Macroeconomic and Welfare Effects of the 2010 Changes to Mandatory Superannuation*

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Abstract

This paper reports on an investigation of the macroeconomic and welfare effects of the major changes of the reform to mandatory superannuation announced by the Australian government in 2010. These changes include gradual increases in mandatory contributions from 9 to 12 per cent of earnings and the effective removal of the flat 15 per cent contribution tax for low income workers. Using a computable overlapping generations model that is calibrated to the Australian economy, we find significantly larger superannuation assets, improved self-funding in retirement and lower government expenditures on the age pension as a result of the reform. The reform also has positive impacts on households’ long run welfare, with higher income households benefiting from the increased contributions and lower income households gaining from the contribution tax removal. The reform yields an aggregate efficiency gain of 0.8 per cent or $11,753 per capita in initial resources for each future generation.

Keywords: Compulsory saving; pension reform; superannuation guarantee; dynamic overlapping generations model

JEL Classification: H55; E21; C68

1 Introduction

In 2010, the Australian government announced that mandatory superannuation guarantee [SG] contributions paid by employers will be increased from 9 to 12 per cent of gross wages in order to increase retirement incomes and national savings. The increases in the mandatory contribution rate are proposed to be carried out gradually, with initial increments of 0.25 percentage points in July 2013 and 2014. Further increments of 0.5 percentage points will apply annually up to 2019-20, when the SG rate will reach 12 per cent of gross wages (Commonwealth of Australia, 2010). In addition, the government...

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announced a superannuation contribution of up to $500 for workers with annual taxable
income of no greater than $37,000 from July 2013, which will effectively remove the
contribution tax for workers on income up to that amount. These two policy changes
constitute the 2010 reform to mandatory superannuation that we examine in this paper.¹

Adequacy of the current 9 per cent SG rate has been questioned for a long time. Al-
ready in 1993, one year after the introduction of the superannuation guarantee, FitzGerald
(1993) proposed to increase the mandatory contribution rate to 18 per cent of earnings
to generate a higher replacement rate from superannuation. In 1995, the Keating gov-
ernment committed to lift mandatory contributions to 15 per cent, but the Liberal gov-
ernment elected in 1996 ignored this agreement and continued with the already-agreed
gradual increases in the SG rate to the existing 9 per cent. The Australian Superannu-
ation Fund Association (1998) also proposed higher mandatory contributions and, more
recently, several submissions to Australia’s Future Tax System [AFTS] (2010) recom-
mented increasing compulsory savings with targets of 12 or 15 per cent of earnings.

The equity of superannuation taxation arrangements has also been a concern. The
existing tax treatment of superannuation places a concessional flat tax rate of 15 per cent
on mandatory (and other employer) contributions and superannuation fund earnings.²
Given the progressive personal income tax schedule with the marginal tax rates ranging
from zero to 45 per cent, higher income earners receive far greater tax concessions on their
mandatory contributions compared to those on low incomes. AFTS (2010) estimates
that about 5 per cent of Australians on very high incomes receive over 37 per cent of
concessional contributions. Hence, the main objective of the contribution tax removal for
low income earners is to make the superannuation system fairer.³

The primary purpose of this paper is to undertake an examination of the implications
of the 2010 superannuation policy reform. The superannuation guarantee policy is an
important pillar of the retirement system in Australia and the 2010 changes to this
policy will have potentially large impacts on the well-being of Australian individuals and,
given the size of the changes, on the Australian economy. The significant increase in
the superannuation contribution rate will alter incentives for the labour leisure choice
over the life cycle, for private saving for retirement and for age pension dependence, as
well as having implications for the labour market and government tax revenues. The
removal of the contributions tax for low income earners will alter work incentives for
these low income earners and have implications for their life-cycle decisions including
reliance upon the age pension in retirement, but will also have potential implications for
the government budget due to lower superannuation tax revenue. Individuals of different
ages and earnings abilities are likely to be impacted by, and react to, the policy changes
in quite different ways.

Understanding and measuring these potential impacts is important. Accordingly, we
analyse (i) the behavioural and welfare effects of the superannuation policy changes on

¹The two policy changes were passed by the Parliament in March 2012. The legislation also includes
a policy of extending mandatory contributions to workers aged between 70 and 75 years, which we do
not examine because of insignificant effects of this policy.

²Mandatory SG contributions and other employer contributions such as salary sacrificing contributions
are made from gross earnings and are taxed in the hands of superannuation funds. There are also
voluntary personal contributions made from after-tax income.

³This policy, however, does not go as far as Recommendation 18 by AFTS (2010, p.84), according to
which employer contributions should be taxed at marginal income tax rates and a flat-rate offset should
be paid to ensure that the majority of taxpayers do not pay more than 15 per cent contribution tax.
different cohorts and on the same cohorts of different income types and, by aggregating across households, (ii) the macroeconomic implications of the reform, including the effects on per capita domestic assets, labour supply, consumption and age pension expenditures to the government. To undertake this task, we simulate the effects of the 2010 changes to mandatory superannuation, using an extension of the computable overlapping generations [OLG] model developed by Kudrna and Woodland (2011a, 2011b). The extended model has several features that make it particularly appropriate for the analysis of superannuation policy. It incorporates inter- and intra-generational heterogeneity amongst households, allowing the evaluation of different impacts upon different household types; it embodies the essential features of Australia’s superannuation, income taxation and age pension policy settings and hence allows for important interactions between household behaviour and these policy settings; and it is a dynamic general equilibrium model, thus allowing for macroeconomic impacts of the superannuation policy changes over time.

The implications of compulsory savings, such as mandatory superannuation, on household and national savings, labour supply and retirement have been examined by a number of researchers. Empirical literature using time series and cross section data has documented a positive impact of compulsory superannuation on total assets and household saving in Australia (FitzGerald, 1993; Connolly and Kohler, 2004; Connolly, 2007). While Connolly (2007) shows no significant impact of mandatory superannuation on intentions regarding the timing of retirement, Buetler et al. (2005), using unit record data from Swiss pension funds, demonstrate that fund members with larger accumulated pension capital tend to retire earlier. The positive effects of compulsory superannuation on national savings, replacement rates and living standards are also derived from micro-simulation projection models (e.g., Gallagher, 1996; Kelly and Morrison, 2008).

The methodology and analysis undertaken in this paper fit into the literature that applies life-cycle utility optimisation models. Guest and McDonald (2002) show that higher mandatory contributions would, amongst other things, increase national savings, while Guest (2004) finds that compulsory superannuation, while slightly raising private saving, reduces non-housing and housing consumption. Creedy and Guest (2008b) use an open economy OLG model to simulate the effects of different superannuation tax treatments for Australia. In doing so, they consider an increase in the contribution rate, but only in connection with its effect upon the results for the different tax schemes. Our paper complements the work of Creedy and Guest (2008b) by focusing on the simulation analysis of the enacted 2010 superannuation reforms, with explicit consideration of an increase in the contribution rate as part of the policy. Additionally, our model incorporates heterogeneity amongst households, with households also distinguished by income type, embodies a richer structure of Australia’s fiscal system, with the means tested age pension and progressive income taxes, and is calibrated for the period of announcement of the policy reform.

Our simulation results for the 2010 superannuation changes show significantly larger superannuation assets due mainly to the higher SG rate. Larger superannuation savings partly offset ordinary non-superannuation assets, but total assets increase as a result of the reform and are over 18 per cent higher in the long run. Self-funding in retirement improves, with the age pension expenditures falling by about 4.6 per cent in the long run due to the means testing of greater assets and asset incomes. However, large asset accumulations produce a dominating income effect on per capita labour supply, which declines by 1.25 per cent in the long run. Similarly to Buetler et al. (2005), we also find
that the increased superannuation assets bring forward full retirement for higher income households. The reform increases long run welfare for all income types, with higher income households benefiting solely from the increased SG rate, while the gains for lower income types are conditional on the removal of their contribution tax. To provide an overall assessment of the superannuation reform, we calculate aggregate efficiency implications and find an efficiency gain of about 0.8 per cent or $11,753 in initial resources, indicating that the reform is potentially Pareto improving.

The paper is organised as follows. In the next section, we formulate a simple model to explain some of the effects on household behaviour associated with the superannuation policy changes. Following that, Section 3 describes the full model. The calibration of the model and a discussion of the benchmark model solution are dealt with in Section 4. The simulation results for the superannuation policy changes are reported and discussed in Section 5. Section 6 performs several robustness checks to alternative assumptions of the model. The final section offers some concluding remarks.

2 A simple model with mandatory superannuation

This section presents a simple model to show how households are impacted and how they would respond in terms of their life-cycle consumption and labour supply decisions to changes in the mandatory SG rate and the contribution tax rate.\(^4\) Understanding these behavioural effects is crucial as they drive the macroeconomic and welfare effects of the reform on which this paper focuses.

