Submission to Productivity Commission

Company Income Tax Cuts in Australia:

A Dynamic General Equilibrium Analysis

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September 2025

Abstract

This submission evaluates Productivity Commission (2025)'s proposal to reform Australia's corporate income tax system. We first quantify the marginal excess burdens (MEB) of the company income tax (CIT) and other major taxes, finding that the CIT is among the least efficient instruments for raising revenue. We then evaluate the macroeconomic and distributional impacts of reducing the corporate tax rate in Australia. Simulation results indicate that lowering the company tax rate from 30% to 20% can serve as a powerful policy tool to encourage investment, boost capital accumulation, raise wages, and increase output. However, welfare outcomes are uneven, varying significantly across households by income level and age. These heterogeneous effects arise from complex general equilibrium adjustments to the reform and depend critically on the fiscal instruments used to offset revenue losses. Thus, while corporate tax cuts can generate substantial efficiency gains, welfare effects vary across generations, between retirees and workers, and between low- and high-income households, depending on the budget-balancing measures adopted by the government. These findings highlight the potential political challenges involved in designing company tax cut reforms.

JEL Classification: E62, H21, H22, H24, H25

Keywords: Corporate taxation, Company income tax cuts, deadweight loss, excess burden, tax incidence, overlapping generations, dynamic general equilibrium, welfare

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1 Introduction

The corporate income tax system plays a critical role in shaping business decisions regarding investment and financing. As such, the structure and level of corporate taxation can have significant implications for efficiency and welfare. Australia's top company tax rate is 30%, with a lower 25% rate for "base rate entities" which typically smaller businesses that meet turnover and passive income tests. This places Australia with one of the highest corporate tax rate among OECD countries, compared to the OECD average of around 24% (e.g., see Figure 1).

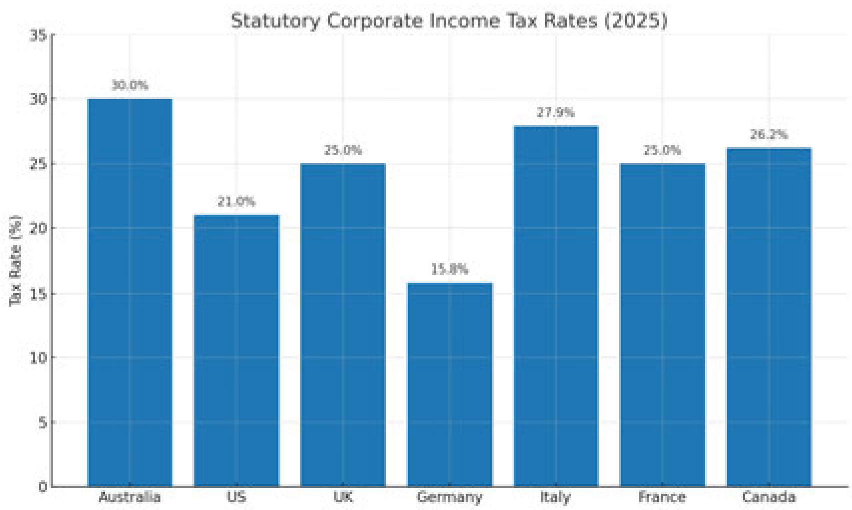


Figure 1: **Statutory corporate/company income tax (CIT) rates for selected countries.**

Should Australia cut company tax? If so, what would be the macroeconomic and welfare impacts? Recently, the Productivity Commission has floated the idea that cutting company income tax would boost national prosperity. Specifically, Productivity Commission (2025) proposes a two-part reform of the corporate income tax system: (i) reducing the standard tax rate to 20% for companies with turnover below A$1 billion, while maintaining the 30% rate for larger firms; and (ii) introducing a 5% Net Cashflow Tax that allows immediate deduction of capital expenditures and is designed to be broadly revenue neutral.

According to the Commission's projections, these measures would generate an additional A$7.4 billion in investment (1.6%), increase GDP by A$14.6 billion (0.5%), and raise labor productivity by 0.4%. To support this proposal, the Commission commissioned two independent studies. The first, by Murphy (2025), employs a long-run comparative static computable general equilibrium (CGE) model, which assumes the economy moves instantaneously to a new steady state, abstracting from the transition dynamics. The second, by Nassios et al. (2025), applies a dynamic CGE model that explicitly captures the path of adjustment from the current equilibrium to the new steady state. Both studies conclude that company tax cuts would stimulate investment, expand employment, raise pre-tax real wages, and boost GDP. However, they diverge on the welfare implications: while Murphy (2025) finds positive effects, Nassios et al. (2025) suggest that Australians would be less prosperous in welfare terms, with an estimated loss of nearly AUD300 per person.

However, both studies abstract from modeling household heterogeneity in intertemporal choices regarding consumption, saving, and labor supply over the life cycle. They also do not fully capture the dynamic general equilibrium adjustments in labor and capital markets—particularly changes in wages, returns on capital, and other prices—that are central to modern macroeconomics and public finance. As a result, these studies cannot account for the full range of behavioral responses and are unable to quantify the distributional and welfare consequences of company income tax (CIT) cuts across different age cohorts and income groups over time.

To fill this gap, our paper develops and applies a dynamic general equilibrium, overlapping generations (OLG) model calibrated to Australian data. This framework allows us to explicitly model household heterogeneity, life-cycle behavior, and market interactions, thereby enabling a comprehensive assessment of both the aggregate and distributional implications of company tax reform.

Our findings indicate that a reduction in the company tax rate can serve as an important policy instrument to encourage investment, stimulate capital accumulation, raise wages, and enhance overall economic output. At the same time, the welfare effects are not uniform: outcomes vary substantially across households by income level and age cohort. These heterogeneous effects arise from the complex general equilibrium adjustments triggered by the tax reform and depend critically on the fiscal instrument chosen to offset the associated revenue loss. Thus, while company tax cuts may generate sizable efficiency gains, their equity and welfare implications hinge on the broader design of fiscal policy.

2 Model overview

The model is based on Tran and Wende (2021). The model is a discrete time, dynamic general equilibrium model, which consists of overlapping households, a perfectly competitive representative firm, foreign investors with perfectly capital mobility and a government with full commitment technology. Specifically, households are born with different skill types that determine their labor productivity over their life cycle, and make decisions on consumption, labor supply and saving to maximize their lifetime utility. Such household heterogeneity allows us to disaggregate marginal excess burden of taxes according to income type, age and generations. On the firm side, we deviate from the previous literature, which usually subsumes all taxes on capital in a single tax rate, and explicitly model the structure of corporate finance and taxes. The firm chooses investment to optimize its market value taking into account future profits and the structure of corporate finance and taxes. The firm relies on internal finance (retained profits) or external finance (debt or equity) to fund its investment plan. Having these new modeling features allows us to have a differentiated assessment of different capital taxes. The government raises revenues from company income tax, personal income tax and consumption tax. The benchmark model is calibrated to match some features of the Australian economy in 2010s. The model is capable of reproducing lifecycle patterns of household behaviours and key macro aggregates including fiscal policy.[1]

3 Result summary

3.1 Marginal excess burden of taxes

To evaluate the potential direction of tax reform in Australia, we calculate the marginal excess burdens (MEB) of taxes. In our calculation, only one tax rate is varied at a time, and any additional revenue raised is redistributed to all households through a uniform lump-sum transfer scheme. The excess burden represents the welfare loss (or gain) that individuals experience as a result of raising taxes. For each household, the MEB is measured as the net present value of the welfare change, normalized by the net present value of the change in net revenue. Our quantitative findings, based on a calibration that reflects the Australian economy, are summarised as follows.

Three main taxes. We begin with three main taxes on business and personal income as well as consumption: company income tax (CIT), personal income tax (PIT) and consumption tax (CT/GST). Table 1 presents the marginal excess burdens (MEB) for the three taxes.[2]

	CIT	PIT	CT
Aggregate	**\$0.62**	**\$0.34**	**\$0.23**
by age group			
+ Old: 65+	\$1.39	-\$0.59	\$0.08
+ Young: 20 to 64	\$0.45	\$0.13	\$0.26
+ Future: -100	\$0.69	\$0.43	\$0.23
by income group			
+ Type 1: low income	\$0.12	\$0.02	\$0.07
+ Type 2: medium income	\$0.52	\$0.28	\$0.17
+ Type 3: high income	\$1.23	\$0.73	\$0.48

Table 1: **Marginal excess burdens (MEB) of raising extra revenue from the company income tax (CIT), the personal income tax (PIT) and the consumption tax (CT/GST).**

[1] We provide more details about our model and calibration in Appendix.

[2] The results presented are normalized for population and productivity growth with the population measure normalized to one. In this setting one dollar per household equals one dollar in total. Changes in aggregate variables, such as GDP and the capital stock, can be thought of as the change per dollar of net revenue. At the same time changes in household variables, such as welfare, can be thought of as the change per dollar of revenue per household.

Table 1 reports a disparity in marginal excess burden. As seen in the first row for aggregate MEB, raising the company income tax is more distorting than raising the personal income tax and consumption tax. Specifically, the aggregate MEB for the company income tax is 64 cents per dollar of tax revenue raised, compared to 34 cents and 23 cents for the personal income tax and the consumption tax, respectively. Our MEB estimates for Australia are relatively higher than estimates from previous studies (e.g., see Ballard, Shoven and Whalley (1985) and Judd (1985)). Specifically, Ballard, Shoven and Whalley (1985) find MEB estimates in the range of 18 to 46 cents for industry level capital tax and a range of 12 to 23 cents for industry level labor tax; meanwhile, Judd (1985) finds a MEB of 12 cents for labor income tax. It is important to note that these studies, like Murphy (2025), focus primarily on long-run steady-state effects. By contrast, our analysis goes beyond steady-state comparisons to fully account for the behavioral responses of different generations and the dynamic general equilibrium effects that unfold along the transition path.

The company income tax is the least efficient tax as it results in the highest MEB at the aggregate level. However, there is significant variation in the MEB across generations and income types when the marginal excess burdens are further disaggregated by age and income type as presented in rows from 2 to 6 in Table 1. In particular, old households are the biggest losers from a company tax increase. Conversely, older households are, on average, better off under a personal income tax increase and only marginally impacted by a consumption tax increase. Lower-income households are also largely unaffected by tax hikes. This occurs as the model assumes any extra revenue generated is re-distributed evenly via the transfer system to balance the budget, the loss of income from lower wages is offset by higher transfers. Low-income households indeed would be only 2 cents and 7 cents worse off under income tax and consumption tax increases, respectively. Conversely, high-income households are significantly worse off as they bear most of the MEB.

Capital vs. labor vs. consumption taxation. We compute marginal excess burdens (MEB) for other forms of taxes on capital and labor income at different sources, including investment tax credits (ITC), depreciation deductions (DD), personal labor income tax (PLT), and personal asset income tax (PAT). It is important to note that, ITC and DD directly affect business income, while the PLT and PAT are on personal (labor and asset) income. We examine whether capital taxes are generally more distortionary than labor taxes and, again, who bears the burden of each tax.

Table 2 reports the marginal excess burden of these taxes. For comparison we also include the marginal excess burdens of the company income tax (CIT), the personal income tax (PIT), and the consumption tax (CT). We classify different taxes into two groups: those imposed on the capital and those on labor. Personal income tax is in both groups as it is collected on both capital and labor income. Consumption tax is in neither group.

We find that taxes levied on firms—whose incidence largely falls on foreign investors—

	Taxes on capital						
					Taxes on labor		
	CIT	ITC	DD	PAT	PIT	PLT	CT
Aggregate	**$0.62**	**$1.03**	**$0.81**	**$0.48**	**$0.34**	**$0.29**	**$0.23**
by age group							
+ Old	$1.39	-$1.86	$0.01	-$0.05	-$0.59	-$0.76	$0.08
+ Young	$0.45	-$1.21	-$0.17	$0.79	$0.13	-$0.07	$0.26
+ Future born	$0.69	$1.81	$1.16	$0.46	$0.43	$0.43	$0.23
by income group							
+ Type 1: low income	$0.12	$0.41	$0.25	$0.24	$0.02	-$0.04	$0.07
+ Type 2: medium income	$0.52	$0.91	$0.70	$0.44	$0.28	$0.23	$0.17
+ Type 3: high income	$1.23	$1.81	$1.51	$0.79	$0.73	$0.72	$0.48

Table 2: **Marginal excess burdens (MEB) of raising extra revenue from different taxes on the firm and households.** Note that, CIT: Company income tax; ITC: Investment tax credits; DD: Depreciation deductions; PAT: Personal asset income tax; PIT: Personal income tax; PLT: Personal labor income tax; and CT: Consumption tax (i.e., GST).

generate a higher marginal excess burden (MEB) than those levied directly on domestic households. Our ranking indicates that reducing investment tax credits produces the highest MEB, while increasing the consumption tax entails the lowest. Among the three firm-level capital taxes (company income tax, investment tax credits, and depreciation deductions), the company income tax is relatively less distortionary.

Overall, our results show that the marginal excess burdens of capital taxes—including company income tax (CIT), investment tax credits (ITC), depreciation deductions (DD), and personal asset taxes (PAT)—are significantly higher than those of labor and consumption taxes. This suggests that shifting the tax burden away from capital and toward labor and consumption would enhance overall economic efficiency.

3.2 Company income tax cuts

We apply the benchmark model to examine the implications of a hypothetical tax reform in which the Australian government reduces the company income tax rate from 30% to 20%. In this scenario, all other taxes are held constant, and the government balances its budget by cutting general spending. While admittedly hypothetical, this assumption allows us to isolate and clearly illustrate the full effects of a company income tax cut, without the confounding impact of alternative financing instruments.

Macroeconomic effects. This cut in the corporate income tax (CIT) reduces company tax revenue by approximately 35%. The lower CIT rate incentivizes firms to increase their investment. As a direct result, investment rises by up to 2% after five years compared to the level in the benchmark model. After 10 years, the rate of increase slows, eventually stabilizing at around 3.5% above the benchmark level in the long run. The higher level of investment leads to an increase in the capital stock, which continues to grow in the medium and long

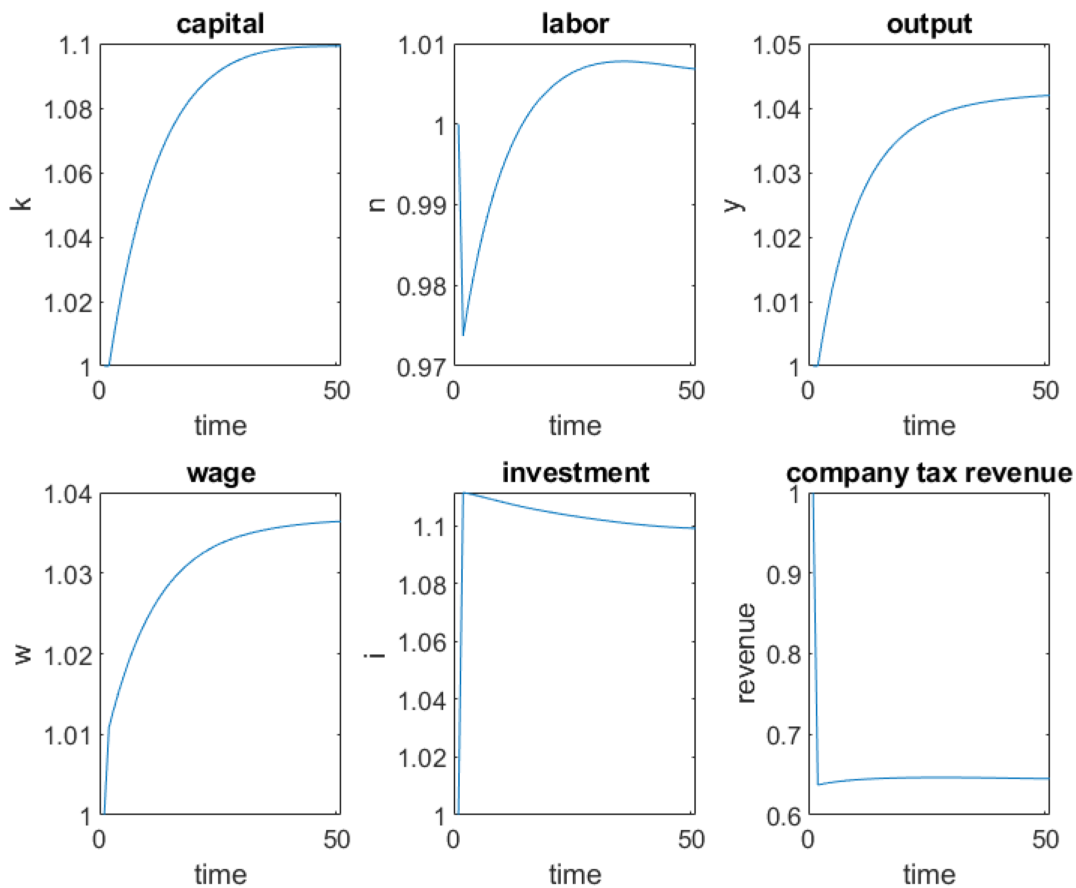


Figure 2: **Aggregate effects of CIT cut financed by general government spending.**

term as firms adjust their investment to fully capitalize on the lower tax rate. A larger capital stock raises the marginal product of labor, prompting firms to demand more labor and offer higher wages to attract it. Consequently, the equilibrium market wage rate increases. Initially, labor supply declines slightly and remains subdued in the short term. However, as the capital stock grows and the marginal product of labor increases, labor supply gradually rises. In the long run, the economy expands, with output increasing by approximately 4% compared to the benchmark level.

Welfare effects. Even though the tax cut generates substantial efficiency gains, the resulting welfare effects are more complex and depend critically on the fiscal instruments used to offset revenue losses. To illustrate this, we consider two alternative financing approaches: [1] reductions in government spending and [2] a lump-sum tax. Table 3 reports the welfare outcomes under these two regimes.

