A Dynamic Economy-wide Analysis of Company Tax Cuts in Australia

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Abstract

We provide a comprehensive analysis of the economy-wide implications of company tax cuts in Australia. This is achieved using VURMTAX, a bottom-up, multi-regional computable general equilibrium (CGE) model of Australia's states and territories with detailed fiscal accounts. We find that a five percentage point reduction in Australia's legislated rate of company tax stimulates growth in investment, real GDP, and real consumer wages. However, real national income and household consumption both fall when the company tax rate is cut, diminishing economic welfare. As we show, this finding is insensitive to: (i) changes in the timing of the tax cuts, i.e., an overnight cut drives similar long-run impacts to staged reductions, or (ii) whether investors form views on expected rates of return on capital via adaptive or forward-looking expectations. The marginal excess burden (MEB) for company tax is therefore negative. This finding contradicts previous studies, which derive a large, positive MEB for company tax. We identify six differences between modelling assumptions applied herein, and those used in a previous study for Australia (Cao *et al.* 2015). As we show, these six factors explain 84 per cent of the difference between MEB estimates derived from VURMTAX and Cao *et al*.

JEL classification: C68; E62; H21; H25;

Keywords: Taxation policy; CGE modelling; Dynamics; Excess burden.

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1 Introduction

A weakening level of domestic investment and an acceleration of company tax cuts internationally through the middle of this decade have stimulated debate for reductions in Australia's company tax rate. Such reductions were advocated by Australia's most comprehensive review of the state and federal tax policy environment, the recent Henry Review of Australia's Future Tax System (2009), although Henry also recommended that "Improved arrangements for charging for the use of non-renewable resources should be introduced at the same time." A reduction in Australia's company tax rate was advocated in order to remain competitive with the average legislated rate in small-to-medium size OECD economies [OECD (2018)]. Presently at 30 per cent for businesses with turnover above A$50m, Australia's incumbent Coalition government has only recently abandoned plans to legislate a five percentage point reduction in the rate of company tax to 25 per cent across the full spectrum of business turnover, gradually phased in to reach full implementation by 2026-27.[1] This would have completed the implementation of the Government's Enterprise Tax Plan no. 2, moving all Australian companies to a flat 25 per cent rate of company tax.[2]

Internationally, there is strong academic support for reducing company tax rates. Pioneering work in the field by Harberger (1964a, 1964b, 1966) yielded simple formulae and estimates of the excess burden of income and corporation taxes in the United States. These excess burdens showed that both US income and corporate taxes diminish national income, and thus economic welfare. Since the seminal work by Harberger, subsequent studies, including Shoven (1976), Feldstein (1978), and Shoven and Whalley (1984), have advanced a variety of efficiency loss arguments that lend further weight to the general conclusion by Harberger.

Making inferences about the economic welfare impacts of company tax in Australia based on this body of international research is difficult, because Australia's system of corporate taxation is unique and the economy is relatively small compared to others, such as the US. While many trace Australia's

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[1] See the Australian Tax Office summary at https://www.ato.gov.au/rates/company-tax/

[2] See the Treasury Laws Amendment (Enterprise Tax Plan No. 2) Bill 2017 at https://www.aph.gov.au/Parliamentary_Business/Bills_Legislation/Bills_Search_Results/Result?bId=r5867

system of dividend imputation back to July 1987 [Peirson *et al.* (2009)], the Income Tax reforms of 1915 ensured companies were only taxed on their profits after dividends, i.e., on retained profits only [Commonwealth Parliament (1915); Reinhardt and Steel (2006)]. In conjunction with a rise in the legislated company tax rate from 7.4 per cent to 47.5 per cent for private companies, Australia's first dividend imputation system was removed in 1940 to fund the Second World War effort. The classical system of double taxation that replaced it remained in place (save several reductions in the tax rate) through to July 1987, when partial dividend imputation was re-introduced. In 2000, Australia shifted to a refundable imputation system. Under this system, when resident shareholders receive a franked dividend from an Australian-listed company, they are provided a tax credit by this company in addition to the dollar value of the dividend they receive. This credit reflects the fact that the company has already paid tax (at the company tax rate) on the profits from which the dividend has been paid, i.e., the dividend is paid out of post-Australian-company-tax profits. Refundable imputation therefore ensures that all residents pay their marginal personal income tax rate on Australian corporate dividend income they receive.

As discussed by Dixon and Nassios (2016), dividend imputation systems are rare internationally, with most countries undertaking some form of double taxation. In double taxation systems, corporate income taxes are paid on profits and personal income taxes are paid on dividends (with some countries levying lower personal tax rates on dividends compared to earned income) [The Senate (2015)]. Australia, New Zealand, Chile and Mexico are the only OECD countries to operate a dividend imputation system [Australian Government (2015)].

The effort to understand the efficiency cost of Australia's unique corporate tax system, and in so doing establish the agenda for Federal and State tax reform, has leant heavily on computable general equilibrium (CGE) modelling [Freebarin (2017)]. Using CGE models with equations systems that correctly model dividend imputation, The Commonwealth Treasury [Rimmer *et al.* (2014); Cao *et al.* (2015); Kouparitsas *et al*. (2016)] and other consultancies and researchers [KPMG (2010); Murphy (2016, 2018); Tran and Wende (2017)] have shown that a cut to the company tax rate in Australia will: (i) stimulate Australian investment by increasing post-tax rates of return; (ii) drive capital growth; and (iii) increase long-run real consumer wage rates. These findings are broadly in line with previous studies of the impact of corporate income taxation in small, open economies [Gordon (1986); Bruce (1992); McKeehan and Zodrow (2017)]. On the other hand, Swan (2018) finds that foreign investors already minimise their payments of Australian corporate taxes by harvesting dividend imputation credits, and posits that a change in the rate of company tax will therefore have little impact on investment.

Dixon and Nassios (2016) also present a simulation-based CGE study of a five percentage point cut to Australia's company tax rate under refundable dividend imputation and concur with points (i) – (iii) above. However, the authors find that a cut to company tax rates in Australia lead to a reduction in real national income, and thus economic welfare of Australian households. Several reasons for this disagreement have been postulated, e.g., time dynamics, which are not accounted for in the work by KPMG (2010), Rimmer *et al.* (2014), Cao *et al.* (2015), Kouparitsas *et al*. (2016), and Murphy (2016, 2018); see also Freebairn (2017) for a discussion of these points. Tran and Wende (2017) do account for dynamics, but their modelling lacks the industry detail of the other models and is predicated on the more flexible Cobb-Douglas production function. Relative to the other models, Tran and Wende (2017) therefore overstate the capacity of the labour market to absorb a larger capital stock over a given timeframe.

In this paper, we build on the study by Dixon and Nassios (2016). Our analysis is based on VURMTAX, a bottom-up, dynamic, multi-regional computable general equilibrium (CGE) model of Australia's states and territories. VURMTAX is a 76-industry two-region model of Australia, with the regions being NSW and the Rest of Australia.[3] As is standard in CGE models, VURMTAX determines the supply and demand for each regionally produced commodity as the outcome of optimising behaviour of economic agents. Regional industries are assumed to choose labour, capital and land in order to maximise their profits while operating in a competitive market. In each region a representative household purchases a particular bundle of goods in accordance with the household's

[3] Rest of Australia abbreviated RoA, is an aggregation of the other five Australian states and the two territories.

preferences, relative prices and its amount of disposable income. Regions are linked via interregional trade, interregional migration and capital movements and governments operate within a fiscal federal framework.

VURMTAX differs from its predecessor VURM in that it also contains a Government Finance module, which provides a comprehensive treatment of revenues, expenditures and budget balances at two levels of Government: Federal and State/Territory. The model contains a number of innovations relating to the treatment of many taxes [see Nassios *et al.* (forthcoming) for a full account]. VURMTAX includes provision for several important aspects of the company tax system in Australia, including: separate treatment of local and foreign investors; explicit modelling of refundable dividend imputation; provision for retained earnings by corporates and the impact of profit retention on the personal income tax base; and an allowance for Australian double taxation treaty (DTT) arrangements and their impact on unfranked dividend withholding taxes.

In VURMTAX simulations, annual industry- and region-specific investment is based on industry- and region-specific expected rates of return on capital in future periods. By default, VURMTAX carries an assumption that investors' expectations of industry- and region-specific post-tax rates of return on capital are adaptive; see section 2.2. In section 2, we describe how this default assumption can be relaxed to incorporate forward-looking investor expectations of corporate income tax rates. We also provide a detailed account of key equations, elasticities and other parameter choices that impact the company tax modelling in section 2, while in section 3 we outline the approach we take to deriving excess burdens in VURMTAX.

In section 4.2, we simulate an overnight five-percentage point reduction (from 30 percent to 25 percent) in Australia's company tax rate, under the default assumption of adaptive investor expectations. This simplification of Enterprise Tax Plan no 2 is designed to identify the key economic responses to a cut in the rate of company tax. Section 4.3 is concerned with simulating the economic impact of Enterprise Tax Plan no. 2, and quantifying the importance of forward-looking investor behaviour relative to the default VURMTAX assumption of adaptive investor expectations.

Finally, in section 5 we compare our results to past studies of company tax in Australia. This comparison focuses on a single measure of the welfare impact of company tax in Australia: the marginal excess burden (MEB). More specifically, we use VURMTAX to calculate the MEB of company tax in Australia. As we show, the MEB we derive for company tax differs markedly from previous estimates for Australia, which are derived using long-run comparative static CGE modelling; see KPMG (2010), Cao *et al.* (2015) and Murphy (2016).

To elucidate the reasons for such disparate MEB estimates, we focus on the study by Cao *et al.* (2015) and identify six key differences in model parameterisation and methodology. By incrementally altering VURMTAX to reflect the parameterisation and methodology underlying the long-run comparative static study by Cao *et al.* (2015), we are able to attribute 84 per cent of the differences in MEB estimates. This addresses some of the points raised by Freebairn (2017), who argues strongly in favour of such attribution/sensitivity analyses in CGE studies of tax policy.

2 The Victoria University Regional Model with Taxation detail (VURMTAX)

In this section we describe VURMTAX, a version of the Victoria University Regional CGE model (denoted VURM). The VURM model is documented in Adams *et al.* (2015). VURMTAX builds on VURM with a more detailed treatment of Australia's tax system.

2.1 Model description

VURMTAX is a 76-industry model of Australia. Herein, we use a two-region (NSW and the Rest of Australia) aggregation of the core eight-region database. Most of the industries produce a single commodity. The key exceptions are the low-density dwellings and high-density dwellings industries, which each produce two commodities: owner-occupied and rental variants of the output of their respective low-density and high-density dwelling services.

Investment in each regional industry is assumed to be positively related to expected rates of return on capital in each regional industry. VURMTAX recognises two investor classes: local investors (i.e. domestic households and government) and foreign investors. Effective tax rates on each investor class differ, with foreign investors not liable to pay Australian personal income tax on their capital income, while they are also unable to claim back Australian franking credits. Capital creators assemble, in a cost-minimizing manner, units of industry-specific capital for each regional industry. Each region has a single representative household and a state government. The federal government operates in each region. The foreign sector is described by export demand curves for the products of each region, and by supply curves for international imports to each region. Supply and demand for each regionally produced commodity is the outcome of optimising behaviour. Regional industries are assumed to use intermediate inputs, labour, capital and land in a cost-minimising way, while operating in competitive markets. Region-specific representative households purchase utility-maximising bundles of goods, subject to given prices and disposable income. Regions are linked via interregional trade, interregional migration and capital movements, and governments operate within a fiscal federal framework.

VURMTAX provides results for economic variables on a year-on-year basis. The results for a particular year are used to update the database for the commencement of the next year. More specifically, the model contains a series of equations that connect capital stocks to past-year capital stocks and net investment. Similarly, debt is linked to past and present borrowing/saving, and the regional population is related to natural growth and international and interstate migration. The model is solved with the GEMPACK economic modelling software [Harrison and Pearson (1996)].

In solving the model, we undertake two parallel model runs: a baseline simulation, and a policy simulation (as discussed in section 5, we also undertake a number of decomposition simulations of the policy simulation). The baseline simulation is a business-as-usual forecast for the period 2017 to 2050. The policy simulation is identical to the baseline simulation in all respects other than the addition of the exogenous shocks describing the policy under investigation. We report model results as percentage (and in some cases, $m) deviations in the values of variables in each year of the policy simulation away from their baseline values.[4]

The remainder of this section deals with selected features of the VURMTAX equation system that are of relevance to our analysis of company tax cuts.

2.2 Investment, capital and corporate tax in VURMTAX

VURMTAX adopts a slightly amended version of the Dixon and Rimmer (2002) specification for investment and capital accumulation. The key features of Dixon and Rimmer (2002) are:

i. every industry has its own variety of capital, which is updated annually according to a perpetual inventory calculation;

ii. every industry undertakes investment according to an industry-specific expenditure profile;

iii. industry investment is a positive function of the industry's expected equilibrium post-tax rate of return, given by the inverse logistic function described in Dixon and Rimmer

[4] See Dixon and Rimmer (2002) for a thorough review of the construction of baseline and policy simulations with a detailed CGE model.

(2002) and calibrated to a trend rate of capital growth (set to 3 per cent for all industries) and an industry-specific "normal" rate of return,

iv. the disequilibrium component of the expected rate of return is eliminated gradually over several time periods in the simulation, so that rates of return and the capital growth rate converge to long run normal or trend settings,

v. expectations are adaptive, i.e., in year *t* the expected rate of return on capital in year *t* + 1 is equal to the actual rate of return on capital in year *t*.

As a consequence of this specification, a positive shock to an industry in a given year (for example, a one-off, permanent demand stimulus) leads initially to a higher rate of return, because capital stocks are exogenously determined in any given year. Under adaptive expectations, the higher rate of return means that investors *expect* a higher rate of return, so investment increases. According to the perpetual inventory method, capital in the following year will be larger as a result of the increase in investment. Ignoring disequilibrium effects, over a period of several years, the capital stock will gradually increase, pushing the rate of return gradually back to its initial level. At this point, the capital growth rate will also return to its initial level, and the capital stock will be permanently larger.

In VURMTAX, we include two features in addition to the standard investor specifications by Dixon and Rimmer (2002):

(i) differential treatment of local and foreign investors, which we describe in section 2.2.1; and

(ii) exogenously imposed forward-looking expectations on tax policy rates. This is described in section 2.2.2.

2.2.1 Differential treatment of local and foreign investors

Because of the differential tax treatment of foreign and local investors, in VURMTAX we separate the investment and capital accumulation mechanisms for foreign and local investors.

The pre-tax rate of return by capital owner o, $R1CAPo\_PT(i,q,o)$, on an investment in industry[5] i in region[6] q by capital owner[7] o is given by:

$$R1CAPo\_PT(i,q,o) = 100 \cdot \left[\frac{V1CAPINCo(i,q,o)}{VCAPo(i,q,o)} - DEPR(i)\right], \qquad \textbf{(2.1)}$$

where $V1CAPINCo(i,q,o)$ is capital rental income (net of state taxes, e.g., share of council rates on capital-improved value that are incident on capital income, before federal corporate income tax and depreciation), $VCAPo(i,q,o)$ is the asset value of the capital stock, and $DEPR(i)$ is the rate of depreciation.

We assume that pre-tax rates of return are equal for local and foreign owners in any industry i and region q, i.e., both local and foreign investors own the same type of industry- and region-specific capital. This leads to the following identity:

$$R1CAPo\_PT(i,q,o) = R1CAP\_PT(i,q). \qquad \textbf{(2.2)}$$

This does not account for Swan's (2018) argument that, through arbitrage, foreign investors are able to take advantage of dividend imputation. In VURMTAX, foreign investors cannot claim back franking credits or trade them to local investors who can claim them. Those franking credits distributed to foreign capital owners therefore go unclaimed. A CGE modelling assessment accounting for Swan's "harvesting" of franking credits is beyond the scope of the present study. However, we do agree with Swan's final assessment that a cut to the company tax rate would be detrimental to Australian economic welfare.