Consider a household that lives two periods, denoted by \(t = 1, 2\). The first is the superannuation accumulation phase in which the household consumes and works and the second is the retirement phase in which the household only consumes. In the first period, the household supplies \((1 - l)\) units of labour \((l\) is leisure and the maximal time is normalised to 1) at a wage rate, \(w\), and pays income tax at rate \(\tau^y\). After tax earnings are allocated between consumption, \(c_1\), and saving, \(A\), which is carried forward to the next period. Thus, the first period budget constraint is \(c_1 + A = (1 - \tau^y) w (1 - l)\). During the first period, the employer contributes a proportion, \(cr\), of earnings received by the household to a superannuation fund, minus the contribution tax paid to the government, the net superannuation contribution in the first period being \((1 - \tau^s) cr \cdot w(1 - l)\), where \(\tau^s\) is the contribution tax rate.\(^5\)

In period 2, the household is retired \((l = 1)\) and allocates all available funds to consumption, \(c_2\). Those funds comprise the superannuation payout, an age pension and after-tax interest income. The superannuation payout in the second period is equal to the contributions plus after tax interest earnings and given by

\[
S(l) = R^S (1 - \tau^s) cr \cdot w (1 - l),
\]

\(^4\)In the following, we draw upon the approach of Creedy and Guest (2008a), who specify a three period model for the analysis of superannuation policy parameters and develop the idea of expressing the impacts in terms of income and price effects. Here we consider a two period model, which is the maximum dimension needed, and extend their analysis by considering the decomposition of the price effect into the standard substitution and income effects.

\(^5\)Note that our base for the contribution rate (the earnings of the household) differs from the treatment of Creedy and Guest (2008a), who base the contribution rate on the total earnings "package"; however, ours seems more in line with actual practice.
where $R^S = 1 + (1 - \tau^r) r$ is the superannuation earnings tax adjusted interest factor, assuming that superannuation interest income is taxable at rate $\tau^r$ but that there is no benefits tax. For simplicity, the age pension is assumed to be universal, given by $p$ and not taxed. In period $t = 2$ (retirement phase), the household’s consumption is therefore \( c_2 = RA + S(l) + p \), where $R = 1 + (1 - \tau^y) r$ is the income tax adjusted interest factor.

Using the two budget constraints, we can derive the lifetime budget constraint as
\[
c_1 + c_2/R + wX \cdot l = wX + p/R, \quad X \equiv 1 - \tau^y + c r (1 - \tau^s) R^S / R.
\]
Thus, the inter-temporal optimisation problem of the household may be expressed as
\[
\max_{c_1, c_2, l} \{u(c_1, l) + \beta u(c_2, 1) : c_1 + c_2/R + wX \cdot l = M \equiv wX + p/R \},
\]
where $M$ is "full income" and $\beta$ represents the preference discount factor. It is noted that the price of leisure, $wX$, and full income, $M$, both depend upon $X$, which embodies information about all of the taxation and superannuation policy parameters ($\tau^y, \tau^s, \tau^r, cr$). Thus, the impact of $cr$ upon household decisions can be determined through the impacts upon those decisions of the price of leisure and full income. Importantly for present purposes, it is evident that $X$ is increasing in $cr$ and decreasing in $\tau^s$.

This formulation of the household’s inter-temporal utility maximising problem shows the role of taxes and the contribution rate, $cr$, in the household’s decision problem, operating through the variable $X$. As pointed out by Creedy and Guest (2008a), there are two types of effects - price and income. The income effect occurs through full income variable, $M$, which rises through $X$ if $cr$ increases or $\tau^s$ decreases, thus creating a positive income effect upon $(c_1, c_2, l)$. In addition, there is a price effect, since $X$ is a coefficient for the wage rate, $w$; an increase in $cr$ or a decrease in $\tau^s$ will raise $X$ and hence raise the tax adjusted wage rate, $wX$, thus creating a price effect. As is well known, this price effect may be decomposed into a pure (Slutsky) substitution effect and an income effect. This income effect, like the full income effect, is positive for all variables and so brings about an increase in $(c_1, c_2, l)$. On the other hand, the tax adjusted wage rate rise will induce the household to reduce the demand for leisure (it is now more expensive) and so hours of work will increase as a result of the substitution effect. Thus, the net effect upon hours of work is ambiguous, with a positive substitution effect and two negative income effects. The ambiguity of the labour supply effect of a wage increase, well known in a static model, is further enhanced in this dynamic context.

To summarise the results from the simple model, the effects of an increase in the superannuation contribution rate, $cr$, or a lower contribution tax rate, $\tau^r$, upon consumption in both periods is positive. However, the effects of these policy changes upon labour supply is ambiguous, depending on the relative strengths of the income and substitution effects operating through full income and the price of leisure.\footnote{These results also apply if we consider the general equilibrium change in the market wage rate. In our model developed further below, the long run solution has the market wage rate given by $w = w^P/(1 + cr)$, where $w^P$ is the wage rate incurred by the employer inclusive of the superannuation contribution. This wage rate is unchanged as a result of any change in $cr$ (see further below for the explanation), so an increase in $cr$ causes $w$ to fall. Taking this general equilibrium effect into account, we can show that $X$ is then replaced by $X/(1 + cr)$, which remains increasing in $cr$. Thus, we get the same qualitative conclusions regarding the impact of a change in $cr$ upon a household’s labour supply and consumption.}

Although the simple model helps to explain various behavioural effects, it ignores many other impacts associated with the superannuation changes. For example, it ab-
stracts from borrowing constraints. Especially, low income households are often unable to offset higher mandatory contributions by reducing their other assets and, therefore, would have to further cut down their consumption prior to receiving their superannuation. The simple model assumes universal pensions rather than means tested pension payments. Under means testing, pension payments would be reduced for some households as a result of the superannuation reform (intensive margin) and possibly cease of others (extensive margin). Furthermore, both superannuation policy changes would have negative direct effects on the government budget. If the government is committed to a balanced budget and adjusts other taxes to offset resulted losses in revenues, there would be additional effects on household behaviour. General equilibrium effects on the wage rate and the redistribution of bequests were also not considered in this simple model. Finally, but not exhaustively, the simple model has just two periods of life for households but households live for many periods with time varying earnings productivity. The simple model is instructive in providing the succinct essence of the channel through which the superannuation policy reform impacts upon the economy, but the real world is more complex.

Clearly, a more general model is needed for the evaluation of the superannuation reform. Hence, to provide more realistic results that would account for the aforementioned effects, we apply a dynamic general equilibrium OLG model that is briefly described in the next section, with the simulation results of the reform presented in Section 5.

3 Model description

3.1 Model overview

The model is a small open economy version of Auerbach and Kotlikoff’s (1987) OLG model that consists of households, production, government and foreign sectors. It builds on Kudrna and Woodland (2011a, 2011b) and extends these studies by incorporating a detailed disaggregation of households into income quintiles based on the ABS (2007) data into the model and by including an updated calibration to more recent Australian data.

The model has a range of aspects that make it appropriate for the superannuation reform analysis. First, the model includes the main features of the government’s policy settings regarding taxes, means tested pensions and mandatory superannuation. Second, households are distinguished not only by age but also by income type, which is important because the tax concessions to superannuation are not evenly distributed across households with different incomes. Third, the production sector comprises profit maximising firms that pay wages and also make mandatory contributions on behalf of working households. Fourth, it is a dynamic, general equilibrium model, which is important since the superannuation reform is bound to have time dependent general equilibrium effects that impact on households, firms and the government budget.

We now provide a technical description of the simulation model, starting with the demographic structure and then proceeding to the individual sectors of the model.
3.2 Demographics

We consider a model economy that is populated by sequences of generations aged between 21 and 90 years \((a = 21, \ldots, 90)\) at any time \(t\). Each generation consists of five income types \(i\) - the lowest, second, third, fourth and highest quintiles, with intra-generational shares given by \(\omega_i\). Every year, a new generation aged 21 years enters the model and faces random survival described by the conditional survival probabilities, \(s_a\), up to the maximum age of 90 years. We assume stationary demographics with a constant population growth rate, \(n\), which implies time-invariant cohort shares, \(\mu_a = \left[\frac{s_a}{(1 + n)}\right] \mu_{a-1}\).

3.3 Households

Each \(i\)-type household who begins her economic life at time \(t\) is assumed to optimally choose consumption, \(c\), and leisure, \(l\), at each age and the timing of retirement to maximise the expected lifetime utility function given by

\[
\max_{\{c_{i+a-21}^t, l_{i+a-21}^t\}} \frac{1}{1 - \gamma} \sum_{a=21}^{90} \tilde{S}_a \beta^{a-21} u(c_{i+a-21}^t, l_{i+a-21}^t)^{1-1/\gamma},
\]

subject to the per-period budget constraint written as

\[
A_{a,t}^i = (1 + r)A_{a-1,t-1}^i + w_t e_a^i (1 - l_{a,t}^i) + AP_{a,t}^i + SA_{60,t}^i + SP_{a,t}^i + ST_a^i + B_{a,t}^i - T(y_{a,t}^i) - (1 + \tau^c) c_{a,t}^i,
\]

where the annual utility, \(u(c, l) = (c^{(1-1/\rho)} + \alpha l^{(1-1/\rho)})^{1/(1-1/\rho)}\), is discounted by the subjective discount factor, \(\beta\), and the unconditional survival probability, \(S_a = \prod_{j=21}^{90} s_{j-1}\). The remaining taste parameters are the inter- and intra-temporal elasticities of substitution denoted by \(\gamma\) and \(\rho\) and the leisure distribution parameter, \(\alpha\).