We find that when the government does not need to raise additional revenue and instead reduces general spending programs that do not directly affect household welfare in our framework, the policy reform generates positive welfare gains for all groups (Column [1]). However, the outcomes change once the government must offset the revenue loss from cutting the company income tax rate. In particular, when a lump-sum tax is used as the financing instrument, the reform creates both winners and losers (Column [2] of Table 3). Current retirees see their welfare reduced, mainly because higher taxes erode their income and wealth more than their income gains from higher wage and interest rates. Younger households and future generations, however, benefit more from stronger wage growth as investment and the capital stock rise higher over time. The distributional effects are uneven: higher-income households gain, while lower-income households lose. This divergence arises because the lump-sum tax places a heavier relative burden on those with lower incomes.

	[1]. Gov. spending (G)	**[2]. Lump-sum tax (T)**
Aggregate	+	+
by age group		
+ Current retirees: 65+	+	–
+ Current workers: 35 to 64	+	–
+ Current workers: 20 to 34	+	+
+ Future generations	+	+
by income group		
+ Type 1: low income	+	–
+ Type 2: medium income	+	–
+ Type 3: high income	+	+

Table 3: **Welfare effects of company income tax cuts financed by general government spending (G) or lump-sum tax (T).**

The government has a wide range of other financing instruments, including personal income tax, labor income tax, consumption tax, or adjustments to franking credits. In these cases, future generations still experience welfare gains in the long run. For current generations, however, the welfare effects are more complex. Welfare outcomes differ across generations, between retirees and workers, and between low- and high-income groups, depending on the budget-balancing measures the government implements. The uneven distribution of welfare effects highlights the political challenges in designing company tax reforms.

4 Concluding remark

Our findings suggest that reducing the company tax rate from 30% to 20% can serve as a powerful policy tool to attract investment, stimulate capital accumulation, raise wages, and boost overall economic output. By lowering the cost of capital, the reform strengthens incentives for firms to expand and invest, which in turn enhances productivity and long-term growth. However, the welfare effects are not uniform. They vary significantly across households depending on income level and age. Crucially, the distributional and welfare effects depend on how the government offsets the revenue losses from cutting the company tax rate. Thus, while corporate tax cuts can generate sizable efficiency gains and support stronger economic growth, their broader implications for equity and welfare ultimately hinge on the overall design of budget-balancing measures. A well-calibrated policy mix is therefore essential to ensure that the benefits of tax reform are both economically significant and socially inclusive.

Appendix

In this appendix, we provide more details about the model, calibration of the full dynamic model, computation of marginal excess burden and additional results for the transitional impacts and additional results for the sensitivity analysis.

B Model

The model is a discrete time, dynamic general equilibrium model, which consists of overlapping households, a perfectly competitive representative firm, foreign investors with perfectly capital mobility and a government with full commitment technology. The benchmark model will be calibrated to match the Australian small open economy.

B.1 Environment

B.1.1 Household

The household sector is filled with heterogeneous households who are different in terms of labor productivity and age.

Demographics. In each period a continuum of households with different skill types $i \in \mathbb{I}=[1,2,3]$ enters the model at age 20 and live to at most to age 100, $j \in \mathbb{J}=[20,\ldots,100]$. They face a stochastic probability of death every period. sp_j is the age-dependent survival probability at age j. The unconditional probability of surviving from age 20 to age j, is given by $S_j=\prod_{s=21}^{j} sp_s$. The size of a new cohort entering the economy and the overall population both grow at the rate g^n. Let $\mu_{t,j,i}$ denote the size of the cohort of skill type i in age j at time t, which evolves according to $\mu_{t+1,j+1,i}=sp_{j+1}\mu_{t,j,i}=\mu_{t,j+1,i}(1+g^n)$.

Preferences. Households value consumption $(c_{j,i})$ and leisure $(l_{j,i})$. Their expected lifetime utility is the sum of current and discounted future intra-temporal utility as $U_{t,j,i}=\sum_{j'=j}^{100} S_j\hat{\beta}^{j'-j}u\left(c_{t+j'-j,j',i},l_{t+j'-j,j',i}\right)$, where $\hat{\beta}$ is the time discount factor and S_j is the unconditional probability of survival. Households have identical intra-temporal preferences over consumption, $c_{t,j,i}\geq 0$, and leisure, $0\leq l_{t,j,i}\leq 1$. The intra-temporal utility is assumed to have the form of $u\left(c_{t,j,i},l_{t,j,i}\right)=\frac{\left(c_{t,j,i}^{\gamma}l_{t,j,i}^{1-\gamma}\right)^{1-\sigma}}{1-\sigma}$, where σ is a parameter governing inter-temporal elasticity of substitution and γ is the consumption share of utility.

Endowments. New households enter the model with a specific income type $i\in\mathbb{I}$ that determines their labor productivity over their life cycle. Their labor efficiency units, denoted by $e_{j,i}$, are type- and age-dependent but time-invariant. In each period, households are endowed with one unit of time that can be allocated over labor market and leisure activities.

Household problem. Households begin with zero assets, $a_{t,j=20,i}=0$, and choose consumption, labor supply and asset holdings to maximize their utility over their lifetime. There are several sources of income. Before-tax labor income is $w_t(1-l_{t,j,i})e_{j,i}$ where w_t is the market wage rate in period t. In our setting, households are able to buy or sell asset, $a_{t,j,i}$, which yields a dividend r_t^a, at a market price p_t^a. Before-tax capital income is $r_t^a a_{t,j,i}$. Households are required to pay labor and asset income taxes at the rates of τ^n and τ^a, respectively. In addition, households are entitled to receive tax credits, namely franking credits, from the government to offset the capital income tax paid by the firm in the form of company income tax.[3] The franking tax credit per asset unit is r_t^{FC}. The effective rate of return from asset holdings is given by $\widetilde{r}_t = r_t^a + r_t^{FC}$.

The household's utility maximization problem can be written in terms of a dynamic programming problem as

$$V_j(a_{t,j,i}) = \max_{\{C_{t,j,i},l_{t,j,i},A_{t+1,j+1,i}\}} \left\{u\left(c_{t,j,i},l_{t,j,i}\right) + \hat{\beta} s p_{j+1} V_{j+1}\left(a_{t+1,j+1,i}\right)\right\} \tag{1}$$

subject to the household's budget constraint

$$(1+\tau_t^c)c_{t,j,i} + p_t^a a_{t+1,j+1,i} = \Upsilon_{t,j,i},$$

the borrowing constraint, $a_{t+1,j+1,i} \geq 0$, and the positivity of leisure and consumption $c_{t,j,i} > 0$ and $1 \geq l_{t,j,i} > 0$. The household's disposable income $\Upsilon_{t,j,i}$ is given by

$$\Upsilon_{t,j,i} = \begin{cases} (1-\tau_t^n)w_t(1-l_{t,j,i})e_{j,i} + (1-\tau_t^a)\widetilde{r}_t a_{t,j,i} + p_t^a a_{t,j,i} + tr_{t,j,i} + bq_{t,i} & \text{if } j \leq 65 \\ (1-\tau_t^a)\,\widetilde{r}_t a_{t,j,i} + p_t^a a_{t,j,i} + pen_{t,j,i} + bq_{t,i} & \text{if } j > 65 \end{cases}$$

where, $tr_{t,j,i}$ is social cash transfers for workers; $pen_{t,j,i}$ is public pensions for retirees; and $bq_{t,i}$ is accidental bequests.[4]

B.1.2 Firm

The firm sector consists of one representative firm which owns capital and the fixed factor and chooses investment, dividends, debt and equity and to maximize its cum dividend share price.

Technology. Output is produced by combining capital, K_t, effective labor, N_t, and the total factor productivity, Z_t, in a Cobb-Douglas production $Y_t = Z_t K_t^{\alpha_k} {N_t}^{\alpha_n}$, where α_k and α_n are capital and labor income shares, respectively. Z_t is the total factor productivity that

[3] In Australia, there is a dividend imputation system that compensates resident households for the company income tax paid by firms. Australia has implemented the dividend imputation system since 1987. Technically, under the imputation system the shareholders who are Australian tax residents are able to claim back some or all of the company income taxes paid by Australian companies in the form of tax credits, namely franking credits.

[4] Note that, $tr_{t,j,i}$ and $pen_{t,j,i}$ are age- and type-dependents in our setting. We will discuss how these benefit payments are calibrated in the calibration section.

grows at the constant rate g. Capital is accumulated according to the law of motion

$$K_{t+1} = (1-\delta)K_t + I_t, \tag{2}$$

where I_t is investment and δ is the depreciation rate. Investment is subject to a quadratic capital adjustments cost with the total cost of investment given by $I_t + 0.5\psi\left(\frac{I_t}{K_t}\right)^2 K_t$.

Corporate finance. The firm is owned by equity holders. There are two channels to finance the firm's investment plan: internal finance by retained incomes and external finance by issuing new equity and debt. For simplicity, we make two assumptions: (*i*) equity is set equal to capital, $\Theta_t = K_t$, which sets equity issuance equal to net investment; and (*ii*) debt is set at a constant fraction of real capital as in Poterba and Summers (1983), so that the level of debt is given by $B_t^f = \xi K_t$, where ξ is a fixed debt to real capital ratio. This debt to capital assumption is used to cap debt holdings in the model. As debt receives preferential tax treatment the firm would be completely debt financed if there is no cap.[5]

Company tax and deductions. The firm pays company income tax (CIT) on its income. Let τ^k be the company tax rate. The company tax payment is given by $\tau^k\left(Y_t - w_t N_t\right)$. The firm is allowed to deduct from its taxable income a fraction of its operation cost including interest payments, investment cost and capital depreciation. Let χ^ξ , χ^I and χ^δ be deductible fractions of interest payments, investment cost and depreciation cost, respectively. The corresponding values of the tax deductions are given by $\chi^\xi r_t^f B_t^f$, $\chi^I I_t$ and $\chi^\delta \delta K_t$. The total tax deduction for the firm is $\left(\chi^\xi r_t^f B_t^f + \chi^I I_t + \chi^\delta \delta K_t\right)$.

Firm problem. The firm maximizes its own value which is given by its cum dividend price multiplied by the number of shares $V_t = p_t^*\Theta_t = (p_t + d_t)\Theta_t$. The value of the firm can be expressed in terms of dividend payments and new equity issuance as

$$V_{t_0} = \sum_{t=t_0}^{\infty} \frac{d_t\Theta_t + p_t(\Theta_{t+1} - \Theta_t)}{\prod_{s=t_0}^{t}(1+r_s)}. \tag{3}$$

The firm's problem is to choose a sequence of $\left\{I_t, d_t, B_t^f, \Theta_{t+1}\right\}_{t=t_0}^{\infty}$ to maximize its market value and subject to its budget constraint

$$\begin{aligned} I_t + 0.5\psi\frac{I_t^2}{K_t} + d_t\Theta_t + r_t B_t^f = {} & (1-\tau_t^k)\left[F_t\left(K_t, N_t, Z\right) - W_t N_t\right] + p_t^k(\Theta_{t+1} - \Theta_t) \\ & + (B_{t+1}^f - B_t^f) + \tau_t^k\left(\chi^\xi r_t^f B_t^f + \chi^I I_t + \chi^\delta \delta K_t\right), \end{aligned} \tag{4}$$

taking account wage rate, interest rate and the company tax policy as given. The firm's problem is also subject to the capital accumulation equation (2). The stock of debt and equity

[5]The equity to capital assumption is a simplifying assumption as the firm is indifferent between paying returns as capital gains or as dividends. This stems from Miller and Modigliani (1961) and our assumption that the marginal foreign investor pays neither dividend taxes nor capital gains taxes, or if they do that the rates are equal.

are further subject to the simplifying assumptions discussed in the corporate finance section.

B.1.3 Government

The government collects revenue from taxing personal and business incomes as well as consumption to finance government purchases and transfers.

Taxes. The government raises revenues from company income tax, personal income tax and consumption tax.

The firm pays company income tax on its gross income with deductions after a full range of deductions. The net business income tax revenue collected from the company is given by

$$TAX_t^k = \tau_t^k \left[F_t \left(K_t, N_t, Z \right) - w_t N_t - \chi^\delta \delta K_t - \chi^\xi r_t^f \xi K_t - \chi^I I_t \right].$$

A dividend imputation system compensates resident households for the company income tax paid by firms. The value of the franking credit per share is computed by $r_t^{FC} = \chi^{FC} \frac{TAX^k}{\Theta_t}$, where χ^{FC} is the share of company income tax paid that firms distribute as franking credits.

Households pay taxes on personal income from supplying labor and holding assets at the rates of τ_t^n and τ_t^a, respectively. The sum of personal (labor and asset) income taxes paid by all households is given by

$$TAX_t^p = \sum_{j \in \mathbb{J}} \sum_{i \in \mathbb{I}} \mu_{t,j,i} \left\{ \tau_t^n w_t (1 - l_{t,j,i}) e_{j,i} + \tau_t^a \left(r_t^a + r_t^{FC} \right) a_{t,j,i} - r_t^{FC} a_{t,j,i} \right\},$$

where $\mu_{t,j,i}$ is the measure of age j and type i households at time t. Note that, households use franking credits against the value of their asset income, $r_t^{FC} a_{t,j,i}$, to reduce their personal income tax liabilities.

The government revenue from consumption tax, TAX_t^c, is given by $TAX_t^c = \sum_{j \in \mathbb{J}} \sum_{i \in \mathbb{I}} \mu_{t,j,i} \tau_t^c c_{t,j,i}$, where τ_t^c is the consumption tax rate.

Hence, the total tax revenue is a sum of three tax revenues:

$$TAX_t = TAX_t^p + TAX_t^k + TAX_t^c.$$

Expenditures. The government has three spending programs: the purchase of goods for government consumption, G_t, government transfers to workers, Tr_t, and age pension for retirees. Government spending programs grow in line with productivity and population. The total amount of government transfers to workers, Tr_t, is given by $Tr_t = \sum_{j \leq 65} \sum_{i \in \mathbb{I}} \mu_{t,j,i} tr_{t,j,i}$, where $tr_{t,j,i}$ is the skill specific transfers. The total amount of age pensions to retirees is given by $Pen_t = \sum_{j > 65} \sum_{i \in \mathbb{I}} \mu_{t,j,i} pen_{t,j,i}$.

Budget balancing rule. How the government balances its budget depends on the scenario. In the baseline the government's budget is balanced every year and the government starts with zero debt. In all scenarios the net present value (NPV) of government spending equal to NPV of revenue which determines both the path of government debt and that the government's budget deficit is stationary in the long run. When the government borrows or lends the evolution of government debt, B_t^G, is given by

$$B_{t+1}^G = TAX_t - G_t - Tr_t - Pen_t - (1 + r_t)\, B_t^G. \tag{5}$$

We assume that the government can borrow and lend at the international interest rate and that all government debt is held by foreigners.

B.1.4 Markets

The economy is small and open with perfect capital and goods mobility. The labor market is assumed to be perfectly competitive with the wage equal to the marginal product of labor. labor is assumed to be internationally immobile implying workers can not migrate in response to economic conditions.

In the domestic financial market, there exists an asset combining agency that combines equity and debt issued by the firm into a single asset which is sold to both residents and foreigners. One unit of the combined asset is defined as one unit of equity plus the proportional share, ξ, of debt. As such the stock of assets equals the stock of equity which equals the capital stock and also the stock of firm bonds divided by the debt financing ratio

$$A_t = \Theta_t = K_t = B_t^f / \xi. \tag{6}$$

The price of the combined asset, p_t^a, is the price of equity plus the share of debt used in funding the firm and is given by $p_t^a = p_t^k + \xi$. The return on the combined asset is given by the return on debt plus the return on equity and is given by $r_t^a = \xi r_t + d_t$.

The domestic capital market is fully integrated into the world capital market. As such, foreigners are the marginal investors and the domestic interest rate, r_t, is exogenous and equal to the world interest rate, $r_t = r$. The domestic firm therefore uses the international interest rate in its maximization problem. As such the rate of return on domestic assets must equal the international interest rate

$$\frac{r_{t+1}^a + p_{t+1}^a - p_t^a}{p_t^a} = r_t = r. \tag{7}$$

Foreign goods and domestic goods are perfect substitutes hence only net exports are tracked in the model. Net exports (NX_t) are determined by the balance of payments and are given by

$$NX_t = r_t^a A_t^{for} - p_t^a (A_{t+1}^{for} - A_t^{for}) + r_t B_t^G - (B_{t+1}^G - B_t^G), \tag{8}$$

where A_t^{for} is the corporate assets held by foreigners.

B.1.5 Competitive equilibrium

The solution to the model is given by prices and quantities that are consistent with the solutions to the households' and firm's problems, the government's budget constraint and foreigners' required rate of return.

