Budget Repair Measures: Tough Choices for Australia's Future

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Tough Choices for Australia's Future*

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Abstract

This study quantifies the macroeconomic and welfare effects of three proposed fiscal measures to eliminate Australian government budget deficits and to reduce public debt by 2030, namely: (*i*) temporary income tax hikes; (*ii*) temporary consumption tax hikes (increases in the GST rate); and (*iii*) temporary transfer payment cuts. Our quantitative analysis is based on a computable overlapping generations (OLG) model that is tailored to the Australian economy. The simulation results indicate that all three examined fiscal measures result in favourable long-run macroeconomic and welfare outcomes, but severe adverse consequences during the fiscal consolidation period. Moreover, our results show that cutting transfer payments leads to the worst welfare outcome for all generations currently alive, and especially the poor. Increasing the consumption tax rate results in smaller welfare losses, but compared to raising income taxes, the current poor households pay much larger welfare costs. Overall, the welfare trade-offs between current and future generations, as well as between the rich and poor, highlight key political constraints and point to tough policy choices for the wellbeing of future Australians.

Keywords: Fiscal Deficit, Public Debt, Fiscal Consolidation, Welfare, Overlapping Generations, Dynamic General Equilibrium

JEL Classification: C68, E21, E63, H55, J26, J45

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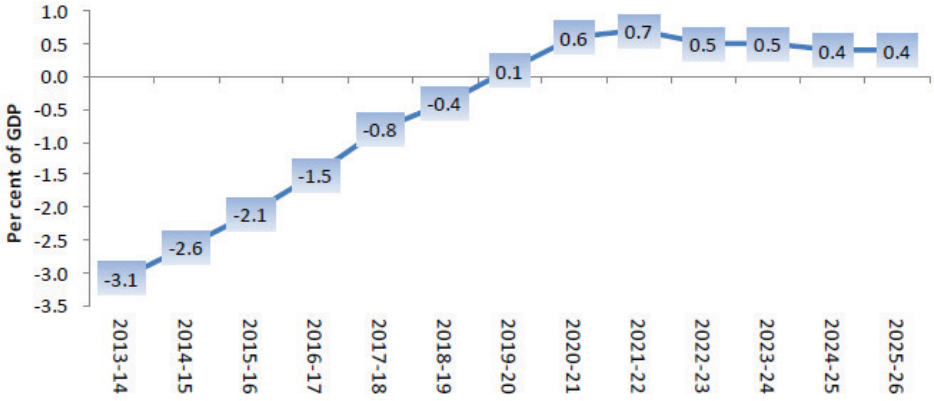
1 Introduction

Recent unfavourable macroeconomic conditions have put the Australian government in a tough fiscal situation with significant budget deficits and rapidly growing public debt.[1] The Australian government is strongly committed to returning its budget to surplus as soon as possible (Australian Government, 2015). A number of fiscal policy measures have been already implemented or proposed to achieve this goal, including temporary tax increases and spending cuts.

According to the government projections in the 2015-16 Federal Budget (Australian Government, 2015), the underlying cash deficit that reached almost 3.1% of GDP in 2013-14 is expected to fall in each and every year over the forward estimates, from $35.1 billion in 2015-16 (2.1% of GDP) to $6.9 billion in 2018-19 (0.4% of GDP). As shown in Figure 1, federal government budget is projected to return to surplus in 2019-20. Modest surpluses, of up to 0.7% of GDP, are expected over the remainder of the medium-term, with a surplus of 0.4% of GDP by the end of the projection period. However, it should be noted that based on the deficit projections in past budgets, there is a significant degree of uncertainty regarding achieving this projected path to budget surpluses.

Figure 1: Budget deficits/surpluses over the course of economic cycle



Notes: The underlying cash balance (budget deficit/surplus) is actual for 2013-14 and projected for the period of 2015-2026 taken from the 20015-16 Budget (Australian Government, 2015).

Undoubtedly, the proposed budget repair measures will have some unpleasant impacts on the economy and wellbeing of Australians. However, ambiguity over potential outcomes

[1] The Australian budget deficit reached almost 3.1% of GDP in 2014 (Australian Government, 2015), being larger than the average budget deficit of 2.5% of GDP across all European countries in that year. More importantly, the deficit is significant for Australia that had an average budget surplus of almost 1% of GDP during 2000-08. Althouth the Australian net government debt is not large by international standards, it is growing very rapidly, increasing from -1.3% of GDP in 2009 to 12.8% of GDP in 2014 (Australian Government, 2015).

of the proposed budget repair measures and disagreement on the timing of these interventions have exacerbated uncertainty and therefore stimulated heated debates among the Australian public and policymakers. More specifically, there are no clear answers to several fundamental questions: What exactly are the macroeconomic effects that would flow from an austerity period? What are the effects on the wellbeing of Australian households? Which households and generations will be the winners or losers and how much will they gain or lose comparatively? Which combination of policy actions are the most preferable - weighing up the macroeconomic effects and the effects on intergenerational and distributional equity?

In this paper, we aim to address these questions in the context of a dynamic general equilibrium, overlapping generations (OLG) framework. In particular, we aim to quantify and compare the economy-wide implications of several budget repair measures to achieve the reductions in the budget deficits plotted in Figure 1. These fiscal policy measures include (*i*) temporary increases in the income taxes, (*ii*) temporary increases in the consumption tax (GST) rate and (*iii*) temporary cuts in the transfer payments.[2] We are especially interested in the welfare implications for different age cohorts and household income types in Australia.

To undertake this quantitative analysis, we employ a small open economy OLG model that is calibrated to the Australian economy. The model comprises overlapping generations of heterogeneous households, perfectly competitive firms, and a government sector incorporating essential fiscal policy settings. The heterogeneous households are different with respect to ages and skill types. The government sector consists of various public transfer programs and a variety of tax financing instruments such as progressive income, consumption, superannuation and corporate taxes. The government can also issue debt to finance its fiscal deficits. Importantly, the economic decisions made by households and firms (i.e., labour supply, saving and investment decisions) are subject to the distortions introduced by the fiscal policy. The rich structure of household heterogeneity and the detailed composition of government fiscal activities are essential to study the effects of various budget repair measures on macroeconomic aggregates and wellbeing of different households.

We first discipline the households in our model to mimic the lifecycle behavior of Australian households, including labour supply, labour earnings and pension payments observed from the household survey data. We also calibrate our benchmark economy to target the key Australian macroeconomic aggregates, the government budget deficits and

[2] It should be pointed out that our paper will not provide and examine reasons for the observed, deteriorating budgetary position of the Australian government. Our goal is to take the projected path to budget surpluses by Australian Government (2015) as given and quantify the macroeconomic and distributional effects of the aforementioned budget repair measures.

net debt between 2000 to 2014. Next, we discipline the model to generate the government budget deficits between 2015 and 2026 according to the projections of the 2015-16 Federal Budget. Finally, we apply our model to quantify the macroeconomic and welfare effects of the proposed budget repair measures to bring the Australian government budget back to balance by 2030.

Our simulation results indicate that while all three budget measures achieve the same fiscal goal (of eliminating the budget deficit and reducing net government debt), the macroeconomic and welfare effects of each budget measure differ significantly across households, generations and over time. More specifically, each examined fiscal measure results in favourable long-run macroeconomic and welfare outcomes, but serious adverse consequences during the consolidation period (2015-2030). The current generations born before the fiscal consolidation period would likely not be supportive of any of the fiscal measures as they would suffer significant welfare losses of up to 7% in their remaining resources due to cuts in their transfer payments (including the age pension) or payments of higher taxes. In contrast to the welfare losses of current generations, all future generations born after the fiscal consolidation period would experience welfare gains of almost 1% in their lifetime resources, as a result of reduced net public debt allowing for smaller taxes or higher transfer payments in the long term.

We show that taxing consumption or income leads to opposing implications for macroeconomic aggregates and welfare of different household income groups. In particular, the required increases in the consumption tax rate have positive effects on per capita labour supply, assets and output, but reduce the welfare of poor households most. Conversely, temporary increases in progressive income tax rates have largely negative effects on the economy, but reduce the welfare of poor households least. Moreover, there are interesting welfare trade-offs when choosing between transfer payment cuts and tax hikes. Cutting the transfer payments results in the largest welfare losses for current generations (particularly older, low income households who have their pension reduced), but the highest welfare gains for future generations, compared to the other two proposed budget repair measures.

In general, our results highlight tough challenges for the government when implementing any of the proposed budget repair measures. We show that the fiscal consolidation plan improves wellbeing of future generations, but at the expense of large welfare losses attained by the current generations. The welfare trade-offs between current and future generations, as well as between the rich and poor, indicate political infeasibility to implement the fiscal consolidation plan. This is a difficult fiscal reform, which requires a proper policy design to smooth out the fiscal burden on the current generations.

Literature. Our paper contributes to several branches of the literature. There is a fairly large body of literature that has been devoted to analysing the macroeconomic and distributional effects of fiscal policy. Jäger and Keuschnigg (1991) examine the burden of increased public debt in open economies, using a numerical overlapping generations model with inelastic labour supply. Baxter and King (1993) use a infinitely-lived, representative agent model to explore the general equilibrium effects of temporary and permanent changes in government spending and tax financing instruments. Heathcote (2005) investigates the effects of tax cuts in a heterogeneous agent model with infinitely-lived agents and incomplete markets. Fehr and Ruocco (1999) investigate the distributional and efficiency consequences of the Italian debt reduction, whereas Kitao (2010), using a similar large scale OLG model, examines the effects of temporary tax cuts and rebate transfers in the US. A more recent paper by Glomm *et al.* (2013) quantifies the macroeconomic and welfare effects of fiscal austerity measures in Greece. In this paper, we follow a similar approach and use an OLG model, but focus on the fiscal consolidation in Australia.

There is also a growing body of macroeconomic literature that analyses the effects of public debt financing. Erceg and Linde (2012) investigate the effects of fiscal consolidation in relation to whether monetary policy is constrained by a currency union membership or by the zero lower bound on policy rates. Forni *et al.* (2010) quantify the macroeconomic implications of permanently reducing the public debt to GDP ratio in euro area countries. Notice that, since these papers use a representative agent framework they often abstract from intergenerational and other distributional effects of fiscal consolidations. Our paper is complementary to these papers as we incorporate agent heterogeneity and a variety of government activities into our model. We are able to analyse not only the aggregate welfare effect but also the distributional welfare effects within and across cohorts.