In the per-period budget constraint (3.2), \(A_{a,t}^i\) denotes the stock of ordinary private assets held at the end of age \(a\) and time \(t\), which equals the assets at the beginning of the period, plus the sum of interest income, \(r A_{a-1,t-1}^i\), labour earnings, \(w_t e_a^i (1 - l_{a,t}^i)\), age pension, \(AP_{a,t}^i\), superannuation payouts, \(SA_{60,t}^i\) and \(SP_{a,t}^i\), social transfer payments, \(ST_a^i\), and accidental bequest receipts, \(B_{a,t}^i\), minus the sum of income taxes, \(T(y_{a,t}^i)\), and consumption expenditures, \((1 + \tau^c_t) c_{a,t}^i\), where \(\tau^c_t\) is the consumption tax rate. Labour earnings are the product of labour supply, \(1 - l_{a,t}^i\), and the hourly wage, \(w_t e_a^i\), where \(w_t\) is the market wage rate and \(e_a^i\) is the age- and income-specific earnings ability variable. The labour supply is required to be non-negative, \(1 - l_{a,t}^i \geq 0\). The taxable income, \(y_{a,t}^i\), comprises labour and interest incomes and the age pension. We also assume that households are born with no wealth and exhaust all wealth at age 90 \((A_{20,t}^i = A_{90,t+70}^i = 0)\) and that they are liquidity constrained \((A_{a,t}^i \geq 0)\) to prevent younger households from borrowing against their superannuation payouts. Accidental bequests, \(B_{a,t}^i\), are assumed to be equally redistributed to surviving households of the same income type and aged between 45 and 65 years.\(^7\)

The means tested age pension, \(AP_{a,t}^i\), that is paid to households aged 65 years and over

\(^7\)The bequest range of 45-65 years reflects intergenerational transfers from parents to children as child bearing occurs largely between 25 and 35 and the probability of death is particularly high from 80 to 90 in the model.
can be expressed as

\[ AP_i^a = \begin{cases} \min \{ API_a^i, APA_a^i \}, & \text{for } a \geq 65 \\ 0 & \text{for } a < 65 \end{cases}, \quad (3.3) \]

where \( API_a^i = \max \{ \min \{ p, p - \theta (\hat{y}_a^i - IT) \} , 0 \} \) represents the income test and \( APA_a^i = \max \{ \min \{ p, p - \phi (A_a^i - AT) \} , 0 \} \) gives the assets test. The pension parameters are the maximum age pension, \( p \), the income and asset taper rates denoted by \( \theta \) and \( \phi \), and the income and asset thresholds given by \( IT \) and \( AT \). The assessable income, \( \hat{y}_a^i \), includes investment earnings and half of labour income.

### 3.4 Mandatory superannuation

We closely follow the superannuation guarantee legislation that mandates each employer to contribute a fraction of earnings to the employee’s account in a superannuation fund. Accordingly, we assume that mandatory SG contributions are paid by firms on behalf of households between ages 21 (model entry age) and 60 years at the contribution rate, \( cr \), from their gross labour earnings. Similarly to the simple model, the employer contributions are taxed at the flat rate, \( \tau^* \), upon entry and then added to the stock of superannuation assets that earns investment income at the interest rate, \( r \). The investment income within the superannuation fund is taxed at the rate, \( \tau^* \). Superannuation assets must be kept in the fund until households reach age 60. At that age, households are assumed to receive a tax free lump sum and the accumulation of the superannuation asset ceases.

The superannuation payout for 60 year old households of income type \( i \) in time period \( t \), \( SA_{60,t}^i \), is given by

\[ SA_{60,t}^i = \sum_{a=21}^{60} [1 + (1 - \tau^*) r]^{60-a} (1 - \tau^*) cr \cdot w_t e_a^i (1 - l_{a,t}^i). \quad (3.4) \]

In addition, working households aged over 60 years are assumed to be paid the SG contributions directly into their private asset accounts.\(^8\) The payment of these contributions is given by

\[ SP_{a,t}^i = (1 - \tau^*) cr \cdot w_t e_a^i (1 - l_{a,t}^i), \quad \text{for } a > 60 \text{ and } 1 - l_{a,t}^i > 0. \quad (3.5) \]

Thus, under the superannuation guarantee system, households’ superannuation funds accumulate by employer contributions that depend upon the earnings of the household and by investment income earning within the fund. Households can affect the contributions only via their choice of hours of work throughout their working life, but obtain the funds only after they reach the age of 60 years. Accordingly, labour supply choices within the accumulation phase have implications for the well being of households in later life and so will be affected by the parameters of the mandatory superannuation system.

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\(^8\)This is consistent with post July 2007 policy, which allows such contributions by seniors to be immediately removed tax free from the superannuation fund.
3.5 Firms and technology

The production sector assumes a large number of perfectly competitive firms that produce a single all purpose output, $Y_t$, using the capital stock, $K_t$, and the labour supply, $L_t$, according to the technology described by the standard CES production function

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

(3.6)

where $\kappa$ is the productivity constant, $\varepsilon$ denotes the capital intensity parameter and $\sigma$ is the elasticity of substitution in production.

The firm’s maximisation problem is to maximise the present value of all future profits discounted at the world interest rate, $r$, subject to the capital accumulation equation, as specified by

$$\max_{(K_t, L_t, I_t)} \sum_{t=0}^{\infty} D_t \left[ (1 - \tau^f) (F(K_t, L_t) - C(I_t, K_t) - I_t - (1 + cr)w_tL_t) \right]$$

s.t. \( (1 + n)K_{t+1} = I_t + (1 - \delta) K_t, \)

(3.7)

where $D_t = (1+n)^t/(1+r)^t$ accounts for discounting and population growth and $\tau^f$ stands for the effective corporation tax rate.$^9$ The adjustment cost function is taken from Fehr (2000) and given by $C(I_t, K_t) = 0.5\psi (I_t/K_t - (n + \delta))^2 K_t$, where $\psi$ is the adjustment cost coefficient and $\delta$ denotes the capital depreciation rate.

Solving the firm’s maximisation problem yields the first-order necessary conditions and gives expressions for the wage rate, $w_t$, interest rate, $r$, and capital price, $q_t$.

3.6 Government

The government is assumed to maintain a balanced budget, which can be expressed, in per capita terms, as

$$TR_t^Y + TR_t^C + TR_t^S + TR_t^F = G + ST + AP_t,$$

(3.8)

where the per capita expenditures are government consumption, $G$, and social transfer payments, $ST$, which both are assumed constant, and the expenditure on the age pension, $AP_t$, while $TR_t^Y$, $TR_t^C$, $TR_t^S$ and $TR_t^F$ are per capita tax receipts from the taxation of household income, consumption, superannuation and corporate profits, respectively. The consumption tax rate, $\tau^c_t$, that is assumed to adjust endogenously to balance the government budget is given as$^{10}$

$$\tau^c_t = \frac{G + ST + AP_t - \left( TR_t^Y + TR_t^S \right)}{\sum_{i=1}^{5} \omega_i \sum_{a=21}^{90} \mu_a c^a_t \omega_a t}. \quad (3.9)$$

$^9$Note that the total wage rate faced by the representative firm $((1+cr)w_t)$ also includes the mandatory SG rate and so the total wage bill is given by $(1+cr)w_tL_t$.

$^{10}$In Section 6, we consider an alternative equilibrating policy instrument by adjusting progressive personal income taxes proportionally to balance the government budget.
3.7 Small open economy and market equilibrium

The model is a small open economy model with the exogenous interest rate, \( r \). When domestic savings fall short of the domestic capital, foreign capital will be employed, which adds to foreign debt. The accumulation of net foreign debt, \( FD_t \), in per capita terms, is

\[
(1 + n)FD_{t+1} - FD_t = TB_t - rFD_t, \tag{3.10}
\]

where \( TB_t \) is the trade balance and \( rFD_t \) is the interest payments on net foreign debt.

The endogenous variables in the model are determined such that all agents make their choices optimally (i.e., households are maximising lifetime utility subject to their inter-temporal budget constraints, the producer is maximising profit, the government balances its budget) and that all markets clear in every time period. The equilibrium conditions for labour, capital and output markets may be expressed as

\[
L_t = \sum_{i=1}^{5} \omega_i \sum_{a=21}^{90} e_{i,t}^a (1 - l_{i,t}^a) \mu_a, \\
q_t K_t = \sum_{i=1}^{5} \omega_i \sum_{a=21}^{90} (A_{i,t}^a + S A_{i,t}^a) \mu_a - FD_t, \\
Y_t = \sum_{i=1}^{5} \omega_i \sum_{a=21}^{90} c_{i,t}^a \mu_a + I_t + G_t + TB_t.
\]

In the steady state (balanced growth) equilibrium all macroeconomic variables expressed in per capita terms are constant in every time period, since the model features no technological progress.

4 Calibration of the model

The model economy prior to the superannuation reform is assumed to be in a steady state equilibrium. This benchmark equilibrium is calibrated to key Australian data averaged over the five-year period ending in June 2010. To solve for this benchmark equilibrium we have to assign the values to the model parameters. In this section we specify inter-generational differences among households and discuss the sources and choices of the values for the model parameters. We then provide comparison of the benchmark steady state solution generated by the model with Australian data for some variables.