For a given model calibration including initial conditions for asset holdings by residents and foreigners $\{A_{0,j,i}, A_0^{for}\}_{j\in\mathbb{J},i\in\mathbb{I}}$; the government's and firm's outstanding debt, equity and initial capital stock $\{B_0^G, B_0^f, \Theta_0, K_0\}$; and initial accidental bequests $\{bq_{0,i}\}_{t\in\mathbb{T}}$; in addition to the exogenous government policy settings $\{\tau_t^c, \tau_t^n, \tau_t^a, , \tau_t^k, \chi^\xi, \chi^I, \chi^\delta, G_t\}_{t\in\mathbb{T}}$ an equilibrium is defined by endogenous model values for the set of household decisions $\{c_{t,j,i},\ l_{t,j,i}, a_{t+1,j+1,i}\}_{t\in\mathbb{T},j\in\mathbb{J},i\in\mathbb{I}}$; the set of firm decisions including labor demand, capital stock, investment, equity and debt $\{N_t, K_{t+1}, I_t, \Theta_{t+1}, B_{t+1}^f, \}_{t\in\mathbb{T}}$; the set of relative prices for wages, assets and returns on assets $\{w_t, p_t^a, r_t^a,\ r_t^{FC}\}_{t\in\mathbb{T}}$; accidental bequests $\{bq_{t+1,i}\}_{t\in\mathbb{T}}$; the government policy decisions $\{T_t, B_{t+1}^G\}_{t\in\mathbb{T}}$; and foreign assets and net exports $\{A_{t+1}^{for}, NX_t\}_{t\in\mathbb{T}}$ such that the following hold:

(i) the choice of leisure, asset holding and consumption are consistent with the solutions to household's problem given in equation (1),

(ii) the investment, capital stock, dividends, firm debt and the stock of equity are consistent with the solution firm's problem given in equation (3),

(iii) the return to assets and the price of assets are consistent with return required by foreign investors as given in equation (7),

(iv) the government's budget balances as given in equation (5), this budget constraint also determines the path of government bonds B^G,

(v) the sum of individual consumption, labor supply, and asset holdings equals aggregate consumption, labor demand, and aggregate domestically owned assets,

$$\begin{aligned} C_t &= \sum_{j\in\mathbb{J}}\sum_{i\in\mathbb{I}} \mu_{t,j,i} c_{t,j,i}, \\ N_t &= \sum_{j\in\mathbb{J}}\sum_{i\in\mathbb{I}} \mu_{t,j,i}(1 - l_{t,j,i}) e_{j,i}, \\ A_t^{dom} &= \sum_{j\in\mathbb{J}}\sum_{i\in\mathbb{I}} \mu_{t,j,i} a_{t,j,i} \end{aligned}$$

(vi) the capital stock equals the total stock of assets as in equation (6), with total assets equal to the sum of domestic assets plus foreign owned assets

$$A_t = A_t^{dom} + A_t^{for}, \tag{9}$$

(vii) the aggregate resource constraint holds, with total production equalling the total use of output as given below

$$C_t + I_t + 0.5\psi \left(\frac{I_t}{K_t}\right)^2 K_t + G_t + NX_t = Y_t, \tag{10}$$

where net exports are given by equation (8) with government bonds evolving according to equation (5),

(viii) bequests are equal to the deceased's assets, including returns, evenly distributed amongst the remaining agents of that type as given by

$$bq_{t,j,i} = \frac{\sum_{j \in \mathbb{J}} \left(\mu_{t-1,j,i} - \mu_{t,j+1,i}\right)(p^a_t + r^a_t) a_{t,j+1,i}}{\sum_{j \in \mathbb{J}} \mu_{t,j,i}}. \tag{11}$$

B.2 Calibration

This section describes how parameters of the model are calibrated. The majority of the parameters are calibrated so that the model matches Australian macroeconomic aggregates. Other parameters are calibrated so that household variables match micro-economic data from the Household, Income and Labor Dynamics in Australia (HILDA) survey or taken from the literature. The frequency of the model is annual and the unit of the model is an individual who represents a household. As a basis of the calibration, we first compute a benchmark steady state economy that approximates the economy of 2010. We summarize these external parameters in Table 7. Internally selected parameters to match a given set of targets from Australian data are presented in table 8.

B.2.1 Household

The population dynamics are calibrated to match the Australian Bureau of Statistic's (ABS) release 3222.0 Population Projections. The population dynamics are set to match the evolution of the cohort of persons aged 20 in 2013-14. Defining $Pop_{20,2014}$ to be the population of persons aged 20 at 1 June 2014 the conditional survival probability is calculated as $sp^*_{21} = Pop_{21,2015}/Pop_{20,2014}$. Due to positive net migration the projected size of some age cohorts increases but we set the conditional survival probability to a maximum value of one. The three skill levels are defined by three education levels. Let $\mathcal{P}_i$ denote the share of the population with skill type i. The share of the population with skill type i at age j is given by $m_{j,i} = \mathcal{P}_i \frac{S_j(1+g^n)^{j-20}}{\sum_{j=20}^{100} S_j(1+g^n)^{j-20}}$. The growth in the population is calibrated according to the ABS's release 3222.0 Population Projections. Growth in the population of persons aged 20 and over is projected to average 1.7 percent from now to 2050 and we use this value for g^n.

The labor efficiency endowments are estimated from HILDA data. The skill type levels are matched to education levels as reported in HILDA, low skill are defined as up to the completion of secondary education, medium skill households have completed vocational training and high skill households have completed a tertiary degree. The shares from in HILDA give the populations shares of the skill types in our calibration. A second order polynomial is fit to the observed data to smooth it. Further, labor productivity is linearly reduced from the fit value produced for age 60 to zero at age 71. This linear trend to zero is imposed so that the model matches the observed hours worked later in life. Further, the decline in labor productivity we impose between ages 60 and 71 partially addresses the upwards bias in observed labor productivity that occurs due to retirement. The labor productivity profiles are shown in Figure (6).

The consumption share of utility γ is set to 0.25 so that the share of hours spent at work in the model matches HILDA data. The intertemporal elasticity $1/\sigma$ is set to 0.4 as in Kudrna, Tran and Woodland (2015).

B.2.2 Firm

The labor share of output, α_n, is set at 0.59, so that the labor share of output matches the average ratio of gross operating surplus to compensation of employees from 1990 to 2014 as in ABS 5204.006. We assume that the capital share of gross mixed income matches the capital share in gross operating surplus and compensation of employees. Further, the capital share of output, α_k, is set at 0.39, so that the fixed factors share of output matches the 2 percent contribution of non-residential land to GDP as in Cao et al. (2015). The depreciation rate, δ, is set at 5.6 percent to match the investment to capital stock ratio in the data. We use the steady state relationship $\delta + g = I/K$ and target the average ratio of gross fixed capital formation to the end of year net capital stock from 1990 to 2014, in both cases excluding dwelling.

The capital adjustment cost ψ is set to 3.33 to target the steady state q-ratio of 1.14 from Oliner, Rudebusch and Sichel (1995). Labor augmenting productivity growth is set to 1.44 percent to match growth in per capita GDP from 1990 to 2014.

We follow Cao et al. (2015) to assume that the firm issues franking credits for 36.8 percent of the tax they pay meaning $\chi^{FC} = 0.368$. The firm is 24 percent debt funded and is able to deduct 100 percent of its interest payments, $\chi^{\xi} = 1.0$. The firm receives investment tax credits for 5 percent of its investment, $\chi^{I} = 0.05$, and is able to claim the remaining 95 percent as depreciation deductions $\chi^{d} = 0.95$.

B.2.3 Government

Tax rates are set to match tax revenue to GDP ratios as from the ABS data. The company income tax (CIT) rate τ^k is set to 29.9 percent to match the CIT revenue to GDP ratio of 5.4 percent. The consumption tax (CT) rate τ^c is set to 6.2 percent to achieve the consumption tax revenue to GDP ratio of 3.6 percent. There is no specific labor income tax on workers' side in Australia. Labor earnings are taxed together with asset income under the personal income taxation, which is progressive. We assume that labor and capital incomes are taxed at an average personal income tax rate, τ^p. This personal income tax (PIT) rate is calibrated to match the personal income tax revenue to GDP ratio of 10.4 percent.

The social cash transfer and pension programs are calibrated to match data from Australian Bureau of Statistics: ABS 5204.030 and ABS 6537. The pension program is about 2.7 percent of GDP from 1990 to 2014; meanwhile, the social transfer program makes up around 5.2 percent of GDP. The social transfer and pension programs are means-tested in Australia. The ABS provides data on government transfers by age and income quintile. We base on that data to impute the social transfers by age and skill. We calibrate the levels of pension benefits and social transfer payments separately to better fit the data and then use the sum of these in the model. Government purchases of goods balance the budget and are 11.5 percent of GDP as in the data.

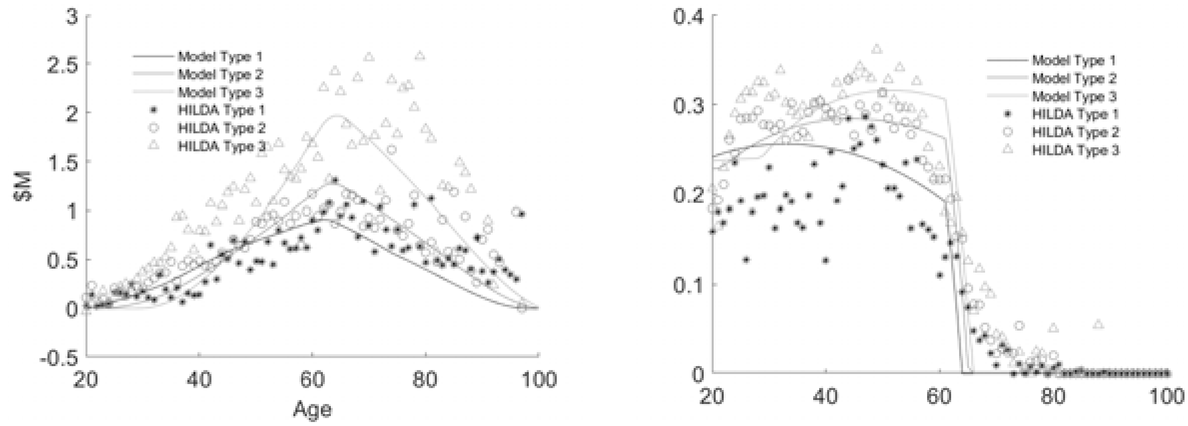
B.2.4 Markets

The world interest rate r is set to target the capital stock to GDP ratio. The capital stock to GDP target is calculated from 1990 to 2014. The target capital output ratio equal to 3.1 implies a world interest rate, r, equal to 3.8 percent in the model.

The discount rate β is used to target the domestic ownership of the capital stock. The discount rate determines households' time preference and therefore their savings and asset accumulation. As there is no concise closed form solution for asset accumulation and β is solved iteratively. In the model β equals 0.990 giving net foreign ownership of 17 percent in line with the average net international investment position relative to the total capital stock from 1990 to 2015.

B.2.5 Model performance

Our benchmark model matches the key macroeconomic data from Australia. In addition, it can replicate the life cycle behaviors of Australian households. Figure 1 depicts the asset holdings and labor supply over the life cycle. Panel 1(a) presents the asset accumulation in the model, compared to that in HILDA. In the model households save for retirement but are bound by the borrowing constraint in the early part of their lives when their labor productivity is lower. We are able to broadly match the observed data but without bequest motives or income uncertainty the life asset accumulation profile is sharper in our model than in the observed data. Panel 1(b) shows the labor supply profiles in the model and in the HILDA data both increase from early working life peaking around mid-life and then declining. Higher skill households generally provide more working hours. The decline in labor hours is steeper in the model than in the observed data suggesting the decline in productivity we impose on the calibration, as discussed above, may be somewhat abrupt. Nonetheless, we replicate the broad patterns.



(a) Asset accumulation index

(b) Share of time spent in labor

Figure 1: Asset holdings and labor supply over the life cycle: Model vs. HILDA data

C Quantitative analysis

We quantify the marginal excess burden of various taxes on income and consumption, using the benchmark model formulated in the previous section.

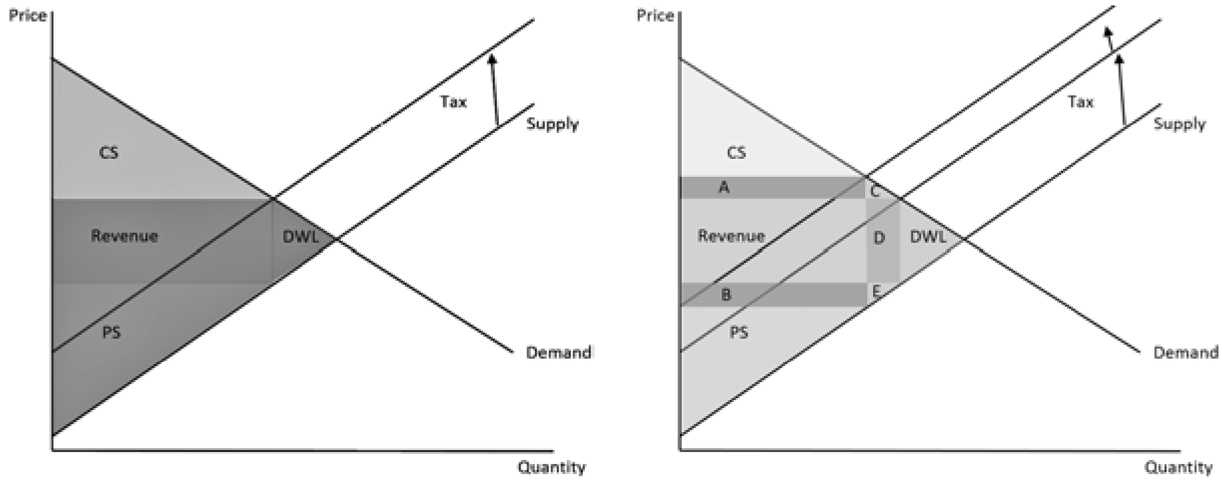
C.1 Computation of marginal excess burden

We first discuss how marginal excess burden is measured in our framework. By definition, the marginal excess burden (MEB) is the change in welfare per unit of revenue gain. In a static framework, the excess burden of taxation can be measured by the area of the associated 'Harberger triangle' (e.g., see Harberger (1964)). Figure 2 demonstrates how excess burden and marginal excess burden can be measured using a demand and supply framework. For example, an MEB of \$0.50 means that if the revenue gain could increase the lump-sum rebate to agents by \$1.00 per period time forever, then the drop in welfare relative the no tax increase is equivalent to a reduction in consumption of 50 cent per period forever.

In a dynamic general equilibrium framework, the excess burden of taxation is more complex since the Harberger triangle is not well defined. We follow the approach in Judd (1987) that uses Hicksian equivalent variation to measure the excess burden.[6]

More precisely, we consider an experiment in which the government aims to raise an additional dollar of revenue through one of its tax instruments. The tax instrument is permanently adjusted to meet the targeted net present value (NPV) revenue increase. The revenue increase target is equal, in NPV terms, to one dollar per household per year adjusted for growth. The revenue increase is the net additional revenue change taking into account other tax bases. In the scenarios the NPV of government spending equals the NPV of revenue, this condition determines the path of government debt.

[6]The equivalent variation transfers calculation is described in more detail in Appendix F.1



(a) Excess burden (b) Marginal excess burden (MEB)

Figure 2: The marginal excess burden of an increase in a tax imposed on suppliers. CS is consumer surplus. PS is producer surplus. Revenue is tax revenue. DWL is the deadweight loss/excess burden of a tax. MEB is the marginal excess burden of a tax increase, $MEB = -\frac{C+D+E}{D-A-B}$.

We calculate the equivalent variation of the policy change for each household and use this as household-specific MEB. The excess burden measures the distortion of a tax relative to a non-discretionary lump sum tax. We construct the core scenarios so that the welfare change faced by each household equals the MEB they bear. In these scenarios the additional government revenue is given back to households through uniform lump sum transfers.[7] When additional revenue is returned uniformly, levying a uniform lump sum tax is simply taking money from households and immediately returning it. As such a uniform lump sum tax does not cause any changes in welfare or other variables and therefore no distortion. In these scenarios, the welfare change of households can be interpreted as their burden of the tax relative to a non-discretionary lump sum tax.

In addition to each household's MEB we report both a total aggregate metric and group-specific metric. The aggregate MEB is defined by the net present value of the marginal excess burdens of all households normalized by dividing by the net present value of the change in net revenue. Our aggregate MEB is an index that measures the total distortion of the particular tax relative to a lump sum tax. The group-specific MEBs are constructed for different age cohorts and skill types. These MEBs allow us to more easily compare the impacts across households and generations.[8]

[7]The household budget with lump-sum transfers has a form of $(1+\tau_t^c)c_{t,j,i} + p_t^a a_{t+1,j+1,i} = \Upsilon_{t,j,i} + tr_t$, where tr_t is the lump-sum transfer.

[8]The formula of the aggregate marginal excess burden (MEB) is provided in the technical appendix. The MEB for different household types is constructed in a similar way. The MEB grouped across old, young and future generations is calculated as a simple average. Old is defined as those 65 and over at the time of the policy change, young are those alive and below 65 at the policy change and the future generation shows the MEB in the long run steady state.

C.2 Three main taxes on income and consumption

We begin with three forms of taxes on business and personal income as well as consumption: company income tax (CIT), personal income tax (PIT) and consumption tax (CT). Table 1 presents the marginal excess burdens (MEB) for the three taxes.[9]

	CIT	PIT	CT
Aggregate	\$0.62	\$0.34	\$0.23
Old: 65+	\$1.39	-\$0.59	\$0.08
Young: 20 to 64	\$0.45	\$0.13	\$0.26
Future: -100	\$0.69	\$0.43	\$0.23
Type 1: low income	\$0.12	\$0.02	\$0.07
Type 2: medium income	\$0.52	\$0.28	\$0.17
Type 3: high income	\$1.23	\$0.73	\$0.48

Table 1: **Marginal excess burdens (MEB) of raising extra revenue from the company income tax (CIT), the personal income tax (PIT) and the consumption tax (CT).**

Our results indicate there is a wide disparity in marginal excess burden. As shown in the first row of Table 1, raising the company income tax is more distorting than raising the personal income tax and consumption tax. Specifically, the aggregate MEB for the company income tax is 64 cents per dollar of tax revenue raised, compared to 34 cents and 23 cents for the personal income tax and the consumption tax, respectively. Our MEB estimates are relatively larger than estimates from previous studies (e.g., see Ballard, Shoven and Whalley (1985) and Judd (1985)). Ballard, Shoven and Whalley (1985) find MEB estimates in the range of 18 to 46 cents for industry level capital tax and a range of 12 to 23 cents for industry level labor tax. Judd (1985) finds a MEB of 12 cents for labor income tax. It is important to note that these studies focus on the long-run steady state effects. We go beyond a steady state analysis and fully account for behavioral responses by different generations and dynamic general equilibrium effects along the transition path.