Post-tax rates of return are complicated by the presence of franking credits, the share of franking credits claimed, personal income taxes and deductions, and treaty discounts. The level of the post-tax rate of return for foreign investors on an investment in industry i in region q is given by:

[5] As discussed in section 2.1, the version of VURMTAX applied in this paper includes 76 distinct industries.
[6] As discussed in section2.1, VURMTAX applied in this paper spans two regions, NSW and RoA (rest of Australia).
[7] In recognising two owners, the owner dimension in VURMTAX includes two elements: *Local* and *Foreign*, representing domestic and international capital owners.

$$R1CAPo(i,q,"Fgn") = [1 - [1 - FSHARE("Fgn") * FCLAIM("Fgn")] * DEDTTY * DEDINT * TGOSLEG("Fgn")] * R1CAPo\_PT(i,q,"Fgn"), \quad \textbf{(2.3)}$$

where we define:

- The legislated corporate tax rate in Australia by capital owner type $o \in \{Loc, Fgn\}$ is defined as $TGOSLEG(o)$. Herein, we set the parameter uniformly across owner at the current legislated rate of 30 per cent;
- The share of equity that pays franked dividends by capital owner type $o \in \{Loc, Fgn\}$ is defined as $FSHARE(o)$;
- The share of franked dividend payed that are claimed as personal income tax offsets by capital owner type $o \in \{Loc, Fgn\}$ is defined as $FCLAIM(o)$;
- The impact double taxation treaties (DTT) have in reducing the withholding tax liability on unfranked dividends owned by foreign investors if defined as $DEDTTY$;
- Because corporate tax is levied on profit net of interest and depreciation, we introduce the share parameter $DEDINT < 1$ to capture the impact of interest deductibility.

We discuss of calibration for each of these key parameters in section 2.4. For non-public industry i in region q, the rate of return for local investors is given by:

$$R1CAPo(i,q,"Loc") = [1 - DEDPIT * RETAINED * TPERINC] \cdot [1 - [1 - FSHARE("Loc") \cdot FCLAIM("Loc")] \cdot DEDINT \cdot TGOSLEG("Loc")] \cdot R1CAPo\_PT(i,q,"Loc"), \quad \textbf{(2.4)}$$

where we define the parameters $RETAINED$ and $DEDPIT$ in the following way:

- Local investors do not pay personal income tax on retained company profits. We account for the impact of retained profits on the personal income tax base via the share parameter $RETAINED < 1$;

- The personal income tax system has many thresholds, and allows for many personal income tax deductions, e.g., uniform expenses. We do not model progressivity or deductions in detail. Instead, we include a share parameter $DEDPIT < 1$ that is appropriately calibrated to model the impact of these features on the base year personal income tax base.

For public or tax-exempt activities, e.g., public administration, defence and owner-occupied dwellings, the rate of return for local investors is given by:

$$R1CAPo(i,q,\text{"}Loc\text{"}) = R1CAPo\_PT(i,q,\text{"}Loc\text{"}). \qquad \textbf{(2.5)}$$

2.2.2 Forward-looking expectations

Models in the MONASH recursive-dynamic style generally employ adaptive expectations when setting expected rates of return. Dixon and Rimmer (2002) create a framework in which model-consistent forward-looking expectations can be implemented in the MONASH model, however, it is computationally expensive, requiring the model to be solved in multiple iterations. In this section, we outline a simplified model of forward-looking expectations, whereby investors have non-static expectations of future corporate tax rates, and adjust their expectations to incorporate the impact of these tax rates on post tax rates of return on capital.

To begin, we denote the expected rate of return on capital in year $t+1$, formed by investor o (where o denotes ownership as "local" or "foreign") in year t , as $EEQRORo(i,q,o)$. Expectations are adaptive if those expected rates of return are set equal to the actual rate of return on capital $R1CAPo\_PT(i,q,o)$ in year t:

$$EEQRORo(i,q,o) = R1CAPo(i,q,o). \qquad \textbf{(2.6)}$$

Under adaptive expectations, investors behave as though the company tax rate will remain at its current-period setting. They have no foresight on future period tax policy. In our analysis of company tax cuts, we introduce an extra term to account for the knowledge of future tax rate changes, which, if passed into legislation, will be announced several years before being implemented. That is:

$$EEQRORo(i,q,o) = R1CAPo(i,q,o) + ERORFWD(i,q,o). \qquad \textbf{(2.7)}$$

where $ERORFWD(i,q,o)$ accounts for known future changes in the rate of company tax. The derivation of $ERORFWD(i,q,o)$ is based on the MONASH derivation [see equation 21.5 – 21.7 in Dixon and Rimmer (2002)]. The MONASH derivation begins with a definition of the present value of an unit of physical capital in industry *i*, purchased in period *t* (Dixon and Rimmer (2002), equation 21.5), i.e.,

$$PV_{i,t} = -\Pi_{i,t} + \frac{1}{R}\left[\left(Q_{i,t+1} - \Pi_{i,t+1}D_i\right)(1 - T_{t+1}) + \Pi_{i,t+1}\right], \qquad \textbf{(2.8)}$$

where:

- $PV_{i,t}$ is the present value of a unit of capital in industry *i*, purchased in period *t*;
- $\Pi_{i,t}$ is the cost of buying or constructing a unit of capital in year *t* for use in industry *i*;
- $Q_{i,t}$ is the rental price of capital in industry *i* in year *t*;
- T_t is the rate of tax on capital income in all industries in year *t*;
- D_i is the rate of depreciation in industry *i*; and
- *R* is equal to 1 plus the post-tax real interest rate.

In writing equation (2.8), we have assumed depreciation to be fully tax deductible,[8] and that any tax on interest is already taken into account in the calculation of the real post-tax interest rate *R*. Nevertheless, (2.8) is readily generalizable to equation 21.5 in Dixon and Rimmer (2002).

In MONASH, the rate of return is derived by assuming that investors expect no change in the tax rate or the inflation-adjusted capital rental rates and construction cost of capital. These assumptions yield an expression for the expected rate of return in industry *i* at time *t*, where all RHS coefficients are known at time *t*:

$$ERORSE_{i,t} = \frac{PV_{i,t}}{\Pi_{i,t}} = -1 + \frac{1}{R}\left[\left(\frac{Q_{i,t}}{\Pi_{i,t}} - D_i\right)(1 - T_t) + 1\right]. \qquad \textbf{(2.9)}$$

[8] We set RALPH = 1.

A feature of Enterprise Tax Plan no. 2 is that the changes to the rate of company tax are announced well in advance. The rationale for this is that investors will react by investing in advance of the tax change. Given that the tax changes are announced in advance, the core assumption underpinning adaptive expectations is violated: in setting expected returns on capital, investors do not expect the tax rate to remain static. To correct this, we can generalise equation (2.8) if we continue to assume that $Q_{i,t+s} = Q_{i,t}$ and $\Pi_{i,t+s} = \Pi_{i,t}$ for all i and s, but we carry future tax rate expectations recursively, to:

$$EROR_{ET2}{}_{i,t} = \frac{PV_{i,t}}{\Pi_{i,t}} = -1 + \frac{1}{R}\left[\left(\frac{Q_{i,t}}{\Pi_{i,t}} - D_i\right)(1 - T_{t+1}) + 1\right] - \left\{-1 + \frac{1}{R}\left[\frac{1}{W_t^*}\left(1 - D_i(1 - T_t) + D_i \sum_{s=1}^{\infty} W_{s,t} T_{t+s}\right) + 1\right]\right\}, \quad \textbf{(2.10)}$$

or

$$EROR\_ET2_{i,t} = EROR\_SE_{i,t}^{(1)} + EROR\_FWD_{i,t}, \quad \textbf{(2.11)}$$

where

$$EROR\_SE_{i,t}^{(1)} = -1 + \frac{1}{R}\left[\left(\frac{Q_{i,t}}{\Pi_{i,t}} - D_i\right)(1 - T_{t+1}) + 1\right], \quad \textbf{(2.12)}$$

and

$$EROR\_FWD_{i,t} = \left(\frac{1}{R^2} - 1\right)\left(\frac{Q_{i,t}}{\Pi_{i,t}} - D_i\right)\sum_{s=1}^{\infty} \frac{1}{R^s}(T_{t+s} - T_{t+1}). \quad \textbf{(2.13)}$$

$EROR\_SE^{(1)}_{i,t}$ is a slightly altered version $EROR\_SE_{i,t}$, while $EROR\_FWD_{i,t}$ is the forward-looking component.

The derivation raises some questions. Firstly, if future tax rates are known to be different from the present tax rate, it is unwise for investors to expect that the future pre-tax rental price of capital will be the same as the present rental price? This is equivalent to investors assuming that both labour supply and demand for industry output are perfectly elastic. Therefore, equation (2.13) overestimates the impact of future changes in the company tax rate on the rate of return on investment.

As an alternative, investors might assume that the future post-tax rental price of capital is equal to the present post-tax price. In this case, the expected rate of return formula reverts to the static expectations formula in equation (2.9), and underestimates the impact of future changes in the rate of company tax on the rate of return. The actual rate of return will fall somewhere between the static and forward-looking expectations given in equations (2.9) and (2.13). Wages and commodity prices will not fully adjust to new tax rates in a single period (as implied by static expectations), yet they will adjust eventually. In section 4 we report the results of simulations with and without accounting for forward-looking expectations of the tax rate cuts.

2.3 The external account in VURMTAX

The stock of net foreign liabilities at the beginning of period $t + 1$, $NFL(q)$, in each region q in VURMTAX accumulate according to the law of motion:

$$NFL(q) = NFL\_LAG(q) - CAB\_LAG(q), \qquad \textbf{(2.14)}$$

where $NFL\_LAG(q)$ is the stock of net foreign liabilities at the beginning of period t, and $CAB\_LAG(q)$ is the current account balance (CAB) in period t. The CAB is equal to the trade account balance $TAB(q)$, the income account balance $IAB(q)$, and other transfers $NCT(q)$:

$$CAB(q) = TAB(q) + IAB(q) + NCT(q). \qquad \textbf{(2.15)}$$

Other transfers are small, and indexed to GDP growth. The trade account balance is defined as the difference between the value of nominal exports $V4TOT(q)$ and imports $V0CIF\_C(q)$, i.e.

$$TAB(q) = V4TOT(q) - V0CIF\_C(q). \qquad \textbf{(2.16)}$$

The income account balance is the sum of interest income $FORINTINC(q)$ and capital income $FORCAPINC(q)$:

$$IAB(q) = FORINTINC(q) + FORCAPINC(q). \qquad \textbf{(2.17)}$$

Foreign interest income is the negative of interest payments on the stock of net foreign debt $NFD(q)$:

$$FORINTINC(q) = -FORINTRTE \cdot NFD(q), \qquad \textbf{(2.18)}$$

where the rate of interest on foreign debt, $FORINTRTE$, is set to 2 per cent.

Foreign capital income is equal to remittances of capital and land income (less all Australian state and federal taxes), on all foreign-owned capital. If we denote the foreign ownership share of capital and land in industry i and region q as $FORSHR(i,q)$, and industry- and region-specific net capital and land income as $V1NCAPINC(i,q)$ and $V1LNDINC(i,q)$ respectively, we can write down the level of foreign capital income as:

$$FORCAPINC(q) = -[1 - [1 - FSHARE("Fgn") * FCLAIM("Fgn")] * DEDTTY * DEDINT * TGOSLEG("Fgn")] * \sum_{i \in IND} FORSHR(i,q) \cdot \{V1NCAPINC(i,q) + V1LNDINC(i,q)\}. \quad \textbf{(2.19)}$$

Region-specific net foreign liabilities $NFL(q)$ are disaggregated into debt, $NFD(q)$, and equity, $NFE(q)$. Net foreign equity is updated according to foreign investment. With net foreign liabilities determined by equation (2.14), net foreign debt is determined by the identity:

$$NFL(q) = NFE(q) + NFD(q). \quad \textbf{(2.20)}$$

In the absence of a change in the domestic savings rate, new investment is financed at the margin by foreigners, either as equity (via direct investment in industry- and region-specific capital) or as debt to finance the current account. Clearly, the income account balance defined in equation (2.17) is sensitive to the type of financing. This is because debt finance earns a fixed rate of interest, $FORINTRTE$, while equity finance earns the going post-tax rate of return on industry capital stocks. This is pertinent for company tax cut simulations, as the post-tax rate of return is clearly affected by the change to the company tax rate; see equation (2.3).

Finally, we note that gross regional income $V0GNP(q)$ is linked to gross state product $V0GSPINC(q)$ by the usual identity:

$$V0GNP(q) = V0GSPINC(q) + IAB(q) + NCT(q). \quad \textbf{(2.21)}$$

As described in Dixon and Nassios (2018), VURMTAX allows for endogenous determination of the national savings rate. In the long run, we use the ratio of foreign-liabilities-to-income as a measure of macroeconomic stability, i.e. we require $NFL_t/GNP_t = R$ for all $t > T$, where T indicates a year in the "long-run" (in this case, 20 years after the last tax rate cut is implemented). For the ratio to stabilise, it can be shown that $CAB_t/GNP_t = gR$, where g is the growth rate of $V0GNP(q)$. This relationship ties down the current account balance in the model, and is accommodated via endogenous determination of the national savings rate. In section 5, we explore the impact of alternative specifications, e.g., holding the national savings rate exogenous, and show that they have little impact on long-run macroeconomic variables and the MEB of company tax estimated using VURMTAX.

2.4 Tax database calibration

In section 2.2 and 2.3, we defined many key equations and parameters that govern how we model Australia's corporate and personal income tax system in VURMTAX. This section is concerned with summarising the data sources used to calibrate key taxation theory parameters.

Because of the role played by franking credits in offsetting personal income tax liabilities in Australia's tax system, as discussed in section 2.2 VURMTAX distinguishes capital ownership on an *industry-by-industry basis* along two dimensions:

- **By investor type:** The domestic capital stock is either foreign-owned or locally owned, with the industry-i and region-q-specific capital foreign capital ownership shares defined as $FORSHR(i, q)$ in equation (2.13). Income from locally owned capital accrues to households. Where that capital is not personal income tax exempt, e.g., as is the case for owner occupied dwellings, the income is subject to personal income tax;
- **By income type:** Capital income is also identified as being either franked or unfranked, with the share of franked dividends received by capital owner type $o \in \{Loc, Fgn\}$ defined as $FSHARE(o)$. While $FSHARE("Fgn")$ is non-zero (because foreign investors do own some shares that pay franked dividends), they are not permitted to claim back those franking credits in VURMTAX. As such, we include the parameter $FCLAIM(o)$. In the baseline forecast for VURMTAX, we then set $FCLAIM("Fgn") = 0$. $FCLAIM("Loc")$ and $FSHARE(o)$ are then calibrated such that the ratio of franked dividends claimed as personal income tax offsets relative to aggregate company tax paid is equal to 33 per cent. This matches the average claim

ratio in ATO Taxation Statistics for Australian companies over the time period spanning 2010-11 to 2013-14.

By distinguishing capital ownership by both investor and income type, VURMTAX carries sufficient capital ownership detail to account for the impact double taxation treaty (DTT) agreements have in reducing withholding tax liabilities of foreign investors who receive unfranked dividend payments. This is reflected in equation (2.3), where we defined the parameter $DEDTTY = 0.86$. This parameter is calibrated based on a study of Australia's double taxation treaty arrangements.[9] We cross-reference these treaty arrangement with foreign direct and portfolio equity investment data from Table 2 of ABS Cat. no 5352.0 (International Investment Position, Australia: Foreign Investment in Australia, level of investment by country). By appropriately weighting unfranked dividend withholding tax rates based on DTT's, with country-by-country foreign direct and portfolio investment shares for Australia, we arrive at the aforementioned value for $DEDTTY$.

With regard to our standard calibration of VURMTAX, the dwelling and public services sectors are assumed to be overwhelmingly domestically owned. These sectors are also corporate income tax exempt. For the remaining non-exempt industries, we assume the region-specific capital ownership share averages 20 per cent. Foreign ownership is however concentrated in the export-oriented resources industries, e.g., LNG, Iron Ore, in line with Connolly and Orsmond (2011) and Dixon and Nassios (2016).

We calibrate the share of interest expense deductions claimed by industries in VURMTAX ($DEDINT$, see section 2.2) to the share of interest deductions claimed by Australian corporates in ATO Taxation statistics[10], relative to corporate earnings before interest and tax (EBIT), which is equal to 38 per cent. In so doing, we arrive at a value for $DEDINT = 1 - 0.38 = 0.62$.

