt-output ratio	0

Note : [a] Calculated from ABS (2006); [b] Based on Commonwealth of Australia (2006).

Table 2: Parameter values of the model in the benchmark SS

Symbol	Description	Value
<i>Demographics</i>		
n	Population growth rate	0.012
s_a	Conditional survival probabilities	[a]
<i>Utility function</i>		
γ	Inter-temporal elasticity of substitution	0.3
ρ	Intra-temporal elasticity of substitution	0.9
β	Subjective rate of time preference	0.01
α	Leisure parameter	1.7
<i>Production function</i>		
κ	Production constant	0.875
σ	Elasticity of substitution in production	0.952
ε	Capital share	0.375
δ	Depreciation rate	0.076
ψ	Adjustment cost parameter	10
<i>Age pension</i>		
p	Maximum legislated single rate age pension per year	0.122382
IT	Income threshold to which p is payable under the income test	0.03172
θ	Income reduction (taper) rate	0.4
AT	Assets threshold to which p is payable under the asset test	2.635
ϕ	Assets reduction (taper) rate	0.078
$eage$	Age pension eligibility age	65
<i>Superannuation guarantee</i>		
cr	Mandatory superannuation contribution rate	0.09
τ^{cs}	Tax rate imposed on superannuation contributions	0.15
τ^r	Tax rate applied to fund investment income	0.15
τ^{sb}	Tax rate on superannuation benefits	0.15
τ^{db}	Tax rate on death (non-dependant) superannuation benefits	0.15
TFT	Tax free threshold to which superannuation payout is free	1.23808
$sage$	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]The SG parameters were applicable in 2004-05.

Table 3: Benchmark SS and actual macroeconomic data

Variable	Benchmark steady state	Australia 2004-05 [a]
<i>Expenditures on GDP (Per cent of GDP)</i>		
- Private consumption	57.00	58.50
- Investment	25.00	25.58
- Government consumption	18.00	18.23
- Trade balance	0.00	-2.74
<i>Government indicators (Per cent of GDP)</i>		
- Age pension expenditures	3.82	2.89
- Government surplus	0.00	1.50
Current revenues		
- Personal income tax taxation	13.63	12.10
- Consumption taxation (= GST revenue)	5.66	4.12
- Superannuation taxation	2.53	0.75
Capital-output ratio	2.83	2.92
Foreign assets-capital ratio	0.00	-0.25
Investment-capital ratio	0.09	0.09
τ^c (=GST)	0.10	0.10

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

Table 4: Sensitivity analysis – alternative parameterisation

	Benchmark SS [a]	γ (=0.4)	β (=0.015)	σ (=1.1)	ε (=0.45)	δ (=0.52)	r (=0.06)	n (=0.02)
Y[b]	0.503	0.498	0.508	0.590	0.689	0.565	0.465	0.531
K[b]	1.422	1.407	1.437	1.926	2.300	1.945	1.221	1.501
L[c]	0.340	0.336	0.343	0.340	0.339	0.341	0.326	0.358
C/Y	0.570	0.601	0.544	0.507	0.493	0.576	0.638	0.538
I/Y	0.250	0.250	0.250	0.289	0.297	0.222	0.233	0.273
TB/Y	0.000	-0.031	0.026	0.025	0.030	0.022	-0.051	0.010
K/Y	2.826	2.826	2.826	3.263	3.360	3.466	2.629	2.826
I/K	0.088	0.088	0.088	0.088	0.088	0.064	0.088	0.096
FA/K	0.000	0.286	-0.241	-0.198	-0.235	-0.166	0.402	-0.114
w	0.874	0.874	0.874	0.936	1.072	0.984	0.837	0.874
τ^c	0.099	0.074	0.123	0.118	0.099	0.071	0.062	0.096

Notes: [a] In the benchmark SS, $\gamma = 0.3$, $\beta = 0.01$, $\sigma = 0.952$, $\varepsilon = 0.375$, $\delta = 0.076$, $r = 0.5$, $n = 0.012$

[b] Output (i.e. GDP), the value of capital stock and other monetary aggregate variables are expressed per average household (per capita) and in units of \$100,000; [c] Labour input is represented by a fraction of time spent working per average household.