Finally, we contribute directly to the literature evaluating the economic effects of fiscal policy in Australia. The core models for fiscal projections and policy analyses by the Federal Treasury (Australian Government, 2015) and the Productivity Commission (Productivity Commission, 2013) are micro-simulation models, which abstract from modelling microfoundations of household behaviour. Contrary to the micro-simulation approach, there is a growing body of literature, using large-scale, life-cycle, general equilibrium models that incorporate the behaviour of households and firms to analyse the impacts of fiscal policy reforms in Australia (see, for example, Kudrna and Woodland (2011a, b) and Kudrna *et al.*, 2015). In this paper, we follow a similar modelling approach, but extend these studies by incorporating a more detailed disaggregation of households into income quintiles, technical progress and the government's ability to issue public debt. Notably, this paper is the first attempt to evaluate the macroeconomic and welfare effects of the proposed budget repair measures, using a dynamic general equilibrium model calibrated

to the Australian economy.

The paper is structured as follows. In the next section, we set up a dynamic, general equilibrium OLG model used for the fiscal policy analysis. Section 3 provides details on the calibration of our model to the Australian economy. In Section 4, we examine a range of policy experiments to repair the budget as proposed in the 2015-16 Federal Budget (Australian Government, 2015), with the results presented in terms of macroeconomic and welfare implications. Section 5 performs a sensitivity analysis of alternative assumptions of the model. Section 6 offers some conclusions.

2 Model description

The model is essentially a small open economy variant of Auerbach and Kotlikoff's (1987) model augmented to capture main features of the Australian economy and that consists of household, production, government and foreign sectors. Details on each of the sectors of the model and a definition of its competitive equilibrium are provided below.[3]

2.1 Household sector

The household sector is populated by sequences of cohorts aged between 21 and 90 years ($a = 21, ..., 90$) at any time t. Each cohort consists of five income or skill types i - the lowest, second, third, fourth and highest quintiles that are distinguished by their productivity and social welfare payments. The intra-generational shares are given by ω_i. It is an overlapping generations model and so every year, a new generation aged 21 years enters the model structure and faces random survival with the maximum possible lifespan of 70 years, while the oldest generation aged 90 years dies. Lifespan uncertainty is described by the conditional survival probabilities, s_a. The model assumes stationary demographics with a constant population growth rate, n, which implies time-invariant cohort shares, $\mu_a = [s_a \diagup (1+n)]\, \mu_{a-1}$.

Households are assumed to make optimal consumption/saving and leisure/labour supply choices by solving their utility maximization problems, which can be defined as follows. Each i-type household who begins her economic life at time t chooses consumption, c, and leisure, l, at each age and the timing of retirement to maximize the expected lifetime utility

[3] The model is an extended version of the general equilibrium OLG model developed for the Australian economy by Kudrna and Woodland (2011a, b). The extensions include (i) a detailed intra-generational heterogeneity based on income distribution data from Australian Bureau of Statistics (ABS) (2007), (ii) technical progress and (iii) a detailed calibration of the fiscal structure with the government budget deficit and net debt observed in 2014.

function given by

$$\max_{\{c^i_{t+a-21},\, l^i_{t+a-21}\}} \frac{1}{1-1/\gamma} \sum_{a=21}^{90} S_a \beta^{a-21} u(c^i_{t+a-21}, l^i_{t+a-21})^{1-1/\gamma}, \tag{1}$$

subject to the per-period budget constraints written as

$$\begin{aligned} A^i_{a,t} &= (1+r)A^i_{a-1,t-1} + LE^i_{a,t} + AP^i_{a,t} + SA^i_{60,t} \\ &\quad + SP^i_{a,t} + ST^i_{a,t} + B^i_{a,t} - c^i_{a,t} - Tax^i_{a,t}, \end{aligned} \tag{2}$$

where the annual CES utility, $u(c,l) = \left[c^{(1-1/\rho)} + \alpha l^{(1-1/\rho)}\right]^{1/(1-1/\rho)}$, being discounted by the subjective discount factor, β, and the unconditional survival probability, $S_a = \prod_{j=21}^{a} s_{j-1}$. The remaining parameters in (1) are the inter- and intra-temporal elasticities of substitution denoted by γ and ρ and the leisure preference parameter, α.

In (2), $A^i_{a,t}$ 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, $rA^i_{a-1,t-1}$, labour earnings, $LE^i_{a,t} = w_t e^i_a \left(h_{a,t} - l^i_{a,t}\right)$, age pension, $AP^i_{a,t}$, superannuation payouts, $SA^i_{60,t}$ and $SP^i_{a,t}$, social transfer payments, $ST^i_{a,t}$, and accidental bequest receipts, $B^i_{a,t}$, minus the sum of consumption, $c^i_{a,t}$, and the total household taxes, $Tax^i_{a,t}$.

As in Altig *et al.* (2001) and Kotlikoff *et al.* (2007), we incorporate a time-augmenting technical progress that allows the model with CES preferences to be consistent with a well-defined balanced growth path. This approach assumes that the time endowment, $h_{a,t}$, increases for every successive generation at the rate of technological progress, g: $h_{a,t} = (1+g)\, h_{a,t-1}$.[4] The gross labour earnings are then equal to the product of labour supply, $h_{a,t} - l^i_{a,t}$, and the hourly wage, $w_t e^i_a$, where w_t is the market wage rate and e^i_a is the age- and income-specific earnings ability variable. Similarly to Altig *et al.* (2001), e^i_a is assumed to increase not only due to the accumulation of human capital but also because of technical progress that makes the earnings ability profile steaper for each income type. The labour supply is required to be non-negative, $h_{a,t} - l^i_{a,t} \geq 0$. Thus, when the household chooses to allocate all time endowment to leisure, $l^i_{a,t} = h_{a,t}$, the households must be fully retired from workforce, supplying zero labour.

The household taxes in (2) include the progressive income, consumption and other taxes, $Tax^i_{a,t} = T\left(y^i_{a,t}\right) + \tau^c_t c^i_{a,t} + tax^i$. The progressive income tax is a function of the

[4] Notice that the typical approach of accounting for technical progress by multiplying the labour input in the production function by a growing productivity factor would not be compatible with a long run equilibrium path in our setup with CES preferences (see Auerbach and Kotlikoff, 1987, p.35). We therefore assume the time augmenting technological change, which implies that in a steady state, all household variables as well as aggregate variables (defined in per capita terms later in the text) grow at the rate of technical progress through time.

taxable income, $y^i_{a,t}$, which comprises labour earnings and assets income. The term, τ^c_t, represents the consumption tax rate and tax^i denotes other taxes that are assumed to be collected as lump sum taxes within each income type of households.[5]

Following Gokhale *et al.* (2001), we abstract from any intended bequests, with all inter-generational transfers being accidental. The accidental bequests, $B^i_{a,t}$, are assumed to be equally redistributed to all surviving i-type households aged between 45 and 65 years. We also assume that households are born with no wealth and exhaust all wealth at age 90 (i.e., $A^i_{20,t} = A^i_{90,t+70} = 0$) and that they are constrained from borrowing (i.e., $A^i_{a,t} \geq 0$).

2.2 Production sector

The production sector contains a large number of perfectly competitive firms that produce a single all-purpose output good that can be consumed, invested in production capital or traded internationally. These perfectly competitive firms demand capital, K_t, labour, L_t, and investment, I_t, to maximize the present value of all future profits subject to the (per capita) capital accumulation equation:

$$\begin{aligned} \max_{\{K_t,\ L_t,\ I_t\}} \quad & \sum_{t=0}^{\infty} D_t \left[\left(1-\tau^f\right) \left(F(K_t, L_t) - C(I_t, K_t) - I_t - (1+cr) w_t L_t\right) \right] \\ \text{s.t.} \quad & (1+n)(1+g)K_{t+1} = I_t + (1-\delta)\, K_t, \end{aligned} \tag{3}$$

where $D_t = (1+n)^t(1+g)^t/(1+r)^t$ accounts for discounting, population and economic growth and τ^f stands for the effective corporation tax rate. Following Fehr (2000), adjustment costs only accure during the transition, with the adjustment cost function given by $C(I_t, K_t) = 0.5\psi \left(I_t/K_t - (n+g+ng+\delta)\right)^2 K_t$, where ψ is the adjustment cost coefficient and δ is the capital depreciation rate. The CES production function is $F(K_t, L_t) = \kappa \left[\varepsilon K_t^{(1-1/\sigma)} + (1-\varepsilon) L_t^{(1-1/\sigma)}\right]^{[1/(1-1/\sigma)]}$, with the productivity constant, κ, the capital intensity parameter, ε, and the elasticity of substitution in production, σ.

Solving the profit maximization problem (3) yields the first-order necessary conditions and gives expressions for the equilibrium wage rate, w_t, interest rate, r, and capital price, q_t.

[5] The taxes and government transfers are further specified in the next section on the calibration of the model.

2.3 Government sector

Pension system. The Australian pension system contains two publicly stipulated pillars. The first is represented by a non-contributory, means tested age pension. The second pillar is a fully-funded superannuation guarantee. The model incorporates the main features of these two pension pillars.

The age pension, $AP^i_{a,t}$, is paid to households of income type i and age pension age ($a \geq 65$) if they satisfy the following income test.[6] Let p_t denote the maximum age pension paid by the government to pensioners provided that their assessable income does not exceed the income threshold, IT_t. The maximum pension, p_t, is then reduced at the taper rate, θ, for every dollar of assessable income above IT_t. Algebraically, the age pension benefit can be written as

$$AP^i_{a,t} = \max\left\{\min\left\{p_t, p_t - \theta\left(\widehat{y}^i_{a,t} - IT_t\right)\right\}, 0\right\}, \tag{4}$$

where the assessable income, $\widehat{y}^i_{a,t}$, consists of interest earnings, $rA^i_{a-1,t-1}$, (from assets holdings) and half of labour earnings, $LE^i_{a,t}$.[7]

The superannuation guarantee requires that employers contribute a given percentage of gross wages into the employee's superannuation fund. Accordingly, the model assumes that mandatory contributions are made by firms on behalf of working households at the contribution rate, cr, from their gross labour earnings, $LE^i_{a,t}$. The contributions net of the contribution tax, $\tau^s cr$, are added to the stock of superannuation assets, $SA^i_{a,t}$, that earns fund income at the after-tax interest rate, $(1-\tau^r)\,r$. 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, $SA^i_{60,t}$, is given by

$$SA^i_{60,t} = \sum_{a=21}^{60} \left[1 + (1-\tau^r)\,r\right]^{60-a} (1-\tau^s)\,cr \cdot LE^i_{a,t}, \tag{5}$$

where τ^r and τ^s denote the fund earnings tax rate and the contribution tax rate, respectively. We further assume that working households aged $a > 60$ are paid mandatory contributions directly into their private assets accounts, denoted by $SP^i_{a,t}$ in (2).[8]

[6] The actual means test of the age pension also includes the assets test and it is the binding test (the income or assets tests resulting in a lower pension benefit) that si used to determine the pension payment. The model considers only the income test as it affects the majority of part age pensioners.