As discussed in section 2.2, we also recognise the impact of retained corporate profits, which reduces personal income tax liabilities on corporate income earned by households. In VURMTAX, this

[9] For a comprehensive list of Australia's active income tax treaties, we rely on data from The Australian Treasury. Please see https://treasury.gov.au/tax-treaties/income-tax-treaties/

[10] See the ATO Taxation Statistics for Companies at https://www.ato.gov.au/About-ATO/Research-and-statistics/In-detail/Taxation-statistics/

requires us to appropriately specify the parameter $RETAINED$, which is equal to the payout ratio. We rely on economy-wide payout ratio estimates by Bergmann (2016), who show that the payout ratio in Australia was equal to 80 per cent in 2015.

Finally, as also noted in section 2.2, tax deductions and progressivity impact the personal income tax base. In VURMTAX, we use the parameter $DEDPIT$ as a degree of freedom in order to ensure the average personal income tax rate matches the Australian average personal income tax rate set out in the Parliamentary Budget Office (2017) report (23.9 per cent). This yields a value for $DEDPIT = 1 - 0.827$.

For the readers' convenience, we summarise all calibration parameters defined here in Table 1.

2.5 Parameterisation: Elasticities

VURMTAX is parameterised by elasticities that govern (inter alia) the proclivity of economic agents to substitute between domestic and imported varieties of commodities; the demand by foreigners for Australian exports; the sensitivity of the labour force participation rate to changes in real consumer wages; and the degree to which industries can substitute between primary factor inputs to production, e.g., the labour/capital substitution elasticity. In this section, we summarise some key elasticities used to parameterise VURMTAX.

2.5.1 Labour/Capital substitution elasticity

In VURMTAX, we use a homogeneous labour/capital substitution elasticity across industries equal to 0.4. In contrast, recent studies of Australia's tax system that rely on excess burden calculations to evaluate the relative efficiency different taxes, e.g., see Cao *et al.* (2015), Kouparitsas et al (2016) and Murphy (2016, 2018), who adopt substitution elasticities that are much larger. For example, Cao *et al.* (2015) apply a labour-capital substitution elasticity equal to 0.9, which is more than two times the value adopted in VURMTAX.

In a broad survey of pertinent CGE and econometric literature, Walmsley, Lakatos and Minor (2015) find support for a great range of labour/capital substitution elasticities. However, an econometric analysis of the first-order profit maximising condition for firms by Chirinko, Fazzari and Meyer

(2004) find strong evidence in support of a labour/capital substitution elasticity of 0.4. This econometric analysis is based on a panel dataset of 1 860 US firms from 1972 to 1991, with the estimates insensitive to the statistical methodology [both Ordinary Least Squares (OLS) and Instrumental Variables (IV) techniques are applied and yield similar estimates]. Contemporary studies for Germany by Kemfert (2008) and Van Der Werf (2008) also support a value of 0.4.

Most recently, Tipper (2012) used three different econometric techniques to estimate economy-wide, three-sector and 20-industry level labour-capital substitution elasticities for the New Zealand economy in the short- and long-run[11], following a similar approach to the study for the US economy by Ballistreri, McDaniel and Wong (2003). The 20-industry level elasticities derived by Tipper (2012) using an AR1 model were generally well below 0.77 in both the short- and long-run.[12] Omitting indeterminate estimates with wide standard errors, the mean (across industries) substitution elasticity in the long-run was 0.29.

2.5.2 Export demand elasticity

As described by Dixon and Rimmer (2002), export demand elasticities in single-country CGE models such as VURMTAX are conceptually equivalent to trade-weighted averages of a series of country-specific import substitution elasticities, such as those that parameterise a model of global trade, e.g., the GTAP model. In VURMTAX, we follow Dixon and Rimmer (2002) and adopt a uniform trade elasticity across all commodities that is equal to -4. This choice of export demand elasticity differs significantly from the values adopted in other CGE studies of Australia's tax system, such as those by Cao *et al.* (2015), Kouparitsas et al (2016) and Murphy (2016, 2018). The central case adopted by Cao *et al.* (2015), for example, is an export demand elasticity equal to -12, with the value for mining exports, as well as some agricultural, tourism-related and education exports, set to -6.

Trade elasticities of smaller magnitude (such as those adopted in VURMTAX) generate larger terms of trade and thus national income effects, particularly when tax policy changes domestically stimulate

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[11] The author notes that the AR1 long-run elasticities derived may not be suitable for long-run CGE analyses, because they are implicitly defined over a two-year time-period.

[12] The exception was the long-run estimate for the Electricity, Gas and Water industry, which was much higher than 1 but accompanied by very large standard errors.

the production of commodities that make up a large share of Australian exports. This point is particularly relevant when assessing the impact of a company tax cut in Australia, as we shall discuss in section. Econometric estimates of export demand elasticities using the United Nations ComTrade database (and thus takes account of changes in export intensity on a commodity-specific basis over time) support export demand elasticities for Australia that are of similar order to those adopted in VURMTAX. See for example Imbs and Méjean (2010), who estimate both export and import price elasticities implied by a Constant Elasticity of Substitution (CES) demand system for 33 countries using trade data from 1995 to 2004. They conclude that an appropriate elasticity for a small, open economy such as Australia lies between -3.1 and -2.3, depending on export intensity and trade weights.[13]

2.5.3 Labour supply elasticity

In VURMTAX we set the labour supply elasticity to 0.15. This choice is predicated on a detailed survey of CGE literature, which we summarise here. Bento and Jacobsen (2007) and Taheripour et al. (2008) employ an uncompensated labour supply elasticity equal to 0.15, whilst Takeda (2007) employs 0.19. Babiker *et al*. (2003) and Fischer and Fox (2007) calibrate their models to labour supply elasticities of 0.25 and 0.10, respectively. To address uncertainty over the value of the labour supply elasticity, Fraser and Waschik (2013) conduct a sensitivity analysis around the central case value of the labour supply elasticity +0.15, re-calibrating the model to a low value of 0.075 and high value equal to 0.30. In a review of the literature (specifically with regard to the U.S. labour market), Borjas (2015) finds that income effects generally dominate substitution effects for US males, driving a negative labour supply elasticity of -0.1. In contrast, substitution effects dominate for US females, driving a small positive labour supply elasticity of +0.2. Evers *et al.* (2008) also examine empirical estimates of labour supply elasticities by gender and across countries. The authors identify a median (uncompensated) labour supply elasticity for men of 0.08, while for women the figure is both higher and exhibits greater variability, with a median of 0.35. In VURMTAX, we do not distinguish labour

[13] Here, we refer to unconstrained estimates of the export demand elasticity for Australia reported by Imbs and Méjean (2010). By unconstrained, we mean that the elasticity is not constrained to be homogenous across sectors. As the authors note, doing so generates a heterogeneity bias and reduces the magnitude of the estimates export demand elasticities.

supply effects by gender or marital status, and adopt an aggregate labour supply elasticity equal to the central case examined by Fraser and Waschik (2013).

2.5.4 The impact of labour/leisure trade-offs

VURMTAX provides two avenues for an expansion in the long-run region-specific labour supply:

(1) via increases in region-specific participation rates, i.e., the region-specific ratio of labour supply to working population increases relative to the baseline forecast, according to the labour supply elasticity in section 2.5.3; and

(2) via regional migration, as we shall describe in section 2.6, which increases the region-specific working age population and thus labour supply at the expense of labour supply in other regions.

In the short-run, changes in tax rates may also cause changes in the unemployment rate, which impacts employment but not labour supply. In VURMTAX, households are assumed to derive no value for leisure consumption that arises as a result of involuntary unemployment.

The labour supply theory described here introduces a labour/leisure trade-off in VURMTAX. In order to calculate the region-specific welfare impact of changes in region-specific tax policy, we must value any additional (foregone) leisure time. Herein, we value any additional labour supplied at the marginal (post-tax) value of labour in the baseline forecast, i.e., the at the base-period real consumer wage. If the marginal value of leisure were higher than this, then workers would have supplied less labour under the baseline. Under this framework, the value of leisure in A$m. consumed in region q in year t of our simulation is therefore equal to:

$$VLEIS_{q,t} = RWAGE^{c,B}_{q,t} \cdot WPOP_{q,t} . \left[1 - PRT_{q,t}\right], \qquad \textbf{(2.24)}$$

where superscript "*B*" denotes a variable that takes its baseline value in both the baseline and policy simulations, $RWAGE^{c,B}_{q,t}$ is the baseline value of the real consumer (superscript c) wage in region q at time t, $WPOP_{q,t}$ is region q's working population at time t, and $PRT_{q,t}$ is region q's participation rate at time t. When the participation rate in region q increases in a policy simulation, i.e., $PRT_{q,t} > 0$, this materialises via an expansion in region-specific labour supply relative to the region-specific working population. From equation (2.24), this reduces the value of leisure derived by households, because some leisure time has been forsaken to increase labour supply in response to the new (higher) policy simulation real post-tax consumer wage. At the national level, we compute the value of changes in leisure time by summing equation (2.24) over all $q \in REG$.

2.6 Model closure

In solving VURMTAX, we undertake two parallel model runs: a baseline simulation and a policy simulation. The baseline simulation is a business-as-usual forecast for the period 2017 to 2050. The policy simulation is identical to the baseline simulation in all respects, other than the addition of the exogenous shocks describing the policy under investigation. In tax policy simulations, this policy is generally a small reduction/rise in a specific tax rate, or a small reduction/rise in a specific tax threshold. We report model results as percentage (and in some cases, $m) deviations in the values of variables in each year of the policy simulation away from their baseline values.[14]

All tax policy simulations conducted using VURMTAX, for the purpose of deriving marginal excess burdens, are undertaken under the following model closure:

(1) Regional labour markets characterised by short-run real wage stickiness with endogenous regional unemployment rates, transitioning to a long-run environment of regional wage flexibility with exogenous regional unemployment rates;

(2) Rates of inter-regional migration are sticky in the short-run, but adjust gradually in response to movements in inter-regional relativities in real post-tax consumer wage rates in order to ensure that such consumer wage relativities are gradually returned to baseline values;

(3) Regional participation rates adjust to deviations in region-specific real consumer wages, as previously discussed in section 2.4;

(4) National private consumption spending is the sum of regional private consumption spending. Within each region, regional average propensities to consume are endogenously adjusted by a

[14] See Dixon and Rimmer (2002) for a thorough review of the construction of baseline and policy simulations with a detailed CGE model.

uniform percentage across all regions, to ensure that the ratio of net foreign liabilities to gross national income stabilizes in the long-run following any given policy shock;

(5) For public consumption spending undertaken by state and local government, we assume a constant ratio of real regional government public consumption spending to real regional private consumption spending. For federal consumption spending within each region, we assume a constant ratio of region-specific federal public consumption spending to national private consumption;

(6) Net operating balances of regional governments and the federal government are held at baseline values via endogenous adjustment of lump sum payments to households.

3 Deriving excess burdens in VURMTAX

The term "excess burden" was coined by Harberger (1962) to describe the impact (in totality) of US corporate tax on US national income. Because VURMTAX is dynamic, it can calculate year-on-year excess burden measures using a similar principle. More specifically, the efficiency loss caused by a tax policy package in time-period *t* at the national (Australia-wide) level ($\mathrm{EB}^{t}_{\mathrm{Nat}}$) is evaluated according to:

$$EB^{t} = -100\left[\frac{\Delta GNI^{t} + \sum_{q}\Delta VLEIS_{q}^{t}}{\sum_{g}\Delta LST_{g}^{t}}\right], \qquad \textbf{(3.1)}$$

where ΔGNI^{t} is the deviation in real gross national income (GNI) in year *t* expressed as the difference between the policy simulation and baseline simulation values for GNI in year *t*; $\Delta VLEIS_{q}^{t}$ is the deviation in the value of leisure in region *q* at time *t*; and ΔLST_{g}^{t} is the deviation in revenue-neutral lump sum transfer by government *g* in year *t*. Equation (23) is a measure of the change in real national income, adjusted for changes in the value of leisure, caused by a change to state or federal tax policy that results in a change in the government's capacity to make a budget-neutral transfer to Australian households of $\sum_{g}\Delta LST_{g}^{t}$. By using the value of aggregate lump sum payments to households in the denominator (rather than, say, revenue raised from the particular tax in question), we take account of general equilibrium effects, including induced changes in: revenue raised from other tax basis, the price of government spending, and government benefit payments[15].

[15] We value these deviations at base period (2017) prices, while all real variables derived for evaluating the excess burden are deflated by a divisia price index of real private, public and domestically financed investment prices.

4 The impact of company tax cuts in Australia: Adaptive versus forward-looking investors

4.1 Scenarios

We report two scenarios here. Firstly, we simulate a single "overnight" cut in the rate of company tax to illustrate the main economic mechanisms underlying Australia's company tax system. Our results are presented in section 4.2. The second simulation represents the phased approach proposed in Enterprise Tax Plan 2 (ETP2), and relies on the actual timetable of company tax cuts proposed in ETP2 and our forward-looking expectations framework described in section 2.2.2. The results from simulation 2 are provided in section 4.3.

4.2 Scenario 1: Overnight cut

4.2.1 Theoretical impact on the Australian capital market

In this scenario, we model a single, unanticipated cut in the company tax rate of 5 percentage points, i.e., from the current legislated rate of 30 per cent to 25 per cent. The basic framework is illustrated in Figure 1**.** Suppose initially that demand is given by *D*, and supply by S_0, such that each unit of capital stock generates pre-tax rental income of R_o. Capital income is taxed at a rate, in per cent, equal 100*(1-R_1/R_0), e.g., 30%. That is, post tax rental income is equal to R_1. Total capital income, equal to K_oR_o, accrues to three beneficiaries: domestic owners of capital receive **C**, foreign owners receive **D**, and the domestic government receives tax revenue **A**+**B**. Under Australia's system of dividend imputation, a large proportion of **A** is offset against the personal income tax liabilities of domestic capital owners.

In the short run, supply of capital is fixed, as new capital takes time to install. If there was an overnight, unanticipated cut in the company tax rate to zero, instead of accruing to government, in the short run **A** and **B** would accrue to the domestic and foreign owners of capital respectively. On the current account, the income account deficit would increase by **B**, as this amount accrues to foreign capital owners instead of the domestic government. The stock of net foreign liabilities would also increase by **B**, leading to an increase in interest payments in future years.

In response to the hypothetical elimination of company tax, the capital supply curve would shift rightward over a period of several years as the result of a positive investment response to higher post-tax rates of return. Assuming Australia is a price-taker on world capital markets, this process would continue, with the capital stock growing and the marginal product of capital falling, until in the long run the (pre- and post-tax) rental price of capital reached R_1 with the supply curve now at S_1.

Aggregate capital income is now K_1R_1. In this stylised figure, capital creation is funded at the margin by foreign investors, for two reasons. Firstly, under full dividend imputation the company tax rate for domestic capital is already zero, so a change in the tax rate provides no investment incentive. Secondly, to the extent that imputed credits are not fully claimed, there is a change in the tax rate, but the domestic response to this change is limited by availability of domestic savings to fund new capital.

Of aggregate capital income K_1R_1, **C** accrues to domestic owners of capital, and **D**+**F** accrues to foreign owners of capital. **A**+**B**+**E** now accrues to other factors of production, chiefly labour. Domestic owners of capital are clear losers from a cut to the company tax rate as they relinquish the part of **A** that they originally claimed as a result of dividend imputation, a result also identified by Tran and Wende (2017).

To summarise, under a non-zero rate of company tax, such as 100*(1-R_1/R_0) per cent depicted in Figure 1, the capital income that accrues to domestic agents (government and local owners of capital) is equivalent to **A**+**B**+**C**, while **D** accrues to non-residents. The immediate impact of eliminating company tax is to transfer **B** to non-residents.

The long run impact of eliminating company tax is that domestic residents (through their ownership of factors of production other than capital) gradually regain **B**, and gain **E**. That is, **A**+**B** is transferred from government to labour, and **E** is gained, also by labour. Domestic capital owners retain **C**, while foreign capital owners retain **D** and gain **F**.

A simple long run view that the average excess burden of company tax is equal to **E**/(**A**+**B**) ignores the fact that **B** is a valuable source of tax revenue that would be temporarily lost in the transition to a zero tax rate. In our dynamic analysis, the up-front loss of **B** is explicitly taken into account, as is the long run gain of **E**. Furthermore, the effect of adding **B** to net foreign liabilities and the subsequent impact of interest payments on the current account is included.