4.1 Intra-generational heterogeneity

Intra-generational heterogeneity is modeled by disaggregating households into five income types (i.e., the lowest, second, third, fourth and highest quintiles) that are distinguished by their exogenously given earnings ability and by their social transfer payments (excluding the age pension). The earnings ability, which is the age profile of the full wage earned with all time endowment allocated to work, is constructed using the estimated lifetime wage function for males with completed high school education taken from Reilly et al. (2005) and income distribution shift parameters. Specifically, the earnings ability profile for the third (middle) quintile is taken from Reilly et al. (2005) and the profiles for lower and higher income quintiles are shifted down and up to approximately replicate the private income distribution in Australia. Based on ABS (2007) data, the shift parameter

\[\text{11}^\text{The exogenous interest rate assumption is also relaxed in Section 6.}\]
is set to 0.26 for the lowest quintile, 0.55 for the second quintile, 1.0 for the third quintile, 1.52 for the fourth quintile and 2.63 for the highest quintile.\footnote{12}

In order to match not only private income but also social welfare and gross total income for each income quintile, we assume that households receive social transfer payments from the government. These payments are assumed to be constant and to be received by households (except for those in the highest quintile) aged younger than 65 years.\footnote{13} The value of these transfer payments is calculated from ABS (2007), which provides the share of social welfare in gross total income for each income quintile. These shares are 0.44 for the lowest quintile, 0.3 for the second quintile, 0.15 for the third quintile and 0.06 for the fourth quintile.

### 4.2 Model parameters

The values of the parameters used in the benchmark steady state are reported in Table 1. The constant annual population growth rate set to 1.7 per cent, which together with the male survival probabilities taken from the 2007-09 life tables (ABS, 2010a) generates the existing old aged dependency ratio of 0.2. The intra-generational shares are equal to 0.2 for each income type, which is based on the quintiles used by ABS (2007).

The values assigned to the utility and technology parameters are standard in the related literature. The utility function parameters are the same across all income types of households. The subjective rate of time preference is chosen to generate the capital output ratio of 3 (ABS, 2010b). The technology constant is calibrated to reproduce the market wage rate, which is normalised to one. The capital depreciation rate is set to target the investment capital ratio of 0.09 (ABS, 2010b). The elasticity of substitution in production and the capital intensity parameter are calibrated via the producer’s first order profit maximisation conditions to match the interest rate and national account data for factor shares. The time endowment is normalised to unity. The exogenous interest rate is assumed to be 5 per cent and the adjustment cost parameter is taken from Auerbach and Kotlikoff (1987). We also target the ratio of net foreign debt to the capital stock of 0.195, reflecting the net foreign ownership of about 19.5 per cent of Australia’s capital stock (ABS, 2010b).

The consumption and corporation tax rates are set to their statutory rates of 10 per cent and 30 per cent, respectively. Tax base parameters are then computed to replicate the average ratios of these tax revenues to GDP over the five-year period ending in June 2010 (Commonwealth of Australia, 2011). The products of the statutory tax rates and the computed tax base parameters give the effective rates of 7.04 per cent on consumption and of 25.9 per cent on corporation profits. We assume no government debt and an income tax function that approximates the 2009-10 progressive personal income tax schedule. The values of the age pension and superannuation parameters are those applicable in 2009-10. The age pension eligibility age is 65 years.

\footnote{12}We also assume that the earnings ability after age 65 declines at a constant rate, reaching zero at age 90 for each income class as Reilly \textit{et al.} considered only workers aged 15-65.

\footnote{13}One can think that these government benefits include welfare payments such as family benefits and disability support pension.
4.3 Computation and benchmark solution

We use the GAMS software to solve for the steady state equilibrium as well as for the transition paths. Our algorithm applies the iterative Gauss-Seidel computational method suggested by Auerbach and Kotlikoff (1987). In particular, these are the steps carried out to solve for the initial steady state of our model. First, choose initial values for the accidental bequest, $B$, the consumption tax rate, $\tau^c$, and the labour input, $L$. Second, calculate the implied market clearing wage rate, $w$, capital stock, $K$, and output, $Y$, using the first order necessary conditions for profit maximization by the producer. Third, given $w$, $B$ and $\tau^c$ solve the household optimization problem (using the DNLP solver, CONOPT) for each income group to obtain household consumption, labour supply and assets profiles. Fourth, given these household optimisation solutions, update values of $B$, $\tau^c$ and $L$ using the bequest allocation rule, the government budget constraint and setting $L$ equal to aggregate household labour supply. The second through fourth steps are iterated until the solutions for $B$, $\tau^c$ and $L$ converge.

The benchmark steady state solution for the key macroeconomic ratios and household net income variables is reported in Table 2, which also provides a comparison with the Australian data reported as averages over the five-year period ending in June 2010. As shown, the distribution of net incomes across the household quintiles and the Gini coefficient match closely the ABS (2011) data.

The comparison of model generated and actual macroeconomic indicators indicates that the model replicates the Australian economy fairly well. The components of domestic aggregate demand are close to their actual values expressed in per cent of GDP, except for the trade balance, which is positive and implied by the calibration target for the net foreign debt to capital ratio. Similar conclusions can be drawn for the government indicators, with the exception of superannuation tax revenues. The difference between the model and actual revenues from the superannuation taxation is largely due to the assumed 40 years of superannuation accumulations in the model, whereas the superannuation guarantee was introduced only in 1992 and only with 3 per cent minimum contributions initially.

A comparison of selected life-cycle profiles from the benchmark model with data drawn from HILDA (Wooden et al., 2002) panel data sets was undertaken. The age profiles for labour supply and labour earnings fit comfortably with empirical profiles obtained using HILDA data. However, the age profiles of superannuation and total financial assets are above those derived from HILDA data sets, for reasons previously mentioned.

5 Policy simulations and analysis

We now use the model specified in the previous section to simulate the effects of the 2010 reform to mandatory superannuation. Under the first policy change in this reform, the mandatory SG contribution rate, $c_r$, becomes time dependent. Prior to 2013, it is to remain at its current rate of 9 per cent; from 2013, it is to be gradually increased on

\footnote{Details of this comparison are available from the authors.}
an annual basis until it reaches 12 per cent of gross labour earnings in 2019.\textsuperscript{15} Under the second policy change, the contribution tax rate, $\tau^*$, becomes dependent on taxable income. The contribution tax rate is equal to 15 per cent prior to 2013 and from that year onwards it is zero for households with an annual taxable income of no greater than $37,000.

The simulation results are discussed in terms of the macroeconomic and welfare effects. These effects are driven by changes in the life-cycle behaviour of households, with some of these behavioural changes pointed out where appropriate. Although the focus is placed on the superannuation reform as a whole, we also simulate the two components of the reform separately and, further below, provide some interesting effects of the two changes. We start this section with a brief overview of the major results, which is followed by a detailed analysis of the macroeconomic and welfare effects of the superannuation reform.

\subsection*{5.1 Overview}

The superannuation reform and the higher SG rate policy in particular will directly increase the superannuation assets available to households upon reaching the access age, which is set to 60 years in our model. The resulting increase in total assets and interest income upon reaching the age pension eligibility age should, therefore, reduce an overall reliance on the public pension support in retirement. Indeed, consistent with this expectation, we find that the age pension expenditures fall throughout the transition period and by over 4.6 per cent in the long run.

There are several important indirect effects associated with the superannuation changes. First, households will alter their saving, labour supply and consumption behaviour throughout their lifetimes in response to the increased future superannuation payouts. Ignoring general equilibrium effects upon variables such as the wage rate and the consumption tax rate for the present, households observe that increased contributions to their superannuation funds (through possibly both policy changes) will mean a greater superannuation payout upon reaching the vesting age of 60 years. Specifically, there is now less incentive to undertake private saving, with especially higher income households offsetting their private savings prior to the superannuation payout age. Also, the superannuation changes have opposing substitution and income effects on life-cycle labour supply and consumption choices, as already discussed in Section 2. The simulation results reported below indicate that, in the medium run (i.e., in 2030), the substitution effect dominates resulting in higher per capita labour supply, while in the long run it is the stronger income effect of larger superannuation assets that causes per capita labour supply to fall. The income effect is significant especially after households receive their superannuation, which reduces their labour supply at older ages.

Second, there will be general equilibrium and inter-temporal effects of the superannuation policy changes that impact households, firms and the government. Of special importance to households are the impacts via changes in the wage rate and consumption tax rate. Given our model specification, the market wage rate received by households falls in the long run due to the increased SG rate, and the consumption tax rate will increase to maintain a balanced government budget. Both impact the life-cycle decisions

\textsuperscript{15}Specifically, the contribution rate is to be increased by 0.25 percentage points in 2013 and 2014, followed by annual increases of 0.50 percentage points until 2019.
of households. In addition, the redistribution of increased asset holdings from older genera-
tions to younger households through accidental bequests strengthens the income effect on
their labour supply.

Third, the macroeconomic variables and, hence, the household life-cycle effects of the
superannuation policy change will vary over the transition path from the initial steady
state to the new steady state. The increased contributions policy is to be phased in
gradually and, additionally, households of different generations will be differently affected.
As households age and new households emerge, choices will change over time leading to
general equilibrium effects that also change. Thus, the transition path embodies complex
movements and changing behavioural responses to market variables. Our discussion below
attempts to address the more salient features of these three aspects of the responses to
the superannuation policy changes.

Overall, although the government’s pension expenditures fall as a result of the super-
avnuation reform, income taxes decrease (due to lower labour earnings as a result of the
wage drop and lower investment earnings caused by the superannuation offset) and have
to be compensated through an increase in the consumption tax rate. This tax increase is
responsible for the elderly not directly affected by the reform being worse off. However,
welfare improves for future generations because of the concessional superannuation tax
treatment enjoyed by all income quintiles. Lower income households no longer face the
15 per cent contribution tax while higher income types are on marginal income tax rates
well above the concessional superannuation taxes.