[7] This is to approximate the existing preferential treatment of income from employment in the age pension means test.

[8] This is consistent with post-July 2007 policy, which allows such contributions by seniors to be im-

Government budget. The government activities are summarised by a budget constraint, which includes an issue of new debt, ΔGD_t, and tax revenues, TAX_t, that finance government consumption expenditure, G_t, interest payments on public debt, rGD_t, and transfer payments to individuals, TR_t:[9]

$$\Delta GD_t + Tax_t = G_t + rGD_t + TR_t. \tag{6}$$

The transfer payments in (6) contain the age pension expenditure, AP_t, and the social transfers, ST_t, which are assumed to paid to households aged $a < 65$. The government collects the total tax revenue, TAX_t, from household income taxes, TAX_t^Y, consumption taxes, TAX_t^C, superannuation taxes, TAX_t^S, and other household taxes, TAX_t^{LS}, as well as from imposing corporate taxes on the firms' profits, Tax_t^F. The per capita transfer payments and tax receipts in period t are given by

$$\begin{aligned}
AP_t &= \textstyle\sum_{i=1}^{5} \omega_i \sum_{a=65}^{90} \mu_a \; AP_{a,t}^i \\
ST_t &= \textstyle\sum_{i=1}^{5} \omega_i \sum_{a=21}^{64} \mu_a \; ST_{a,t}^i \\
TAX_t^Y &= \textstyle\sum_{i=1}^{5} \omega_i \sum_{a=21}^{90} \mu_a \; T(y_{a,t}^i) \\
TAX_t^C &= \textstyle\sum_{i=1}^{5} \omega_i \sum_{a=21}^{90} \mu_a \; \tau_t^c \; c_{a,t}^i \\
TAX_t^S &= \textstyle\sum_{i=1}^{5} \omega_i \sum_{a=21}^{60} \mu_a \left[\tau^s cr \cdot LE_{a,t}^i + \tau^r rSA_{a-1,t-1}^i\right] \\
TAX_t^{LS} &= \textstyle\sum_{i=1}^{5} \omega_i \sum_{a=21}^{90} \mu_a \; tax_t^i \\
TAX_t^F &= \tau^f (Y_t - \delta q_t K_t - (1+cr) w_t L_t).
\end{aligned} \tag{7}$$

2.4 Foreign sector

We employ a small open economy framework since that description best fits the Australian economy. In this small open economy model, the interest rate, r is exogenous and equal to the world interest rate, r^w.[10] Letting FA_t stand for the per capita net foreign asset holding at the beginning of time period t, the international budget constraint can specified as

$$(1+n)(1+g)FA_{t+1} - FA_t = TB_t + rFA_t, \tag{8}$$

where the left side of (8) represents per capita capital flows and the right side is the current account comprising the per capita trade balance, TB_t, and the per capita interest

mediately removed tax free from the fund.

[9] Note that the issue of new debt (or the change in net government debt) in period t is equal to the budget deficit in that period.

[10] The exogenous interest rate assumption is relaxed in Section 5, which examines how sensitive the results are to the imperfect capital mobility assumption with an endogenous interest rate.

receipts (payments) from foreign assets holdings (debt), rFA_t.

2.5 Competitive equilibrium

Given government policy settings for the taxation and pension systems, the demographic structure and the world interest rate, a competitive equilibrium is such that

(a) households make optimal consumption and leisure decisions by maximizing their lifetime utility (1) subject to their budget constraint (2);

(b) competitive firms choose labour and capital inputs to solve their profit maximization problem in (3);

(c) the current account is balanced and the stock of net foreign assets, FA_t, in (8) is freely adjusted so that $r_t = r^w$;

(d) the labour, capital and goods markets clear

$$\begin{aligned} L_t &= \textstyle\sum_{i=1}^{5} \omega_i \sum_{a=21}^{90} e_a^i (h_{a,t} - l_{a,t}^i)\mu_a, \\ q_t K_t &= \textstyle\sum_{i=1}^{5} \omega_i \sum_{a=21}^{90} \left(A_{a-1,t-1}^i + SA_{a-1,t-1}^i\right) \mu_a + FA_t - GD_t, \\ Y_t &= \textstyle\sum_{i=1}^{5} \omega_i \sum_{a=21}^{90} c_{a,t}^i \mu_a + I_t + G_t + TB_t. \end{aligned} \tag{9}$$

where μ^i and ω_i denote inter- and intra-generational shares.

(e) the government budget constraint (6) is satisfied.

(f) the bequest transfers are equal to the total amount of assets within each skill type left by the deceased agents, $B_t^i = \sum_a (1 - s_a) \left(A_{a,t}^i + SA_{a,t}^i\right) \mu_a$.[11]

3 Calibration

We now provide specific details on the calibration procedure that is to replicate or closely approximate the key macroeconomic data and fiscal indicators in 2014, including the budget deficit and net government debt to GDP ratios in that year. Note that the standard assumption of a steady state equilibrium would not do the job in matching these two government indicators, as the observed budget deficit to GDP ratio would

[11] As mentioned, we assume that accidental bequests are equally redistributed to surviving households of the same income type aged between 45 and 65 years, reflecting intergenerational transfers from parents to children.

imply much larger government debt to GDP ratio in a steady state than that observed from the data.[12] Therefore, we use a two stage calibration procedure that together with the values of the model parameters is discussed in this section.

3.1 First stage calibration

The first stage calibration assumes that the model economy is in a steady state equilibrium. We compute this initial steady state economy and target key Australian macroeconomic data and fiscal indicators for the period of 2000-08.[13] During that period, the Australian government run small budget surpluses, having only minimal net public debt. Therefore, we make an assumption of a balanced government budget with zero net government debt in this initial steady state. Given the aforementioned aim to calibrate the model to approximate the observed budgetary position of the Australian government in 2014, we use the fiscal policy settings and the policy parameter values (e.g., the pension maximum benefit and the tax rates) as of year 2014. We then compute the adjustment parameters for each tax revenue and government expenditure to match the observed ratio of the given government indicator to GDP averaged over the period of 2000-08. In this sub-section, we present and discuss the values of main model parameters and outline exogenously given differences among the five income types of households. In the next sub-section, we then provide specific details on the adjustment parameters to match the actual composition of the Australian government budget.

3.1.1 Model parameters

The values of the main parameters used in the initial (or benchmark) steady state of the model and the sources are reported in Table 1. The table indicates that some of the parameters are taken from related literature, some exactly match actual data and others are calibrated such that the benchmark solution yields outcomes consistent with observed data derived from ABS (2014a) and Australian Government (2015).

[12] In a steady state, the net government debt to GDP ratio can be derived from the budget constraint in (6) as $\text{Deficit\_GDP}/(n+g+ng)$. Given the rates of population growth and technical progress and the budget deficit of 3.07% of GDP in 2014, the implied steady state net debt would equal to 98.27% of GDP, compared to the actual net debt of only 12.8% of GDP in 2014.

[13] We use the GAMS software to solve for this steady state equilibrium (as well as for the baseline and policy transition paths that are discussed later in the text). Our algorithm applies the iterative Gauss-Seidel computational method suggested by Auerbach and Kotlikoff (1987) and that is specified for the small open economy model in Kudrna and Woodland (2011a). In brief, the algorithm involves choosing initial values for some endogenous variables and then updating them by iterating between the production, household and government sectors until convergence.

Table 1: Values of the main model parameters

Description	Value	Source
Demographics		
Population growth rate	0.016	Data
Fraction of households of income type	All 0.2	Data [a]
Conditional survival probabilities	ABS (2014b)	Data
Utility function		
Inter-temporal elasticity of substitution	0.4	Literature [b]
Intra-temporal elasticity of substitution	0.9	Literature [b]
Subjective discount factor	0.99	Calibrated
Leisure parameter	1.5	Literature [b]
Technology		
Production constant	0.872	Calibrated
Elasticity of substitution in production	0.778	Calibrated
Capital share	0.45	Data
Depreciation rate	0.055	Calibrated
Adjustment cost parameter	10	Literature [c]
Technical progress rate	0.015	Data
Policy parameters		
Maximum age pension p.a. (in $100,000)	0.21504	Data
Income test free threshold p.a. (in $100,000)	0.04056	Data
Income reduction rate	0.5	Data
Mandatory contribution rate	0.095	Data
Contribution tax rate	0.15	Data
Effective earnings tax rate	0.075	Data
Statutory consumption tax rate [GST]	0.1	Data
Statutory corporation tax rate	0.3	Data
Income tax function	-	Estimated [d]

Notes: [a] Households are disaggregated into income quintiles based on ABS (2007); [b] The values of these parameters are similar to Auerbach and Kotlikoff (1987) and Fehr (2000); [c] This value is taken from Auerbach and Kotlikoff (1987); [d] The function is estimated, using the 2013-14 income tax schedule.

Recall that the demographic structure of the model is assumed to be stationary, with the age-specific survival rates, s_a, and the annual population growth rate, n, being time-invariant, which implies constant cohort shares, μ_a. We take s_a as the average survival probability over males and females from the 2011-13 life tables (ABS, 2014b) and set n to 1.6%, which is the annual population growth rate from 2013 to 2014. Note that the model with these two demographic factors generate an old-age dependency ratio of 0.22 that is similar to the actual dependency ratio in 2014. Given the use of quintiles in ABS (2007), the intra-generational shares, ω_i, are equal to 0.2 for each income type of households in the model.

The functional forms of the household utility and production technology are standard in related literature. Importantly, the values assigned to the utility and technology parameters are similar to those used by others (see, for example, Auerbach and Kolikoff (1987) and Fehr, 2000). We calibrate the subjective discount factor, β, in the lifetime utility (1) to match the capital to output ratio ($= 3.085$). Most of the production function parameters are also calibrated to replicate other calibration targets such as the investment rate

of 0.085. The wage rate, w, is normalised to one and the exogenous interest rate, r, is set to 4%. The adjustment cost parameter, b, is set to 10 as in Auerbach and Kolikoff (1987) and the rate of technological progress, g, to 1.5% per year based on Productivity Commission (2013). We also set the equilibrium condition for the capital market to target the net foreign assets to capital ratio of -0.173. This reflects the net foreign ownership of 17.3% of Australia's capital stock averaged over the period of 2000-08 (ABS, 2014a).