The company income tax is the least efficient tax as it results in the highest MEB at the aggregate level. However, there is significant variation in the MEB across generations and income types when the marginal excess burdens are further disaggregated by age and income type as presented in rows from 2 to 6 in Table 1. In particular, old households are the biggest losers from a company tax increase. Conversely, older households are, on average, better off under a personal income tax increase and only marginally impacted by a consumption tax increase. Lower-income households are also largely unaffected by tax hikes. This occurs as the model assumes any extra revenue generated is re-distributed evenly via the transfer system to balance the budget, the loss of income from lower wages is offset by higher transfers. Low-

[9] The results presented are normalized for population and productivity growth with the population measure normalized to one. In this setting one dollar per household equals one dollar in total. Changes in aggregate variables, such as GDP and the capital stock, can be thought of as the change per dollar of net revenue. At the same time changes in household variables, such as welfare, can be thought of as the change per dollar of revenue per household.

income households indeed would be only 2 cents and 7 cents worse off under income tax and consumption tax increases, respectively. Conversely, high-income households are significantly worse off as they bear most of the MEB.

We next examine each individual tax and analyze the underlying mechanisms through which it distorts economic activity and welfare.

Company income tax (CIT). Figure 3 displays the dynamic effects of the company income tax (CIT) increase on four key variables: excess burden, tax revenue, capital stock and labor income. Figure 9 in the Appendix presents further information on other variables including interest and dividend payments, after tax asset incomes, labor supply and asset holdings over the life cycles.

The CIT distorts the firm's incentive to invest. A higher company income tax rate lowers dividends, which subsequently lowers the value of capital and investment, as seen in Panel 3 of Figure 3. As the capital stock decreases the marginal product of capital increases ensuring dividends meet the foreign investors required rate of return. However, resident's returns are higher in the long run as they receive franking credits which increase in value. A lower capital stock decreases the marginal product of labor and therefore wages.

Household's responses to these changes can be understood in terms of both income and substitution effects of lower wages, higher transfers, reduced asset prices and changing rates of return. Panel 4 of Figure 3 shows labor supply decreasing as the substitution effect from lower wages is larger than the accompanying income effect, especially given the offsetting impact of higher transfers. Households also shift the timing of labor supply forward across their life in response to higher asset returns created for residents. This is matched by increased domestic saving.

The magnitude of the aggregate welfare loss per dollar of revenue is largely explained by the fall in wages relative to the change in revenue. Increasing company income tax to raise one dollar of net revenue reduces long run labor income by over $4 the majority of which is due to the decline of wages. The decline in wages comes from the lower capital stock and the magnitude of this change is driven by the assumption that capital is internationally perfectly mobile.

The welfare loss to residents mainly comes through lower wages and the initial fall in the capital price. Panel 1 of Figure 3 presents the marginal excess burdens by skill and age. In the long run lower wages drive welfare decreases for the top two income groups.[10] Welfare is almost unchanged for the bottom income group as the increase in transfers offsets their fall in wages. Most of the oldest households have few remaining assets and are therefore not particularly negatively affected by the decline in asset values. Retired households who hold

[10] Figure 8 in the Appendix decomposes the welfare impact on type 2 households according to price and policy changes. It directly shows how the changes in prices impact welfare. The calculation of the welfare decomposition is described in Appendix section F.1.

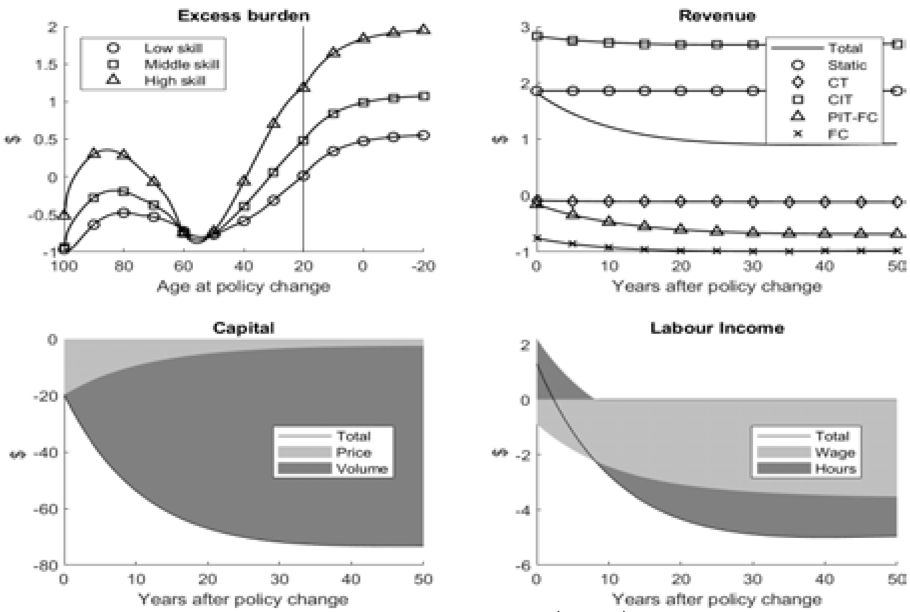


Figure 3: **The impacts of a company income tax (CIT) increase.** Note that, the CIT is permanently adjusted to raise the targeted net present value (NPV) revenue increase by $1.

more assets, determined both by type and age, are more negatively affected by the asset price decrease and also the decline in returns. The welfare loss of households aged 20 to 60 is smaller than that of future generations or of recently retired older households. These households work while wages have not fully declined, are able buy assets while they are cheaper and experience higher returns later in life.

The company tax revenue must initially increase by $2.91 in order to raise one dollar of net revenue, as shown in Panel 2 of Figure 3. The large CIT revenue increase is to offset the increase in franking credit use and the decreases in personal income tax (PIT) and consumption tax (CT) revenue. Declining output causes revenue to fall further over time. To raise the equivalent of $1 per period in NPV terms revenue must increase by $1.60 in the first period. The additional revenue trends down to $0.96 once the capital stock has fully adjusted. If changes in quantities and prices were not taken into account the tax increase would be projected to raise $1.87. We refer to this projection, which does not take into account changes in quantities and prices, as the static projection.[11] In terms of tax scoring this implies a one dollar increase in static revenue projection raises only $0.53 in net revenue when accounting for dynamic responses.

Personal income tax (PIT). Figures 4 and 10 present the dynamic effects of the personal income tax (PIT) increase.

The personal income tax increase results in lower after-tax wages and realized returns on assets for residents. As such, households substitute towards leisure and away from saving. Households not only reduce labor supply over their life but also shift labor supply from earlier

[11] The static revenue projection takes into account increased franking credit use under a CIT increase.

to later in life as they value saving less. When the policy change is brought in, households shift labor supply to later in life causing aggregate labor supply to decline by more in the medium term than in the long run, as shown in Panel 4 of Figure 4.

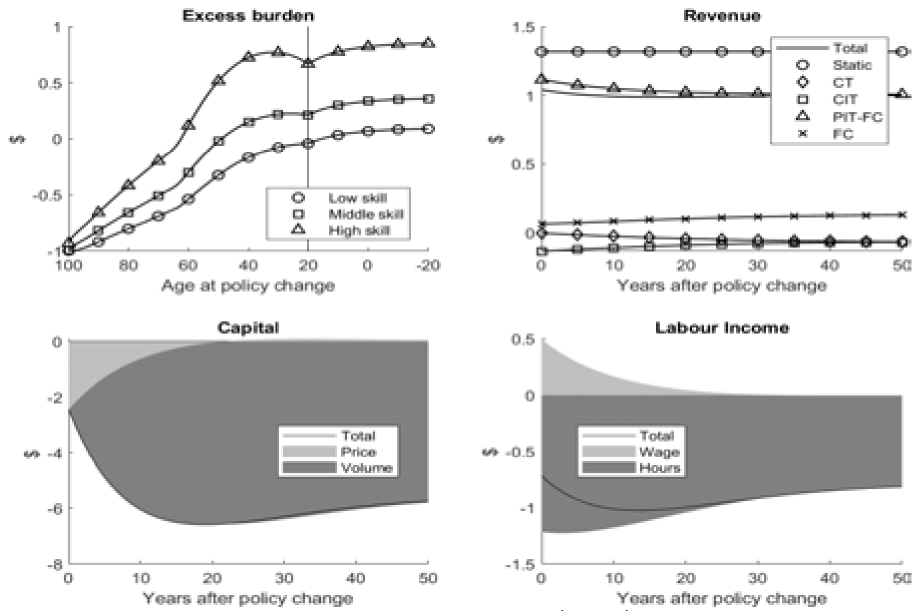


Figure 4: **The impacts of a personal income tax (PIT) increase.** Note that, the PIT is permanently adjusted to raise the targeted net present value (NPV) revenue increase by $1.

The decline in labor supply reduces the marginal product of capital and the return on assets. As such the firm invests less and the capital stock declines. The distortions to the household labor supply decision and the savings decision drives the welfare losses. The tax collects revenue in line with earnings which means lower income and older households pay less additional tax. As such, the oldest households and those with the lowest labor productivity are better off from the policy change due to the increased transfers. Future high labor productivity households are the most negatively affected as they work with a lower capital stock.

The aggregate marginal excess burden is smaller than that for the company income tax with welfare losses largely reflecting income patterns. The smaller aggregate distortion can also be observed in smaller capital stock and labor supply changes. The difference between the static revenue estimate and the dynamic estimate is also smaller for the PIT than the CIT. In terms of tax scoring a PIT increase that is projected to raise one dollar of static revenue raises $0.75 once the dynamic effects are taken into account. This tax score reflects smaller impacts on macroeconomic variables and limited changes in the other tax bases in response to the PIT increase.

Consumption tax (CT). Figures 5 and 11 display the dynamic effects of the consumption tax (CT) increase.

A consumption tax increase raises the cost of consumption and causes substitution towards leisure. However, unlike the personal income tax, this increase does not significantly affect the intertemporal decision. As such households decrease labor supply more uniformly over their lives.

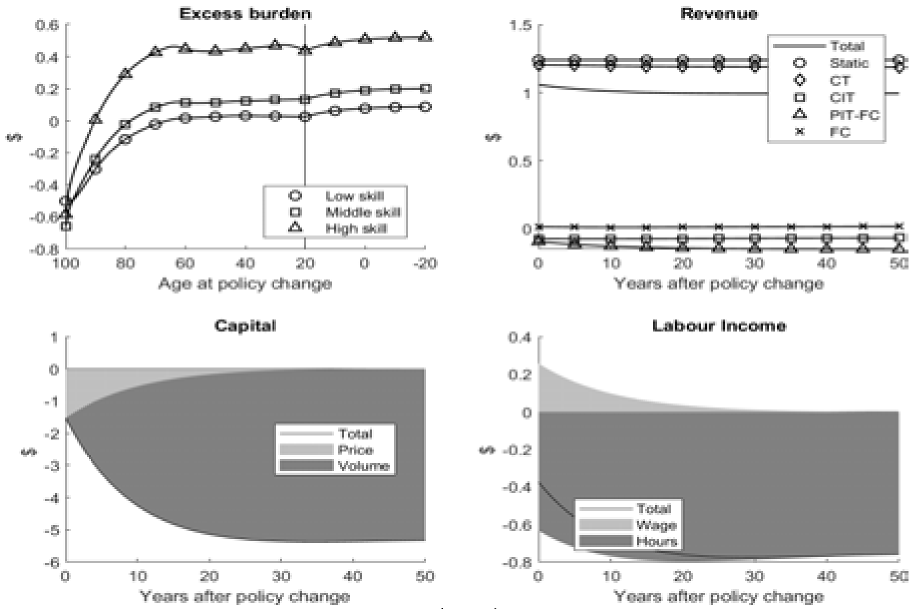


Figure 5: **The impacts of consumption tax (CT) increase.** Note that, the CT is permanently adjusted to raise the targeted net present value (NPV) revenue increase by $1.

The welfare impacts of the CT increase largely mirror the consumption patterns in the model, as shown in Figure 5 with older households consuming less. The welfare changes also reflect that the value of the capital stock declines in value initially and in volume over time hurting current asset holds and future wage earners.

The aggregate marginal excess burden from raising the CT is smaller than the personal income tax. The reason is that the CT is collected over a larger base and does not distort intertemporal decisions. The older households largely do not pay the personal income tax; however, they pay the consumption tax. This implies that consumption tax revenue is collected from a bigger pool of households. The consumption tax on retired households is effectively a lump sum tax as the intertemporal trade off between consumption and leisure is eliminated. This implies no distortion. The tax revenue collected from working households is relatively smaller; and therefore leads to a smaller distortion. A consumption tax increase to raise one dollar using a static model raises $0.81 in our dynamic setting, as shown in Panel 3 of Figure 5.

Thus, our MEB analysis confirms a tax efficiency ranking, frequently made by economic scholars and the popular press, that company income tax, which is a common type of capital income taxation, is more distortionary than personal income tax and consumption tax.

C.3 Other forms of income taxation

We compute marginal excess burdens (MEB) for other forms of taxes on capital and labor income at different sources, including investment tax credits (ITC), depreciation deductions

(DD), personal labor income tax (PLT), and personal asset income tax (PAT). It is important to note that, ITC and DD directly affect business income, while the PLT and PAT are on personal (labor and asset) income. We examine whether capital taxes are generally more distortionary than labor taxes and, again, who bears the burden of each tax.

Table 2 reports the marginal excess burden of these taxes. For comparison we also include the marginal excess burdens of the company income tax (CIT), the personal income tax (PIT), and the consumption tax (CT). We classify different taxes into two groups: those imposed on the capital and those on labor. Personal income tax is in both groups as it is collected on both capital and labor income. Consumption tax is in neither group.

	Taxes on capital						
					Taxes on labor		
	CIT	ITC	DD	PAT	PIT	PLT	CT
Aggregate	\$0.62	\$1.03	\$0.81	\$0.48	\$0.34	\$0.29	\$0.23
Old	\$1.39	-\$1.86	\$0.01	-\$0.05	-\$0.59	-\$0.76	\$0.08
Young	\$0.45	-\$1.21	-\$0.17	\$0.79	\$0.13	-\$0.07	\$0.26
Future	\$0.69	\$1.81	\$1.16	\$0.46	\$0.43	\$0.43	\$0.23
Type 1	\$0.12	\$0.41	\$0.25	\$0.24	\$0.02	-\$0.04	\$0.07
Type 2	\$0.52	\$0.91	\$0.70	\$0.44	\$0.28	\$0.23	\$0.17
Type 3	\$1.23	\$1.81	\$1.51	\$0.79	\$0.73	\$0.72	\$0.48

Table 2: **Marginal excess burdens (MEB) of raising extra revenue from different taxes on the firm and households.** Note that, CIT: Company income tax; ITC: Investment tax credits; DD: Depreciation deductions; PAT: Personal asset income tax; PIT: Personal income tax; PLT: Personal labor income tax; and CT: Consumption tax.

We find that the taxes levied on the firm, therefore incidence on foreign investors, result in a higher MEB than those levied on households. Our ranking points out that a reduction in investment tax credits has the highest MEB, while raising the consumption tax has the lowest MEB. Overall, our results indicate that the marginal excess burdens of the taxes on capital, including CIT, ITC, DD and PAT, dominate MEBs of the taxes on labor and consumption.

We discuss the mechanism behind the excess burden of each tax separately in Appendix A.4.

D Extensions and sensitivity analysis

D.1 Different tax policy settings

The marginal excess burden quantifies the marginal distortion of a tax at a particular policy setting. In this section, we study the extent to which marginal excess burdens (MEBs) of taxes vary across different policy settings.

Table 3 presents aggregate MEB for a range of tax rates. For each calculation only the tax rate for which the MEB is being calculated is varied, while the other taxes are remained unchanged at the rates in the benchmark calibration.[12]

We find that the MEBs increase at an increasing rate in our model. That said, the MEBs of different taxes increase at different rates. The MEB of company income tax (CIT) becomes negative as the rate goes to zero while the MEBs of the other taxes remain strictly positive as the rates go to zero. The MEB of each tax depends not only on its own rate but also the rate of other taxes. While personal labor income tax (PLT) and consumption tax (CT) differ in their treatment of retired households, they both reduce the consumption that can be afforded from labor income, they both contribute to the labor income tax wedge. As such, the MEB of CT and PLT taxes depend not only on their own rates but on the corresponding PLT or CT rates. Even at low tax rates their MEBs remain positive as the corresponding PLT or CT rate is not reduced. The CT curve has a flatter slope than the PLT as the CT collects less revenue for a particular rate. For example, a PLT of 50 percent would collect 50 percent of labor income while a 50 percent CT only collects 33 percent of consumption expenditure. Hence the CT collects less revenue and the distortion increases less rapidly.

Tax rate (%)	CIT	PAT	PIT	PLT	CT
0	-\$0.10	\$0.09	\$0.12	\$0.07	\$0.18
5	-\$0.04	\$0.18	\$0.16	\$0.13	\$0.22
10	\$0.02	\$0.30	\$0.22	\$0.22	\$0.26
15	\$0.11	\$0.46	\$0.28	\$0.32	\$0.30
20	\$0.22	\$0.69	\$0.37	\$0.47	\$0.33
25	\$0.38	\$1.05	\$0.49	\$0.67	\$0.37
30	\$0.62	\$1.54	\$0.65	\$0.95	\$0.41
35	\$1.04	\$2.45	\$0.88	\$1.38	\$0.45
40	\$1.97	\$4.06	\$1.25	\$2.00	\$0.48

Table 3: **Aggregate Marginal Excess Burdens (MEB) at different initial tax rate calibrations.** Note that, CIT: Company income tax; PAT: Personal asset income tax; PIT: Personal income tax; PLT: Personal labor income tax; and CT: Consumption tax.

Personal asset income tax (PAT) is more distorting than PLT or CT at higher rates but less distorting at rates close to zero. PAT is less distorting at low rates as it does not directly contribute to the labor income tax wedge. The larger distortion of PAT at higher rates is driven by the elasticity of saving and discussed in Section C.3.

The mobility of foreign capital makes company income tax (CIT) a very distorting tax at higher CIT rates. However, at low CIT rates it has a negative MEB. Part of the CIT revenue is collected from fixed factors owned by foreigners. Taxing this source causes no distortion and benefits residents as they receive the revenue. At low CIT rates the benefit of taxing foreign owned rents outweighs the distortion to variable capital and CIT has a negative MEB.

[12] The MEBs in Table 3 are calculated as in previous sections however the initial model calibration is changed for each calculation. In each initial calibration transfers are adjusted to balance the government's budget. Figure 7 plots the MEB against the initial tax rate, in the figure the black dots indicate the MEBs in the core calibration.