5.2 Macroeconomic effects

The superannuation reform alters households’ consumption, labour supply and saving
decisions, as indicated above. These decisions will affect the labour and output markets
and capital formation in our general equilibrium framework. Furthermore, changes in
tax payments and pension receipts by households will impact the government budget,
which requires, under our assumptions, adjustments in the consumption tax rate. In this
subsection, we provide some details on these macroeconomic and fiscal implications of
the superannuation reform.

Table 3 reports the macroeconomic effects for each component of the superannuation
reform and for the reform as a whole. The results are presented as percentage changes in
the selected per capita variables in the selected years of the transition and in the long run.
We first discuss the long run implications of the policy reforms and then turn attention
to transition path implications.

Insert Table 3 around here

5.2.1 Long run implications

The long run implications of the superannuation reform as a whole for selected variables
are provided in the last column of Table 3. For the production sector, we observe that
the policy reform results in a 1.25 per cent fall in the labour supply, capital stock and
output levels. Given our specification of a linearly homogeneous production function, the
exogenously given interest rate effectively determines the capital-labour ratio and, hence,
the marginal products of capital and labour.\footnote{The total wage rate is set by profit maximising firms to the marginal product of labour, which, under the constant return to scale assumption for the production function, depends on the capital-labour ratio. This, combined with small open economy property of our model, implies that the capital labour ratio in the long run is determined by the exogenous interest rate and the production function parameters. Thus, the capital labour ratio, the marginal products of labour and capital and the total wage rate are unchanged in the long run.} Thus, in the long run, labour, capital and output move in unison.

Also, the SG rate creates a wedge between the market wage rate received by households \((w_t)\) and the total wage rate faced by firms \((w_t(1 + cr))\), which is equal to the marginal product of labour. Since the latter is unchanged, as just mentioned, the wage rate received by households falls (by 2.68 per cent) in the long run in response to an increase in \(cr\). Thus, households receive lower market wages but with the promise of a greater superannuation payout at age 60 years, providing an income effect. They are also cognisant of the possibility of increasing the payout by working longer, giving a price effect of the reform to labour supply by changing the net price of labour to the household in each year of working life. This price effect can, as well known and as discussed in the previous section, be decomposed into a pure substitution effect and an income effect. These two effects arising from the superannuation policy changes - income and substitution - have impacts upon life-cycle decisions of households.

To aid the interpretation of the macroeconomic impacts, Figure 1 provides plots of the average life-cycle profiles for several variables (consumption, labour supply, total assets, private assets and pension payments) in the benchmark steady state and the new steady state arising from the superannuation policy change. The simulated response of households is to, on average, slightly increase labour supply when very young (thus yielding long run income and asset gains due to the compound interest effect) and to reduce labour supply more significantly when older, particularly following the superannuation payout at age 60 years. Panel (a) of Figure 1 shows a significant reduction in labour supply in the years between receipt of superannuation and eligibility for the age pension (60-65 years of age), but also in the post pension eligibility period (65 years and beyond). The result is a long run reduction in labour supply of almost 1.25 per cent, due to the stronger income effect arising from larger superannuation assets.\footnote{Creedy and Guest (2008b) examine the abolition of the concessional contribution tax rate, which should have similar effects to the higher SG rate policy. However, they find higher aggregate labour supply over the entire transition and in the long run. Several differences between the two models may account for the divergent labour supply effects. First, their use of transfer payments to balance the government budget effectively eliminates the income effect of the contribution tax removal on labour supply. Second, their model abstracts from life uncertainty and accidental bequests, whereas increased bequests from larger assets held by older generations strengthen the income effect on labour supply in our model. Third, households in their model face no borrowing constraints. Allowing households to borrow against their future superannuation payouts in our framework would generate larger superannuation offsets and, thus, weaken the income effect.} The income effect also brings forward full retirement for higher income households by about one year in the long run, which is supported by empirical evidence of Buetler \textit{et al.} (2005).

\textbf{Insert Figure 1 around here}\n
On the other hand, as shown in panel (b) of Figure 1, the income effect of greater superannuation payouts upon consumption profiles is the mirror image of that for labour supply. That is, the income effect dominates and encourages households to reduce consumption at younger ages and to increase consumption more significantly at older ages,
meaning beyond age 60 years. As a result, aggregate consumption rises by 1.22 per cent in the long run. The long run increase in average consumption (a measure of living standards) results from greater household retirement consumption, which outweighs lower consumption of younger households facing higher consumption taxes and lower market wages.

As expected, the reform leads to large increases in superannuation assets, with the increases arising primarily from the higher SG contribution rate. The share of superannuation assets in the total assets increases from 52 per cent in the initial steady state equilibrium to almost 60 per cent in the new steady state equilibrium. Panel (c) if Figure 1 shows the average life-cycle effects upon total and private assets, indicating that households accumulate a smaller amount of private assets in anticipation of higher superannuation assets after age 60 years. Although some of the increases in superannuation assets are offset through decreases in ordinary non-superannuation assets, domestic total assets are over 18 per cent larger in the long run as a result of the superannuation reform, indicating positive and significant reform effects on household saving. These large increases in total assets and household saving correspond with the finding of some papers on voluntary tax-favoured retirement accounts (e.g., Imrohoroglu et al., 1998) and Fehr et al., 2008). Since the physical capital stock declines in the long run by 1.25 per cent, the increase in total domestic assets is exported abroad, leading to a significant reduction (of 82.1 per cent) in net foreign debt in the long run.

Of particular interest is the effect of the superannuation reform on the government’s age pension expenditures. Our model incorporates the main aspects of the age pension means test, so the increase in superannuation assets is expected to lead to fewer households accessing the age pension (extensive margin impact) and/or households drawing a lower pension in view of higher household interest income and assets causing the income and assets tests to bind more stringently (intensive margin impact). These impacts are observed by examination of age profiles for pension payments for the different quintiles; the lowest quintile households remain on the full age pension, but the other quintile households reduce dependence by receiving lower payments and move onto the full pension later as a result of the reform (see panel (d) of Figure 1 for the average life-cycle impact). The results in the last column of Table 3 indicate that overall reliance of eligible households on the age pension declines as a result of increased superannuation savings, leading to greater private incomes and assets in retirement. In the long run, per capita age pension expenditures decrease by 4.65 per cent due to the means testing of larger private incomes and assets. The reduced pension expenditures imply smaller total government expenditures and revenues as we assume a balanced government budget with constant public consumption.

On the revenue side of the budget, personal income tax receipts represent the largest component of tax revenue. These tax receipts decline significantly, caused by decreases in all sources of the personal income taxation. The investment income decreases due to smaller private assets of households aged younger than 60 years and the fall in the market wage rate lowers labour earnings. Superannuation tax revenues are 18.43 per cent greater in the long run due to the higher SG rate policy and the resulting large increases in superannuation assets. Although pension expenditures by the government decline, the

\[18\] The increases in the domestic assets and saving would be significantly smaller if we allow borrowing against future superannuation. Creedy and Guest (2008b), using a model with liquidity unconstrained households, even find a small reduction in the saving rate as a result of the contribution tax removal.
consumption tax rate, which balances the government budget in our framework, rises by about 7.9 per cent in the long run to offset lower revenues from the personal income taxation.

5.2.2 Transition path implications

Table 3 shows the changes in selected variables arising from the policy reform for several selected years to give some indication of the nature of the transition path from the initial to the new steady state. From an examination of the results in Table 3, it is apparent that the changes in the variables differ over the transition path and that the nature of their time paths also differ.

The implications for per capita labour supply is determined by the interaction of the opposing income and substitution effects on labour supply of households distinguished by age and income type (for explanation of these two effects see Section 2). Table 3 shows that the impact (or announcement) effect of the reform as a whole on per capita labour supply is negative, with effective labour supply declining by 0.25 per cent in 2010. This decrease is due to lower labour supply of mainly younger households that reduce their working hours prior to gradual increases in the mandatory SG rate. The impact reduction on labour supply just noted leads to an increase in the market wage rate and, due to the fixed capital stock, to a small initial reduction in output. The lower labour supply and output level lead to lower incomes and government taxation revenues that require an immediate increase of 1.41 per cent in the consumption tax rate to maintain the government balanced budget. These impact effects arise largely from households altering their life-cycle behaviour in anticipation of the announced policy changes to take place in 2013 and beyond.

While the transition paths for quantities like consumption, labour supply, capital and output do not exhibit a monotone adjustment from the initial to the new steady state values, the transition paths for most value variables and the consumption tax rate do show a monotone adjustment. The notable exception is the taxation revenue from superannuation, which initially declines and then rises to a long run level 18.43 per cent higher than its initial level. The medium and long run higher levels are due to the large increases in superannuation contributions that begin to take place in 2013 and then gradually increase. The initial drop in superannuation taxation revenue is due to low initial labour supply (hence lower total contributions at the old contribution rate) and the subsequent removal of the contributions tax for low income households.