The policy settings for the age pension, superannuation and taxation and their parameter values in the model are those applicable in the financial year of 2013-14. Specifically, the age pension parameters presented in Table 1 relate to those for single pensioners and match the actual values applicable from September 2013 to June 2014. The mandatory superannuation contribution rate of 9.5% of gross earnings is for year 2014. The consumption and corporation tax rates are set to their statutory rates of 10% and 30%, respectively. The income tax function in the model is an approximation of the 2013-14 progressive income tax schedule.

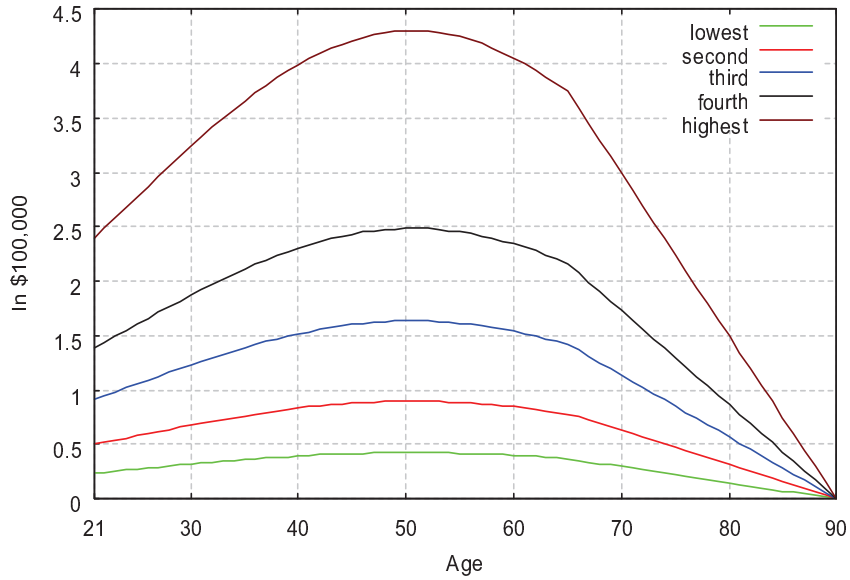
3.1.2 Intra-generational heterogeneity

The five income or skill household types (i.e., income quintiles) differ by their (i) earnings ability, e_a^i, (ii) social transfers, ST_a^i, and (iii) other taxes, tax^i, which all are exogenously given.

The earnings ability (or productivity) profiles are constructed using the estimated lifetime wage function taken from Reilly *et al.* (2005) and income distribution shift parameters based on ABS (2007) data. In particular, the earnings ability profile for the third quintile is taken from Reilly *et al.* (2005) and is adjusted for technical progress in the same way as in Altig *et al.* (2001).[14] The earnings ability profiles for lower and higher income quintiles are shifted down and up, using the shift parameters, to approximately replicate the private income distribution in Australia. Based on ABS (2007) data, the shift parameter 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. The earnings ability profile for each of the income quintile is plotted by Figure 2 as the potential annual wage in units of $100,000 with all time endowment allocated to work. Note that we further assume the earnings ability after age 65 to decline at a constant rate, reaching zero at age 90 for each income class as Reilly *et al.* considered only workers aged 15-65.

[14] The growth-adjusted earnings ability profile for the third quintile takes the form: $e_a = \exp(\alpha_0 + (g + \alpha_1)X + \alpha_2 X^2)$, where parameters α_0, α_1 and α_2 are taken from Reilly *et al.* as averaged estimates for males and females with 12 education years, X represents years of potential experience ($a - 5 -$Education years) and the term g denotes the rate of technical progress.

Figure 1: Age-specific earning ability across the income quintiles



Notes: Potential annual wage earned with all time endowment allocated to work that is constructed using the age wage function from Reilly et al. (2005), adjusted for technical progress, and income distribution shift parameters based on ABS (2007) data.

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 transfers (other than the age pension) from the government. These payments are assumed to be received by households in the lowest to fourth income quintiles aged younger than 65 years ($a < 65$). The transfers are also derived from ABS (2007) that 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. One can think that these government benefits include welfare payments such as family benefits, disability support pension and unemployment benefit.

The five household types also differ in terms of the other taxes, tax^i. We again use the ABS (2007) data to derive the share for each income type in the total taxes paid. These shares are 0.08 for the lowest quintile, 0.1 for the second quintile, 0.15 for the third quintile, 0.22 for the fourth quintile and 0.45 for the highest quintile. We then calculate the other tax to match the observed ratio of the non-taxation revenue to GDP (1.53% of GDP averaged over the period of 2000-08) and apply these shares to account for the third exogenous source of heterogeneity among the household quintiles.

3.2 Second stage calibration

The second stage calibration involves matching the actual ratios of the budget deficit to GDP during the period of 2009-2014. We run a transition path with the calibration period

of 2009-2014, and re-compute all the adjustment parameters to match the observed ratios of the given government revenue and expenditure to GDP. This approach generates net government debt that closely approximates the actual net public debt in 2014, which is used as the base year for the policy analysis. Note that in the remaining years of this baseline transition to a new steady state (2015-2150), it is assumed that the budget deficit to GDP ratio (and all adjustment parameters) are kept unchanged as in 2014. We further assume that public consumption, G_t, is adjusted to keep the budget deficit to GDP ratio constant.[15]

We discuss the computed adjustment parameters and provide some comparison on how well the model fits the key Australian data below.

3.2.1 Adjustment parameters

The adjustment parameters are computed for each of government expenditures and for each of tax revenues such that the model matches the exact composition of the government budget in the initial steady state (2000-08) and in each year of the calibration period (2009-14). The values of these adjustment parameters together with the calibration targets taken from Australian Government (2015) are provided in Table 2.

Table 2: Adjustment parameters and calibration targets for government tax revenues and expenditures

Government indicator	Adjustment parameters [a]				Calibration targets (in % of GDP) [b]			
	2000-08	2010	2012	2014	2000-08	2010	2012	2014
Tax revenue								
Personal income tax	0.82	0.69	0.74	0.77	11.49	9.80	10.50	10.90
Consumption tax	1.28	1.10	1.00	1.13	6.95	6.20	5.70	6.40
Corporation tax	0.92	0.83	0.91	0.90	4.70	4.30	4.70	4.60
Superannuation tax	0.58	0.41	0.41	0.41	0.70	0.50	0.50	0.50
Other tax [c]	1.00	1.25	0.91	0.91	1.53	1.90	1.40	1.40
Transfer payments								
Age pension	0.90	1.00	1.00	1.03	2.50	2.80	2.82	2.93
Other social transfers [d]	1.00	1.07	1.10	1.14	4.00	4.25	4.40	4.59

Notes: [a] Adjustment parameters are computed to replicate calibration target for each revenue and expenditure in % of GDP in initial steady state (2000-08) and during calibration period (2009-2014); [b] Taken from Australian Government (2015); [c] This item represents non-taxation revenues; [d] These payments include family benefits, disability pension and unemployment benefits.

The algebraic description of the model in Section 2 is kept as simple as possible and so it abstracts from the adjustment parameters. However, one should notice that the household budget constraint (2) and the per capita government revenues and expenditures in (7) would need to include these parameters. Let's consider the adjustment parameter for the

[15] In order to solve for this baseline transition path, we use the parameter values presented in Table 1 and the same algorithm outlined above to solve the initial steady state. However, the existing generations (i.e., cohorts aged 21-90 of the five income types) alive prior to 2009 must be treated differently from the steady state simulation. Specifically, these households solve their utility maximization problems again but over shorter lifetimes endowed with their assets obtained from the initial steady state.

age pension. As shown in Table 2, its computed value is 0.9 in the initial steady state, implying that the ape pension payments, $AP^i_{a,t}$, in (2) and in (7) are scaled down for each household type to match the actual pension expenditure of 2.5% of GDP averaged over the period of 2000-08. The reason for this adjustment in pension payments is because the model assumes the actual pension parameters for 2013-14 (with higher maximum pension benefit) and for single pensioners (whereas the couple maximum pension rate is smaller than the rate for single pensioners). The same modification in Section 2 need to be carried out to account for all other adjustment parameters. More specifically, the progressive income tax, $T\left(y^i_{a,t}\right)$, is also scaled down with the adjustment parameter of 0.82 in the initial steady state, as the model does not account for any tax offsets available for lower income earners. Given the superannuation tax adjustment parameter of 0.58 in the initial steady state, the effective superannuation tax rates on contributions and fund earnings are lower than the statutory ones. This is because the superannuation guarantee system is fully mature in the model (with mandatory contributions at 9.5% of gross earnings made over the entire working lives), whereas it has yet to achieve full maturity in Australia.

Table 2 also indicates that the effective consumption tax rate (i.e., the product of the statutory GST rate of 10% and the consumption adjustment parameter) equals 12.8% initially. This is because we use the calibration target for the consumption tax revenue (i.e., 6.95% of GDP) that includes not only the GST revenue but also receipts from other indirect taxes. The other tax, tax^i, in (2) is assumed to be collected as a lump sum tax within each income type and is to target the government non-taxation revenue, in order for the model to exactly replicate the total revenue of the government budget.

3.2.2 Model performance

The benchmark steady-state solution (2000-08) and the solutions in the selected years of the calibration period (2009-14) for the key macroeconomic and fiscal variables are reported in Table 3, which also provides a comparison with Australian data. The comparison of model generated and actual macroeconomic indicators indicates that the model replicates the Australian economy fairly well. Importantly, the model exactly matches the observed budget deficit to GDP ratios over the calibration period of 2009-2014 and closely approximates the net government debt in % of GDP in 2014.[16]

[16] Our model does also a good job in approximating the lifecycle behavior of Australian households observed from the HILDA surveys (Wooden *at al.*, 2002). The comparison of lifecycle labour supply, labour earnings and pension payments generated by the model for the initial steady state and for selected years of the calibration period with the cross-sectional profiles derived from HILDA is available from authors upon request.