Analyzing how the MEB varies with tax rates is useful beyond knowing the MEB at different policy settings. This analysis provides a linkage between our local MEB analysis and the more standard global optimal tax analysis. Optimal tax analysis searches for policy settings that maximise welfare according to a specified social welfare function. The MEB measure, being a weighted aggregation of households' welfare, is itself a social welfare function. Collecting less revenue from highly distorting taxes and more from less distorting taxes would raise welfare according to this welfare aggregation. A policy setting where the MEBs of all taxes are equal would maximize welfare according to this welfare aggregation.

D.2 Alternative model assumptions

We check the robustness of the main results under different model specifications and calibration assumptions, including alternative methods to allocate the additional tax revenue, foreign ownership share, the role of fixed factors, franking credits, capital adjustment speed, economic growth, intertemporal elasticity of substitution and elasticity of labor supply. Table 4 summarizes the results.

	CIT	ITC	DD	PAT	PIT	PLT	CT
Benchmark model	$0.62	$1.03	$0.81	$0.48	$0.34	$0.29	$0.23
LSRA	$0.61	$1.14	$0.84	$0.48	$0.35	$0.31	$0.23
Closed economy	$0.37	$0.37	$0.37	$0.37	$0.24	$0.21	$0.20
Decreased foreign ownership	$0.83	$1.22	$1.02	$0.43	$0.34	$0.31	$0.24
Increased foreign ownership	$0.40	$0.82	$0.60	$0.57	$0.31	$0.26	$0.22
Increased fixed factors	$0.21	$1.03	$0.79	$0.38	$0.31	$0.28	$0.21
No fixed factors	$0.82	$1.04	$0.83	$0.49	$0.33	$0.29	$0.23
No franking credit use	$0.59	$0.86	$0.71	$0.77	$0.41	$0.31	$0.24
Increased franking credit use	-$1.01	-$4.14	-$1.45	$0.14	$0.22	$0.26	$0.21
Revenue spent by government	$0.37	$0.73	$0.54	$0.26	$0.14	$0.10	$0.04
Faster capital adjustment	$0.39	$0.78	$0.59	$0.55	$0.34	$0.28	$0.22
No growth	$0.00	$1.51	$0.14	$0.84	$0.40	$0.28	$0.20
Debt tied to equity	$0.67	$1.09	$0.86	$0.48	$0.34	$0.30	$0.23
Lower intertemporal elasticity	$0.77	$1.15	$0.97	$0.29	$0.28	$0.28	$0.22
Lower consumption weight	$0.60	$1.07	$0.81	$0.69	$0.43	$0.36	$0.28

Table 4: **Marginal excess burdens (MEB) of raising extra revenue from different taxes under different model specifications and assumptions.** Note that, CIT: Company income tax; ITC: Investment tax credit; DD: Depreciation deductions; PAT: personal asset income tax; PIT: Personal income tax; PLT: Personal labor income tax; and CT: Consumption tax.

Lump Sum Redistributive Authority (LSRA). In the benchmark simulation, we follow the conventional approach in the previous literature and assume that additional tax revenue is redistributed back to all alive and future households uniformly. In our heterogeneous agent model, this assumption has distributional implications. In this sensitivity analysis, we account for the distributional effects of the uniform redistribution assumption. We introduce a system of income transfers administered by a hypothetical Lump Sum Redistribution Authority (LSRA). The LSRA undertakes lump sum redistributions across all generations and household types (via lump sum transfers or taxes), so that all households undergo the same welfare change as measured by their equivalent variation. The magnitude of the welfare change can be used to assess the efficiency of a tax increase at the margin, while accounting for the distributional consequences of how the government spends additional tax revenue.

We report the results in row 2 of Table 4. Comparing row 1 and row 2, we find that the LSRA changes are generally slightly larger than the aggregate marginal excess burdens (MEB) under the benchmark specification. The difference is in part due to the slightly larger decline in labor supply and output with the LSRA transfers. Effective labor supply generally declines further under the LSRA as the households who benefit most from the LSRA transfers are higher skilled and younger, who make a larger effective contribution to the labor market. Increased transfers for these households result in a positive income effect that causes these households to consume more leisure and total effective labor supply to decline further. The corresponding decline in output reduces revenue meaning the welfare loss per dollar of net revenue is slightly larger.

These experiments show how closely our MEB measure is tidied to a measure of efficiency. The MEB under the uniform transfers and the welfare changes under LSRA are fairly close despite the LSRA measure generally being larger as explained above. As the LSRA welfare change can be used as a measure of efficiency of a tax, as it measures the Pareto improvement or deterioration, the MEB can be used as a proxy for efficiency of a tax. Further, the MEB gives a sense of the uniform welfare change possible if the appropriate transfers could accompany the tax change.

Closed economy. In this sensitivity analysis we simulate a model with a closed economy where there is no capital mobility or goods trade across borders. This contrasts with the standard model specification where the economy is modelled as small and open with perfect capital mobility where foreigners are the marginal investors and where there is one good that is perfectly substitutable with foreign goods. In this sensitivity the capital market clears when the stock of assets equals the stock of savings. The firm finances investment from retained earnings and maximizes its cum dividend value taking into account taxes paid by households on dividends and also the franking credits households receive. In moving to a closed economy we keep household parameters unchanged such as the discount rate.[13]

We report the results in row 4 of Table 4. We find that the aggregate marginal excess burdens for taxes on the capital are lower in the closed economy as the supply of capital is less elastic. While the MEB of personal asset tax is very close to the other capital taxes,

[13]The interest rate and capital to output ratios vary between the open and closed economies. As the foreign capital is not available in the closed economy the capital to output ratio is higher and the interest rate is lower in the benchmark model.

the distribution of the burdens is very different. PAT taxes dividends and interest earnings. Consistent with Auerbach (1979) for an internally financing firm, dividend taxation does not affect the firm's cost of capital while interest taxation does. In a closed economy PAT mainly reduces asset values lowering welfare of older households and raises the future capital stock benefiting younger and future households. We report the distributional impacts in Table 9.

Foreign ownership. In the benchmark calibration we assume that foreigners own 17 percent of assets. In order to understand the role of foreign ownership, we simulate a model with alternative foreign ownership rates by adjusting the assets held by residents. This is implemented through adjusting the time discount rate.

We first lower the initial share of foreign ownership to zero while continuing to assume perfect capital mobility. Table 10 indicates that the MEB of the firm taxes is larger when there is less foreign ownership. The firm taxes raise less net revenue per unit of assets when the assets are owned by residents rather than foreigners because of the dividend imputation system. As a direct result, the distortion per dollar of net revenue is higher when foreign ownership is lower. Furthermore, the company income tax (CIT) raises revenue from the fixed factor which is effectively a lump sum transfer from foreigners to residents. When foreign ownership is lower this transfer is smaller and the welfare loss from the CIT is larger. Conversely, when we increase the share of foreign ownership from 17 percent to 50 percent, there are opposite effects. The aggregate distortion from the company taxes decreases. The alternate foreign ownership specifications change the magnitude of the MEBs but ordering of the aggregate distortions is preserved. However, the preferences over different tax instruments of households' changes. With increased foreign ownership young households prefer the CIT to the PIT, PAT and CT.

Fixed factors. In the standard calibration we assume that the fixed factor of production contributes 2 percent of output calibrated to the contribution of non-residential land. Cao et al. (2015) assume that natural resources and other fixed factors contribute a further 6 percent of output. To better understand the role of fixed factors, we consider two alternative assumptions on the fixed factors contribution: 8 percent of output and 0 percent. We summarized the results of the sensitivity analysis with fixed factors in Tables 13 and 12.

When fixed factors contribute a larger share of output the aggregate marginal excess burden is relatively lower for the taxes on the firm side. Taxing the fixed factors of production is essentially a lump sum tax. As such when there are more fixed factors the firm taxes are less distortionary. In our small open economy setting with an imputation system, taxing the fixed factor is partially a transfer from foreigners to residents, this raises the welfare of domestic households. More fixed factors mean there is a larger transfer from foreigners to residents to offset the welfare losses due to the distortions of the taxes. While the ordering of the aggregate marginal excess burdens for the different taxes is again preserved the impacts on different groups vary. Under the increased fixed factor specifications future households prefer the company income tax over the other taxes as it delivers a welfare increase on average.

Without the fixed factor the decrease in asset prices after raising the company income tax is less than in the benchmark model. The welfare losses of households alive at the time of the policy change are lesser. When there are no fixed factors the distortion from taxation is large mainly due to a more flexible production sector. However, households alive at the time of the policy change would, on average, prefer a consumption tax increase over a company income tax increase. The main reason is that the consumption tax increase immediately makes their consumption more expensive while the company income tax increase mainly lowers future wages.

General government consumption. In this experiment, we assume that the government allocates additional tax revenue to general government spending instead of transfers. The marginal excess burden in this experiment is taken as the equivalent variation minus the revenue change. As seen in row 10 of Table 4, the marginal excess burdens of all taxes are consistently smaller, compared to the baseline scenarios. The main reason is that there is no income effect resulting from the additional transfers to households in this setting. Without the additional transfers households supply more labor and tax revenue increases. As a result, the distortions per dollar of revenue are relatively smaller. However, the ranking of tax distortions remains unchanged. The distributional effects are reported in Table 16.

Franking credits. In the benchmark calibration households are allowed to deduct 37 percent of franking credits. In this experiment, we consider two extreme cases: (*i*) no franking credit use; and (*ii*) 100 percent franking credit use. The results are reported in Tables 14 and 15. We find that in the no franking credit case an increase in the company income tax (CIT) raises more net revenue. The increase in the CIT is not fully offset by the franking credit use in the personal tax system. As a result, the distortion per dollar of revenue is lower. Conversely, in a setting where 100 percent franking credit can be used an increase in the CIT results in a net revenue decrease. The increase in CIT revenue is more than offset by increased franking credit use and the decline in the other tax bases. With 100 percent franking credit use the CIT is beyond the peak of the Laffer curve at that rate. The aggregate marginal excess burden (MEB) is negative as the revenue change is negative.

Debt to equity ratio. Under the standard model specification we assume a constant share of capital is financed through debt. In this sensitivity we allow the firm to borrow a fixed share of the value of its equity. Note that, as the price of equity is greater than the value of capital we decrease the ratio of debt to equity, so that the overall level of firm debt is held constant in both the benchmark model and in this sensitivity analysis. Table 19 displays the result of this experiment. In this setting when changes in the value of firm equity result in changes in the firm's borrowing capacity. However, the effect through this channel is rather small. There is only a marginal increase in the distortion of the firm taxes.

Faster capital adjustment. In our benchmark economy, half of the capital stock adjustment in response to a tax change is completed within approximately 9 years. We adjust the parameters so that half of capital stock adjustment is completed in 4 years. In particular, we lower the capital adjustment cost parameter ψ from 3.3 to 0.25. When the firm responds more quickly to tax changes the distortion of taxation is higher. However, the model also assumes firms are not able to deduct adjustment costs from taxable revenue which means adjustment costs raise the distortion of firm taxes. As shown in Table 17, under the calibration used here the second effect dominates. A lower adjustment cost leads to a lower distortion for firm taxes.

No economic growth. We assume that productivity and populations both grow by 1.7 percent per year in our benchmark calibration. We now check our results with a no growth assumption. That is, both population and productivity growth are set to zero, while the risk-free interest rate is maintained. We report the results in Table 18. We find that lower growth decreases the NPV of future revenue and welfare. Distortions that manifest in the future are given lower weight when growth is lower. When there is no growth the company income tax (CIT) has the lowest MEB.

Intertemporal elasticity of substitution. In the benchmark calibration the intertemporal elasticity of substitution is 0.4. Instead, we simulate a model with an intertemporal elasticity of substitution of 0.2. We report the results in Table 20. We find that the adverse effects on saving from resulting from higher personal income tax (PIT) and personal asset tax (PAT) are relatively smaller when the elasticity of intertemporal substitution is smaller.

Increased elasticity of labor supply. We examine the role of parameter value for consumption share in utility. We consider a model with a lower consumption share of 0.125, compared to 0.25 in the benchmark model. Our simulation results are summarized in the last row of Table 4 and in Table 21. A reduction in the consumption share of utility increases the uncompensated elasticity of labor supply. As such, the distortions from taxes that predominantly affect the labor supply decision increase.

D.3 Intentional bequest and progressive income tax

We extend the benchmark model to include the following features: (i) intentional bequest and (ii) progressive income taxes.

Bequest motive. We follow the approach in De Nardi (2004) to incorporate intentional bequest motives to the model. That is, households now derive additional utility from bequeathing assets upon death. Household's expected utility has a new form of

$$U_{t,j,i} = \sum_{j'=j}^{100} \left[S_j \hat{\beta}^{j'-j} u\left(c_{t+j'-j,j',i}, l_{t+j'-j,j',i}\right) + (1 - S_j)\, \phi\left(a_{j+1}\right) \right]. \tag{12}$$

The utility from bequeathing is specified as $\phi(a) = \phi_1 \left(1 + \frac{a}{\phi_2}\right)^{1-\sigma}$, where the term ϕ_1 reflects the concern about leaving bequests and ϕ_2 measures the extent to which bequests are a luxury good.

We discipline the bequest parameters to match data from Australia. Productivity Commission (2015) reports the estimated value of bequests is around 3 percent of GDP in Australia. Fink and Redaelli (2005) documents variation of bequests by income level. Accordingly, we set $\phi_2 = 0.02$ and adjust ϕ_1 for low, middle and high income types in the model. As a result, high income households hold more assets and leave more bequests at the end of the life cycle. We also recalibrate the discount rate to match the resident's share of asset holdings.

	CIT	PIT	CT
Aggregate	\$0.90	\$0.36	\$0.22
Old	\$1.63	-\$0.21	\$0.18
Young	-\$0.40	\$0.18	\$0.15
Future	\$1.32	\$0.44	\$0.25
Type 1	\$0.62	-\$0.11	\$0.04
Type 2	\$0.76	\$0.30	\$0.16
Type 3	\$1.41	\$0.87	\$0.49

Table 5: **Marginal excess burdens (MEB) of raising extra revenue in an extended model with bequest motives.** Note that, CIT: company income tax; PIT: personal income tax; and CT: consumption tax CT.

We report marginal excess burdens (MEBs) of the three main taxes in Table 5. Overall, we find the MEB tax efficiency ranking is quite similar to the one found in the benchmark model. The excess burdens of the consumption and personal income taxes are broadly unchanged. However, the MEB of the company income tax is higher. Raising revenue via the company income tax remains the least efficient policy instrument in this extended model.

Progressive personal income tax. We now turn to a progressive personal income tax system. We approximate the income tax code by a parametric tax function where the marginal tax rate increases linearly with income until income reaches the top marginal tax bracket after which the marginal tax rate is constant. We find this approach straightforward to implement and calibrate. This also allows for a range of simple to understand policy experiments. Under this specification the marginal tax rate is given by

$$\tau(y) = \begin{cases} \tau^{p,*} \frac{y}{\overline{y}} & \text{if } y < \overline{y} \\ \tau^{p,*} & \text{if } y \geq \overline{y}, \end{cases} \tag{13}$$

where, y is taxable income which includes labor and capital income as $y = w_t(1 - l_{t,j,i})e_{j,i} + \widetilde{r}_t a_{t,j,i}$; $\overline{y}$ is the income threshold for the top marginal tax rate; and $\tau^{p,*}$ is the marginal tax rate of the top personal income tax bracket. Accordingly, the tax payment is given by

$$tax(y) = \begin{cases} \tau^{p,*}\frac{y}{\overline{y}}\frac{y}{2} & \text{if } y < \overline{y} \\ \tau^{p,*}(y - \overline{y}) + \overline{y}\frac{\tau^p}{2} & \text{if } y \geq \overline{y}, \end{cases} \tag{14}$$

In our calibration, we set $\tau^{p,*} = 45\%$ which is the top marginal tax rate in $2014 - 15$ in Australia. We calibrate the income tax threshold $\overline{y}$ so that the overall personal income tax matches the baseline calibration.[14]

	CIT	PIT	CT
Aggregate	\$0.85	\$0.34	\$0.23
Old	-\$0.28	-\$0.68	-\$0.08
Young	-\$0.30	\$0.10	\$0.18
Future	\$1.25	\$0.44	\$0.26
Type 1	\$0.29	\$0.00	\$0.06
Type 2	\$0.76	\$0.27	\$0.17
Type 3	\$1.53	\$0.76	\$0.49

Table 6: **Marginal excess burdens (MEB) of raising extra revenue in an extended model with progressive income taxes.** Note that, CIT: company income tax; PIT: progressive personal income tax; and CT: consumption tax CT.

We report the marginal excess burdens (MEBs) of three main taxes in Table 6.[15] We find that the MEB of the personal income tax is quite similar in our new model with progressive income taxation. However, the distribution of tax burden is changed. Higher income households bear higher excess burdens of taxes; meanwhile, lower income households enjoy lower excess burden. This result reflects the change in the distribution of tax liability due to progressive marginal tax rates. Interestingly, the overall tax efficiency ranking is relatively unchanged.e results in higher marginal excess burden than taxing on labor income and consumption taxes.

E Additional information

F Overview of the Australian tax and transfer system

There are three main taxes on personal/individual income, business income and consumption tax in Australia.

[14] A more detailed description is provided in our technical appendix. In short, we broadly calibrate to the income tax code for 2014-15 as provided by ATO at https://www.ato.gov.au/Rates/Individual-income-tax-for-prior-years/.

[15] When changing the personal income tax rate we change the top rate and the marginal rates for all incomes increase proportionally.

Personal income tax. There is no specific labor income tax in Australia. All labor earnings are combined together with income from assets and other sources to form individual personal income which are taxed under the personal income taxation. The personal income tax code is progressive with the top marginal tax rate of 45 percent for taxable income above $180,000.