For other variables, such as government pension expenditures and income taxes, we observe small reductions upon impact that gradually get larger over time and end up 4.65 and 5.10 per cent lower in the long run than in the initial steady state. The decline in pension expenditure largely correlates with the increase in superannuation assets, mitigated by the reduction in incomes. Overall, if the purpose of the superannuation policy was to reduce reliance of households on the age pension then it must be judged a success. Clearly, the impact and subsequent reductions in taxation receipts exceeding the reductions in pension payments has required the government (in the model) to raise the consumption tax rate to maintain a balanced budget.

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19 The focus here is placed on the higher SG rate policy as the superannuation tax policy change has a minimal impact on per capita labour supply.
5.2.3 Components of the policy reform

The previous discussion has focused upon the superannuation policy reform as a whole. However, it is clear from the results presented in Table 3 that the two components of this reform - the increase in the superannuation contribution rate for all households and the removal of the superannuation contribution tax for low income households - have quite distinct impacts.

Concentrating, for simplicity of exposition, upon long run effects, it is apparent from a comparison of the simulation results in Table 3 for the two separate policies and the policy as a whole that the contribution tax removal policy component has rather small effects. Accordingly, the full policy impacts are largely driven by the increased contribution rate component. Perhaps, as expected, the superannuation contribution tax removal for low income households results in only a modest increase in superannuation assets (3.16 per cent compared to 30.37 per cent for the other policy component), since these households have low labour earnings and correspondingly low contributions. Hence, the tax relief contributes little to net contributions. On the other hand, the impact of this tax relief upon superannuation tax receipts by government is more substantial, and is for a 8.16 per cent fall, which, by itself, requires the consumption tax rate to rise by 2.19 per cent to balance the government budget. In short, the tax relief component of the superannuation policy contributes only modestly to superannuation assets, but creates a more substantive reduction in tax revenue for the government that negates some of the substantial increases in tax revenue arising from the second policy component (increasing the contributions rate) and thereby contributing to a much higher consumption tax rate.

5.3 Welfare and efficiency effects

We use equivalent variation measures to calculate the distributional welfare effects of the reform. These welfare calculations measure the proportional percentage increase in consumption and leisure for each generation that is needed in the benchmark scenario to produced the realised remaining lifetime utility in the reform scenario (for more detailed information, see Auerbach and Kotlikoff, 1987, p. 87).

Table 4 reports the distributional welfare effects that are labelled as "Without LSRA" for each superannuation policy change and the reform as a whole. The effects are presented as percentage changes in remaining utility for different cohorts at the time of the policy announcement (i.e., inter-generational effects) and for the five income classes (i.e., intra-generational effects). Several observations can be drawn from these results. First, the reform package has negative impact on welfare of older cohorts that no longer participate in workforce and, therefore, do not receive any SG contributions. Second, younger cohorts of the two lower quintile income types accumulate superannuation assets and so attain higher welfare as a result of the reform, an outcome that is crucially dependent upon the removal of the contribution tax for these households. In fact, future generations of the second quintile gain the most in welfare, with a long run welfare increase of 0.49 per cent. Third, younger and future born generations of higher income quintiles also attain

\[\text{Note that the youngest generation at the time of the policy announcement is aged 21 years. All generations aged 20 years and younger are born in the succeeding years of the transition. The results for the generation aged -80 in year 2010 approximate the long run welfare effects.}\]
higher welfare, an outcome that is driven solely by the increased SG contribution rate.\textsuperscript{21}

Fourth, younger cohorts of the third quintile experience welfare gains due mainly to the higher SG contribution rate but also due to the contribution tax removal.\textsuperscript{22}

Insert Table 4 around here

Clearly, an important objective of the superannuation tax change is to extend superannuation tax concessions to low income earners and thus to improve the vertical equity of the superannuation system. The abolition of the 15 per cent contribution tax rate for low income households is essential for them to gain in welfare as a result of the superannuation reform. As depicted in Table 4, the higher SG contribution rate policy alone would increase welfare only for higher income groups, while lower income groups with no preferential tax treatment of their superannuation would suffer from welfare losses because of the reduction in the market wage rate and the increased consumption tax rate that compensates for higher superannuation tax concessions.

The discussion of the welfare implications above has revealed that while some generations and income classes would gain others would lose in welfare. To provide overall assessment of the superannuation reform changes, we calculate an aggregate efficiency effects by applying a hypothetical Lump Sum Redistribution Authority [LSRA] (see, for example, Auerbach and Kotlikoff (1987) and Nishiyama and Smetters, 2005). The LSRA restores utility of households alive at the time of the policy announcement through lump-sum transfers or taxes and raises or reduces lifetime utility of all future born generations by a uniform amount. In the case of an increase in lifetime utility of future born generations, the given policy change generates efficiency gains and is potentially Pareto improving.\textsuperscript{23} Table 4 shows that the 2010 superannuation reform is potentially Pareto improving, generating an aggregate efficiency gain of almost 0.8 per cent or $11,753 in initial resources for each future generation, arising almost entirely from the increased mandatory SG rate.

6 Robustness checks

Robustness checks of the macroeconomic and welfare impacts of the superannuation reform to two alternative assumptions of the model were undertaken. The model modifications include an alternative policy instrument to balance the government budget and endogenising the domestic interest rate.

Tables 5 and 6 report the percentage point deviations between the reform impacts obtained under each alternative model assumption and those obtained using the baseline model reported above for selected macroeconomic variables and welfare measures, respectively. For brevity, these robustness checks are discussed only for the superannuation reform as a whole.

\textsuperscript{21}These households are on marginal tax rates of well above the 15 per cent contribution tax.

\textsuperscript{22}Only a few cohorts of the third quintile earn below $37,000 per year and thus face no contribution tax. These are of very young ages and just before the access age of 60 years.

\textsuperscript{23}A more common technique is to simply sum up welfare changes across generations with weights assign to the utility of different generations. As pointed out in Nishiyama and Smetters (2005), this standard welfare function approach implicitly assumes that lump-sum transfers are made across households in order to compensate the losers of policy reform with some of the gains of the winners, but it fails to capture the price effects and behavioural changes associated with these lump-sum transfers.
6.1 Income tax adjustments balancing the budget

In the first model variation, the budget-balancing consumption tax rate is now assumed to be fixed and the government budget is balanced by proportionally raising or lowering the personal income taxation schedule. A change in the current GST rate of 10 per cent seems politically unlikely, while changes to the personal income tax schedule have often been implemented. Moreover, the two tax instruments have potentially different incentive effects upon households and, hence, upon the economy.

The change from consumption to the income tax rate as the budget equilibrating policy instrument decreases the incentive to work by reducing the after-tax wage rate. As a consequence, the long run aggregate labour supply falls by a further 0.472 percentage points as a result of the policy reform, as indicated in Table 5. Under our model assumption of a fixed world interest rate, the long run capital stock and output are also adversely affected by the same amount. The alternative income tax policy instrument is also less favorable for household consumption, with the long run increase being 0.69 percentage points smaller. While reductions in age pension expenditures are 0.389 percentage points smaller compared to those presented in Section 5, they are still significant, confirming improved self-funding for many households in retirement.

The welfare and efficiency implications reported in Table 6 indicate that older retired generations (e.g., those aged 80 years in 2010) are better off under the income tax adjustment rule as they then face low or no income taxes and are spared an increase in the consumption tax rate. For similar reasons, the long run welfare gains for lower income households are also greater when income tax changes are used to balance the budget. In contrast, increases in income tax rates adversely affect especially higher income earners. Overall, the second last column of Table 6 reveals a 0.254 percentage point lower efficiency gain compared to the gains presented under the alternative consumption tax instrument in Section 5.

6.2 Endogenous domestic interest rate

The base model made the assumption that the domestic interest rate was equal to the exogenously given world interest rate. To examine the implications of relaxing this assumption, we now assume that the domestic interest rate is endogenous and depends upon the level of foreign debt. Specifically, we now assume that the domestic interest rate is determined as \( r_t = \pi + \gamma (FD_t / Y_t - FD_{2010} / Y_{2010}) \), where \( \pi \) is the exogenous world interest rate, \( FD_t / Y_t \) is the ratio of net foreign debt to output and the parameter \( \gamma > 0 \) gives responsiveness to the changes in \( FD_t / Y_t \). Following Guest (2006), we set \( \gamma \) to 0.02. Under this specification, the domestic interest rate will rise if the ratio of net foreign debt to output increases. This assumption of an endogenous domestic interest rate implies that the capital labour ratio and the total wage rate faced by firms will now change in the long run as well as during the transition. Hence, long run changes in the capital stock, labour supply and output will differ.\(^{24}\)

\(^{24}\)This would also occur in a closed economy. Similar results to ours reported below are obtained by Fehr et al. (2008) who, using a closed economy OLG model, show that the introduction of voluntary
The results in Table 5 indicate that the macroeconomic impacts of the superannuation reform are very sensitive to changes in the assumption concerning the interest rate. Under the baseline assumption of a constant interest rate, the superannuation reform yielded a large reduction in net foreign debt arising from a large increase in superannuation assets. Under the alternative assumption, the now endogenous long run domestic interest rate falls by over 6.6 per cent. The lower interest rate drives larger investment, leading to a long run capital stock that is almost 6.43 percentage points higher than under the fixed interest rate assumption. The capital stock actually increases as a result of the superannuation reform, while labour supply falls only marginally. Consequently, the level of economic activity in the economy, as measured by capital stock and output, increases due to the policy reform, in contrast with a reduction under the fixed interest rate assumption.