4.2.2 Back-of-the-envelope calculation of main macroeconomic results

A back-of-the-envelope (BOTE) calculation provides some insight into the appropriate magnitude for macroeconomic results. Equations (4.1) - (4.5) provide an abstraction of some of the key model equations from VURMTAX:

$$k - y = -\sigma(q - p), \tag{4.1}$$

$$y = S_L l + S_K k, \tag{4.2}$$

$$p = S_L w + S_K q, \tag{4.3}$$

$$ror^* = 2(q - p^*), \tag{4.4}$$

$$ror_o = ror^* - \frac{100}{1-T_o} dT_o, \tag{4.5}$$

where as in section 2.2, o is an element of the set of capital owners in VURMTAX and can take two elements: *local* and *foreign.* In equations (4.1) – (4.5), we also define:

- k to be the percentage change in aggregate capital stocks;
- y to be the percentage change in output;
- q to be the percentage change in gross rental income earned on capital;
- p to be the percentage change in the price of output;
- l to be the percentage change in aggregate labour employed;
- w to be the percentage change in the wage;
- ror^* to be the percentage change in the pre-tax rate of return to capital, where the ratio of gross to net pre-tax return is assumed to be 2;
- p^* to be the asset price index;
- ror_o to be the percentage change in the post-tax rate of return on capital owned by owner o;
- T_o to be the rate of tax on capital income paid by owner o, e.g., $T_o = 0.3\ \forall o$ indicates a legislated rate of 30% that is uniform across all owners;

- S_L to be the share of labour used in production (same for foreign- and domestic-owned production);
- S_K to be the share of capital used in production (same for foreign- and domestic-owned production); and,
- σ to be the primary factor substitution elasticity in the CES production function.

For the flexible labour market, equations (4.1) - (4.5) yield endogenously determine six variables: k, y, q, w, ror^* and ror_{local}. The remaining exogenous variables are: p, l, p^*, $ror_{foreign}$, and dT_{local} and $dT_{foreign}$.

This stylised model represents a typical small-country under a long-run closure: the prices of output (p) and capital creation (p^*), and the post-tax rate of return on foreign-owned capital, are unaffected by Australian policy settings. As is typical in a long-run comparative static framework, aggregate labour is exogenous.

With some manipulation of equations (4.1) - (4.5), we arrive at:

$$k = -\frac{\sigma}{S_L} \cdot \frac{100}{2(1-T_{foreign})} \cdot dT_{foreign}. \qquad \textbf{(4.6)}$$

For a cut of five percentage points to the legislated rate of tax on foreign-owned capital in this stylised model, i.e., assuming full imputation of domestically owned capital income, the actual tax rate (net of deductions) falls by 2.6 percentage points, that is, $dT_{foreign}= -0.026$. With $\sigma = 0.4$ and $S_L = 0.75$, the BOTE derivation suggests an increase in aggregate capital stocks of around 1 per cent.

Solving for the other variables is straightforward. Equation (4.2) of the stylised model shows that output increases by 0.25 per cent, and equation (4.3) shows that wages increase by 0.6 per cent. Because of the greater availability of deductions for domestic investors (chiefly through dividend imputation), the effective fall in the tax rate (dT_{local}) is less than the fall in the tax rate on foreign-owned capital. Given that the rate of return on foreign-owned capital is fixed, the post-tax rate of return must fall for domestic-owned capital.

This stylised model illustrates the long-run effects of a lower required rate of return on capital. However, it offers no explanation for the funding of the additional capital, nor does it account for the dynamic adjustment path of the economy following the tax cut. Note that the result is also invariant to the share of foreign ownership in the initial solution capital stock; indeed, there is no coefficient denoting the foreign ownership share in the BOTE framework in equations (4.1) - (4.5).

The BOTE framework does trace out the impact of change to the tax rate on an economy that is a price-taker on world markets, providing approximate magnitudes for the long-run effects on capital stocks, output and wages, which are consistent with the VURMTAX model, which we shall demonstrate in section 4.2.3.

Before moving to the results from the VURMTAX model, we introduce one final BOTE equation to calculate gross national income (GNI). In its levels form, we define GNI, Y^*, as the sum of labour income, domestically-owned capital income, and tax revenue collected on foreign-owned capital income, i.e,:

$$Y^* = WL + S_d QK + S_f T_f QK, \tag{4.7}$$

where S_d and S_f denote the shares of capital owned by domestic (local) and foreign investors, respectively, and all other expressions are as previously defined.

In percentage change format, with some substitutions from earlier equations, equation (4.7) becomes:

$$y^* = \frac{WL}{Y^*} w + \frac{QK}{Y^*}(q + k) + \frac{S_f QK}{Y^*} 100 dT_f, \tag{4.8}$$

where $WL/Y^* = S_L Y/Y^*$ and $QK/Y^* = S_K Y/Y^*$. Based on the earlier coefficient values, $Y/Y^* = 1.04$. Given these expressions, equation (4.8) can be simplified to yield:

$$y^* = \frac{Y}{Y^*}\left(y + S_f S_K 100 dT_f\right), \tag{4.9}$$

Using the values assumed or obtained earlier (and assuming $S_f = 0.2$), we find that $y^* = 0.125$. That is, the loss in taxation revenue from non-resident investors accounts for around half of the increase in output, meaning that only half of the benefit accrues to the domestic population. This BOTE result suggests that there is a gain in national income, albeit small. This result contrasts markedly with the VURMTAX outputs we shall discuss in section 4.2.3: VURMTAX simulations of a cut to company tax drive national income below baseline, i.e., $y^* < 0$ in the long-run. This contrast arises here because, unlike VURMTAX, the BOTE model fails to take into account (among other things) three important factors that subtract further from national income.

The first of these is the effect of an increase in the share of foreign investment. The BOTE exposition treated S_f as a fixed coefficient, yet capital growth that occurs as a result of a company tax cut will be funded by non-resident investors. Equation (4,9) treats S_f as a fixed coefficient, but it is clear that an increase in S_f will have a negative effect on domestic income (for a negative value of dT_f, i.e. a tax rate cut).

The second factor is the terms of trade effect. This is ignored in the BOTE model because we assume that Australia is a price-taker on world markets, i.e.,we assume that an expansion in Australia's output can be absorbed without any impact on the price level. However, VURMTAX reflects the more realistic assumption that Australia has some market power in both export markets and import-competing markets; see our discussion of export demand elasticities in VURMTAX in section 2.5.2. In VURMTAX, an expansion in Australia's output leads to real devaluation, causing two departures from the BOTE result for real GNI. The first of these is that the impact on the rate of return, and hence the capital stock, output level and income, is muted by the devaluation. The second is that, in terms of purchasing power, real domestic income is reduced relative to real output, because domestic consumers purchase imports which have become more expensive in local currency terms.

The third important factor omitted in the BOTE model is the dynamic adjustment to the long-run. As illustrated in Figure 1, the immediate effect of the company tax rate cut is to transfer area **B** (tax revenue collected from non-resident investors), from the umbrella of GNI to non-resident investors. The long-run impact of this transfer is not captured in the BOTE model. Over a period of several years, over which wages gradually adjust as additional foreign-owned capital is installed, net foreign liabilities will increase as a result of this transfer. This structural shift will have a permanent and negative impact on GNI.

When these three factors are taken into account, as they are in VURMTAX, the weak positive result for GNI derived from the BOTE model is reversed; as we shall show, the VURMTAX simulations find that there will be a small negative impact on GNI as a result of a cut to the company tax rate.

4.2.3 Simulation results

VURMTAX was used to simulate an overnight reduction of five percentage points in the rate of company tax. The cut to company tax is hypothetical only, with key differences from the federal government's company tax cut package in the timing and eligibility for the tax cut, which is discussed in section 4.3. In Simulation 1, there is a one-off, unanticipated cut in the legislated rate of company tax from 30 per cent to 25 per cent in a single year. After allowing for deductions, dividend imputation, and taxation treaty discounts, this translates to a cut to the tax rate of 1.7 percentage points for domestic investors and 2.6 percentage points for foreign investors.

As shown in Figure 2, the long-run results of this simulation are similar to those predicted by the back-of-the-envelope model. Thirty-years after the tax cut, capital stocks are 0.70 per cent larger than they otherwise would have been, with real output (+0.25 per cent relative to baseline) and the real consumer wage (+0.47 per cent relative to baseline) also elevated. Differences between the VURMTAX results and the BOTE results are due to many factors, including the three mentioned in section 4.2.2 (terms of trade effect, foreign ownership share and dynamic effects), compositional differences derived from VURMTAX's 76 industries, and the impact of fixed factors of production in many industries.

The immediate effect of a cut to company tax is to increase post-tax rates of return on capital for both local and foreign investors (although more so for non-resident investors), which stimulates investment expenditure. As shown in Figure 2, aggregate investment jumps to almost 1 per cent above the base case in the year that the tax cut is implemented.

At this stage, investors are earning a post-tax rate of return higher than the base case rate of return. The high rate of return signals to investors to continue to invest at a rate that pushes the capital growth rate above the base case growth rate. The subsequent increase in capital stocks and wages in the following years gradually dampens the rate of return on capital, with investment falling, although remaining above the base case, and capital stocks rising throughout the forecast period, until the capital growth rate returns to its base case level.[16] For domestic investors, the post-tax rate of return is adversely affected by higher wages, an effect that is not fully offset by the company tax cuts.

Stronger investment has a short term positive impact on employment, which peaks at around 0.15 per cent above base line two years after the tax cut. The temporary spike in employment is gradually eliminated as the real wage adjusts upwards, returning the unemployment rate to its base case level, in accordance with the usual Dixon and Rimmer (2002) dynamic sticky wage adjustment theory. The smaller positive impact on employment in the long run is the result of a higher participation rate, which is assumed to be positively linked to the real wage, as described in sections 2.5.3 and 2.5.4.

The increase in GDP is driven initially by employment, but as employment returns to its base case level, in later periods the increase in GDP is attributed to the larger capital stock. Although GDP increases, as foreshadowed by the back-of-the-envelope result and discussion, gross national income falls in the long run as a result of the cut to the company tax rate. This is illustrated in Figure 3**.**

There are three phases in the evolution of the long-run GNI result. Firstly, in the year of the company tax cut, there is a sharp fall in GNI. This is explained by the fall in tax revenue derived from the foreign owners of capital, or the loss of area **B** in Figure 1. In the second phase, from 1 to 10 years after the tax cut, there are two competing effects on GNI. Ceteris paribus, the increase in GDP has a positive impact on GNI, which is evident from 1 to 3 years after the tax cut, but the positive impact on GNI is offset by the negative impact of the continuing loss of taxation revenue from non-resident investors. As net foreign liabilities build, the cost of debt servicing starts to detract from GNI relative to GDP. Further, the increase in GDP, which was attributable to labour (a domestically owned factor)

[16] A curious result illustrated in Figure 2 is the difference between the long-run increases in capital stocks and investment. Given that the capital stock stabilises at a new, higher level than the baseline, the investment to capital ratio might be expected to return to its base case level, i.e., the deviation from base case in aggregate investment should be the same as the deviation in capital stocks. However, Figure 2 shows that investment is only 0.5 per cent higher than the base case, a much smaller deviation from base than the capital stock. This difference is attributed to compositional effects. Long-run results for the investment to capital ratio in each industry show very little change. However, aggregate capital is calculated based on industry capital income weights, while aggregate investment is calculated based on industry investment expenditure weights. Several of the industries for which there is a large positive impact on both capital stocks and investment (including Aluminium, Banking, and Finance) account for a high share of the economy's capital income relative to their share in the economies investment expenditure. Conversely, ownership of dwellings, for which there is a negative impact on both capital stocks and investment, accounts for a low share of capital income relative to its share of investment expenditure. These compositional differences drive the differences in the results for the aggregate measures of capital and investment.

in the early years, is attributable to new, foreign-owned capital in later years and adds little directly to GNI.

The final phase, beyond 10 years after the tax cut, is the stabilisation phase. In this phase, the savings rate is gradually increased in order to stabilise the ratio of net foreign liabilities to GNI. Without this, GNI would continue to fall even though GDP would change very little. For net foreign liabilities to stabilise, the current account balance needs to move towards surplus. With the factors determining the income account balance fixed in place, this is achieved through an increase in the economy-wide savings rate, which enables the trade account balance to move towards surplus. Savings as a percentage of household disposable income increases by 0.67 per cent. The long-run impact on real GNI is a fall of around 0.12 per cent relative to the base case. Net foreign liabilities stabilise as a percentage of GNI at 2.7 per cent higher than the base case, as illustrated in Figure 5**.** [17]

Figure 5 plots results for the expenditure composition of GDP and the terms of trade. It shows that in the long-run, exports and investment account for a larger share of GDP, while domestic absorption accounts for a smaller share. The results for exports and investment are as we expect: investment is larger to service a larger capital stock, while exports are larger, because the trade balance moves towards surplus. With the trade balance moving towards surplus, the terms of trade declines relative to the long-run base case, by 0.33 per cent. This reduces domestic purchasing power relative to domestic incomes.

Real absorption falls to 0.27 percent below the base case in the long-run, consistent with the decline in GNI and the increase in the savings rate. This result indicates a larger negative impact on material welfare than that indicated by the decline in GNI, which was 0.12 per cent.

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[17] An approximate "sense-check" of the long-term gap between the results for real GDP and real GNI suggests that the modelling results are plausible. Supposing that capital income accounts for one-third of GDP, and foreign capital income accounts for one-fifth of capital income, and the tax cut accounts for 5 per cent of foreign capital income, the loss of tax revenue from foreign capital would account for one-third of one per cent of GDP. This accounts for most of the difference between GDP and GNI illustrated in Figure 3**.** The remaining difference is accounted for, among other things, a larger share of foreign capital in GDP, and a decline in the terms of trade required to support a larger trade surplus.

The short-run impacts on the expenditure composition of GDP differ from the long run impacts. The immediate effect of the cut to company tax is to stimulate investment, which also stimulates imports. The spike in investment is funded by an increase in the current account balance, and consequently an increase in the trade deficit, consistent with the fall in exports in the year that the tax cuts are implemented. There is a small increase in the terms of trade. In the following years, as GDP gradually moves above the base case and investment gradually returns towards the base case, exports recover and imports begin to fall. During the stabilisation phase, exports grow strongly and imports fall further, reflecting the increase in the domestic savings rate.

Having understood the GDP expenditure-side impacts of a cut to company tax, we now have a framework in which to understand industry impacts. Short-run industry impacts are influenced by the large increase in investment and the decline in exports, while long-run industry impacts are influenced by the large increase in exports and investment, and the decline in public and private consumption. This is confirmed by the industry results illustrated in Figure 6.

In the short-run, the main impact of the company tax cut is to increase activity in construction and business services, to support the increase in investment. The impact on other industries is very small. In the long-run, when capital stocks have had time to adjust, and the economy has adjusted to produce more exports and less for domestic consumption, the industry impacts are more pronounced. Figure 6 shows that the industries to expand the most relative to the base case are mining, manufacturing and transport. With higher investment activity, the construction industry is also larger. However, lower domestic consumption activity means that sectors such as health, education and public administration decline relative to the base case.

4.3 Scenario 2: Enterprise Tax Plan no. 2

We now turn to modelling company tax cuts as proposed in Enterprise Tax Plan 2 (ET2). In these simulations, the baseline represents Enterprise Tax Plan 1 (ET1).[18] The policy simulation represents

[18] Enterprise Tax Plan no. 1 (ET1) legislates for a reduction in the rate of company tax in Australia from 30 per cent to 25 per cent, phased in over 10 years, for businesses with turnover of under $50 million. The company tax rate remains at 30 per cent for businesses with annual turnovers in excess of $50 million.

ET2, and differences between the policy and base case can be attributed to the implementation of ET2 relative to ET1. The economic mechanisms are similar to those described in section 4.2 for the overnight rate cut, with two key differences.

The first of these is that by altering the base case to reflect the implementation of ET1, the nature of the policy shock is changed. This scenario traces out the impacts of company tax cuts that are biased toward foreign-owned capital, because foreign-owned companies are predominantly above the $50 million threshold for turnover.[19] The shocks to the tax rate are illustrated in Figure 7**.** Until 2019, ET2 is the same as ET1, i.e., the tax rate is cut to 27.5 per cent for businesses with turnover of up to $50 million. As such, the policy and baseline tax rates are identical. From 2020 to 2024, the tax rate of 27.5 per cent is gradually extended to larger businesses (as indicated by annual turnover), such that by 2024, all businesses are subject to the 27.5 per cent company tax rate. From 2025 to 2027, the company tax rate is reduced for all businesses to 25 per cent. The larger tax cuts for foreign businesses, as illustrated in Figure 7, are derived from the greater weight placed on large businesses in calculating the average company tax rate for foreign-owned capital.