Business income tax. The statutory corporation income tax rate is 28 percent. However, Australia is one of very few countries that has pioneered in implementing a dividend imputation system since 1987. Under the imputation system, the shareholders who are Australian tax residents are allowed to claim back some or all of the corporate taxes paid by Australian companies in the form of tax credits, namely franking credits. Australian tax residents use franking tax credits to reduce the personal income tax payable.

Consumption tax. A New Tax System (Goods and Services Tax) Act 1999 in which the Goods and Services Tax (GST) was introduced so as to reduce the reliance on income tax. The statutory goods and services (GST) rate is 10 percent in Australia.

Social transfers. Government has many social transfer programs for families in Australia including family tax benefits, childcare subsidy, housing subsidy, disability insurance, unemployment insurance, health care and aged care.

Age pension. There is an age pension program for retirees with the following distinct features: (*i*) the pension benefits are dependent on economic status (assets and income); (*ii*) coverage of the pension system is not universal in that only a fraction of the retiree population, i.e., the poorer elderly, receives pension benefits; (*iii*) the pension benefits are independent of individuals' contribution history; and (*iv*) the tax financing instrument is not restricted to payroll tax revenue collected from the current working population.

F.1 Computation of marginal excess burden

We follow Judd (1987) and use Hicksian equivalent variation to measure the excess burden. That said, as we have finitely lived heterogeneous households we modify the equivalent variation calculation. More broadly our approach is consistent with many of the definitions of the excess burden measure and we provide additional discussion with how our measure fits the broader marginal excess burden (MEB) literature in the technical appendix.

Equivalent variation. We measure the welfare change using the equivalent variation. We define the equivalent variation in terms of the per period transfer that delivers the same change in expected utility as the policy change. The equivalent variation EV is given by

$$EV(\mathcal{P}^p, \mathcal{P}^b) = \min \ T^{EV}_{t,20,i} \quad \text{suchthat} \quad \bar{V}_{t,20,i}\left(\bar{A}_{t,j,i}|\mathcal{P}^b, T^{EV}_{t,20,i}\right) \geq V_{t,20,i}(A_{t,j,i}, \mathcal{P}^p).$$

where the household's value function with the additional transfer T^{EV} is denoted by $\bar{V}_{t,j,i}(A_{t,j,i}, T^{EV}_{t,j,i})$. We use the overscore to denote baseline values, as such the value function $\bar{V_{t,j,i}}$ encompasses the budget constraint given by

$$\begin{aligned}&\bar{p}_t^a A_{t+1,j+1,i} + (1+\bar{\tau}^c)C_{t,j,i} = \\ &(1-\bar{\tau}^p)\left(\bar{W}_t(1-L_{t,j,i})\epsilon_{j,i} + (\bar{r}_t^a + \bar{r}_t^{FC})A_{t,j,i}\right) + \bar{TR}_{t,j,i} + T_{t,j,i}^{EV} + \bar{p}_t^a A_{t,j,i} + \bar{BQ}_{t,i},\end{aligned} \tag{15}$$

The households value function with the transfers is given by

$$\begin{aligned}&\bar{V}_{t,j,i}(A_{t,j,i}, T_{t,j,i}^{EV}) = \\ &\max_{\{C_{t,j,i}, L_{t,j,i}, A_{t+1,j+1,i}\}} \left\{U\left(C_{t,j,i}, L_{t,j,i}\right) + \hat{\beta} sp_{j+1} \bar{V}_{t+1,j+1,i}\left(A_{t+1,j+1,i}, T_{t+1,j+1,i}^{EV}\right)\right\}\end{aligned} \tag{16}$$

where the equivalent variation transfers for a given household are defined to grow in-line with productivity, $T_{t,j,i}^{EV}(1+g^{\Lambda}) = T_{t+1,j+1,i}^{EV}$.

For households in the model at the time of the policy change, $t = 0$, the transfers are calculated at this time. For these households the equivalent variation is given by

$$\min T_{t,20,i}^{EV} \quad \text{such that} \quad \bar{V}_{0,j,i}\left(A_{0,j,i}, T_{t,20,i}^{EV})\right) \geq V_{0,j,i}(A_{0,j,i})$$

Measuring marginal excess burden. In the core scenarios the additional revenue is returned to households allowing us to assess the distortion caused by a tax. When additional revenue is uniformly returned to households, a uniform lump tax causes no changes in the model and therefore no distortions. Conversely, a uniform lump sum tax that is used to fund increased government consumption would result in a negative income effect for households, a labor supply response, and broader macroeconomic changes. When the revenue is returned to households uniformly, any changes from a tax increase are due to the adverse effects of the tax relative to a uniform lump sum tax. As such, the excess burden in these scenarios is the welfare change as measured by the equivalent variation.

For an overall measure of the distortion of the tax we aggregate over the welfare loss faced by the households. Our aggregation weights all households equally and discounts future welfare change by the interest rate faced by the government. We normalize the aggregation by dividing by the net present value of the change in revenue. We define this measure as the aggregate marginal excess burden (MEB) which is given by

$$\text{MEB} = \frac{\sum_{t=0}^{\infty}\sum_{i=1}^{3}\sum_{j=20}^{100} M_{t,j,i} T_{t,j,i}^{EV}\left(\frac{1}{1+r}\right)^t}{\sum_{t=0}^{\infty}\frac{TAX_t^N - T\bar{A}X_t^N}{\prod_{i=0}^{t}(1+r_i)}}.$$

As discussed above, the equivalent variation is calculated the year the household enters the labor market or the year the policy change occurs, whichever comes first.

The MEB is a summary metric for the distortion from each tax that aggregates household's excess burdens. The welfare impacts of different households vary significantly across generations and types which makes comparing taxes difficult. The summary metric provides a point of reference in comparing the taxes. The summary metric is an aggregation of the households' welfare changes. The choice of weights when aggregating the excess burdens is in itself a normative choice but we feel the measure constructed here is intuitive. The metric can be used as a proxy for the efficiency of a tax as the metric closely matches the welfare changes under a Lump Sum Redistributative Authority scenarios. The summary metric is not only useful in comparing different taxes it is also useful in examining the impact parameter choices and model formulations. We do not suggest that this summary metric should be the only measure a policy maker should consider. However, it serves as a useful starting point.

We also construct sub-aggregations to compare the impacts across cohorts and types. We create measures for each type and these are constructed in the same way as the total aggregation. We also present the MEB for the old, young and future generations. These are simple averages where old is defined as those 65 and over at the time of the policy change, young are those alive and below 65 at the policy change and the future generation shows the MEB in the long run steady state.

F.2 Calibration tables and figures

In this section we report parameter values used in our benchmark model calibrated to match data from Australia. The majority of the parameters are calibrated so that the model matches Australian macroeconomic aggregates. Other parameters are calibrated so that household variables match micro-economic data from the Household, Income and Labor Dynamics in Australia (HILDA) survey or taken from the literature. We summarize these external parameters in Table 7. Internally selected parameters to match a given set of targets from Australian data are presented in table 8. Our benchmark steady state economy is able to approximate the economy of 2010.

F.3 Discussion for other forms of income taxation

In this section we discuss the mechanism behind the excess burden of each tax separately.

Investment tax credits (ITC). We consider an experiment where the share of investment is no longer claimed immediately, but can then be claimed as depreciation deductions later. Reducing investment tax credits (ITC) lowers the share of investment the firm can immediately claim as a tax deduction. This means the reduction in the ITC is offset by increases in depreciation deductions later, $\Delta\chi^I = -\Delta\chi^\delta$.

The dynamic effects of a reduction in ITC are reported in Figure 12. Reducing ICT raises the cost of investment and results in less investment occurring. The price of assets also increases but is held down in the near term due to lower capital adjustment costs from lower investment.

Parameters:		Explanation/Source:
- Periods working	$J_1 = 45$	
- Periods retired	$J_2 = 35$	
- Population growth rate	$g^n = 0.0132$	ABS projection in 2014
- Labor productivities by skill	$\{e_j\}_{j=1}^{J_1}$	Calculated from HILDA data
- Total factor productivity	$Z = 1$	Normalization
- Labor augmenting productivity growth	$g^\Lambda = 0.0143$	Average GDP growth 1990-2014
- World interest rate	$r = 0.0376$	To target K/Y from ABS data
- labor income share	$\alpha_n = 0.592$	Calculated from ABS data
- Capital income share	$\alpha_k = 0.388$	Calculated from ABS data
- Capital depreciation	$\delta = 0.056$	Calculated from ABS data
- Debt to equity ratio	$\xi = 0.24$	Cao et al (2015)
- Franking credit share	$\chi^{FC} = 0.368$	Cao et al (2015)
- Debt deduction share	$\chi^\xi = 1.0$	Cao et al (2015)
- Investment tax credit share	$\chi^I = 0.05$	Cao et al (2015)
- Depreciation deduction share	$\chi^d = 0.95$	Cao et al (2015)

Table 7: External Parameters

Parameters:		Explanation/Source:
- Relative risk aversion	$\sigma = 2.5$	to match literature
- Preference on consumption vs. leisure:	$\gamma = 0.25$	to match labor supply
- Discount factor	$\beta = 0.990$	to match 17% net foreign ownership
- Capital adjustment cost	$\psi = 3.33$	to match q-ratio
- Company Income tax	$\tau^k = 0.299$	to match revenue/ GDP (ABS 5204)
- Personal income tax	$\tau^p = 0.156$	to match revenue/ GDP
- Consumption tax	$\tau^c = 0.062$	to match revenue/ GDP
- Residual Government spending	$G/Y = 0.115$	to balance initial government budget

Table 8: Internal parameters used to match a set of target moments in the data.

In the medium term the price of assets continues to rise consistent with increasing dividends from the decreasing capital stock and the increasing marginal product of capital.

Unlike raising the company income tax, reducing the ITC is a boon to retired households as the price of their assets increases. The welfare of older households increases through both the asset price increases and increased transfers. It is younger households and future generations whose welfare is reduced through lower wages due to the lower capital stock.

The aggregate distortion caused by a reduction in the ITC is larger than for the company income tax because of the windfall gains to foreigner investors and older households. Auerbach and Kotlikoff (1987) note that, in a closed economy, decreasing the ITC is similar to moving from a consumption tax to a labor income tax. That is, decreasing investment incentives shifts the burden of taxation from the old to the young. Reducing the ITC increases asset prices and acts as a transfer to older households and foreign investors. The reduction in the ITC only affects new capital raising the overall distortion relative to the company income tax. The net

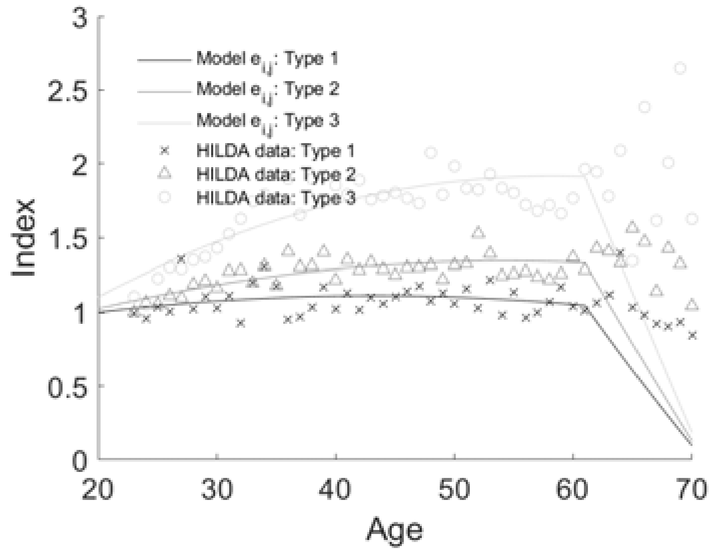


Figure 6: **Labor productivity over life-cycle by type: Model vs. Data.**

revenue raised falls significantly over time as reducing the ITC leads to higher depreciation deductions in the future.

Interestingly, while the reduction in the ITC results in largest aggregate welfare losses many households alive at the time of the policy change are better off.

Depreciation deductions (DD). We model a reduction in depreciation deductions (DD) by reducing the share of depreciation deductions claimable, χ^{δ}. The dynamic effects are reported in Figure 13.

This reduction raises the effective tax rate on capital. Lowering depreciation deductions has similar impacts to an increase in the company income tax (CIT) with investment, the capital stock and wages all falling over time. However, the change in depreciation deductions only affects variable capital and therefore causes a larger aggregate distortion per dollar of revenue. As the depreciation deduction only affects variable capital the value of assets falls by less than under a CIT increase.

The larger per dollar distortion from the depreciation deductions, compared with the CIT, can be seen in the larger aggregate welfare loss. However, the welfare loss is smaller for asset rich households at the time of the policy change.

Lastly it is worth noting that the way debt deductions have been modelled here means that a decrease in debt deductibility has the identical impact to lower depreciation deductions. We have assumed that debt can only be held against variable capital and not against the value of the fixed factor. Under this assumption lowering debt deductions only directly affects the return to variable capital. If debt were also held against the fixed factor then lowering debt deductions would be more like a company income tax increase.

Personal asset income tax (PAT). We consider an experiment where the government raises the tax rate on households' asset income stream, essentially introducing a personal asset income tax (PAT). This tax effectively reduces the returns to assets held by domestic households. The impact of the PAT increase is equivalent to a decrease in franking credit deductibility. As such, the MEBs for the PAT are equivalent to the MEB of a reduction in dividend imputation in our model.

Increasing the PAT distorts households' incentives to work and save and leads to decreases in saving and labor supply. The dynamic effects are reported in Figure 15. In our small open economy model with perfect capital mobility, the decrease in domestic saving is perfectly offset by increased foreign investment. However, changes in aggregate labor supply affect output and the aggregate capital stock.

The PAT causes the largest aggregate welfare loss among taxes directly imposed on the households. In addition, the PAT is more distorting than the personal labor income tax. The PAT is the least preferred tax for the high productivity households because they hold the most assets. Meanwhile, the low productivity households prefer the PAT over the PLT.

Personal labor income tax (PLT). In the core model households labor income and income from assets are taxed at the same rate. We consider an experiment where the tax rate on the labor income stream is raised, essentially introducing a personal labor income tax (PLT). In the model, the PLT this is equivalent to a broad payroll tax. The dynamic effects are shown in Figure 14. The PLT decreases the take home wage of households. The impacts of increasing PLT display characteristics of both the personal income tax (PIT) and consumption tax (CT) increases. As with the consumption tax, the PLT directly distorts the consumption leisure trade off. The tax base of the PLT is relatively smaller than that of the consumption tax as it only collects taxes from working households.

The aggregate marginal distortion caused by the PLT is lower than the personal income tax but higher than the consumption tax. It is lower than the personal income tax because it does not affect intertemporal decisions. It is higher than the consumption tax because it does not collect revenue from older households whose expenditure is inelastic. Retired households prefer the PLT increase to either personal income tax or consumption tax increases while future households prefer a consumption tax increase.

F.4 Additional results for sensitivity analysis

	CIT	ITC	DD	PAT	PIT	PLT	CT
Aggregate	$0.37	$0.37	$0.37	$0.37	$0.24	$0.21	$0.20
Old	$0.16	-$1.14	-$0.44	$2.36	-$0.15	-$0.57	$0.06
Young	$0.54	-$0.10	$0.24	$1.62	$0.23	-$0.00	$0.27
Future	$0.40	$0.88	$0.63	-$0.41	$0.28	$0.40	$0.19
Type 1	$0.09	$0.03	$0.06	$0.18	-$0.07	-$0.11	$0.05
Type 2	$0.31	$0.30	$0.31	$0.33	$0.17	$0.15	$0.15
Type 3	$0.73	$0.79	$0.76	$0.61	$0.62	$0.62	$0.44

Table 9: **Marginal excess burdens (MEB) in a closed economy.** Note that, CIT: Company income tax; ITC: Investment tax credits; DD: Depreciation deductions; PAT: Personal asset income tax; PIT: Personal income tax; PLT: Personal labor income tax; and CT: Consumption tax.

	CIT	ITC	DD	PAT	PIT	PLT	CT
Aggregate	$0.83	$1.22	$1.02	$0.43	$0.34	$0.31	$0.24
Old	$2.40	-$2.22	$0.42	-$0.10	-$0.55	-$0.73	$0.19
Young	$0.86	-$1.66	-$0.11	$0.71	$0.15	-$0.07	$0.31
Future	$0.84	$2.22	$1.42	$0.41	$0.43	$0.44	$0.23
Type 1	$0.24	$0.50	$0.35	$0.21	$0.04	-$0.03	$0.08
Type 2	$0.71	$1.07	$0.88	$0.39	$0.28	$0.24	$0.18
Type 3	$1.57	$2.13	$1.86	$0.71	$0.72	$0.73	$0.49

Table 10: **Marginal excess burdens (MEB) with lower foreign ownership share.** Note that, CIT: Company income tax; ITC: Investment tax credits; DD: Depreciation deductions; PIT: Personal income tax; PAT: Personal asset income tax; PLT: Personal labor income tax; and CT: Consumption tax.

Aggregate	$0.40	$0.82	$0.60	$0.57	$0.31	$0.26	$0.22
Old	$0.30	-$1.42	-$0.43	$0.08	-$0.70	-$0.83	-$0.13
Young	-$0.03	-$0.66	-$0.25	$1.01	$0.09	-$0.07	$0.15
Future	$0.55	$1.33	$0.89	$0.51	$0.41	$0.39	$0.25
Type 1	$0.02	$0.34	$0.17	$0.13	-$0.04	-$0.08	$0.05
Type 2	$0.33	$0.73	$0.52	$0.48	$0.24	$0.20	$0.16
Type 3	$0.86	$1.40	$1.11	$1.13	$0.75	$0.68	$0.47

Table 11: **Marginal excess burdens (MEB) with higher foreign ownership share**. Note that, CIT: Company income tax; ITC: Investment tax credits; DD: Depreciation deductions; PIT: Personal income tax; PAT: Personal asset income tax; PLT: Personal labor income tax; and CT: Consumption tax.