Table 6 shows that long run welfare gains from the reform are substantially higher for all income classes, due primarily to relatively higher wages and lower consumption taxes under an endogenous interest rate. There is also an increase in the aggregate efficiency gain by 0.129 percentage points compared to the fixed interest rate case, indicating that larger discounted welfare gains in the long run outweigh slightly higher welfare losses in the short run.

6.3 Summary

The above robustness tests indicate that the general thrust of the superannuation reform, in terms of generating higher superannuation assets and lower age pension expenditures remains intact. However, these alternative assumptions lead to different impacts upon incentives that generate some differences in distributional and macroeconomic outcomes. Although not reported here, we also examined the sensitivity of our results to the presence of the recently legislated gradual increase in the eligibility age for the age pension and for projected changes in the age structure of the population. Again, while there are some differences in macroeconomic and welfare impacts, the superannuation reform continues to yield greater private assets, lower pension expenditures and overall welfare gains.

7 Concluding remarks

The Australian government’s 2010 reform to the mandatory superannuation scheme represents a major change in Australia’s retirement policy landscape. Under this reform, the gradual increases in the mandatory SG contribution rate from 9 to 12 per cent of labour earnings and the policy that effectively removes the 15 per cent tax on mandatory contributions for low income households are expected to boost the superannuation benefits of working Australians and to reduce reliance upon the age pension upon retirement. Given the extent of the policy change, it is also likely to have important macroeconomic impacts. To provide an account of the potential consequences of this superannuation reform, this paper has reported and discussed the results of a simulation of the major policy changes of the reform using a dynamic general equilibrium OLG model of the Australian economy.

tax-favored retirement accounts would significantly increase total assets, capital stock and output and lower the interest rate in the long run.
Based on our simulations, we find that the superannuation reform would significantly increase superannuation assets, leading to larger domestic total assets and saving. Self-funding of households in retirement would improve, with overall reliance on the age pension decreasing due to the means testing of greater retirement assets and private incomes. Larger total assets would increase long run per capita consumption, but would also reduce per capita labour supply and the retirement age for higher income households by one year. We have also found the superannuation reform to be potentially Pareto improving, producing an aggregate efficiency gain of $11,753 in initial resources for each future born household. The increased mandatory SG contribution rate policy has been shown to be the dominant policy change, while the main effects of the supporting policy of the contribution tax change were to extend the superannuation tax concessions to low income households and thus to improve fairness of the superannuation system.

The sensitivity analysis undertaken has revealed that the direction of impacts of the superannuation policy change was largely unaffected by using income tax rates rather than the consumption tax rate to maintain a balanced government budget, though the sizes of some of these impacts were changed to some degree. In particular, use of income tax rates to balance the government budget would provide disincentives for households to supply labour due to higher income tax rates, with the superannuation reform generating less favorable outcomes for average labour supply and consumption and for welfare of higher income quintiles. However, while it is still the case that the government’s age pension expenditures fall, that superannuation assets increase and that welfare increases when the domestic interest rate is permitted to be endogenous, the impact of the reform on some important macroeconomic variables is quite different under this alternative model assumption. Under a flexible interest rate, the superannuation reform leads to an interest rate fall that encourages capital deepening and higher wages that enhance the labour supply. Thus, the economy expands in contrast to the case when the interest rates is fixed.

It is important to note that the model considers only mandatory contributions to superannuation and so ignores other concessional contributions such as those arising through salary sacrificing arrangements. Salary sacrifice contributions, which together with mandatory contributions are subject to the annual limit, are often made by, especially, higher income earners and older households. Increases in the mandatory superannuation guarantee contribution rate by employers could encourage some households to reduce their other concessional contributions. If this is the case, total superannuation asset increases would be less than we have calculated and the results obtained in our simulations would need to be qualified.

References


FIGURE 1
Average Life Cycle Long Run Responses to the Superannuation Reform

(a) Labour supply
(b) Consumption
(c) Private and total assets
(d) Age pension
### TABLE 1

**Values of Key Parameters of Benchmark Steady State Model**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n$</td>
<td>Population growth rate</td>
<td>0.017</td>
<td>Calibrated[a]</td>
</tr>
<tr>
<td>$\omega_i$</td>
<td>Fraction of households of income group $i$</td>
<td>All 0.2</td>
<td>Data[b]</td>
</tr>
<tr>
<td>$s_a$</td>
<td>Conditional survival probabilities</td>
<td>ABS (2010a)</td>
<td>Data</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>Inter-temporal elasticity of substitution</td>
<td>0.35</td>
<td>Literature[c]</td>
</tr>
<tr>
<td>$\rho$</td>
<td>Intra-temporal elasticity of substitution</td>
<td>0.9</td>
<td>Literature[c]</td>
</tr>
<tr>
<td>$\beta$</td>
<td>Subjective rate of time preference</td>
<td>0.014</td>
<td>Calibrated</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>Leisure intensity parameter</td>
<td>1.4</td>
<td>Literature[c]</td>
</tr>
<tr>
<td>$\kappa$</td>
<td>Production constant</td>
<td>0.885</td>
<td>Calibrated</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>Elasticity of substitution in production</td>
<td>0.939</td>
<td>Calibrated</td>
</tr>
<tr>
<td>$\varepsilon$</td>
<td>Capital share</td>
<td>0.450</td>
<td>Calibrated</td>
</tr>
<tr>
<td>$\delta$</td>
<td>Depreciation rate</td>
<td>0.073</td>
<td>Calibrated</td>
</tr>
<tr>
<td>$\psi$</td>
<td>Adjustment cost parameter</td>
<td>10</td>
<td>Literature[d]</td>
</tr>
<tr>
<td>$\bar{\tau}^c$</td>
<td>Statutory consumption tax rate [GST]</td>
<td>0.1</td>
<td>Data</td>
</tr>
<tr>
<td>$\bar{\tau}^f$</td>
<td>Statutory corporation tax rate</td>
<td>0.3</td>
<td>Data</td>
</tr>
<tr>
<td>$\nu^c$</td>
<td>Consumption tax base parameter</td>
<td>0.704</td>
<td>Calibrated[c]</td>
</tr>
<tr>
<td>$\nu^f$</td>
<td>Corporation tax base parameter</td>
<td>0.866</td>
<td>Calibrated[e]</td>
</tr>
<tr>
<td>$p$</td>
<td>Maximum pension per year (in $100,000)</td>
<td>0.174694</td>
<td>Data</td>
</tr>
<tr>
<td>$IT$</td>
<td>Income test threshold (in $100,000)</td>
<td>0.03976</td>
<td>Data</td>
</tr>
<tr>
<td>$\theta$</td>
<td>Assets test threshold (in $100,000)</td>
<td>3.07</td>
<td>Data</td>
</tr>
<tr>
<td>$AT$</td>
<td>Income reduction (taper) rate</td>
<td>0.5</td>
<td>Data</td>
</tr>
<tr>
<td>$\phi$</td>
<td>Assets reduction (taper) rate</td>
<td>0.039</td>
<td>Data</td>
</tr>
<tr>
<td>$cr$</td>
<td>Mandatory superannuation contribution rate</td>
<td>0.09</td>
<td>Data</td>
</tr>
<tr>
<td>$\tau^s$</td>
<td>Superannuation contribution tax rate</td>
<td>0.15</td>
<td>Data</td>
</tr>
<tr>
<td>$\tau^r$</td>
<td>Superannuation earnings tax rate</td>
<td>0.071</td>
<td>Data[f]</td>
</tr>
</tbody>
</table>

**Notes:**
[a] The population growth rate is calibrated such that it together with survival probabilities generates the old age dependency ratio of 0.2;[b] Each generation is divided into income quintiles based on ABS (2007);[c] The values of these parameters are similar to those in Auerbach and Kotlikoff (1987);[d] This value is taken from Auerbach and Kotlikoff (1987);[e] The products of the tax base parameters and the statutory consumption and corporation tax rates give the effective consumption and corporation tax rates of 7.04 and 25.9 per cent, respectively;[f] This is roughly a value for the effective tax rate on superannuation earnings.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Benchmark Model</th>
<th>Australia 2006-10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expenditures on GDP (percent of GDP)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Private consumption</td>
<td>55.27</td>
<td>56.22</td>
</tr>
<tr>
<td>- Investment</td>
<td>27.03</td>
<td>27.38</td>
</tr>
<tr>
<td>- Government consumption</td>
<td>15.78</td>
<td>17.88</td>
</tr>
<tr>
<td>- Trade balance</td>
<td>1.93</td>
<td>-1.30</td>
</tr>
<tr>
<td><strong>Government indicators (percent of GDP)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Age pension expenditure</td>
<td>2.78</td>
<td>2.70</td>
</tr>
<tr>
<td>- Personal income taxes</td>
<td>12.41</td>
<td>11.49</td>
</tr>
<tr>
<td>- Corporation taxes</td>
<td>5.27</td>
<td>5.27</td>
</tr>
<tr>
<td>- Consumption taxes (GST revenue)</td>
<td>3.89</td>
<td>3.89</td>
</tr>
<tr>
<td>- Superannuation taxes</td>
<td>1.14</td>
<td>0.80</td>
</tr>
<tr>
<td><strong>Targeted calibration ratios</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Capital-output ($K/Y$)</td>
<td>3.00</td>
<td>3.00</td>
</tr>
<tr>
<td>- Investment-capital ($I/K$)</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td>- Foreign debt-capital ($FD/K$)</td>
<td>0.195</td>
<td>0.195</td>
</tr>
<tr>
<td><strong>Net income share</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Lowest quintile</td>
<td>0.070</td>
<td>0.075</td>
</tr>
<tr>
<td>- Second quintile</td>
<td>0.126</td>
<td>0.125</td>
</tr>
<tr>
<td>- Third quintile</td>
<td>0.185</td>
<td>0.171</td>
</tr>
<tr>
<td>- Fourth quintile</td>
<td>0.242</td>
<td>0.229</td>
</tr>
<tr>
<td>- Highest quintile</td>
<td>0.377</td>
<td>0.401</td>
</tr>
<tr>
<td>Gini coefficient</td>
<td>0.324</td>
<td>0.326</td>
</tr>
</tbody>
</table>