Table 5: Macroeconomic implications of the age pension means test removal

Variable	Initial SS [a]	Time period [b]								New SS [a]
		0	5	10	20	30	40	50	200	
Labour supply	0.340	%	1.000	1.264	1.570	1.693	1.731	1.728	1.691	0.345
Wage rate	0.874	%	-0.229	-0.207	-0.147	-0.091	-0.051	-0.025	0.000	0.874
Capital stock	1.422	%	0.387	0.707	1.172	1.446	1.592	1.661	1.691	1.446
Domestic assets	1.422	%	0.274	0.234	-0.217	-0.534	-0.589	-0.541	-0.324	1.418
Foreign assets	0.000	?	-0.012	-0.015	-0.025	-0.031	-0.033	-0.032	-0.029	-0.029
Capital price (Tobin's q)	1.000	%	0.918	0.595	0.369	0.206	0.103	0.045	0.000	1.000
Output [c]	0.503	%	0.679	1.064	1.428	1.604	1.681	1.704	1.691	0.512
- Consumption	0.287	%	0.082	1.054	1.341	1.268	1.240	1.247	1.311	0.291
- Investment	0.126	%	0.976	1.358	1.573	1.669	1.703	1.709	1.691	0.128
- Trade balance	0.000	?	0.001	0.000	0.000	0.001	0.001	0.001	0.001	0.001
Government expenditures [d]	0.110	%	4.332	4.649	4.949	5.095	5.158	5.177	5.166	0.116
- Age pension expenditures	0.019	%	21.553	21.553	21.553	21.553	21.553	21.553	21.553	0.023
Total government revenues	0.110	%	4.332	4.649	4.949	5.095	5.158	5.177	5.166	0.116
- Income tax revenues	0.069	%	2.288	2.520	2.839	3.156	3.401	3.441	3.477	0.071
- Consumption tax revenues	0.029	%	11.102	10.919	11.066	11.478	11.751	11.711	11.538	0.032
- Superannuation taxation	0.013	%	0.193	0.069	0.043	-0.002	-0.125	-0.094	0.010	0.013
Consumption tax rate (=GST)	0.099	%	11.011	10.237	9.907	10.003	10.382	10.336	10.094	0.109

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, apart from the values for foreign assets and trade balance, which are in levels. [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 6: Macroeconomic implications of the labour earnings removal of the age pension income test

Variable	Initial SS [a]	Time period [b]								New SS [a]
		0	5	10	20	30	40	50	200	
Labour supply	0.3396	%	0.366	1.123	1.691	1.992	2.159	2.241	2.293	0.3474
Wage rate	0.8736	%	-0.137	-0.134	-0.164	-0.160	-0.120	-0.052	0.000	0.8736
Capital stock	1.4221	%	0.000	0.347	0.683	1.257	1.667	2.101	2.293	1.4547
Domestic assets	1.4221	%	0.000	-1.465	-2.789	-4.812	-5.965	-6.796	-6.860	1.3246
Foreign assets	0.0000	?	-0.010	-0.036	-0.059	-0.094	-0.113	-0.128	-0.130	-0.1301
Capital price (Tobin's q)	1.0000	%	0.713	0.696	0.660	0.500	0.339	0.127	0.000	1.0000
Output [c]	0.5033	%	0.236	0.577	0.964	1.534	1.875	2.079	2.293	0.5148
- Consumption	0.2869	%	1.688	1.583	1.462	1.093	0.777	0.639	0.568	0.2885
- Investment	0.1258	%	0.803	1.132	1.420	1.812	2.042	2.172	2.293	0.1287
- Trade balance	0.0000	?	-0.005	-0.004	-0.002	0.001	0.003	0.004	0.005	0.0049
Government expenditures [d]	0.1098	%	0.194	0.340	0.676	1.307	1.688	1.913	2.134	0.1121
- Age pension expenditures	0.0192	%	-0.269	-0.779	-0.681	0.236	0.805	1.130	1.388	0.0195
Total government revenues	0.1098	%	0.194	0.340	0.676	1.307	1.688	1.913	2.134	0.1121
- Income tax revenues	0.0686	%	0.065	0.039	0.145	0.350	0.503	0.619	0.792	0.0691
- Consumption tax revenues	0.0285	%	0.572	1.239	2.289	4.227	5.327	6.168	6.221	0.0303
- Superannuation taxation	0.0127	%	0.049	-0.048	-0.070	-0.071	-0.078	0.019	0.216	0.0127
Consumption tax rate (=GST)	0.0994	%	-1.101	-0.340	0.815	3.100	4.515	5.563	5.622	0.1050

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, apart from the values for foreign assets and trade balance, which are in levels. [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.