	CIT	ITC	DD	PAT	PIT	PLT	CT
Aggregate	$0.21	$1.03	$0.79	$0.38	$0.31	$0.28	$0.21
Old	$4.72	-$0.67	$1.17	-$0.13	-$0.41	-$0.56	$0.52
Young	$2.06	-$0.94	$0.22	$0.63	$0.19	-$0.05	$0.44
Future	-$0.38	$1.75	$1.02	$0.36	$0.38	$0.40	$0.15
Type 1	-$0.12	$0.40	$0.24	$0.17	$0.03	-$0.05	$0.06
Type 2	$0.15	$0.90	$0.68	$0.34	$0.26	$0.21	$0.16
Type 3	$0.63	$1.82	$1.48	$0.65	$0.68	$0.69	$0.45

Table 12: **Marginal excess burdens (MEB) with increased fixed factors.** Note that, CIT: Company income tax; ITC: Investment tax credits; DD: Depreciation deductions; PAT: Personal asset income tax; PIT: Personal income tax; PLT: Personal labor income tax; and CT: Consumption tax.

	CIT	ITC	DD	PAT	PIT	PLT	CT
Aggregate	$0.82	$1.04	$0.83	$0.49	$0.33	$0.29	$0.23
Old	-$0.29	-$2.38	-$0.41	$0.00	-$0.68	-$0.85	-$0.08
Young	-$0.31	-$1.34	-$0.36	$0.85	$0.10	-$0.08	$0.19
Future	$1.20	$1.85	$1.24	$0.45	$0.43	$0.43	$0.26
Type 1	$0.27	$0.44	$0.29	$0.19	-$0.00	-$0.05	$0.07
Type 2	$0.72	$0.94	$0.74	$0.42	$0.26	$0.23	$0.18
Type 3	$1.47	$1.76	$1.50	$0.89	$0.75	$0.72	$0.50

Table 13: **Marginal excess burdens (MEB) with no fixed factors.** Note that, CIT: Company income tax; ITC: Investment tax credits; DD: Depreciation deductions; PAT: Personal asset income tax; PIT: Personal income tax; PLT: Personal labor income tax; and CT: Consumption tax.

	CIT	ITC	DD	PAT	PIT	PLT	CT
Aggregate	$0.59	$0.86	$0.71	$0.77	$0.41	$0.31	$0.24
Old	$0.77	-$1.02	-$0.05	$0.05	-$0.61	-$0.78	$0.07
Young	$0.59	-$0.29	$0.21	$1.08	$0.17	-$0.06	$0.26
Future	$0.63	$1.28	$0.92	$0.75	$0.51	$0.45	$0.25
Type 1	$0.19	$0.36	$0.27	$0.45	$0.06	-$0.03	$0.08
Type 2	$0.51	$0.76	$0.62	$0.70	$0.33	$0.24	$0.18
Type 3	$1.11	$1.49	$1.28	$1.18	$0.84	$0.75	$0.50

Table 14: **Marginal excess burdens (MEB) with no franking credit.** Note that, CIT: Company income tax; ITC: Investment tax credits; DD: Depreciation deductions; PIT: Personal income tax; PAT: Personal asset income tax; PLT: Personal labor income tax; and CT: Consumption tax.

	CIT	ITC	DD	PAT	PIT	PLT	CT
Aggregate	-$1.01	-$4.14	-$1.45	$0.14	$0.22	$0.26	$0.21
Old	-$3.28	$9.34	-$0.88	-$0.17	-$0.57	-$0.74	$0.10
Young	-$0.06	$9.29	$1.13	$0.44	$0.08	-$0.08	$0.25
Future	-$1.20	-$8.51	-$2.19	$0.10	$0.30	$0.38	$0.20
Type 1	-$0.52	-$2.21	-$0.78	-$0.01	-$0.05	-$0.06	$0.05
Type 2	-$0.92	-$3.80	-$1.33	$0.11	$0.17	$0.20	$0.15
Type 3	-$1.60	-$6.49	-$2.27	$0.34	$0.56	$0.65	$0.45

Table 15: **Marginal excess burdens (MEB) with increased franking credits.** Note that, CIT: Company income tax; ITC: Investment tax credits; DD: Depreciation deductions; PAT: Personal asset income tax; PIT: Personal income tax; PLT: Personal labor income tax; and CT: Consumption tax.

	CIT	ITC	DD	PAT	PIT	PLT	CT
Aggregate	$0.37	$0.73	$0.54	$0.26	$0.14	$0.10	$0.04
Old	$0.91	-$1.88	-$0.28	-$0.33	-$0.80	-$0.94	-$0.22
Young	$0.22	-$1.21	-$0.32	$0.50	-$0.06	-$0.23	$0.05
Future	$0.44	$1.40	$0.84	$0.24	$0.22	$0.21	$0.05
Type 1	-$0.05	$0.19	$0.06	$0.05	-$0.14	-$0.19	-$0.10
Type 2	$0.29	$0.62	$0.44	$0.22	$0.08	$0.04	-$0.01
Type 3	$0.91	$1.40	$1.15	$0.53	$0.48	$0.46	$0.27

Table 16: **Marginal excess burdens (MEB) with additional tax revenue allocated to general government consumption.** Note that, CIT: Company income tax; ITC: Investment tax credits; DD: Depreciation deductions; PIT: Personal income tax; PAT: Personal asset income tax; PLT: Personal labor income tax; and CT: Consumption tax.

	CIT	ITC	DD	PAT	PIT	PLT	CT
Aggregate	\$0.39	\$0.78	\$0.59	\$0.55	\$0.34	\$0.28	\$0.22
Old	\$0.99	-\$2.48	-\$0.74	-\$0.13	-\$0.69	-\$0.85	-\$0.01
Young	\$0.45	-\$1.17	-\$0.26	\$0.88	\$0.14	-\$0.07	\$0.24
Future	\$0.34	\$1.39	\$0.84	\$0.51	\$0.43	\$0.41	\$0.22
Type 1	-\$0.03	\$0.22	\$0.09	\$0.28	\$0.02	-\$0.05	\$0.06
Type 2	\$0.30	\$0.67	\$0.49	\$0.48	\$0.27	\$0.22	\$0.16
Type 3	\$0.91	\$1.46	\$1.20	\$0.89	\$0.75	\$0.71	\$0.48

Table 17: **Marginal excess burdens (MEB) with faster capital adjustment.** Note that, CIT: Company income tax; ITC: Investment tax credits; DD: Depreciation deductions; PIT: Personal income tax; PAT: Personal asset income tax; PLT: Personal labor income tax; and CT: Consumption tax.

	CIT	ITC	DD	PAT	PIT	PLT	CT
Aggregate	\$0.00	\$1.51	\$0.14	\$0.84	\$0.40	\$0.28	\$0.20
Old	\$0.14	-\$4.35	-\$0.31	\$0.18	-\$0.56	-\$0.76	-\$0.01
Young	-\$0.37	-\$1.33	-\$0.46	\$1.07	\$0.31	\$0.11	\$0.21
Future	\$0.58	\$7.47	\$1.16	\$0.97	\$0.77	\$0.72	\$0.25
Type 1	-\$0.40	\$0.46	-\$0.34	\$0.67	\$0.11	-\$0.04	\$0.05
Type 2	-\$0.07	\$1.36	\$0.06	\$0.77	\$0.33	\$0.22	\$0.14
Type 3	\$0.51	\$2.70	\$0.73	\$1.11	\$0.78	\$0.69	\$0.45

Table 18: **Marginal excess burdens (MEB) with no economic growth.** Note that, CIT: Company income tax; ITC: Investment tax credits; DD: Depreciation deductions; PAT: Personal asset income tax; PIT: Personal income tax; PLT: Personal labor income tax; and CT: Consumption tax.

	CIT	ITC	DD	PAT	PIT	PLT	CT
Aggregate	\$0.67	\$1.09	\$0.86	\$0.48	\$0.34	\$0.30	\$0.23
Old	\$1.36	-\$1.95	\$0.03	-\$0.06	-\$0.59	-\$0.76	\$0.07
Young	\$0.46	-\$1.21	-\$0.13	\$0.78	\$0.14	-\$0.07	\$0.26
Future	\$0.76	\$1.89	\$1.21	\$0.45	\$0.43	\$0.43	\$0.24
Type 1	\$0.16	\$0.45	\$0.29	\$0.23	\$0.02	-\$0.04	\$0.07
Type 2	\$0.57	\$0.97	\$0.75	\$0.43	\$0.28	\$0.23	\$0.18
Type 3	\$1.31	\$1.89	\$1.58	\$0.78	\$0.73	\$0.72	\$0.49

Table 19: **Marginal excess burden with debt tied to equity.** Note that, CIT: Company income tax; ITC: Investment tax credits; DD: Depreciation deductions; PAT: Personal asset income tax; PIT: Personal income tax; PLT: Personal labor income tax; and CT: Consumption tax.

	CIT	ITC	DD	PAT	PIT	PLT	CT
Aggregate	$0.77	$1.15	$0.97	$0.29	$0.28	$0.28	$0.22
Old	$1.89	-$1.89	$0.27	-$0.17	-$0.60	-$0.75	$0.13
Young	$0.55	-$1.23	-$0.13	$0.56	$0.08	-$0.09	$0.23
Future	$0.87	$1.99	$1.37	$0.25	$0.37	$0.41	$0.22
Type 1	$0.25	$0.51	$0.38	$0.05	-$0.03	-$0.06	$0.06
Type 2	$0.67	$1.02	$0.85	$0.25	$0.22	$0.21	$0.16
Type 3	$1.43	$1.96	$1.72	$0.58	$0.66	$0.70	$0.47

Table 20: **Marginal excess burdens (MEB) with lower inter-temporal elasticity.** Note that, CIT: Company income tax; ITC: Investment tax credits; DD: Depreciation deductions; PAT: Personal asset income tax; PIT: Personal income tax; PLT: Personal labor income tax; and CT: Consumption tax.

	CIT	ITC	DD	PAT	PIT	PLT	CT
Aggregate	$0.60	$1.07	$0.81	$0.69	$0.43	$0.36	$0.28
Old	$1.21	-$1.92	-$0.10	$0.17	-$0.52	-$0.73	$0.12
Young	$0.49	-$1.18	-$0.13	$1.04	$0.22	-$0.01	$0.32
Future	$0.66	$1.85	$1.14	$0.66	$0.53	$0.50	$0.28
Type 1	$0.04	$0.34	$0.16	$0.47	$0.09	-$0.02	$0.10
Type 2	$0.51	$0.96	$0.71	$0.61	$0.36	$0.29	$0.22
Type 3	$1.26	$1.92	$1.56	$1.03	$0.87	$0.83	$0.56

Table 21: **Marginal excess burdens (MEB) with smaller consumption weight in utility.** Note that, CIT: Company income tax; ITC: Investment tax credits; DD: Depreciation deductions; PAT: Personal asset income tax; PIT: Personal income tax; PLT: Personal labor income tax; and CT: Consumption tax.

	CIT	ITC	DD	PAT	PIT	PLT	CT
Aggregate	$0.59	$0.60	$0.59	$0.57	$0.39	$0.35	$0.30
Old	$0.25	-$1.16	-$0.34	$2.16	-$0.15	-$0.61	$0.19
Young	$0.76	$0.10	$0.49	$1.66	$0.38	$0.13	$0.37
Future	$0.65	$1.42	$0.97	-$0.39	$0.48	$0.65	$0.27
Type 1	$0.09	$0.05	$0.07	$0.15	-$0.09	-$0.13	$0.17
Type 2	$0.52	$0.51	$0.52	$0.52	$0.31	$0.27	$0.24
Type 3	$1.16	$1.23	$1.19	$1.06	$0.94	$0.92	$0.52

Table 22: **Marginal excess burdens (MEB) with US policy settings.** Note that, CIT: Company income tax; ITC: Investment tax credits; DD: Depreciation deductions; PAT: Personal asset income tax; PIT: Personal income tax; PLT: Personal labor income tax; and CT: Consumption tax.

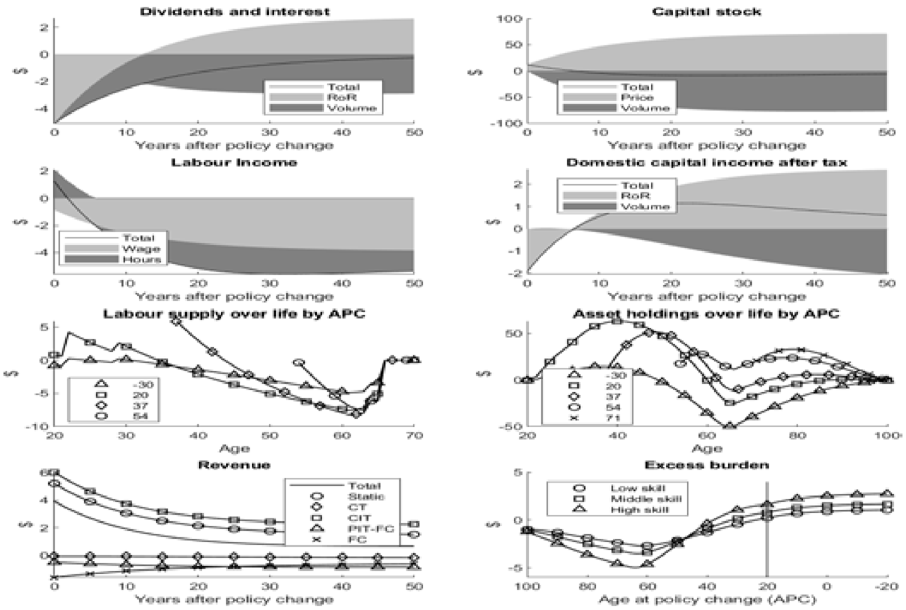


Figure 7: Marginal excess burdens (MEB) by initial tax rate.

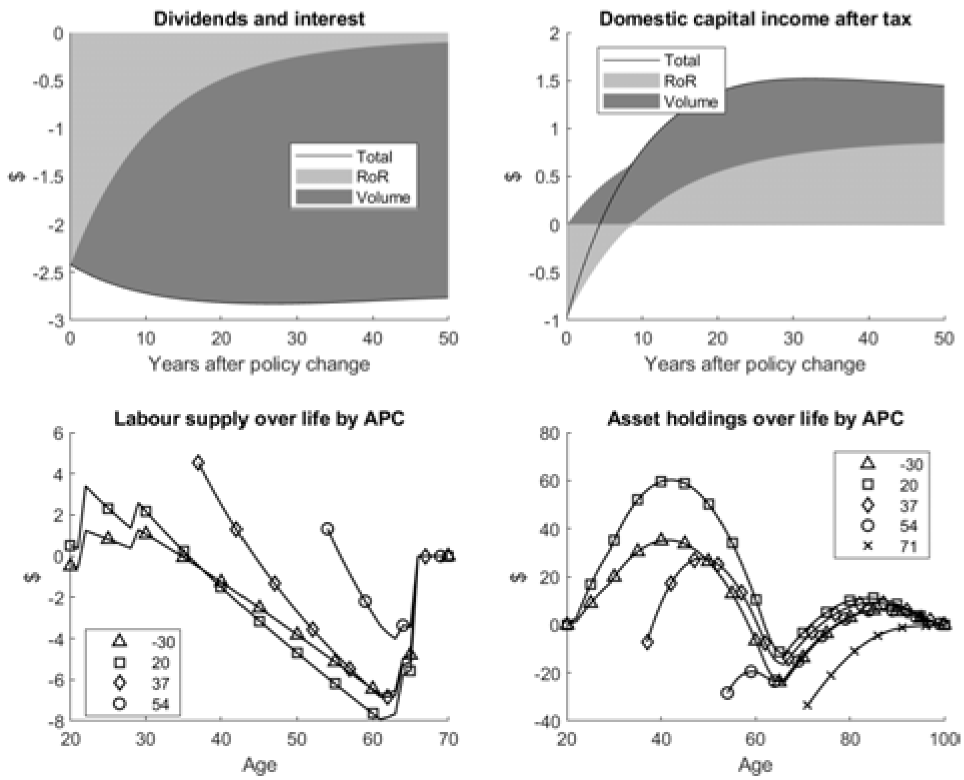


Figure 8: **Decomposing welfare impacts for type 2 households by scenario.** Note that, CIT: Company income tax; ITC: Investment tax credits; DD: Depreciation deductions; PIT: Personal income tax; PAT: Personal asset income tax; PLT: Personal labor income tax; and CT: Consumption tax; p^a: asset price impact; $r^a + r^{FC}$ rate of return on assets and franking credits impact; w wages impact; τ tax settings direct impact; T government transfers impact.

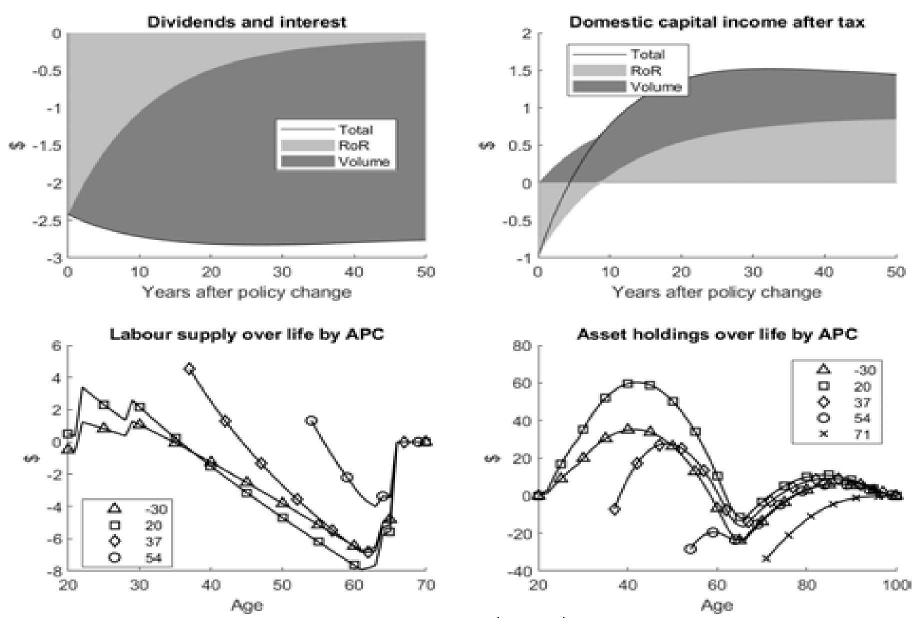


Figure 9: **The impacts of company income tax (CIT) increase.** Note that, the CIT is permanently adjusted to raise the targeted net present value (NPV) revenue increase by $1.

