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UNDERSTANDING THE ECONOMY-WIDE EFFICIENCY AND INCIDENCE OF MAJOR AUSTRALIAN TAXES

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2 The views expressed in this paper are those of the authors and do not necessarily reflect those of the Australian Government.

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ABSTRACT

In recent years, a series of studies have been undertaken in Australia that use static general equilibrium models with a representative household to compare the relative efficiency of different Australian taxes. This paper aims to complement these earlier studies and contribute to a broader discussion about the structure of Australia's tax system by estimating the welfare cost and identifying the economic incidence of marginal changes to the tax system. Our estimates of the additional welfare cost of a marginal tax change (that is, the marginal excess burden) of major Australian taxes largely align with estimates reported in earlier Australian studies. Consistent with earlier studies, stamp duty on conveyances and the company income tax are the least efficient taxes (that is, they have relatively high marginal excess burdens), while the most efficient tax is a hypothetical broad-based land tax. We test the sensitivity of the ranking of the efficiency of major Australian taxes to a range of assumptions about economic agents and the structure of the Australian economy and find that the relative marginal excess burden of major Australian taxes is robust to a wide range of model parameters. Finally, we show that the incidence of major taxes is largely borne by workers through lower real wages caused by lower labour productivity.

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1. INTRODUCTION

The main taxes used in Australia to raise government revenue lead to losses in economic efficiency by distorting price signals and thereby changing the behaviours of individuals, firms and investors. In recent years, a series of studies have been undertaken in Australia that use static general equilibrium models to compare the relative efficiency of different Australian taxes (Access Economics, 2008 and 2011; KPMG, 2010 and 2011; Independent Economics, 2014; and Rimmer, Smith and Wende, 2014). This paper aims to complement these earlier studies and contribute to a broader discussion about the structure of Australia's tax system by estimating the additional welfare cost (that is, the marginal excess burden) and identifying the economic incidence of marginal changes to the tax system. We also analyse the sensitivity of these findings to a range of assumptions about economic agents and the structure of the Australian economy.

There are many approaches used in the published tax literature to estimate the marginal excess burden and economic incidence of taxation. Three broad approaches include: partial equilibrium analysis of one factor or goods market; micro-simulation analysis; and general equilibrium analysis. The general equilibrium analysis approach can be further categorised into static or dynamic analysis, with either a representative household or heterogeneous households. Each of these modelling approaches has strengths and weaknesses. For example, micro-simulation analysis is typically well suited to studying the distributional effects of taxation on heterogeneous households, but provides limited information on the effects of taxation on aggregate levels of economic activity because the models typically do not account for second round effects on other markets.[3]

This paper examines the incidence and efficiency of five Australian taxes using a static representative household general equilibrium model. The model used in this paper reflects Treasury's current general equilibrium modelling capacity for tax analysis.[4] The major strength of this widely-used approach, over partial equilibrium analysis, is that it examines interactions between different taxes and captures the second-round effects of taxes throughout the economy. Moreover, this approach analyses the economic effects of different taxes within a consistent framework which, at the very least, enables a comparison of the relative efficiency of different taxes in broad terms.

Nevertheless, representative household general equilibrium models are necessarily a simplification of the economy that cannot account for all of the diverse effects of taxation on the Australian economy and society more generally. For example, a significant limitation with the model used in this paper (as well as previous Australian studies that compared the efficiency of different taxes) is that it includes a single representative household. This means that the impact of the progressive individuals' income tax scales (or targeted transfer payments) cannot be examined in this model.

Another significant limitation of the model is that it ignores dynamics, that is, the transition paths from the immediate point of change to the tax system to the long-run equilibrium. Results from the model may overstate the welfare cost of tax increases because it does not account for any resource and

3 See Creedy and Duncan (2002) for further detail.

4 Treasury's current general equilibrium modelling capacity for tax analysis is limited to a static representative household general equilibrium model which was developed to provide analysis to the Business Tax Working Group (BTWG). For further detail see Australian Government (2012).

adjustment costs incurred along the transition path.[5] Accordingly, while such models are useful for drawing broad conclusions about the relative efficiency of various taxes, care needs to be taken about its application to policy development.

The broader tax analysis literature demonstrates that dynamic heterogeneous household general equilibrium models, such as overlapping generations (OLG) models, can capture important aspects of both household heterogeneity and transitional pathways. In particular, these models overcome some of the limitations with representative household static and dynamic, general equilibrium models by providing detail on the distributional, transitional and activity effects of changes in tax policy. OLG models are viewed in the public finance literature as the preferred modelling framework for policy analysis. This is a modelling direction that Treasury intends to explore further in the future.