The second difference relative to section 4.2 is that the tax cut is phased in. This simulation models the response of investors that occurs in advance of the tax cuts, i.e., after the tax cuts are announced but before they is implemented. For comparison, Figure 8 includes results without anticipation of the tax cuts (labelled AE for adaptive expectations); see section 2.2 for a discussion of adaptive and forward-looking expectations.

Figure 8 shows that under ET2, GDP will gradually become higher than the base case, reflecting the gradual phase-in of the tax cut. Until 2023, GNI follows a similar path the GDP. When the large tax cuts for foreign-owned capital are implemented in 2024 and beyond, a wedge appears between GNI and GDP. As with this simple case, when primarily driven by foreign investment, the transmission of

[19] 97% of businesses with less than 20 employees are wholly Australian owned, whereas over 25% of businesses with more than 200 employees have foreign ownership of greater than 50% (ABS Cat. No. 8167.0, 2017).

growth in GDP to domestic incomes is weak. Further, the loss of tax revenue from existing foreign-owned capital detracts from GNI.

Figure 8 shows that the incorporation of forward-looking behaviour in adjusting to known future changes in the tax rate (relative to the case where investors assume that the future rate of company tax is equal to the present rate of tax) makes very little difference to GDP or GNI in the long run. During the phase-in period, the anticipation of future changes in the tax rate brings forward the investor response, and yields a short-lived, small positive deviation in GNI, which occurs in the interval between investors responding to the anticipated tax cuts, and the loss of revenue when the tax cuts actually occur.

Overall, the long-run gains to GDP from the simulation of Enterprise Tax Plan 2 are smaller than the gains in the simple case described in Section x. Positive results for key macroeconomic indicators including investment and capital stocks, real wages, employment and GDP (see Figure 9) are smaller in the simulation of ET2 than they are in the simple simulation. This is because the tax cut is smaller, because we simulate the difference between ET1 and ET2, and much of the tax cut for domestic businesses is enacted under both plans. This stimulates less investment relative to the base case, and consequently a smaller increase in economic activity. Appealing to the argument advanced in explaining the results of the simple tax cut, we might expect that the fall in GNI would also be smaller. However, the tax cuts modelled here are biased towards foreign-owned businesses, which account for a larger share of large businesses than they do overall. The differing impacts on local and foreign investment are illustrated in Figure 10. As a result, ET2 leads to a smaller stimulus to output, but a similar loss of revenue and national income as illustrated in the simple case.

Results for the expenditure side of GDP and industry activity in Figure 11 and Figure 12 show that there is very little difference from the simple case in the long-run. However, the short-run results are quite subdued relative to the simple case, because the tax cut is phased in. There is no sudden spike in investment as there is in the simple case. As a result, growth in capital stocks and the real wage also occur more gradually; see Figure 9**.**

5 The marginal excess burden of company tax in Australia

In this section, we shift focus and compare VURMTAX results of company tax cuts to past work for Australia. To facilitate our study, we use VURMTAX to derive the marginal excess burden (MEB) of company tax in Australia. We adopt the standard model closure outlined in section 2.6, and use the formalism described in section 3 to estimate the MEB using a simulated small reduction in Australia's company tax rate. Specifically, we reduce the legislated company tax rate from 30 per cent to 29.6 per cent.

Under the closure described in section 3.1, VURMTAX generates estimates for the MEB of each of these three taxes according to equation (3.1). These estimates are summarised by the blue bars in Figure 13. As a point of comparison, we have summarised previous estimates of this measure for Australia, which were reported by KPMG (2010), Cao *et al.* (2015) and Murphy (2016). As shown in Figure 13, VURMTAX yields very different estimates of the MEB of company tax to each of the previous three studies. In section 5.1, we elucidate six key differences between the models employed in previous studies, and VURMTAX. We then use VURMTAX to determine the incremental impact of each of these differences on the MEB of company tax, in section 5.2. For simplicity, we focus our attribution analysis on the study by The Australian Federal Treasury [Cao *et al.* (2015)].

5.1 Key differences between Cao *et al.* (2015) and VURMTAX

VURMTAX includes over 1.5 million distinct equations that describe the behavioural response of various economic agents, e.g., households, industries, state and federal governments, etc, to changes in tax rates, relative changes in factor and commodity prices, real wage rates, etc. Nevertheless, in studying Cao *et al.* (2015), we identified six important differences in methodology and model parameterisation that form the basis of our excess burden attribution analysis. The first three reflect differences in model parameterisation:

1. Export demand (trade) elasticities in Cao *et al.* (2015) vary between -6 (for industries such as Mining) and -12, i.e., a classical small-country assumption with little scope for movements in export prices. In VURMTAX, we assume the trade elasticity is uniform across commodities

and equal to -4; see section 2.5.2. Relative to the excess burden of company tax derived using VURMTAX, this parameterization biases the result derived by Cao *et al.* (2015) up, because it damps the responsiveness of Australia's terms of trade to changes in the company tax rate;

2. The magnitude of labour-capital substitution elasticities applied by Cao *et al.* (2015) are equal to 0.9, which is much higher than the value of 0.4 traditionally adopted in VURMTAX; see section 2.5.1. Relative to the excess burdens reported herein, higher labour-capital substitution elasticities bias results upwards, because the capital/labour ratio is permitted to rise further in response to a company tax cut;

3. Other parameterization differences are evident across the two models. For example, whereas VURMTAX assumes no price-induced substitution between intermediate inputs and primary factor inputs to industry production, i.e., a Leontief production function governs industry production, Cao *et al.* (2015) allow some substitution via a CES production function where the substitution elasticity is set equal to 0.2. As we shall show, this has little explanatory power when it comes to attributing differences in relative company tax excess burden estimates.

The remaining three differences between Cao *et al.* (2015) and the analysis herein are methodological.

4. Cao *et al.* (2015) assume foreign owned capital shares to be homogeneous across industries, and equal to 20.7 per cent. As discussed in section 2.4, the VURMTAX carries theory that allows for inhomogeneous foreign capital ownership shares across Australian states/territories and industries. We use this theoretical structure to reflect the findings by Connolly and Orsmond (2011), allowing for higher foreign ownership shares in key export- and capital-intensive sectors, e.g., mining and LNG. States/territories that are intensive in mining and LNG production, are therefore more reliant on foreign capital. Additionally, we assume the company-tax-exempt dwelling and public service sectors to be overwhelmingly domestically-owned, with an average foreign ownership share for privately-owned capital of 20 percent.

5. Cao *et al.* (2015) assume that the stock of domestically owned capital is invariant. Based on the description in Cao *et al.* (2015), this is achieved via endogenous determination of the national

savings rate. In VURMTAX, we assume that national savings rate adjusts in the long-run to stabilize the growth in net foreign liabilities relative to GNI. For a more detailed description of this mechanism, see section 2.3. As we shall show, the excess burden is generally insensitive to changes in the national savings rate, which is in line with similar findings by Cao *et al.* (2015);

6. Cao *et al.* (2015) utilize a comparative-static CGE model that operates under a long-run closure. As discussed in section 2.2 and highlighted in section 4, VURMTAX is a dynamic model that operates under a default assumption of adaptive investor expectations. In this framework, the economy transitions from a short-run environment of fixed real wages and capital stocks, to a long-run closure where capital stocks can adjust to drive rates of return on capital back to baseline and the unemployment rate returns to baseline via real consumer wage adjustment. This difference in modelling methodology is important, because comparative-static models operating under a long-run closure do not capture the upfront transfer to foreign investors that arises when company tax rates fall.

5.2 The relative impact of parameter differences, model methodology and welfare metrics

In this section, we illustrate the incremental impact of the difference in parameterisation and methodology on the MEB of a company tax cut (a reduction in the legislated tax rate from 30 cents in the dollar to 29.6 cents in the dollar). This is achieved by running VURMTAX seven times. In each simulation, we impose an identical 0.4-percentage point reduction in the legislated company tax rate and alter a single parameter or feature of the model to reflect the parametrisation or methodology in Cao *et al.* (2015). This process is summarised below.

[1] In simulation [1], we simulate a 0.4-percentage point cut in Australia's legislated corporate tax rate under a standard VURMTAX parameterization and closure (see sections 2.4, 2.5 and 2.6);

[2] In simulation [2], we alter the standard VURMTAX parameterization by setting all export demand elasticities for Agriculture, Mining, Education and Tourism services to -6. All

remaining export demand elasticities are set to -12. The shock is identical to simulation [1]. This flattens commodity-specific export demand curves, muting the terms of trade response to a company tax cut;

[3] Together with all changes in point [2] above, in simulation [3] we set the labour/capital substitution elasticity to 0.9 across all 76 VURMTAX industries. This increases the economy-wide capital stock in response to the tax cut in simulation [1]. The capital/labour ratio therefore expands relative to the simulations [1] and [2]. National income and thus the national MEB increase relative to the results derived under a standard parameterization of VURMTAX;

[4] In conjunction with the changes in point [3] above, in simulation [4] we allow for price-induced substitution between intermediate and primary factor inputs to production by setting the substitution elasticity to 0.2. As we show, this has little impact on the national MEB of a company tax cut, compared to simulation [3];

[5] In simulation [5], we modify simulation [4] by assuming foreign-owned capital is homogeneous across all 76 industries in VURMTAX. In so doing, we keep the value of foreign-owned capital as a share of the aggregate national capital stock from simulation [1]; the stock of foreign-owned capital is then re-distribute across all industries in such a way that the average foreign ownership share is identical to the industry-by-industry foreign ownership share;

[6] Simulation [6] is concerned with isolating the impact of differing assumptions of the national savings rate response to changes in the company tax rate. As such, we modify simulation [5] by deactivating the net foreign liability stabilizing mechanism, i.e., the average propensity of households to consume from disposable income remains fixed;

[7] To demonstrate the impact of dynamics, in conjunction with the changes described in points [2] - [6] above, we quarantine foreign-owned capital installed at the time of the tax rate cut from the policy change, i.e., we simulate a cut in the corporate tax rate on newly-installed capital only. As the existing capital depreciates over time and is replaced, that new capital pays the new (reduced) rate of 29.6 per cent. This deactivates an important feature of dynamic CGE

analyses of company tax cuts, i.e., the upfront cost of the policy is no longer realized because the rate cut is grandfathered, in order to illustrate the effective impact of foreign windfall gains.

Because we simulate the impact of an identical tax cut in 2019 in simulation [1] – [7], we can study the sensitivity of the MEB of company tax to changes in model parameterisation and methodology. This facilitates our attribution study. We present MEB results over a thirty-one year time horizon (2019 – 2050) in Figure 14.

The results in Figure 14 can be understood in the following way. The green bars and solid line map out the time-path of the year-on-year excess burden of a 0.4 percentage point company tax cut. As shown in Figure 14, under a standard VURMTAX parameterisation the MEB settles at -26 per cent in the long-run (2050). The negative excess burden is in sharp contrast to Cao *et al.* (2015), whose long-run comparative static result (ignoring profit shifting) of a marginal change in the company tax rate is equal to 42 per cent (see the dark blue dot in Figure 14).[20] The remaining coloured bars in Figure 14 map the incremental impact of each of the changes outlined previously in points [2] – [7]. The cumulative impact of each of these changes on the standard VURMTAX result (the solid line in Figure 14), is summarised by the dotted line in Figure 14. The dotted line is therefore the time-path of the MEB of a company tax cut simulated in VURMTAX in simulation [7]. In what follows, we summarise Figure 14:

- **Green bars**: Our standard dynamic MEB of company tax derived using VURMTAX, which is stable and equal to -26 per cent in the long-run;
- **Purple bars**: Relatively elastic export demand schedules mute the terms of trade impact of company tax cuts in VURMTAX by approximately 60%, relative to the movement realized in our core VURMTAX simulation described in point [1] above. This is emphasised by the purple bars in our plot of the percentage deviation in the level of the terms of trade from its baseline forecast (see Figure 15). In muting the fall in the terms of trade, relatively elastic export demand

[20] Profit shifting plays a relatively small role in driving the excess burden of company tax based on sensitivity analysis conducted by Cao *et al.* (2015). This is highlighted in Figure 14, where we include Treasury's result both with profit shifting (red dot in 2034) and without profit shifting (blue dot). In VURMTAX, we assume the proclivity to shift profits from Australia remains unaltered in response to changes in Australia's company tax rate.

curves also mute the fall in national income (see Figure 16) we experience when the company tax rate is cut. From equation (3.4) and as shown by the purple bars in Figure 14, this elevates the MEB of a company tax cut. Overall, the MEB with elastic export demand curves rises 16 cents in the dollar relative to outcome under a standard VURMTAX parameterisation, from -26 to -10 cents in the dollar;

- **Light blue bars:** Higher labour/capital substitution elasticities raise the domestic capital stock relative to its level under a standard VURMTAX parameterisation (see the blue bars in Figure 17), whilst also damping the real wage response (see Figure 18). Via equation (3.2), this damps the long-run labour supply response to a company tax cut slightly; with real wage adjustment in the long-run assumed to drive unemployment rates back to their baseline levels, a smaller expansion in long-run labour supply drives a smaller expansion in long-run employment, as shown in Figure 19. With capital stocks elevated and employment slightly damped relative to our standard VURMTAX parameterisation, higher labour/capital substitution elasticities drive the capital/labour ratio, and thus national income, higher (see the blue bars in Figure 16). Incrementally, this drives the MEB up by 27 cents in the dollar in 2050. In cumulative terms, higher labour/capital substitution and elastic export demands drive the excess burden from -26 to 16 cents in the dollar in 2050;

- **Light green bars**: There are many other parameterisation differences between the two models. As discussed, herein we explore the impact of one such difference, by allowing for some price-induced substitution between intermediate and primary factor inputs to production. As expected, the impact of this change is small: in incremental terms, the MEB increases by 2 cents in the dollar in 2050. In cumulative terms, intermediate/primary factor substitutability, higher labour/capital substitution and elastic export demands drive the excess burden from -26 to 18 cents in the dollar in 2050;

- **Grey bars:** Summarise the impact of adjusting the industry composition of foreign-owned capital. Reducing foreign ownership of capital in the mining and resources industries, comes at the expense of increasing foreign ownership of the dwelling and public service industries. In

VURMTAX, these industries are company tax exempt. Adjusting foreign capital ownership patterns across industries, therefore damp the windfall gains to foreign investors of company tax cuts. Foreign capital income flows therefore rise (see the grey bars in our plot of the foreign capital income account deviation in Figure 20**,** which are positive). This drives both national income (see Figure 16) and the MEB (see Figure 14) higher. In incremental terms, the MEB increases by 15 cents in the dollar in 2050, while in cumulative terms the excess burden increases from -26 to 33 cents in the dollar in 2050;

- **Black bars:** In incremental terms, moving to an exogenous national savings rate and relaxing our constraint on net foreign liability (NFL) accumulation has little impact on the long-run national income level (Figure 16), because it does not constrain the capacity of the economy to reach it new (higher) optimal capital stock (Figure 17). As such, the impact on the MEB in incremental terms is small (-3 cents in dollar in 2050). When considered in conjunction with the previous modifications, the MEB of company tax goes from -26 to 30 cents in the dollar;
- **Orange bars:** Capture the impact of grandfathering the tax cut. No upfront transfer to foreign investors arises as a result (see the orange bars in our plot of the foreign capital income account deviation in Figure 20**,** which are positive). This buoys national income in the short-run (see Figure 16), and thus the MEB (see Figure 14). In incremental terms, ignoring the short-run costs of a company tax cut elevate the MEB by 31 cents in the dollar. Because exempt capital depreciates over time, the impact of grandfathering also diminishes over time; in the short-run, it is the dominant effect, whereas in 2050 it is responsible for an incremental gain of 1 per cent in the MEB. When considered in conjunction with the previous modifications, the MEB of company tax goes from -26 to 31 cents in the dollar in 2050.