Table 3: Comparison of model-generated values for key variables with Australian data

Variable	Model generated [a]				Australian data [b]			
	2000-08	2010	2012	2014	2000-08	2010	2012	2014
Private consumption [c]	54.12	56.42	57.08	56.84	57.71	55.38	53.72	55.47
Public consumption [c]	18.87	19.77	17.50	18.86	17.41	18.01	17.88	17.68
Investment [c]	26.54	26.23	26.33	26.53	26.44	27.76	28.18	27.40
Trade balance [c]	0.47	-2.43	-0.91	-2.23	-1.71	-0.97	-0.13	-0.43
Total tax revenue [c]	25.37	22.70	22.80	23.80	25.37	22.70	22.80	23.80
Budget surplus [c]	0.00	-4.21	-2.92	-3.07	0.74	-4.21	-2.92	-3.07
Net government debt [c]	0.00	2.06	9.25	12.13	3.16	3.30	9.90	12.80
Capital to GDP [d]	3.09	3.06	3.08	3.10	3.09	3.16	3.05	3.22
Investment to capital [d]	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Foreign assets to capital [d]	-0.17	-0.18	-0.20	-0.21	-0.17	-0.18	-0.18	-0.17

Notes: [a] The model-generated values relate to the initial steady state equilibrium in 2000-08 and to selected years of the calibration period in 2009-14; [b] The values are derived from ABS (2014a) and Australian Government (2015), with the values for 2000-08 being averages over that period; [c] In % of GDP; [d] Ratio.

4 Quantitative analysis

In this section, we report on the implications of several budget repair measures to eliminate the budget deficits over the consolidation period as plotted in Figure 1. As mentioned, these measures include the required adjustments either in the progressive income taxation or in the consumption tax rate or in the transfer payments. The results for key macroeconomic variables as well as for welfare across and within generations are presented with respect to the baseline transition. We first outline some of the key macroeconomic effects of the baseline transition and then we proceed to the macroeconomic and welfare effects of the three budget repair measures.

4.1 Baseline transition

The baseline transition includes the calibration period of 2009-14 (that matches the composition of the government budget as discussed in the previous section) and the remaining period from 2015 to a new steady state in 2150. In that remaining period of the baseline transition, we keep the budget deficits in % of GDP unchanged as observed in 2014 and adjust public consumption to balance the government budget with an increasing net debt and interest payments. From now on, we will concentrate on the implications over the period from 2015 to 2150.

Table 4 reports the macroeconomics effects in the selected years of the baseline transition and in the long run that relates to year 2150. The results are presented as percentage changes in de-trended, per capita variables relative to year 2014, with net government debt expressed in % of GDP. The table also shows the values for the selected variables in 2014, which are reported in units of $100,000 and as per capita for all the monetary variables, as

per capita and in efficiency units for labour supply and in % of GDP for net government debt.

Table 4: Macroeconomics implications during baseline transition
(Percentage changes in selected de-trended, per capita variables from year 2014)

Variable	2014 [a]		2015	2020	2030	2050	Long run
Labour supply	0.356	%	0.00	-0.03	-0.06	-0.08	-0.06
Capital stock	2.351	%	-0.04	-0.22	-0.40	-0.50	-0.51
Domestic assets	1.950	%	-0.05	-0.23	-0.38	-0.44	-0.68
Net foreign assets	-0.485	%	-4.22	-23.34	-53.28	-91.16	-136.51
Net government debt [b]	12.130	-	14.74	26.67	45.65	69.85	98.27
Output (GDP)	0.758	%	-0.02	-0.09	-0.17	-0.22	-0.22
- Private consumption	0.431	%	-0.03	-0.15	-0.30	-0.33	-0.36
- Public consumption	0.143	%	-0.61	-3.38	-7.65	-12.88	-18.94
Age pension costs	0.022	%	0.10	0.49	0.83	0.87	0.94
Total tax revenue	0.180	%	-0.03	-0.16	-0.32	-0.40	-0.43
- Personal income tax	0.083	%	-0.05	-0.26	-0.50	-0.64	-0.69
- Consumption tax	0.049	%	-0.03	-0.15	-0.30	-0.33	-0.36

Notes: [a] The values for monetary variables in 2014 are presented in units of $100,000 and per capita; Labour supply is presented in per capita and efficiency units and net government debt in 2014 and other selected years of the transition is presented in % of GDP.

The results for the baseline transition in Table 4 can be summarized as follows. First, net government debt increases significantly during the transition despite the reductions in public consumption that is required to keep the budget deficit constant at 3.07% of GDP. In the long run, net government debt reaches 98.27% of GDP and is more than 8 times larger than in the base year of 2014.[17] Second, the large increases in net government debt are shown be funded from abroad through capital imports, which lead to significant decreases in net foreign assets during the baseline transition. As shown in Table 4, net foreign assets decrease by 136.5% in the long run relative to 2014.[18] Third, in our small open economy, these substantial changes in government debt and foreign assets have no impact on the domestic interest rate and so the effects of the baseline transition on the other key macroeconomic and fiscal variables reported in Table 4 are relatively small.[19]

[17] As pointed out before, the steady state debt to GDP ratio is implied by the assumed deficit to GDP ratio and the rates of population growth and technological progress. Note that the higher these growth rates are the smaller government debt to GDP ratio is for the given budget deficit to GDP ratio.

[18] The negative value for net foreign assets in 2014 implies net foreign debt, which increases significantly during the transition due to capital inflows that finance increased public borrowing depicted by a growing net government debt.

[19] In a small open economy model with the exogenous domestic interest rate, the marginal products of capital and labour as well as the capital labour ratio are unchanged in the long run. Hence, the change in labour supply must be matched by the change in the capital stock in the long run. The observed difference between the long run effects on labour and capital in Table 4 is due to the changes in the effective tax rate on firm's profits (that are to match observed company tax revenues in % of GDP) during the calibration period of 2009-14, which alter the capital labour ratio in the long run.

4.2 Budget repair measures

We now consider a fiscal consolidation plan of gradually reducing the budget deficits according to the projections in the 2015-16 Federal Budget by Australian Government (2015a) (see Figure 1). We make a further assumption that the budget surplus of 0.4% of GDP projected for 2025-26 declines at a constant rate to reach zero in 2029-30. After 2030, there is no longer budget surplus or deficit. Nevertheless, the government still has a significant debt and has to pay off the interest payments and the principle, which it does gradually over time.

4.2.1 Implementation

We assume that the government has three fiscal policy options to finance the fiscal consolidation plan: (i) the income tax rates, (ii) the consumption tax rate and (iii) transfer payments.[20] Specifically, we restrict that the adjustments in income or consumption taxes or transfer payments are made to balance the government budget constraint in (6). Note that, while it is straightforward to implement the consumption tax adjustments via temporary increases in the effective consumption tax rate, τ_t^c, additional assumptions need to be made for the other two measures. In the case of the income tax adjustments, we assume a proportional increase or decrease in the progressive income tax function through a scalar, λ_t, that is calculated as

$$\lambda_t = \frac{G_t + TR_t + rGD_t - \left(\Delta GD_t + TAX_t^C + TAX_t^S + TAX_t^{LS} + TAX_t^F\right)}{\sum_{i=1}^{5} \omega_i \sum_{a=21}^{90} \mu_a T\left(y_{a,t}^i\right)}.$$

In the case of the transfer payment measure, a similar scalar is computed to adjust (temporarily cut) the transfer payments ($TR_t = AP_t + ST_t$) to finance the deficit reductions.

The macroeconomic and welfare effects that we discuss below are determined by the behavioural lifecycle responses of households to the fiscal consolidation. We assume the government to announce the fiscal consolidation (i.e., the path of the fiscal deficit/surplus to GDP ratio in Figure 1) at the beginning of 2015. The existing households of different ages and income types (alive in 2015) unexpectedly learn about the government's fiscal consolidation plan and re-optimize their labour supply, consumption and saving decisions over their remaining lifetimes. Note that these households are endowed with their assets that they accumulated in 2014 prior to the fiscal consolidation. We take these assets from

[20] We also consider two alternative tax measures to repair the government budget: (i) temporary levy on labour income (i.e., the introduction of payroll tax) and (ii) temporary levy on domestic total assets income (i.e., the introduction of capital income tax). The discussion of the macroeconomic and welfare effects of these two alternative budget repair measures has been relegated to the Appendix.

the simulation of the baseline transition. Further note that all the existing and future born households are assumed to have perfect foresight about the future tax or transfer changes required to repair the government budget.

We start by discussing the main macroeconomic effects and then we focus on the welfare effects of the three budget repair measures.

4.2.2 Macroeconomic effects

The simulation results of the three budget repair measures for the key macroeconomic variables are provided in Table 5. The table shows these effects as percentage changes in the selected per capita variables in the selected years of the transition and in the long run with respect to the baseline results. Recall that the baseline results assumed the actual budget deficit of 3.07% of GDP in 2014 to stay unchanged during the period of 2015-2150. The long run effects in Table 5 then compare the implications in the new policy and baseline steady states and essentially can be approximated by the results for year 2150.

As expected, the fiscal consolidation leads to either tax hikes or transfer payment cuts initially. For instance, in 2020 (when the government budget returns to a surplus), the required tax hike is more than 42% in average income tax rates or over 52% in the consumption tax rate. Alternatively, the required cut in transfer payments to households in 2020 amounts to almost 36%. After 2022 when the budget surplus peaks at 0.7% of GDP (see Figure 1), the required tax hikes or transfer payment cuts start to moderate. Eventually, all three fiscal adjustments result in the reduced tax rates or increased transfer payments. As shown in Table 5, the examined fiscal consolidation leads to a reduction of 14.3% in the consumption tax rate or an increase of 8.6% in the transfer payments in the long run. This long run result of lower tax rates or higher transfer payments is due to reduced net government debt, which initially further increases from 12.8% of GDP in 2014 to over 20% of GDP in 2020. However, as the government further cuts the budget deficits and then pays off interest payments and the principle, net government debt starts to decline, converging to zero in the new steady state of each budget repair measure.[21] Notice that reduced government debt leads to significant increases in net foreign assets (i.e., reductions in net foreign debt) in each of the three fiscal policy simulations.

[21] Recall that the net government debt to GDP ratio reaches almost 100% of GDP in the new steady state of the baseline transition with the budget deficit of 3.07% of GDP.