The remainder of the paper is organised as follows. Section 2 describes the methodology used to analyse and estimate the marginal excess burden and incidence, which includes: a summary of the economy-wide model; a summary of the model calibration; and a brief discussion of how taxes have been captured in the model. Sections 3 to 7 then analyse the marginal excess burden and incidence of five major taxes: company income taxation, personal income taxation, goods and services taxation (GST), broad-based land taxation, and stamp duty on conveyances. Section 8 compares the relative efficiency of the five taxes and discusses the limitations with the analysis. Appendix A presents an extensive sensitivity analysis of the model's marginal excess burden estimates to key parameters.

2. METHODOLOGY

Taxes typically distort the functioning of capital, labour and goods markets which results in lower utility (that is, a loss of welfare). The size of the total welfare cost associated with a tax is reflected by its excess burden, which effectively measures the total loss of welfare implied by a major tax or a tax system. Economic policy does not typically contemplate the wholesale replacement of a major tax or a tax system. As such, the tax analysis literature, including this paper, typically focuses on the marginal excess burden, which captures the increment to the total welfare cost associated with one dollar of additional revenue from raising the tax rate of a given tax head.

There are many approaches used in the published tax literature to estimate the marginal excess burden and economic incidence of taxation. This paper examines the incidence and marginal excess burden of five Australian taxes using a static representative household computable general equilibrium (CGE) model. The main advantage of a CGE model over a partial equilibrium model is its ability to capture some of the main second round effects of taxes on households, firms and investors.[6] Another advantage of a CGE model is that it can capture interactions between different taxes. In this paper, we estimate the economy-wide effects of a marginal increase in tax rates on factor incomes, expenditure and welfare. The results from this CGE modelling are used to illustrate how different agents in the economy are affected by a marginal increase in certain taxes in the long-run and the ultimate cost to Australian households, which is summarised in estimates of marginal excess burdens.

5 See, for example, Mendoza and Tesar (1998).

6 Goulder and Williams III (2003) find that ignoring the general equilibrium or second round effects of tax can bias the marginal excess burden for a given tax.

Structure of the economy-wide model and key assumptions

The analysis reported here uses a revised version of the Independent Economics Computable General Equilibrium (IECGE) model, which is a static model of the Australian economy originally developed by Independent Economics. The version of the model used in this paper incorporates revisions to the original model by Treasury and Independent Economics in 2012 to capture more aspects of company income taxation.[7] Details of that model and analysis are reported in Rimmer et al. (2014). More recently, Treasury has made further revisions to this model. These revisions are described in the sections below on the economic agents, tax coverage and calibration of the model.[8]

There are four economic agents or decision makers represented in the model: a representative household; firms; government; and the foreign sector.

Household

For analytical tractability, Australian households are modelled via a single representative household which is calibrated in the model to match the expenditure and income patterns, and taxes faced by aggregate Australian households. This approach does not capture heterogeneous household types. Importantly, this assumption limits the modelling of the personal (or individuals) income tax to a stylised flat rate equal to the effective average tax rate and the average labour supply elasticity. Therefore, the model does not capture heterogeneous labour supply responses across different groups of taxpayers and the progressive tax rates scale on individuals' income. This will likely underestimate the marginal excess burden of personal income tax.

The representative household derives welfare (or utility) from leisure and the consumption of various goods and services. They are assumed to have a constant elasticity of substitution (CES) utility function between leisure and a consumption bundle, with the consumption bundle comprising an aggregation of a variety of goods and services which is also based on a CES function, where each good and service consumed is a CES bundle of locally produced and imported products. The household sells its labour services to firms (labour supply) and owns all domestically-owned capital (both fixed factors including land, location-specific factors (for example, natural resources) and firm-specific factors (for example, intellectual property) and variable capital such as structures and equipment) which it rents to firms. The household is also subject to taxation on labour and capital income, and purchases of goods and services.

The representative household maximises its utility subject to a budget constraint, which is a function of after-tax labour and capital income; franking credits; and lump-sum government transfers.

7 Independent Economics designed the overall economic structure of the model. In 2012, Treasury in collaboration with Independent Economics, incorporated more aspects of the company income tax system and calibrated the model to match the business tax data in 2012 for modelling commissioned by the Business Tax Working Group (BTWG).

8 The work presented in this paper was undertaken by the Treasury and should not be attributed to Independent Economics. Since the development of the original IECGE model, Independent Economics has separately undertaken model development. Independent Economics' updated model is titled the Extended IECGE model.