Implementing each of the six modifications described in points [2] – [7] in section 5.1, VURMTAX yields an estimate for the MEB of Australian company tax rate of 31 cents in the dollar in 2050 (thirty-one years post-simulation). Differences in modelling methodology (specifically recursive time dynamics, and inhomogeneous foreign capital ownership patterns across industries) and parameterisation (principally, differences in export demand and labour/capital substitution elasticities) between the study presented herein and Cao *et al.* (2015), therefore explain 84 per cent of the discrepancy between the two sets of MEB estimates. We suspect the remainder of the differences are a result of other methodological and parameterisation differences, with very little difference attributable to our use of real national income (leisure-adjusted) instead of measures of consumer welfare, e.g., equivalent variation.

5.3 Summary

Because national income falls when we simulate a company tax cut using VURMTAX, we find that the MEB of company tax is negative and equal to -26 per cent. Our literature survey in section 5.1 highlights that this result differs markedly from previous studies for Australia, e.g., Cao *et al.* (2015) find the MEB for company tax is 42 per cent (ignoring profit shifting). In this section, we elucidate the factors that cause such a marked discrepancy between cross-study MEB estimates. We achieve this using decomposition diagrams to quantify the impact on the MEB of altering six key assumptions in VURMTAX to mirror those in Cao *et al.* (2015). Two of these are alterations to our default export demand and labour/capital substitution elasticities, which explain 63 per cent of the difference between the two MEB estimates. This is because flattening export demand curves mutes the negative response of the terms of trade to cuts in company tax rate, while greater substitution between labour and capital stimulates the capital/labour ratio when we reduce the corporate tax rate.

Among the four other differences, price-induced substitution between primary and intermediate factors of production by firms, and endogenous adjustments to the national savings rate, have minor impacts on the MEB. The remaining two factors are important, but for different reasons. In VURMTAX, the overall share of foreign-owned capital is similar to that adopted in Cao *et al.* (2015). The two studies differ in the degree of homogeneity across industries. In Cao *et al.* (2015), the foreign ownership share is homogeneous across all industries and thus partially attributed to corporate tax-exempt industries, including the public sector. As a consequence, foreign ownership of the remaining industries, that are liable for company tax, is biased downwards by Cao *et al.* (2015). When the company tax rate is reduced, we expect that the impact on heavily foreign-owned sectors, such as mining, is underestimated by Cao *et al.* (2015), and as such the windfall gains to foreign investors is understated. This once more elevates national income, economic welfare and the MEB of the tax. Finally, we assess the impact of time dynamics on welfare by grandfathering the tax cuts. In the short-run, the MEB is elevated when we grandfather the policy, because we ignore a cost of company tax cuts (the windfall gain on existing foreign-owned capital), but continue to receive the benefits. When simulated in combination, the six factors described here account for 84 per cent of the long-run differences in MEB estimates for company tax.

6 Concluding remarks

From the Australian federal election campaign in 2016 until the demise of the Turnbull Prime Ministership in August 2016, the debate over the merits of changes to Australia's corporate income tax rate was prominent on the Australian policy landscape. This article describes the most comprehensive economic modelling study to date of the impacts of changing Australia's rate of corporate tax, building on earlier economic modelling of company tax cuts by Dixon and Nassios (2016). The key finding from this study is consistent with Dixon and Nassios (2016), which is that Australian national income is permanently depressed when the corporate tax rate is cut. In contrast to the rhetoric of the proponents of the tax cut, the modelling finds that cutting the rate of company tax has a negative impact on the post-tax returns to local investors.

Several factors distinguish the analysis herein from Dixon and Nassios (2016). Firstly, Dixon and Nassios (2016) study the company tax cuts using an aggregated version of the VU-National model. Herein, we develop an equation system that carries the full detail of Australia's corporate tax system, and embed this theory within VURMTAX, a multi-regional dynamic CGE model of Australia's states and territories with multiple layers of government and detailed fiscal accounts.[21] Imbued with this new theory, VURMTAX carries parameters to make allowance for partial franking credit claim back by local investors. The baseline forecast in VURMTAX therefore accurately replicates ATO taxation statistics, which show that the share of company tax receipts claimed back as franking credits by Australians average 33 per cent. VURMTAX also accounts for the impact of double taxation treaties (DTTs) on foreign corporate income and withholding tax liabilities. In calibrating the DTT theory, we rely on ABS foreign investment data by country, and The Treasury's comprehensive summary of Australian DTTs. We also account for the impact of retained profits on the corporate income tax base, which yields an effective tax rate on foreign investment that is broadly in line with the US Congressional Budget Office (2017).

[21] While we do not focus exclusively on the regional consequences of the policy, these are discussed by Nassios *et al.* (forthcoming).

With these model enhancements providing the context of Australia's system of corporate taxation, to illustrate the key economic mechanisms of the response we simulate a simple five percentage point cut in Australia's legislated company tax rate. The results of this simulation in section 4.2 also show that company tax cuts are good for "jobs and growth". Employment, real GDP, real wages and the capital stock are all elevated relative to baseline when the company tax rate is cut. Critically, the loss of revenue linked to the tax cut means that this comes at the expense of a fall in national income, which confirms the key insight by Dixon and Nassios (2016).

An important feature of Enterprise Tax Plan no 2 is the gradual phase-in of tax cuts announced many years in advance. To model forward-looking investor behaviour in a multi-regional, recursive dynamic CGE model, we make some adjustments to the VURMTAX framework, described in section 2.2.2. As we show in section 4.3, forward-looking expectations do not reverse the negative national income result from section 4.2. In fact, under Enterprise Tax Plan no. 2, relative to the simple tax cut, the outcome for national income is further below the baseline. This is partly because the direct benefit of company tax cuts under ET2 accrues disproportionately to foreign investors because of dividend imputation and because under ET1, domestic investors already receive a substantial tax cut. Foreign investors therefore crowd out domestic investors in anticipation of future tax cuts, increasing the foreign share of capital ownership in Australia. With a larger foreign capital ownership share when the tax cuts are implemented (in accordance with the Enterprise Tax Plan no. 2), the windfall gain to the foreign investors is larger. Hence, whether investors' expectations are adaptive or forward looking, the analysis herein establishes that real national income falls in response to a reduction in Australia's company tax rate.

As discussed by Freebairn (2017), important differences exist in the results of independent CGE studies of company tax policy in Australia, and these differences, particularly in the response of real national income to a tax cut, have defined the Australian policy debate for several years. While reasons for the differences in cross-study conclusions have been postulated, e.g., see Freebairn (2017), no simulation-based assessments have been presented that highlight and quantify the causes. This is the focus of section 5 herein, where we use decomposition diagrams to study why the MEB of company tax estimated in VURMTAX differs from the estimate by Cao *et al.* (2015). We find that 84 per cent of the difference in results can be explained by six key assumptions that differ between the two studies. Importantly, two of parameter assumption differences (for export demand and labour/capital substitution elasticities, see section 2.5 for a review of VURMTAX assumptions) explain 63 per cent of the cross-study MEB variances, with the other four factors explaining remainder. It is our hope that this study focuses future debates of the merit of company tax cuts in Australia to a discussion of the six key assumptions that drive Australia's welfare response.

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Tables

Table 1: VURMTAX parameter calibration for company tax policy modelling

Variable name	Description	Value in VURMTAX by capital owner	
		Local	*Foreign*
FSHARE	Share of gross operating surplus that are assumed to be franked equity payments.	0.45	0.43
FCLAIM	Share of franked dividends paid that are claimed as a PIT liability offset.	0.9	0
DEDTTY	Discount factor for investors due to double tax treaty countries.	n/a	0.86
DEDINT	Corporate tax base reduction due to interest deductibility	0.62	0.62
TGOSLEG	Legislated tax rate for company tax	0.3	0.3
DEDPIT	Personal income tax base reduction due allowable deductions and thresholds.	0.173	n/a
RETAINED	Share of profits retained by corporates for the purposes of reducing the personal income tax base.	0.8	n/a

Table 2: Key long-run results, overnight 5 per cent cut to company tax versus ET2

	Simple scenario, year 40	ET2 vs ET1, year 2060
Real GNI	-0.12	-0.19
Real GDP	0.25	0.18
Employment	0.06	0.04
Capital stocks	0.70	0.56
Real wage	0.47	0.35
Investment	0.50	0.39
- local	0.26	0.13
-foreign	2.18	2.24
Real private and public consumption	-0.27	-0.35
Exports	1.29	1.33
Imports	-0.02	-0.10
Terms of trade	-0.33	-0.35
Net foreign liabilities (% of GDP)	2.75	2.04
Current account balance (% of GDP)	-0.36	-0.32
APC	-0.22	-0.25

Figures

Figure 1: The market for capital.

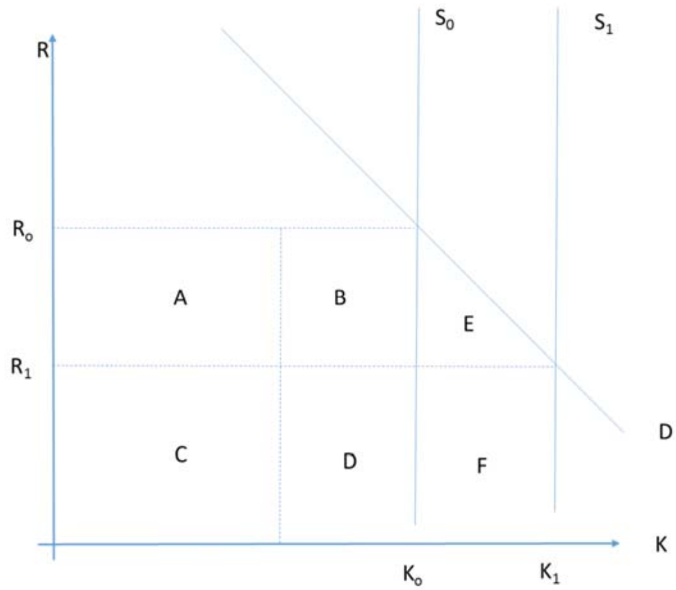

Figure 2: Impact of key macroeconomic variables of a five percentage point company tax rate cut.

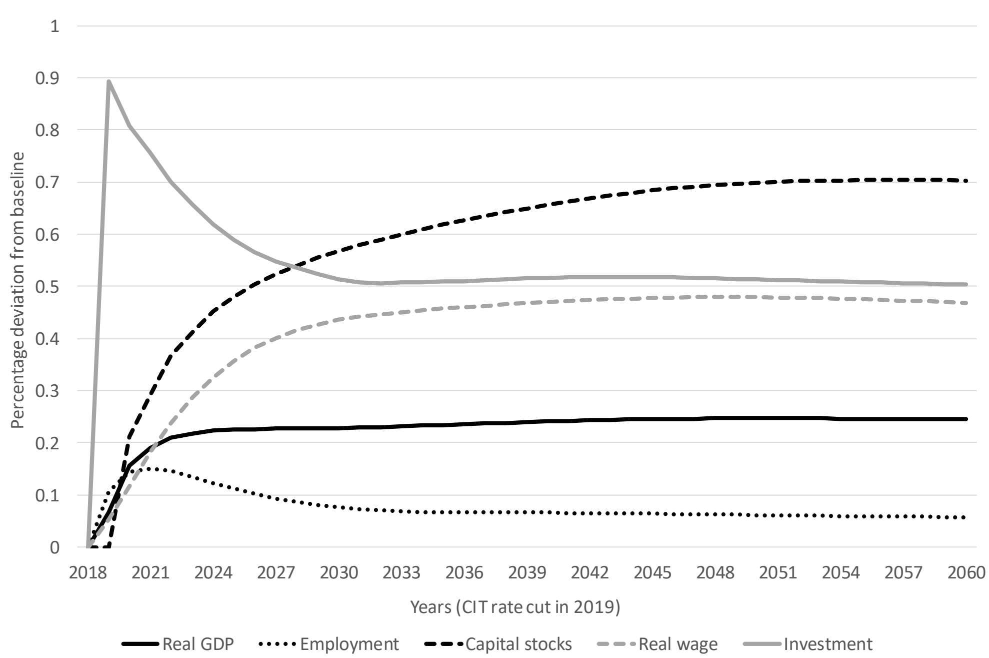

Figure 3: Real GDP and **real GNI** response to a five percentage point company tax rate cut.

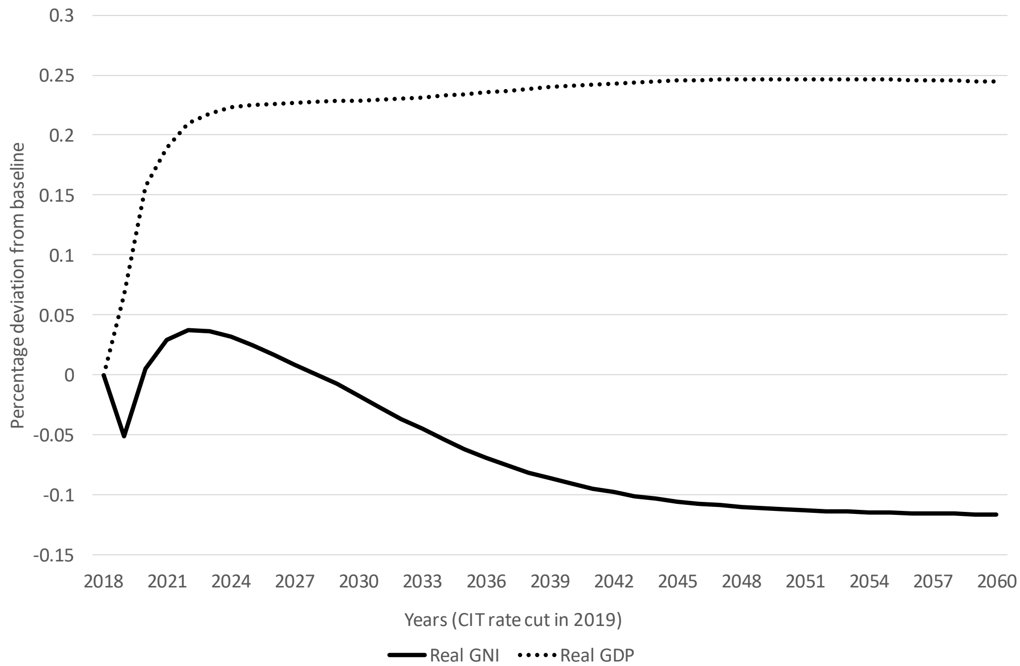

Figure 4: Ratio of **net foreign liabilities (NFL) to GNI** in response to a five percentage point company tax rate cut.

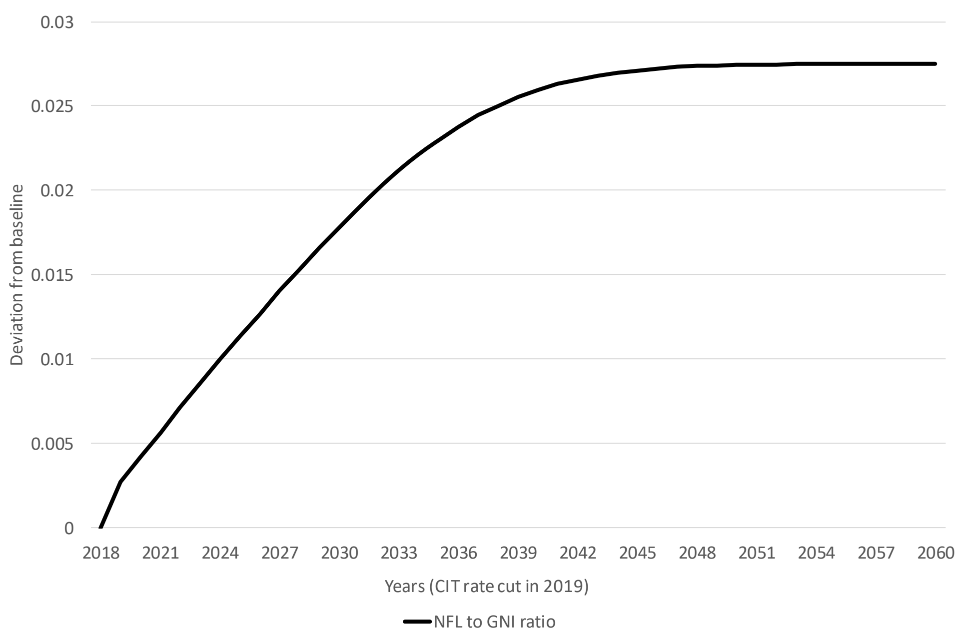

Figure 5: Changes in the **expenditure side of GDP** and the **terms of trade** in response to a five percentage point company tax rate cut.