Table 5: Macroeconomic effects of eliminating budget deficits with different policy instruments
(Percentage changes in selected variables from baseline results with unchanged 2014 deficit to GDP ratio)

Variable	(i) Temporary income tax hikes				(ii) Temporary consumption tax hikes				(iii) Temporary transfer payment cuts			
	2015	2020	2030	Long run	2015	2020	2030	Long run	2015	2020	2030	Long run
Labour supply	2.07	-6.64	-2.96	0.66	0.63	-0.28	0.02	-0.11	1.91	2.02	1.29	-0.74
Capital stock	0.00	-1.61	-2.04	0.66	0.00	-0.04	0.00	-0.11	0.00	0.56	0.85	-0.74
Domestic assets	0.00	-1.61	-12.82	7.88	0.00	0.14	-1.61	-0.06	0.00	1.80	-0.42	-3.08
Net foreign assets	11.25	18.63	5.95	76.82	-0.08	10.24	30.48	64.98	-5.62	10.46	31.18	61.19
Government debt [a]	14.55	20.24	11.78	0.00	14.68	19.30	11.35	0.00	14.56	19.05	11.23	0.00
Output (GDP)	1.34	-4.98	-2.65	0.66	0.42	-0.20	0.01	-0.11	1.26	1.52	1.14	-0.74
- Consumption	-1.05	-4.68	-4.77	2.65	-1.25	-4.35	-2.79	1.38	-2.87	-2.41	-1.18	0.47
Age pension costs	0.08	0.63	1.85	-2.14	-0.08	-0.11	0.12	0.04	-7.15	-39.15	-23.06	11.08
Total tax revenue	1.84	12.14	7.39	-3.89	1.92	12.07	7.16	-3.62	-0.09	0.32	0.34	-0.58
- Income tax	2.16	32.88	20.86	-10.40	0.44	-0.21	-0.34	-0.14	0.59	1.05	0.71	-1.19
- Consumption tax	-1.05	-4.68	-4.77	2.65	5.60	45.53	27.21	-13.13	-2.87	-2.41	-1.18	0.47
Policy instrument [b]	0.21	42.61	29.22	-12.67	6.93	52.15	30.86	-14.31	-5.42	-35.89	-20.33	8.60

Notes: [a] Net government debt presented in % of GDP; [b] The fiscal policy measure to eliminate budget deficits is either (i) income taxation or (ii) consumption tax rate or (iii) transfer payments.

Table 5 reveals quite distinct impacts on key macroeconomic variables such as per capita labour supply among the three fiscal policy adjustments.[22] Let's first consider the two tax measures to finance the fiscal consolidation plan. Both tax measures has positive effects on per capita labour supply initially, but the impact effect in 2015 of income tax adjustments is almost three times higher than that due to the consumption tax hikes. The reason is that the households alive in 2015 foresee significant tax hikes in the near future (e.g., in 2020) and so increase their labour supply (and savings) initially when the tax rates are still relatively low. The impact effect on labour supply is particularly significant in the case of distortive, progressive income tax changes. When the large increases in the income tax rates are actually adopted, households reduce their labour supply, resulting in much smaller per capita labour supply than in the case of less distortive, consumption tax hikes. For example, the decline in per capita labour supply is 6.64% in 2020 with income tax hikes, whereas under the consumption tax hikes, the labour supply decrease in 2020 is negligible. In the long run, zero government debt allows for lower income tax rates, which provide labour supply and saving incentives and lead to increased per capita labour supply and domestic assets. Similar transitional and long run effects of the two tax budget repair measures to those on per capita labour supply can be observed in Table 5 for other macroeconomic variables such as GDP per capita.

The effects of the temporary cuts to transfer payments (i.e., the third financing budget repair options examined in this section) are positive for labour supply on impact (in 2015) as well as during the fiscal consolidation. This is due to the reduced income effect on

[22] Notice that the same qualitative finding can be observed from Table A1 in the Appendix that discusses the effects of two alternative budget repair measures. That is, while the effects on net government debt are very similar among all five fiscal measures to repair the government budget, their implications on macroeconomic variables such as effective labour supply, capital stock, GDP and consumption per capita are quite different.

labour supply that these transfer payments (i.e., social transfers to households younger than 65 years and age pension payments to households aged 65 years and older) generate. In the long run, however, the implications for most macroeconomic variables are opposite to the transitional effects as are the adjustments in transfer payments. For example, the long run decreases in per capita labour supply and domestic assets from higher transfer payments to households are 0.74% and 3.08%, respectively.

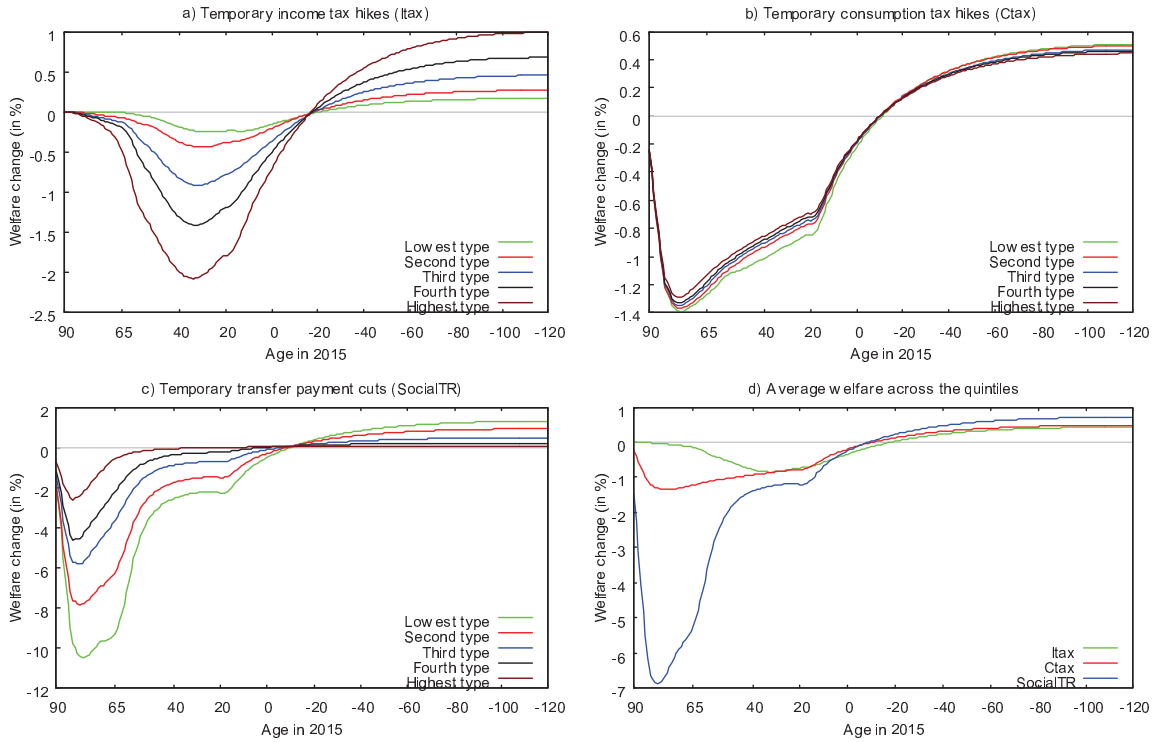
Table 5 also shows that while the already discussed effects on net government debt are very similar across the three budget repair measures, the effects on other selected fiscal variables (e.g., income and consumption tax revenues) differ greatly, depending on the underlying fiscal policy instrument that finances the fiscal consolidation. For example, the temporary increase in the consumption tax rate of 52.2% in 2020 raises the consumption tax revenue by 45.5% in the same year. In the long run when the consumption tax rate is lower, the consumption tax revenue declines by 13.1% relative to the baseline result with the unchanged consumption tax rate.

4.2.3 Welfare effects

We calculate standard equivalent variations to measure the effects of the three examined budget repair measures on welfare of households across generations and income types. These welfare calculations measure the proportional percentage increase/decrease in consumption and leisure for each generation (over its remaining lifecycle) that is needed in the benchmark scenario (with constant deficit to GDP ratio as in 2014) to produce the realized remaining lifetime utility in each reform scenario (for more detailed information, see Auerbach and Kotlikoff (1987), p.87).

Figure 3 depicts the distributional welfare effects of the three budget repair measures. The effects in Figures 3a-3c are presented as percentage changes in the remaining utility for each income quintile of every generation relative to the remaining utility level under the baseline transition. In order to compare the three fiscal adjustments, Figure 3d plots the inter-generational welfare effects of the two tax hikes and the transfer cuts averaged over the five income types of households. The numerical values for the welfare effects of these budget repair measures on selected generations are displayed in Table A2 that is placed in the Appendix. Note that Table A2 also provides a comparison with the welfare effects of the two alternative budget repair measures.

Figure 3: Welfare implications of eliminating budget deficits
(Percentage changes in remaining household utility relative to baseline transition)



Notes: The oldest (youngest) household in 2015 when the scheduled reductions in the government budget deficits are phased in is 90 years (21 years) old. The generations who are younger than 21 years are born in the subsequent periods of the transition.

Several observations can be drawn from these results. First, all existing generations alive in 2015 (i.e., cohorts aged 21-90 years) when the fiscal consolidation begins attain welfare losses. Figure 4d shows that the welfare losses are particularly large in the case of temporary transfer payment cuts, with some older cohorts loosing up to 7% of remaining resources due to the reductions in their pension payments. The temporary increases in the consumption tax rate have also negative effects on the welfare of older generations. Although the magnitude of these effects is much smaller than those observed for the transfer payment cuts, the consumption tax hikes are more negative for the welfare of older households than the income tax hikes. This is simply because all generations pay the tax on their consumption, whereas the income taxes are predominantly paid by the working-age generations. Therefore, the income tax hikes mainly affect the welfare of young and middle age generations.

Second, while all the existing generations bear the welfare costs of the fiscal consolidation due to the required tax hikes or transfer payment cuts, all future generations born after the fiscal consolidation (i.e., after 2030) experience welfare gains. As shown in Figure 3d (and Table A2 for the average welfare), in the long run, generations gain, on average, over 0.76% or 0.51% in their lifetime resources as a result of the transfer payment adjustments or the tax adjustments, respectively. As already discussed, the tax hikes or

transfer payments cuts to fund the fiscal consolidation are only temporary, with the long run elimination of public debt resulting in reverse changes in these fiscal policy instruments. Consequently, the long run tax cuts or transfer payment increases have positive effects on the welfare of future generations.