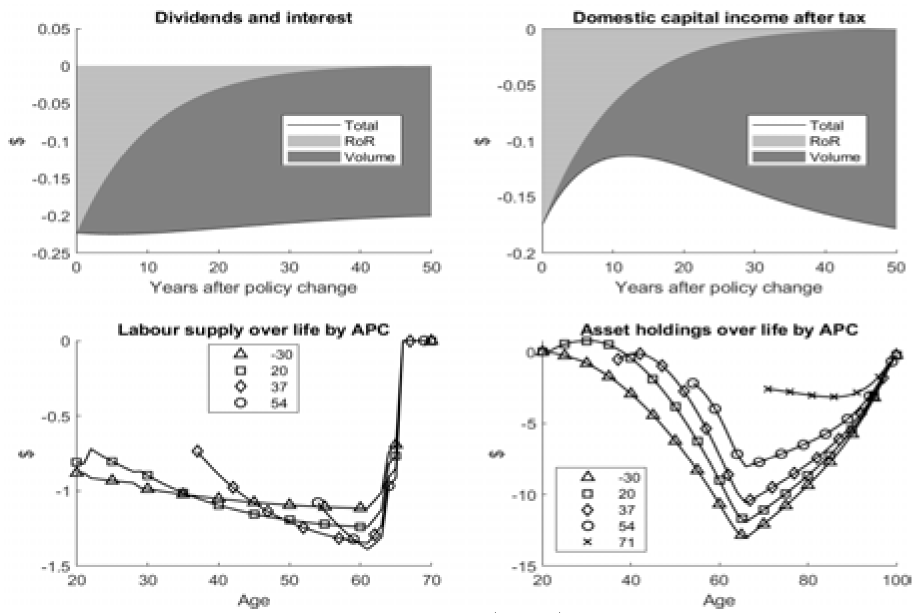


Figure 10: **The impact of personal income tax (PIT) increase.** Note that, the PIT is permanently adjusted to raise the targeted net present value (NPV) revenue increase by $1.

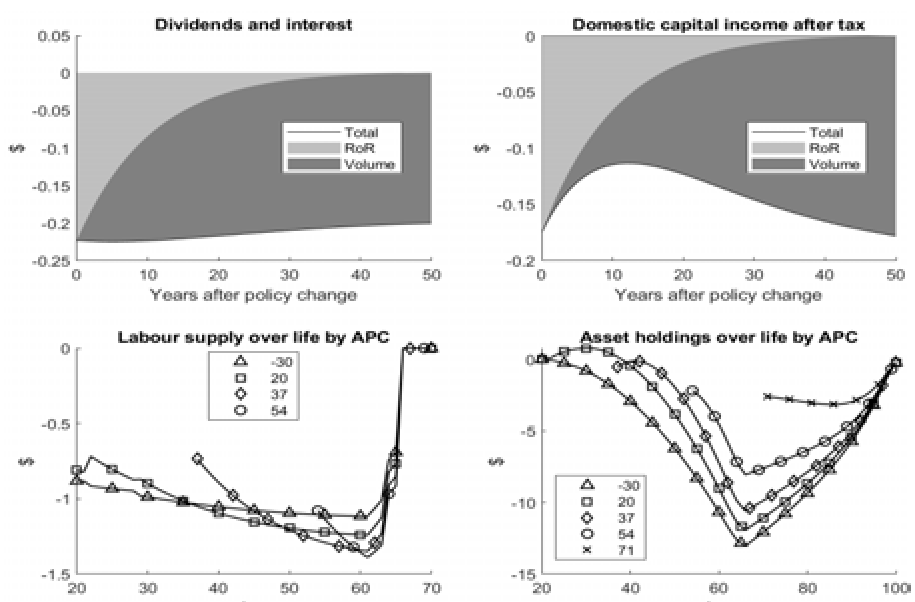


Figure 11: **The impacts of consumption tax (CT) increase.** Note that, the CT is permanently adjusted to raise the targeted net present value (NPV) revenue increase by $1.

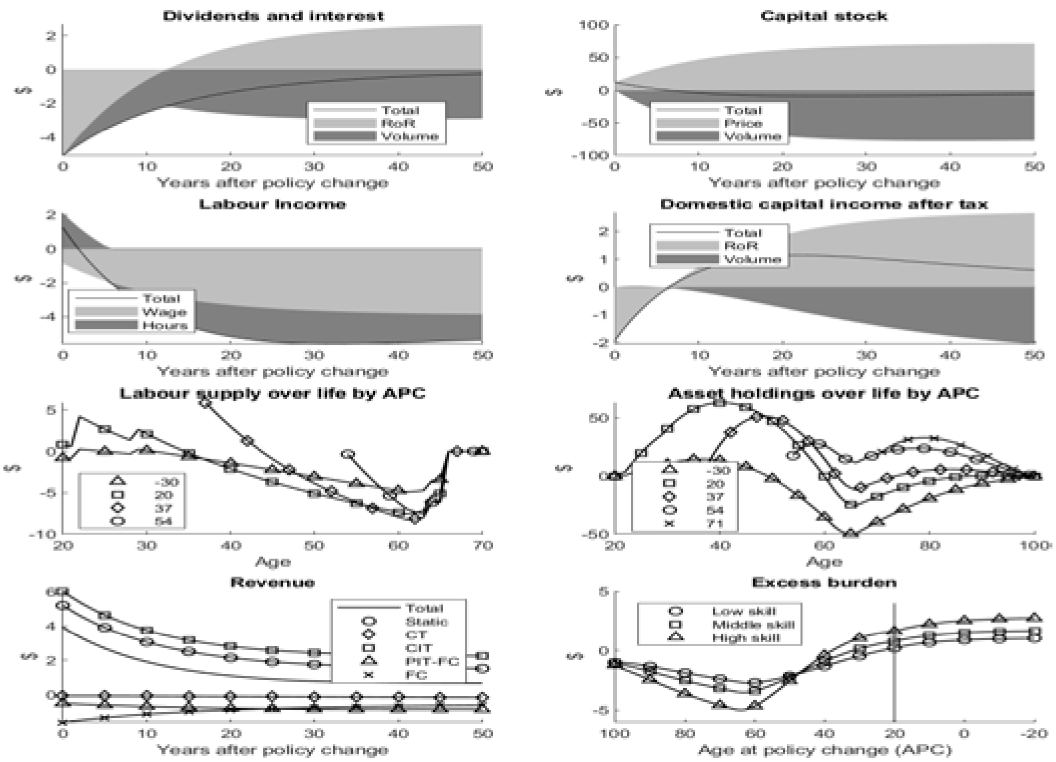


Figure 12: **The impact of investment tax credit (ITC) reduction.**

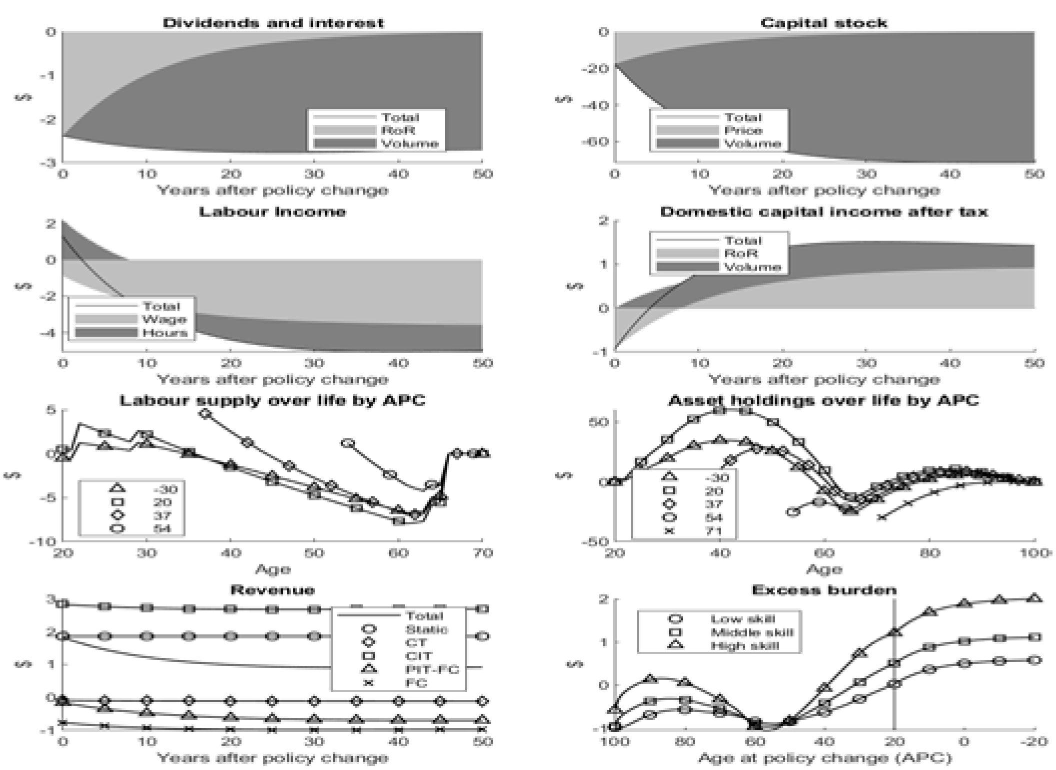


Figure 13: **The impacts of debt deduction (DD) reduction.**

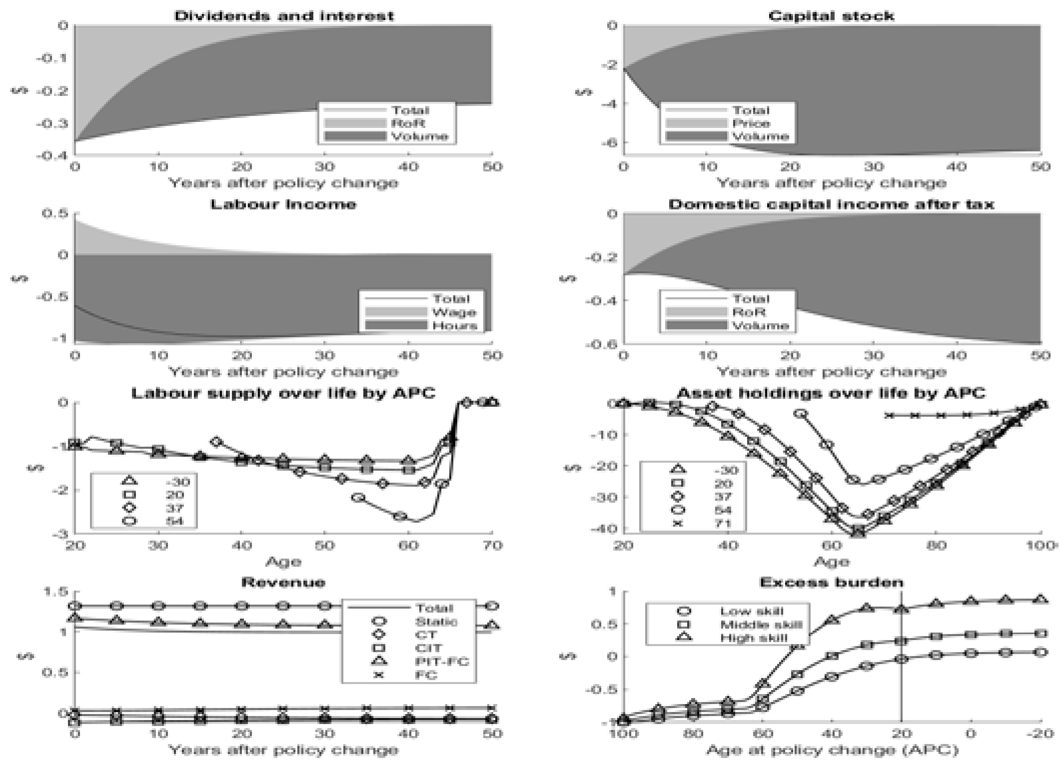


Figure 14: **The impacts of personal labor income tax (PLT) increase.**

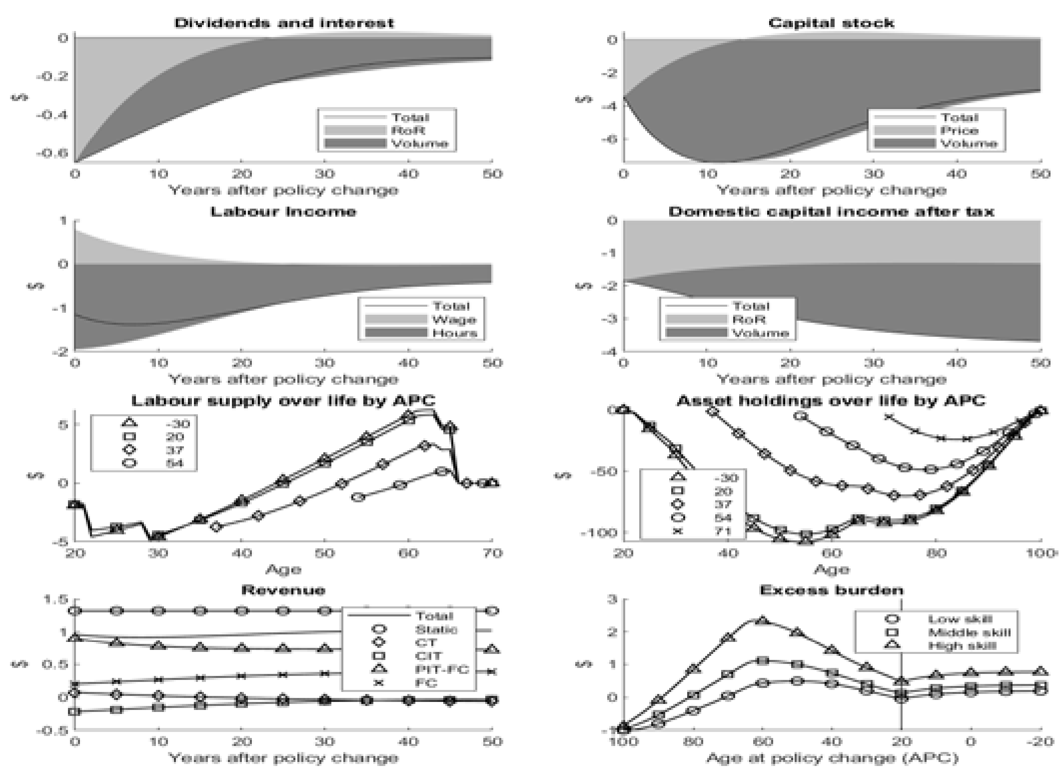


Figure 15: **The impacts of personal asset income tax (PAT) increase.**

References

Auerbach, Alan J. 1979. "Share valuation and corporate equity policy." *Journal of Public Economics* 11(3):291–305. D.2

Auerbach, Alan J. and Laurence J. Kotlikoff. 1987. *Dynamic Fiscal Policy.* Cambridge Unversity Press. F.3

Ballard, Charles L., John B. Shoven and John Whalley. 1985. "General Equilibrium Computations of the Marginal Welfare Costs of Taxes in the United States." *The American Economic Review* 75(1):128–138. 3.1, C.2

Cao, Liangyue, Amanda Hosking, Michael Kouparitsas, Damian Mullaly, Xavier Rimmer, Qun Shi, Wallace Stark and Sebastian Wende. 2015. "Understanding the economy-wide efficiency and incidence of major Australian taxes." *Australian Treasury working paper* 1. B.2.2, D.2

Commission, Productivity. 2025. "Creating a more Dynamic and Resilient Economy." *Interim Report* . (document), 1

De Nardi, Mariacristina. 2004. "Wealth Inequality and Intergenerational Links." *Review of Economic Studies* 71(743-768). D.3

Fink, Günther and Silvia Redaelli. 2005. Understanding Bequest Motives An Empirical Analysis of Intergenerational Transfers. DNB Working Papers 042 Netherlands Central Bank, Research Department. D.3

Harberger, A.C. 1964. "The measurement of waste." *American Economic Review* 54:58–76. C.1

Judd, Kenneth L. 1985. "Redistributive Taxation in a Simple Perfect Foresight Model." *Journal of Public Economics* 28:59–83. 3.1, C.2

Judd, Kenneth L. 1987. "The Welfare Cost of Factor Taxation in a Perfect-Foresight Model." *Journal of Political Economy* 95(4):675–709. C.1, F.1

Kudrna, G., C. Tran and A. Woodland. 2015. "The Dynamic Fiscal Effects of Demographic Shift: The Case of Australia." *Economic Modelling* 50:105–122. B.2.1

Miller, Merton H and Franco Modigliani. 1961. "Dividend Policy, Growth, and the Valuation of Shares." *Journal of Business* 34(4):411–33. 5

Murphy, Chris. 2025. "Corporate Tax Reform Modelling Scenarios: First Stage Report." *Report* . 1

Nassios, Jason, Janine Dixon, Xianglong Locky Liu and Sam Marginson. 2025. “Broad vs Targeted Company Tax ReformsA CGE Analysis of Ten Percentage PointReductions in Australia.” *CoPS Working Paper No. G-356* . 1

Oliner, Stephen, Glenn Rudebusch and Daniel Sichel. 1995. “New and Old Models of Business Investment: A Comparison of Forecasting Performance.” *Journal of Money, Credit and Banking* 27(3):806–826. B.2.2

Poterba, James M. and Lawrence H. Summers. 1983. “Dividend taxes, corporate investment, and ’Q’.” *Journal of Public Economics* 22(2):135–167. B.1.2

Productivity Commission. 2015. “Housing decisions of older Australians.”. D.3

Tran, Chung and Sebastian Wende. 2021. “On the Excess Burden of Taxation in an Overlapping Generations Economy.” *Journal of Macroeconomics* 70. 2