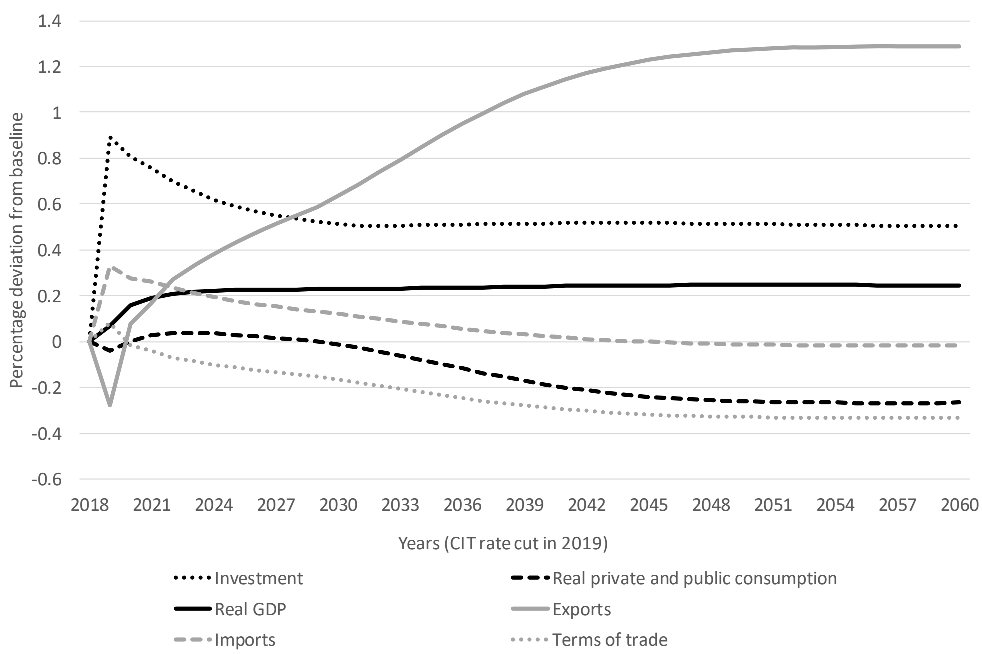

Figure 6: Impact on **industry output (**Australia-wide), in both the short-run (Year 1) and long-run (Year 40).

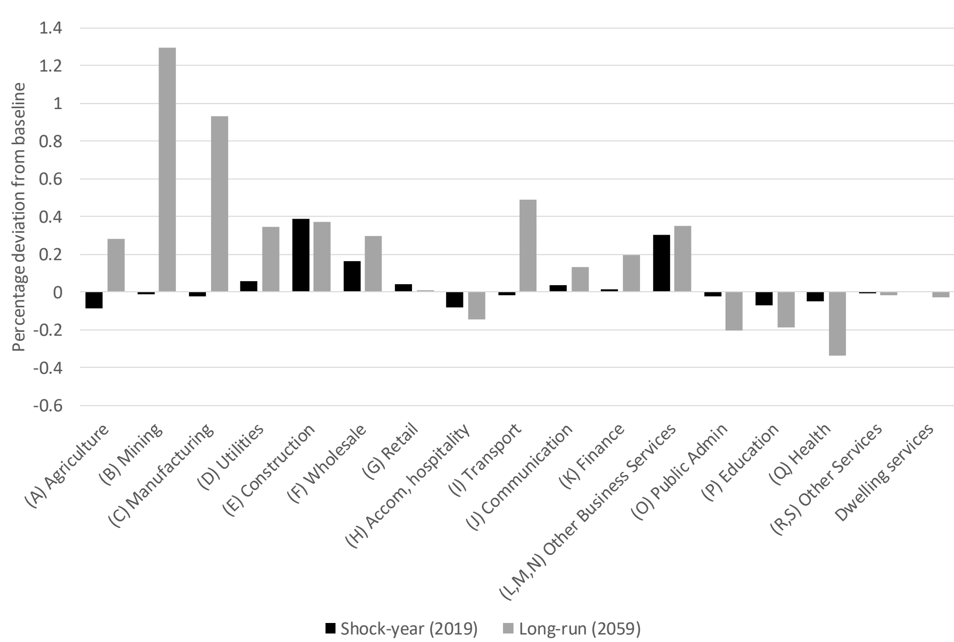

Figure 7: Difference between CIT rate under ET2 and ET1, for foreign and locally-owned capital.

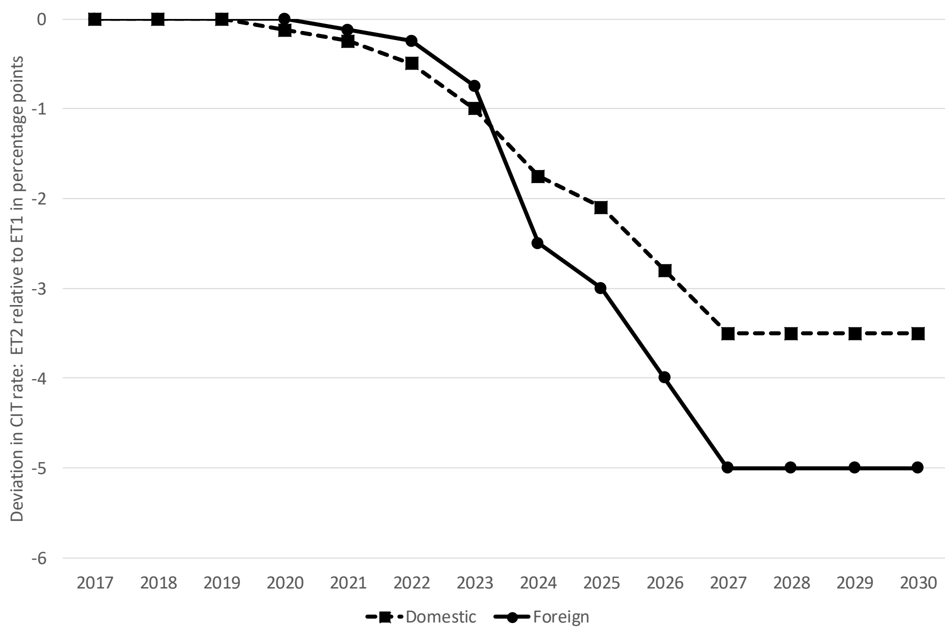

Figure 8: Impact of ET2 relative to ET1 (the base case scenario in VURMTAX) under forward-looking and adaptive expectations of the future tax rate.

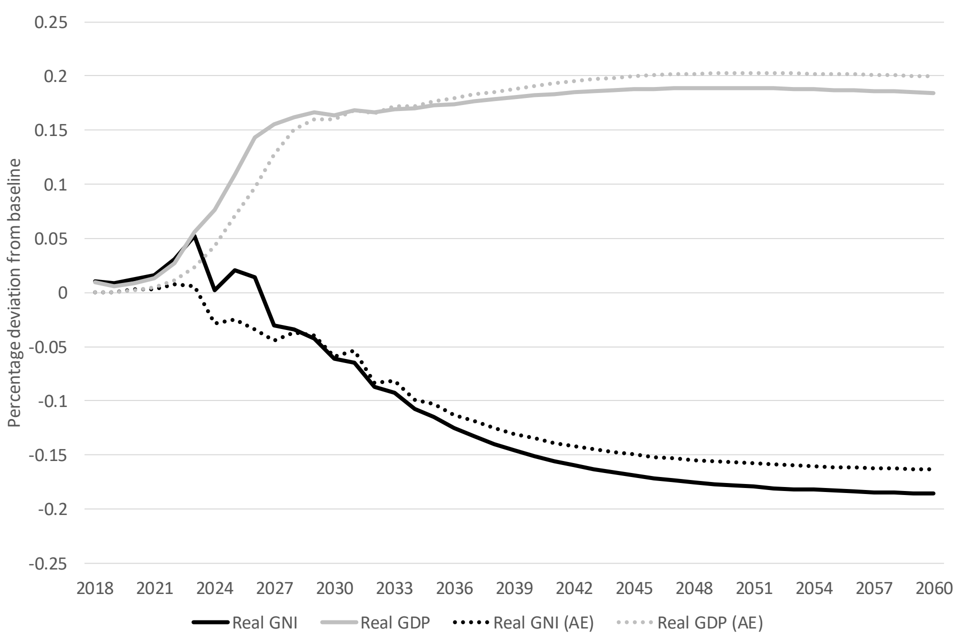

Figure 9: Impact of ET2 on key macroeconomic variables.

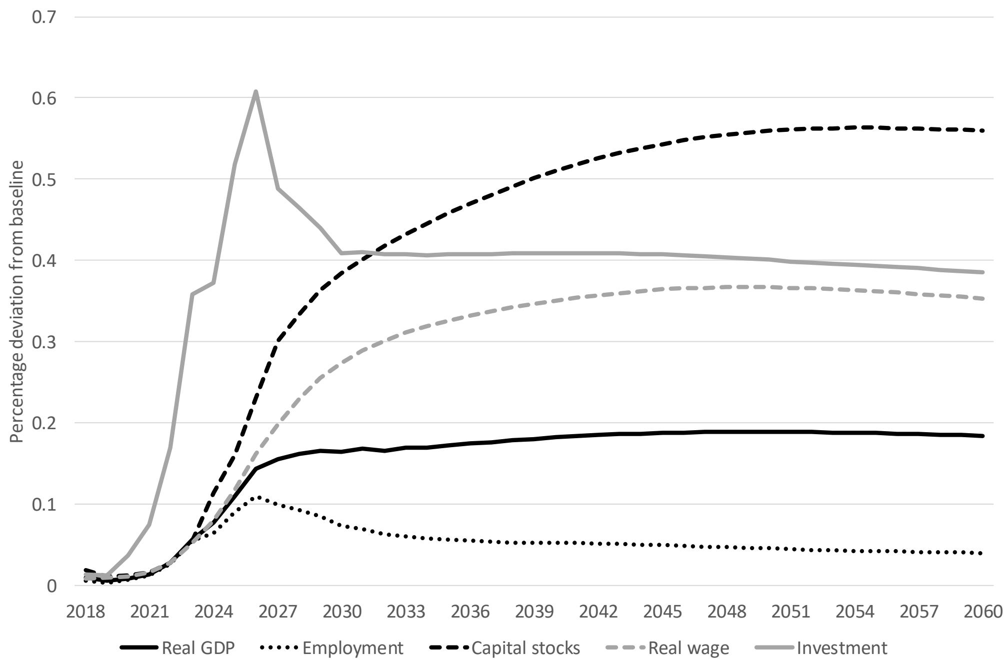

Figure 10: Impact of ET2 on local and foreign investment.

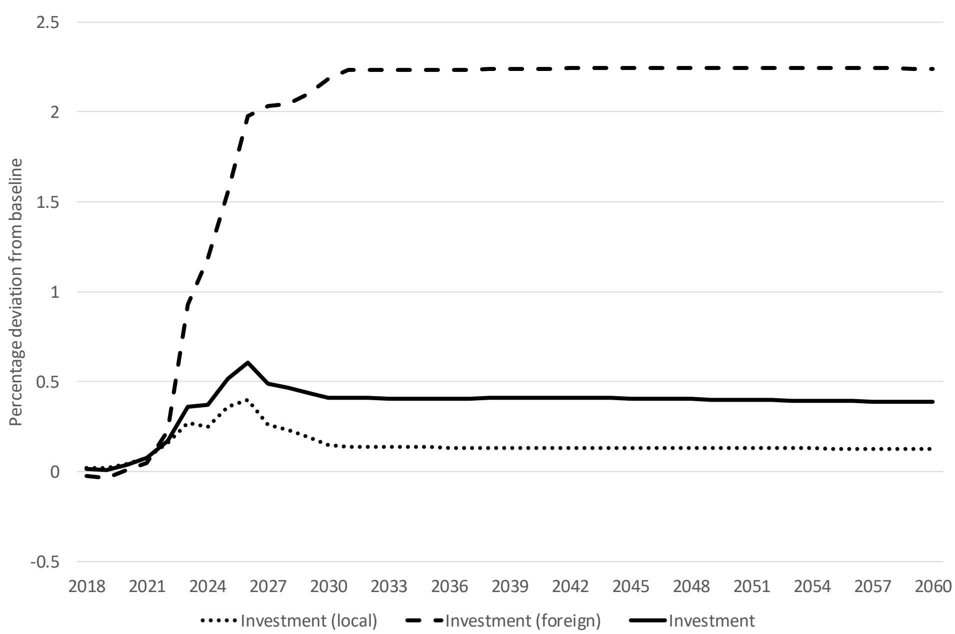

Figure 11: Impact of ET2 on the expenditure side of GDP.

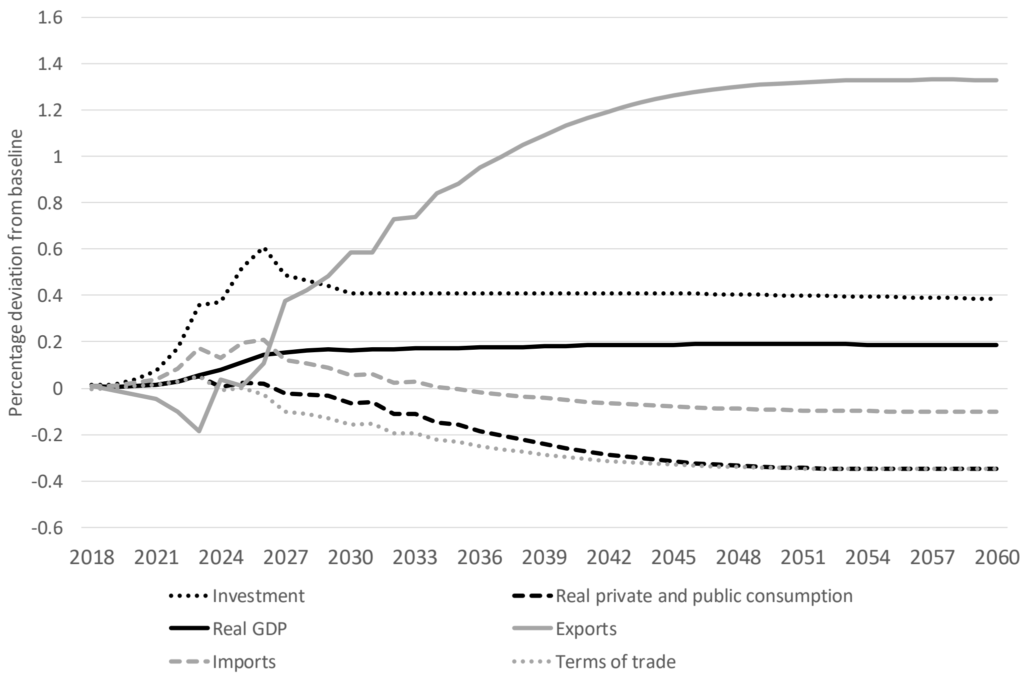

Figure 12: Long-run (year 2050) industry output response under ET2.

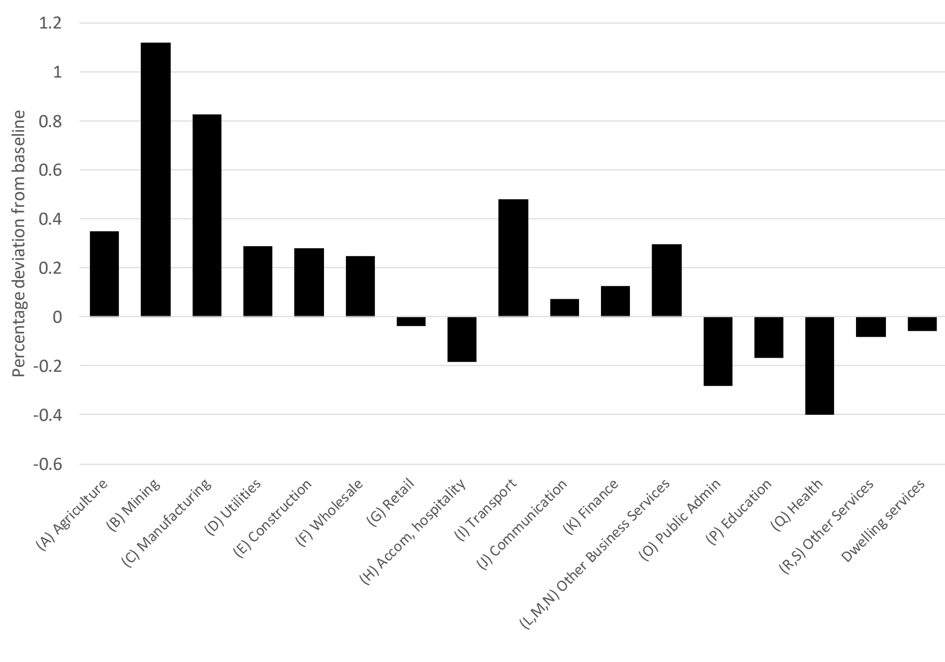

Figure 13: Marginal excess burden of company tax in Australia.