Third, Figures 3a-3c display interesting differences in the intra-generational welfare effects across the three fiscal policy measures. The consumption tax hikes and in particular the transfer payment cuts are more negative for the welfare of lower income types of the existing cohorts. This is due to the regressive nature of the flat consumption tax rate and because of reduced transfer payments (both the age pension for those 65 years and over and other social transfers to those aged younger than 65 years) representing an important source of income for low income households. For instance, in the case of the transfer payment measure, some older cohorts in the lowest quintile experience welfare losses of over 10% in their remaining utility, while the welfare losses for the same cohorts in the highest quintile do not exceed 2.5% (see Table A2 for the cohorts aged 80 years in 2015).

Conversely, the temporary increases in the income tax rates, which are progressive, reduce the welfare of higher income types more than the welfare of lower income types. Figure 3a shows welfare losses in excess of 2% in remaining utility for some young and middle age cohorts in the highest quintile but only less than 0.25% welfare losses for the same age generations in the lowest quintile. In the long run, the reverse effects on each of the fiscal policy instruments (i.e., either tax cuts or transfer payment increases balancing the government budget with no public debt) produce opposing distributional welfare effects to those during the fiscal consolidation. For example, the highest income households of future generations born after the fiscal consolidation benefit the most from the income tax cuts (with long run welfare increased by almost 1.1% in lifetime resources), whereas future generations in the lowest quintile attain the highest welfare gain (almost 1.4% in the long run) under the transfer payment policy.

5 Sensitivity analysis

This section provides a sensitivity analysis of the long run steady state results for key macroeconomic aggregates reported in Section 4 to alternative assumptions of the model. The modifications of the economic model include (*i*) an economic slowdown via the reduced rate of technical progress and (*ii*) allowing for an endogenous domestic interest rate linked to changes in net foreign assets.

5.1 Economic slowdown

Recent economic projections for Australia indicate that the economy could stay in unfavourable macroeconomic conditions for quite a while (International Monetary Fund [IMF], 2015). How would economic slowdown affect key macroeconomic and fiscal variables, including the level of net government debt in the long run? And how would the macroeconomic effects of the examined budget repair measures presented in Section 4 alter in a situation when the economy experiences a slowdown. This sub-section aims to provide answers to these questions. Specifically, we consider a scenario in which the economy has a lower rate of technical progress set to 1% per year compared to the annual technical change of 1.5% assumed in our base model.

Table 6 compares the long run macro results for the baseline transition (with unchanged deficits in % of GDP) and the three budget repair measures generated by the modified model with lower technical progress with those derived from the base model. Recall that in our model, altering technical progress rate, g, affects household behaviour through changes in (i) earning ability profile, e_a^i, and (ii) time endowment. Any reduction in g flattens the earning ability profile, thus reducing the effective wage rate for each quintile over the lifecycle, as well as making younger households relatively less productive than older households.

Table 6: Sensitivity of long run macro effects to economic slowdown
(Differences between long run results with technical change of 1% and 1.5%)

Variable	Baseline transition [a]	Policy instrument to eliminate budget deficit [b]		
		(i) Income tax rates	(ii) Consumption tax rate	(iii) Social transfers
Labour supply	-7.01	0.31	-0.09	-0.29
Capital stock	-6.98	0.31	-0.09	-0.29
Domestic assets	8.41	7.65	-0.09	5.52
Net foreign assets	50.78	48.79	26.86	38.74
Net government debt [c]	19.08	0.00	0.00	0.00
Output (GDP)	-7.00	0.31	-0.09	-0.29
- Private consumption	-2.82	2.33	1.11	4.32
Age pension costs	20.38	-1.76	0.04	12.62
Total tax revenue	-5.31	-3.44	-3.08	-5.80
- Personal income tax	-6.76	-9.44	-0.12	-15.45
- Consumption tax	-2.82	2.33	-10.57	4.32
Policy instrument	-12.72	-11.07	-11.24	12.48

Notes: [a] Deficit of 3.07% of GDP kept unchanged with adjustments in public consumption; [b] Long run deficit of 0% of GDP with adjustments in (i) income taxation, (ii) consumption tax rate or (iii) social transfers; [c] Deviation in net debt to GDP ratio.

The results comparing the baseline transitions in Table 6 show significant declines in long run labour supply, capital stock, GDP and consumption (all presented as per capita) due to lower g. Note that we report the effect on effective labour supply, which decreases directly due to the reduced lifecycle earning ability (see the labour market

equilibrium condition in (9) for the calculation of labour supply) and indirectly because of the dominating substitution effect on households' hours of work from the reduced earnings ability. Interestingly, the stock of domestic assets is shown to increase compared to our base model with higher g. The intuition behind this result is that younger households save more due to lower expected future earnings, generating higher average domestic assets. In retirement, however, total assets are smaller compared to those in the economy with higher g, resulting in the increased expenditure on the means tested age pension.

Economic slowdown modeled through reduced g directly affects net government debt that is found to increase by additional 19 percentage points of GDP relative to the base model simulation of the baseline transition.[23] Importantly, the reduced tax revenues and increased expenditures on pensions and interest payments require further cuts in government consumption that is assumed to clear the government budget constraint during the baseline transition.

The comparison of the long run effects of eliminating the budget deficit and net debt reveals that these effects vary greatly across the three fiscal measures. Nevertheless, there are two results that are common for each fiscal policy measure. First, the elimination of larger government debt in the economy with reduced growth allows for a more significant tax cut or transfer payment increase in the long run. As a result, positive effects on consumption per capita are larger than those obtained from our base model. For instance, Table 6 shows that the additional 5.19 percentage point increase in transfer payments generates a further 0.5 percentage point increase in per capita consumption. Second, the elimination of larger government debt (relative to net debt in the economy with higher g) leads greater improvement in foreign investment position, as indicated by the further increase in net foreign assets.

The relative effects on effective labour supply, capital stock and domestic assets differ among the three fiscal measures, depending on the implications of budget equilibrating policy instruments for the interaction of the substitution and income effects. As shown in Table 6, the long run reduction in distortive, income tax rates has positive and significant effects on labour supply and especially domestic assets, while the additional consumption tax cut in the economy with slower growth leads to insignificant effects on these macro variables in comparison with those reported in Section 4.

[23] In the long run steady state, the net government debt to GDP ratio equals to $\text{Deficit\_GDP}/(n+g+ng)$, which with $g = 1\%$, $n = 1.6\%$ and $\text{Deficit\_GDP} = 3.07\%$ implies net government debt of 117.35% of GDP, compared to 98.27% of GDP reported in Section 4.

5.2 Endogenous interest rate

Our base model described in Section 2 made the assumption that the domestic interest rate was equal to the exogenously given world interest rate and was unaffected by the changes in net government debt. We now relax this small open economy assumption and examine the effects of the three budget repair measures, assuming an imperfect capital mobility framework with the domestic interest rate depending upon the level of foreign assets. Specifically, in this setting the domestic interest rate is determined as

$$r_t = \overline{r} - \gamma \left(FA_t/Y_t - FA_{2014}/Y_{2014} \right),$$

where $\overline{r}$ is the exogenous world interest rate ($= 0.04$), FA_t/Y_t is the ratio of net foreign assets to GDP and the parameter $\gamma > 0$ gives responsiveness to the changes in FD_t/Y_t. Following Guest (2006), we set γ to 0.02. Under this specification, the domestic interest rate will fall (increase) if the ratio of net foreign assets to GDP increases (decreases). 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. Hence, long run changes in the capital stock, labour supply and output will differ. The effects that we discuss below may be thought of as being similar to the effects derived from a closed economy model.

Table 7 shows the sensitivity of the long run macroeconomic effects by comparing the effects derived from this endogenous interest rate framework with the long run effects from our base model discussed in Section 4. The table also compares the two baseline transitions with the current budget deficit to GDP ratio and with either endogenous or exogenous interest rates. The results for the baseline transition indicate a long run increase of 13.77% in the domestic interest rate, which is due to reduced net foreign assets (or higher net foreign debt that funds an increasing net government debt). However, relative to the small open economy results, Table 7 indicates that net foreign assets increase significantly as the higher interest rate leads to larger domestic assets and lower capital stock. Per capita labour supply is shown to further decline in the endogenous interest rate framework, which is due to work disincentives from the reduced wage rate. Consequently, as both inputs to production fall, the effect on GDP per capita is more negative than in the small open economy with an exogenous interest rate. Recall that the net government debt to GDP ratio in the long run is implied by the given deficit to GDP ratio (3.07% of GDP) and exogenous rates of population growth and technical progress. The long run debt amounts to 98.27% of GDP in both economies, and so the displayed difference for net government debt in Table 7 is zero.

Table 7: Sensitivity of long run macro effects to alternative market structure
(Differences between long run results with endogenous and exogenous interest rate)

Variable	Baseline transition [a]	Policy instrument to eliminate budget deficit [b]		
		(i) Income tax rates	(ii) Consumption tax rate	(iii) Social transfers
Labour supply	-0.88	1.54	0.99	0.53
Wage rate	-3.39	5.14	4.01	3.61
Capital stock	-8.35	13.93	10.46	8.92
Domestic assets	13.14	-14.26	-12.94	-12.81
Net foreign assets	98.75	-37.20	-33.46	-32.15
Net government debt [c]	0.00	0.00	0.00	0.00
Interest rate	13.77	-17.36	-13.73	-12.39
Output (GDP)	-3.51	5.60	4.12	3.32
- Private consumption	-1.26	3.43	2.42	1.69
Age pension costs	-2.58	2.40	2.70	9.74
Total tax revenue	-0.34	-1.79	-1.76	0.12
- Personal income tax	-1.91	-3.33	2.34	1.45
- Consumption tax	-1.26	3.43	-6.85	1.69
Policy instrument	-2.63	-6.56	-8.60	5.42

Notes: [a] Deficit of 3.07% of GDP kept unchanged with adjustments in public consumption; [b] Long run deficit of 0% of GDP with adjustments in (i) income taxation, (ii) consumption tax rate or (iii) social transfers; [c] Deviation in net debt to GDP ratio.

The effects of the examined budget repair measures are positive for most macroeconomic variables relative to those derived from the small open economy model. For example, the long run capital stock, labour supply, GDP and consumption per capita all increase in this imperfect capital mobility framework. These positive effects are due to improved net foreign assets that cause the domestic interest rate to decline. The reduced interest rate increases investment demand and leads to a larger capital stock. The resulting capital deepening then generates a positive effect on the wage rate, which provides further incentives for households to increase their labour supply. Consequently, both labour supply and GDP per capita increase. The reduced interest rate, however, implies a lower rate of return on assets, leading to smaller domestic assets than in our base model. The relative net foreign assets (i.e., difference between the results in endogenous and exogenous interest rate economies) are then shown to decline as more capital inflows are needed to support the increased capital stock.[24] The long run results in Table 7 also indicate a larger tax cut or a larger transfer payment increase resulting from budget deficit and government debt eliminations when the domestic interest rate is endogenous.