*Notes:* The data for Australia are five year averages over the period ending in June 2010.
### Table 3

**Macroeconomic Implications of Superannuation Policy Changes**

(Percentage Changes in the Selected Macroeconomic Variables from the Initial Steady State Solution)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Initial SS solution</th>
<th>(i) Gradual increases in the mandatory SG rate</th>
<th>(ii) Contribution tax removal for low income groups</th>
<th>(iii) Superannuation reform as a whole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour supply</td>
<td>0.4084</td>
<td>%</td>
<td>-0.21</td>
<td>0.16</td>
</tr>
<tr>
<td>Wage rate</td>
<td>1.0000</td>
<td>%</td>
<td>0.10</td>
<td>-0.91</td>
</tr>
<tr>
<td>Capital stock</td>
<td>2.3133</td>
<td>%</td>
<td>0.00</td>
<td>0.16</td>
</tr>
<tr>
<td>Domestic assets</td>
<td>1.8629</td>
<td>%</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>- Ordinary private</td>
<td>0.9450</td>
<td>%</td>
<td>0.00</td>
<td>-0.22</td>
</tr>
<tr>
<td>- Superannuation</td>
<td>0.9705</td>
<td>%</td>
<td>0.00</td>
<td>0.21</td>
</tr>
<tr>
<td>Foreign debt</td>
<td>-0.4504</td>
<td>%</td>
<td>0.95</td>
<td>2.21</td>
</tr>
<tr>
<td>Output (GDP)</td>
<td>0.7702</td>
<td>%</td>
<td>-0.12</td>
<td>0.16</td>
</tr>
<tr>
<td>- Consumption</td>
<td>0.4257</td>
<td>%</td>
<td>-0.10</td>
<td>-0.13</td>
</tr>
<tr>
<td>Pension expenditures</td>
<td>0.0215</td>
<td>%</td>
<td>-0.02</td>
<td>-0.05</td>
</tr>
<tr>
<td>Total tax revenues</td>
<td>0.1749</td>
<td>%</td>
<td>0.00</td>
<td>-0.01</td>
</tr>
<tr>
<td>- Personal income</td>
<td>0.0955</td>
<td>%</td>
<td>-0.22</td>
<td>-1.07</td>
</tr>
<tr>
<td>- Superannuation</td>
<td>0.0088</td>
<td>%</td>
<td>-0.07</td>
<td>6.54</td>
</tr>
<tr>
<td>Consumption tax rate</td>
<td>0.1000</td>
<td>%</td>
<td>1.46</td>
<td>1.80</td>
</tr>
</tbody>
</table>

*Notes: The monetary values of the initial steady state solution (rounded to 4 decimal places) are expressed in units of $100,000 and per capita.*
### TABLE 4

**Welfare Implications of Superannuation Policy Changes**  
*(Percentage Changes in Welfare from the Initial Steady State Solution)*

<table>
<thead>
<tr>
<th>Policy change</th>
<th>Age in 2010</th>
<th>Without LSRA [a] Household income type</th>
<th>With LSRA for all types [b]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lowest</td>
<td>Second</td>
<td>Third</td>
</tr>
<tr>
<td>(i) Gradual increases in the SG rate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>-0.045</td>
<td>-0.045</td>
<td>-0.044</td>
</tr>
<tr>
<td>60</td>
<td>-0.067</td>
<td>-0.065</td>
<td>-0.062</td>
</tr>
<tr>
<td>40</td>
<td>-0.103</td>
<td>-0.080</td>
<td>-0.031</td>
</tr>
<tr>
<td>20</td>
<td>-0.140</td>
<td>-0.059</td>
<td>0.080</td>
</tr>
<tr>
<td>-20</td>
<td>-0.081</td>
<td>-0.035</td>
<td>0.185</td>
</tr>
<tr>
<td>-80</td>
<td>-0.103</td>
<td>-0.057</td>
<td>0.161</td>
</tr>
<tr>
<td>(ii) Removal of contribution tax for low income groups</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>-0.047</td>
<td>-0.047</td>
<td>-0.046</td>
</tr>
<tr>
<td>60</td>
<td>-0.043</td>
<td>-0.033</td>
<td>-0.047</td>
</tr>
<tr>
<td>40</td>
<td>0.125</td>
<td>0.166</td>
<td>-0.038</td>
</tr>
<tr>
<td>20</td>
<td>0.252</td>
<td>0.316</td>
<td>0.030</td>
</tr>
<tr>
<td>-20</td>
<td>0.317</td>
<td>0.348</td>
<td>0.062</td>
</tr>
<tr>
<td>-80</td>
<td>0.317</td>
<td>0.348</td>
<td>0.062</td>
</tr>
<tr>
<td>(iii) Reform as a whole</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>-0.099</td>
<td>-0.098</td>
<td>-0.097</td>
</tr>
<tr>
<td>60</td>
<td>-0.123</td>
<td>-0.111</td>
<td>-0.120</td>
</tr>
<tr>
<td>40</td>
<td>0.038</td>
<td>0.117</td>
<td>-0.077</td>
</tr>
<tr>
<td>20</td>
<td>0.139</td>
<td>0.337</td>
<td>0.104</td>
</tr>
<tr>
<td>-20</td>
<td>0.312</td>
<td>0.507</td>
<td>0.301</td>
</tr>
<tr>
<td>-80</td>
<td>0.293</td>
<td>0.488</td>
<td>0.280</td>
</tr>
</tbody>
</table>

*Notes:* [a] Standard equivalent variations measures in %; [b] Measured as both percentage and dollar gains in initial resources.
<table>
<thead>
<tr>
<th>Variable</th>
<th>(i) Income Tax Changes Balancing Government Budget</th>
<th>(ii) Endogenous Domestic Rate of Interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour supply</td>
<td>0.085</td>
<td>-0.291</td>
</tr>
<tr>
<td>Wage rate</td>
<td>-0.038</td>
<td>0.072</td>
</tr>
<tr>
<td>Capital stock</td>
<td>0.000</td>
<td>-0.128</td>
</tr>
<tr>
<td>Domestic assets</td>
<td>0.000</td>
<td>-0.060</td>
</tr>
<tr>
<td>Foreign debt</td>
<td>-0.967</td>
<td>-1.333</td>
</tr>
<tr>
<td>Output (GDP)</td>
<td>0.049</td>
<td>-0.222</td>
</tr>
<tr>
<td>Consumption</td>
<td>0.002</td>
<td>-0.095</td>
</tr>
<tr>
<td>Pension expenditures</td>
<td>0.013</td>
<td>0.056</td>
</tr>
<tr>
<td>Interest rate</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Consumption tax rate</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Income tax adjustments</td>
<td>0.214</td>
<td>1.889</td>
</tr>
</tbody>
</table>
TABLE 6
Sensitivity of Welfare Effects of Superannuation Reform to Alternative Assumptions
(Percentage Point Changes from Baseline Welfare Results of Superannuation Reform)

<table>
<thead>
<tr>
<th>Alternative Assumptions</th>
<th>Age in 2010</th>
<th>Without LSRA (a) Household Income type</th>
<th>With LSRA for all types (b)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lowest</td>
<td>Second</td>
<td>Third</td>
</tr>
<tr>
<td>(i) Income Tax Changes</td>
<td>80</td>
<td>0.041</td>
<td>0.051</td>
</tr>
<tr>
<td>Balancing Government</td>
<td>60</td>
<td>0.056</td>
<td>0.063</td>
</tr>
<tr>
<td>Budget</td>
<td>40</td>
<td>0.089</td>
<td>0.071</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>0.098</td>
<td>0.068</td>
</tr>
<tr>
<td></td>
<td>-20</td>
<td>0.099</td>
<td>0.063</td>
</tr>
<tr>
<td></td>
<td>-80</td>
<td>0.097</td>
<td>0.061</td>
</tr>
<tr>
<td>(ii) Endogenous</td>
<td>80</td>
<td>-0.007</td>
<td>0.002</td>
</tr>
<tr>
<td>Domestic Rate of</td>
<td>60</td>
<td>-0.007</td>
<td>-0.007</td>
</tr>
<tr>
<td>Interest</td>
<td>40</td>
<td>-0.003</td>
<td>-0.018</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>-0.036</td>
<td>-0.044</td>
</tr>
<tr>
<td></td>
<td>-20</td>
<td>0.196</td>
<td>0.212</td>
</tr>
<tr>
<td></td>
<td>-80</td>
<td>0.334</td>
<td>0.348</td>
</tr>
</tbody>
</table>

Notes: [a] Standard equivalent variations measures in %; [b] Measured as both percentage and dollar gains in remaining resources.