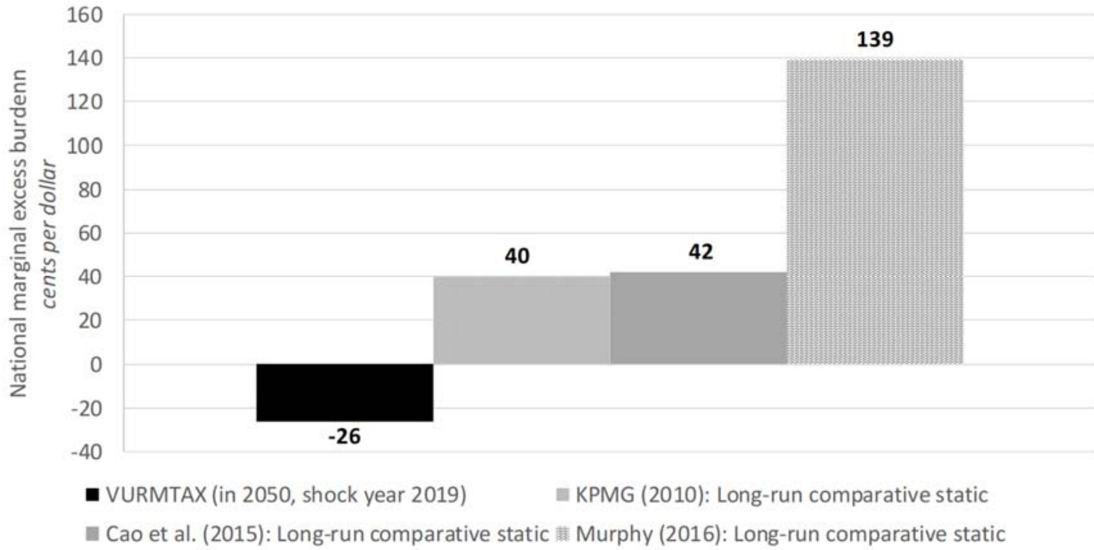

Figure 14: Attribution of the differences between the marginal excess burden of company tax in Australia estimated using VURMTAX (solid line), to the result derived by Cao *et al.* (2015, blue dot).

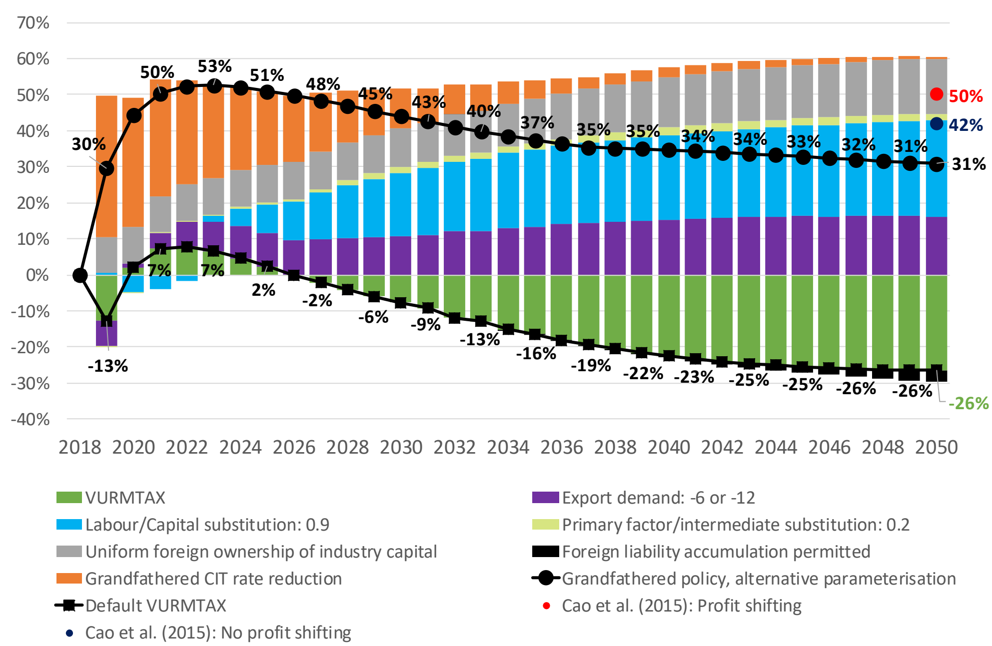

Figure 15: Terms of Trade, percentage deviation from the baseline forecast when the company tax rate in Australia falls by 0.4 percentage points from 30 per cent to 29.6 per cent.

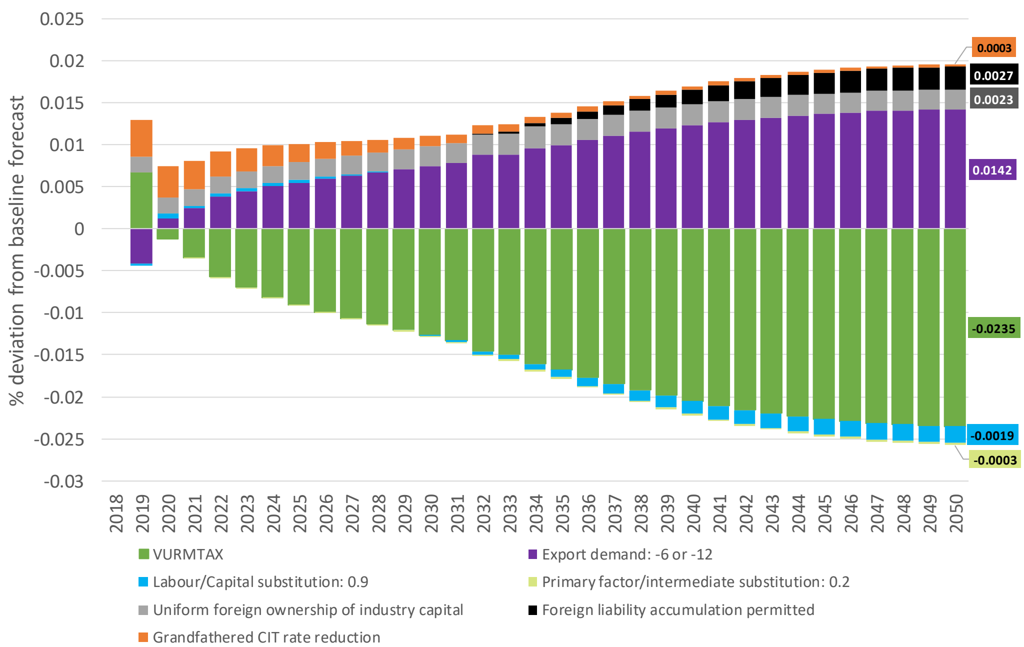

Figure 16: Real national income, percentage deviation from the baseline forecast when the company tax rate in Australia falls by 0.4 percentage points from 30 per cent to 29.6 per cent.

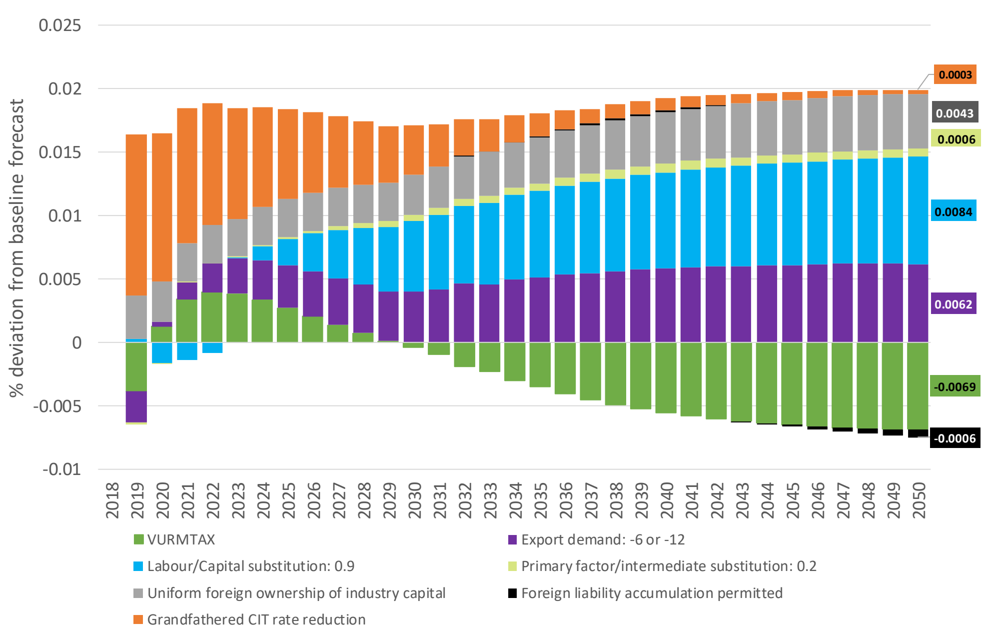

Figure 17: Capital stock, percentage deviation from the baseline forecast when the company tax rate in Australia falls by 0.4 percentage points from 30 per cent to 29.6 per cent.

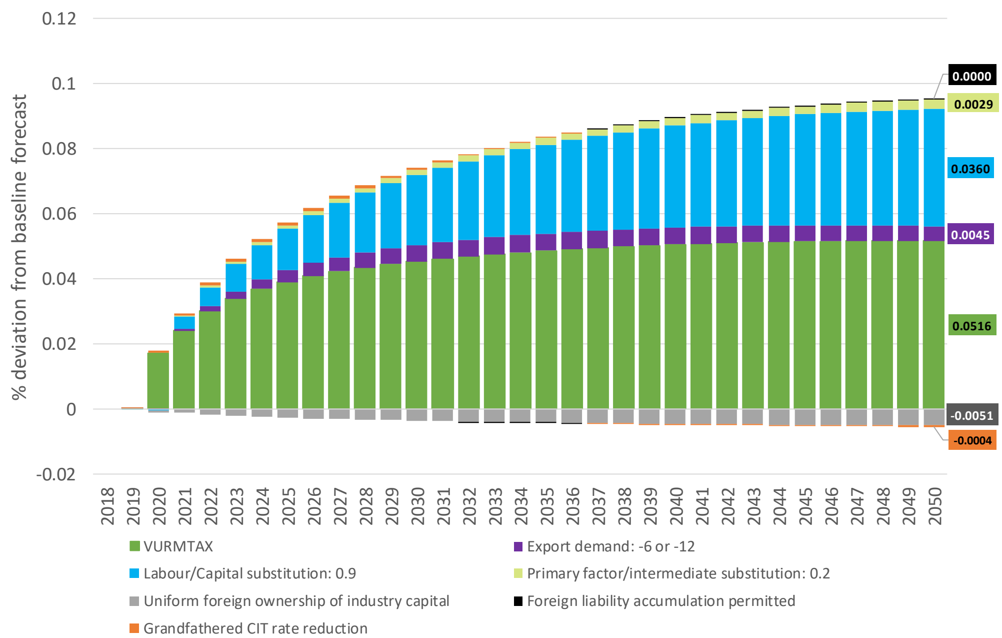

Figure 18: Real consumer wage, percentage deviation from the baseline forecast when the company tax rate in Australia falls by 0.4 percentage points from 30 per cent to 29.6 per cent.

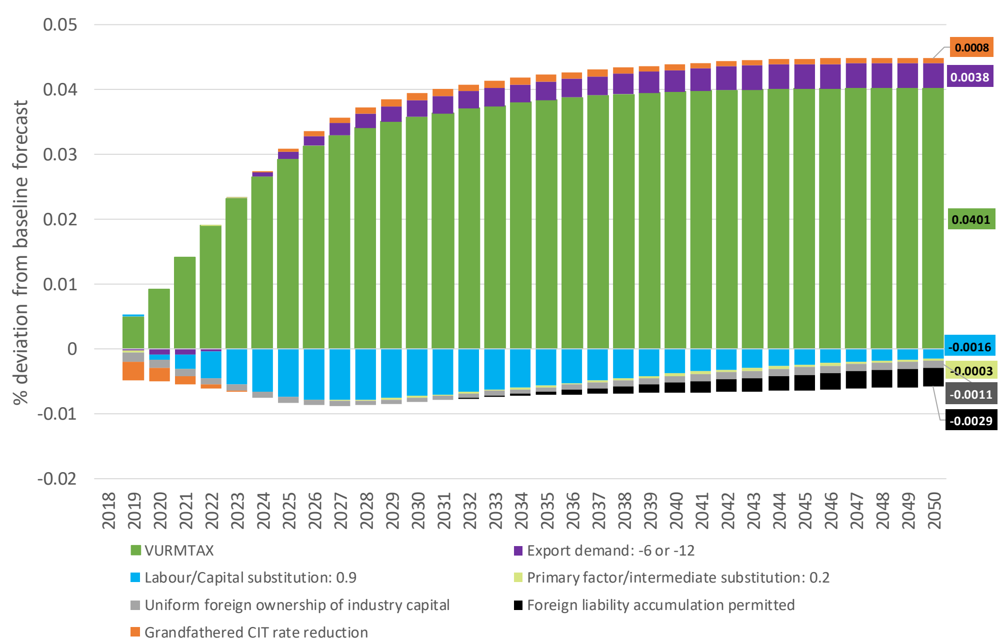

Figure 19: Employment, percentage deviation from the baseline forecast when the company tax rate in Australia falls by 0.4 percentage points from 30 per cent to 29.6 per cent.

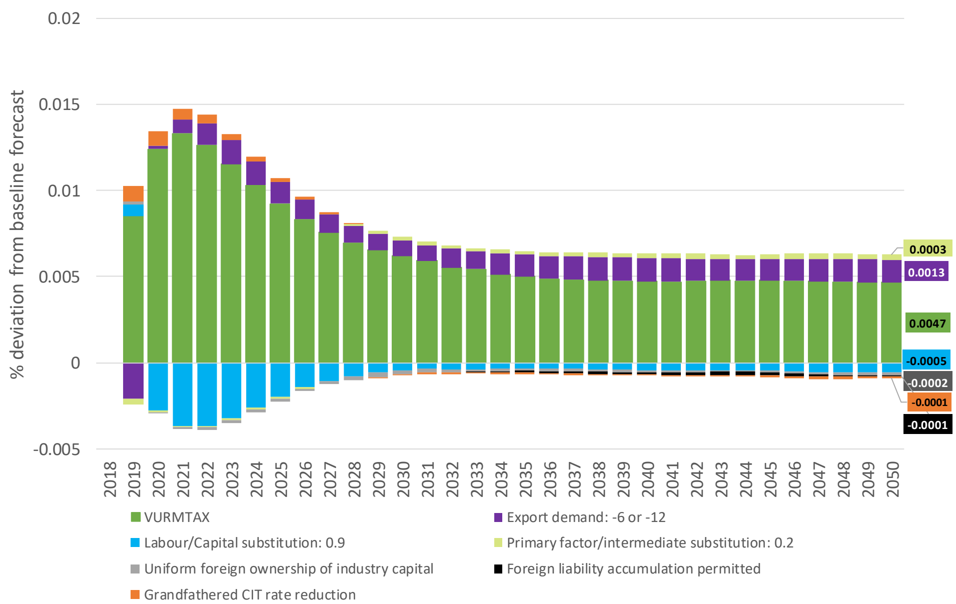

Figure 20: Foreign capital income account, A$m deviation from the baseline forecast when the company tax rate in Australia falls by 0.4 percentage points from 30 per cent to 29.6 per cent.