[24]Note that in both economies all three budget repair measures lead to increased net foreign assets in the long run. However, the long run improvements are larger in the small open economy. Hence the difference in the long run effects on net foreign assets reported in Table 7 is negative. This is because the reduced government debt has no impact on the domestic interest rate and so it has much smaller impacts on domestic assets and the capital stock than in this modified model with an endogenous interest rate.

6 Conclusion

We quantify and compare the macroeconomic and welfare effects caused by proposed fiscal reforms to balance the government budget by 2030 in Australia. Using a computable, general equilibrium OLG model calibrated to match the data in Australia, we find that while the examined policy options achieve the same fiscal goal, the macroeconomic and welfare outcomes differ significantly. Specifically, the current generations would not support any fiscal austerity measures because they are worse off by having their transfer payments cut or having to pay higher taxes. Our results suggest interesting outcomes when choosing between temporary transfer payment cuts or tax increases to fund the fiscal consolidation. Cutting transfer payments results in the worst welfare losses for the current generations, but the highest welfare gain for the future generations.

Our results carry implications for designing a feasible consolidation strategy for Australia. Even though the long-run benefits of budget repair measures are undeniable, the transitional costs to the economy and welfare are significant and unavoidable. The budget repair measures are indeed tough policy choices for a better future in Australia. Our results consistently suggest that none of the three fiscal austerity measures are politically feasible as they will likely fail to gain the political support of current generations. The conflict of interest between the current and future generations suggests political infeasibility for any structural fiscal reforms.

Our dynamic general equilibrium framework with overlapping generations can be applied to study the effects of structural tax reforms proposed by the Henry Tax Review (AFTS, 2010) and by the Tax White Paper (Australian Government, 2015b). Notice that, in our paper we abstract from altruistic motives, so that there are no intended bequests and other forms of intergenerational transfers through family line. Introducing intergenerational transfers creates a new channel that links the welfare of current generations to that of future generations, which might affect welfare outcomes and increase political support by current generations for the fiscal consolidation plan. We leave these extensions for future research.

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Appendix A - Alternative fiscal measures

The government has a wide range of policy measures to repair its budget. In this Appendix, we analyse the effects of two alternative tax measures: (i) a special levy on labour income (i.e., temporary introduction of a flat payroll tax rate) and (ii) a special levy on total assets income (i.e., temporary introduction of a flat capital income tax rate). The macroeconomic and welfare effects of the two alternative budget repair measures and the comparison with the effects of the three policy measures examined in Section 4 are presented and discussed below.

Table $A1$ reports the macroeconomic effects of the two alternative policy measures that are presented for key macroeconomic variables as percentages changes in selected transitional years and in the long run relative the baseline results displayed in Table 4. As expected, the two budget-equilibrating tax instruments increase to finance deficit reductions during the consolidation period. Whereas the special levy on labour income is relatively small (peaking at 9% in 2020), the assets or capital income levy is significantly higher, reaching 37% in 2020. This difference is due to (i) total assets income being smaller than labour income and (ii) more distortive nature of the capital income tax (leading to large decreases in domestic assets and assets income). Similarly to the main tax measures discussed in Section 4, the transitional effects of the two alternative tax measures on net government debt are much the same. The net debt initially increases and peaks at about 20% of GDP in 2020 after which it starts to gradually decline, converging to zero in the long run.

Table A1: Macroeconomic effects of eliminating budget deficits with alternative policy instruments
(Percentage changes in selected de-trended variables from baseline results with unchanged deficit to GDP ratio)

Variable	Temporary labour income levy				Temporary assets income levy			
	2015	2020	2030	Long run	2015	2020	2030	Long run
Labour supply	2.81	-3.41	-0.85	0.03	-4.34	-2.77	0.94	-0.74
Capital stock	0.00	-0.70	-0.68	0.03	0.00	-0.18	0.74	-0.74
Domestic assets	0.00	0.39	-9.13	2.34	0.00	-9.18	-21.84	16.91
Net foreign assets	3.66	17.21	11.59	68.85	4.94	-20.16	-26.85	94.94
Government debt [a]	14.48	19.80	11.54	0.00	15.18	19.44	11.12	0.00
Output (GDP)	1.84	-2.50	-0.79	0.03	-2.90	-1.90	0.87	-0.74
- Consumption	-2.32	-4.93	-3.86	1.76	3.20	1.59	-1.46	1.27
Age pension costs	0.10	0.64	1.24	-0.83	-0.10	0.93	3.54	-3.87
Total tax revenue	1.78	12.16	7.31	-3.73	2.28	12.16	7.56	-1.90
- Income tax	1.85	-14.86	-9.71	3.13	-3.06	-3.55	-2.04	1.69
- Consumption tax	-2.32	-4.93	-3.86	1.76	3.20	1.59	-1.46	1.27
Policy instrument [b]	0.00	0.09	0.06	-0.02	0.09	0.37	0.26	-0.10

Notes: [a] Net government debt presented in % of GDP; [b] The fiscal policy instrument to eliminate budget deficits is temporary levy on either (i) labour income or (ii) total assets income.

Table $A1$ also shows very different effects on effective labour supply, domestic assets, GDP and consumption over time between the two alternative tax measures. While the

fiscal consolidation with the temporary labour income levy initially increases per capita labour supply (due to the same reason as discussed for progressive income tax hikes), the temporary capital income levy has a significantly negative effect on labour supply, which on impact falls by 4.34%. As a result of introducing this capital income levy, households demand not only more leisure and also more consumption, with per capita consumption increasing by 3.2% in 2015. These two adjustments in households' behaviour have a significant impact on the total assets accumulation, resulting in large reductions in domestic assets during the consolidation period. Implied decreases in total assets earnings then require further increases in the capital income levy balancing the government budget. The results for net foreign assets also vary greatly between these alternative budget repair measures. The effects of the temporary labour income levy are qualitatively similar to those from the income tax hikes, with net foreign assets being positively impacted by gradual reductions in net government debt. In contrast, the temporary assets income levy leads to significantly lower net foreign assets during the consolidation period because of increased capital imports replacing reduced domestic savings in funding the capital stock.

The welfare effects of the two alternative tax measures and of the three main budget repair measures are displayed in Table $A2$. These effects are presented for each household income quintile and for average welfare of four selected cohorts. The selected cohorts in Table $A2$ include two existing generations (aged 80 and 40 years in 2015) and two future born generations (aged 0 and -150). The results for the generation aged -150 in 2015 represent the long run welfare effects.

Table A2: Welfare implications of eliminating government deficits with different policy instruments

Policy instrument	Age in 2015	Income quintile					Average welfare
		Lowest	Second	Third	Fourth	Highest	
Temporary income tax hikes	80	0.00	-0.02	-0.04	-0.05	-0.07	-0.03
	40	-0.19	-0.38	-0.83	-1.31	-2.00	-0.78
	0	-0.16	-0.21	-0.36	-0.51	-0.70	-0.33
	-150	0.18	0.28	0.50	0.74	1.09	0.47
Temporary consumption tax hikes	80	-1.35	-1.33	-1.31	-1.30	-1.26	-1.31
	40	-1.01	-0.93	-0.90	-0.88	-0.85	-0.93
	0	-0.22	-0.19	-0.19	-0.18	-0.17	-0.20
	-150	0.54	0.51	0.50	0.49	0.47	0.51
Temporary transfer payment cuts	80	-10.41	-7.83	-5.81	-4.53	-2.41	-6.87
	40	-2.56	-1.77	-0.89	-0.37	-0.06	-1.39
	0	-0.51	-0.31	-0.12	0.00	0.02	-0.24
	-150	1.38	0.99	0.50	0.22	0.02	0.76
Temporary levy on labour income	80	0.00	0.00	0.00	0.00	0.00	0.00
	40	-0.96	-1.01	-1.16	-1.26	-1.40	-1.12
	0	-0.39	-0.40	-0.46	-0.48	-0.49	-0.43
	-150	0.46	0.50	0.55	0.59	0.63	0.53
Temporary levy on assets income	80	-0.06	-0.36	-0.67	-0.90	-1.18	-0.56
	40	-0.94	-1.33	-1.69	-1.89	-2.12	-1.48
	0	-0.10	-0.06	-0.05	-0.03	-0.01	-0.06
	-150	0.39	0.58	0.70	0.76	0.87	0.61

Notes: Standard equivalent variation measures (in percent) relative to baseline transition with the government deficit to GDP ratio kept constant as in 2014; Age -150 in 2015 shows long run welfare effects.

The comparison of the two alternative tax measures in Table $A2$ indicates that while the labour income levy has no effect on older cohorts (depicted by those aged 80 years in 2015) as these households already retired from work, the capital income levy results in significant welfare losses for older cohorts. Specifically, the cohorts aged 80 years loose, on average, 0.56% of their remaining resources as a result of funding the consolidation plan with the capital income levy. The welfare losses attained by existing generations are greater for higher income quintiles as they hold larger assets relative to the assets of lower income types. In the long run, the government debt elimination generates a subsidy (rather than levy) on either labour or capital income. These subsidies produce long run gains in average welfare and in welfare of more affluent households that are relatively higher in case of capital income tax/subsidy adjustments

Importantly, Table $A2$ enables us to compare all five budget repair measures in terms of the intergenerational effects (on average welfare across different cohorts) and the intra-generational effects (on welfare of different income quintiles). Starting with the intergenerational effects and comparing the results for average welfare, the budget repair measure with transfer payment adjustments results in the highest welfare gains in the long run, followed by the capital income tax/subsidy adjustments. The two fiscal measures, however, produce by far the worst welfare losses for the current generations who face welfare cuts and special levy on their capital income. The comparison of the intra-generational effects among the five examined fiscal measures reveals that while temporary consumption

tax hikes and particularly transfer payment cuts hurt especially the poor, the other tax hikes (progressive income tax hikes in particular) generate larger welfare losses for the rich. In the long run, however, the intra-generational effects reverse as the elimination of government debt allows for either tax cuts or special subsidies on labour and capital income or a transfer payment increase.

In sum, these welfare trade-offs between current and future generations, as well as between the rich and poor, highlight key political constraints and point to tough policy choices for wellbeing of future Australians.