The model assumes a fixed domestically owned capital stock. Combined with the model's perfect international capital mobility assumption, the model implies domestic capital income is invariant to marginal changes to the personal income tax system. Our sensitivity analysis shows that the rival assumption of a fixed domestic savings rate yields very similar outcomes. Both these assumptions have been adopted in previous Australian studies (Access Economics, 2008 and 2011; KPMG, 2010 and 2011; and Independent Economics, 2014) that have examined the long-run economic costs of small changes in taxes using a static, economy-wide model.

Firms

The model identifies 111 different sectors, each of which produces a different good or service. The objective of each firm is to maximise its profits, given the prices of its output and all of its inputs. Production technology varies across sectors based on assumed multi-layered nested production structures and an appropriately specified elasticity of substitution at each level of the nest. Firms can employ up to 12 different primary factors: labour, eight types of produced capital and three fixed factors which are owned by domestic or foreign households.

Similar to Australian households, for analytical tractability firms are modelled via a single representative firm for each of the 111 different sectors. For industries where firms are largely homogeneous (for example, firms with similar production functions) this simplification has little effect. However, for industries where firms are of different sizes and have different production functions, this simplification will potentially reduce the accuracy of the modelling and the results.

Government

The government is assumed to collect all taxes and use the revenue for its consumption of goods and services. Real government spending on each good or service is held fixed. Government spending is assumed to not directly affect the welfare of households.[9] Finally, the Government is assumed to maintain a balanced budget via a lump sum transfer to households (that is, all increases in net revenue are redistributed to households via a lump-sum transfer). The public finance literature (see for example Musgrave 1959) refers to this closure assumption as 'differential incidence' since it captures the tax incidence from raising one tax and lowering another (in this case lump-sum taxation).

Foreign sector

Australia is assumed to be a small open economy in capital markets. Australia can access the global market for funds, so long as the after-tax rate of return on capital equals the global rate of return. We consider this to be a reasonable assumption for a static analysis of the long run impacts of taxes on welfare. Foreign households own part of Australia's variable capital and fixed factors.

Similarly, the model assumes Australia is to a large extent a small open economy in the goods markets. Specifically, Australia is assumed to be a price taker for imports, meaning that changes in the Australian economy do not influence the price of imports. Australia is effectively a price taker for exports, with a standard value for the export price elasticity of demand of -12. For some industries such as coal and iron ore, where Australia has some market power, a lower value of elasticity of -6 is used.

9 Real government spending is fixed across all scenarios in this paper, so adding it to the household utility function would not make any difference to the welfare calculations reported here.

Financial markets

Capital is financed by a mixture of equity and debt in fixed proportions. The after-tax return required on both debt and equity is equal to the global rate of return. The cost of capital for firms takes into account deductions for the cost of debt financing. It is therefore important that the mix of debt and equity is appropriately estimated for each industry. As such a debt-to-equity ratio has been estimated using ATO Taxation Statistics data (Australian Taxation Office, 2014). This ratio is assumed to be fixed (and discussed further in the calibration section below).[10] This allows the model to account for greater tax deductions in industries which have higher debt-to-equity ratios.

Equilibrium

All markets are assumed to clear: wages adjust to clear the labour market; capital supply, via inflows or outflows of foreign capital, adjusts to ensure the after-tax rate of return on capital employed for domestic production is equal to the global required rate of return; and expenditure prices adjust to clear goods and services markets.

Consumption and investment must be sustainable in the long-run. For example, the level of net exports must be sufficient to fund the foreign income account.

The CGE model used here is a comparative static framework. This means it provides analysis of the change in the economy from its current long-run equilibrium (calibrated to actual data) to a new long-run equilibrium under the new tax regime (that is, when capital, labour and goods markets have fully adjusted to the policy change). As such, it does not provide an indication of the time it takes to achieve the new equilibrium or the potential resource or adjustment costs incurred along this transition path. In general, tax changes that imply changes to the capital stock will involve an adjustment cost, with static marginal excess burden estimates overstating the true welfare loss.

Company tax analysis undertaken by Kudrna and Woodland (2010) using a dynamic model suggests that roughly half of the adjustment (reflected by the rate of capital accumulation) to a capital tax change is completed in 10 years, with the full adjustment largely completed in 30 years. It is reasonable to expect faster adjustment to tax changes that imply relatively small changes to investment (or the capital stock) and relatively large changes to consumption.

Tax coverage and calibration

The economy-wide model incorporates five of Australia's major taxes. It captures the complexity of these taxes to varying degrees. The taxes we examine comprise:

- company income tax, incorporating some complexities in the company income tax system;
- a stylised flat income tax on individuals' labour and capital (termed 'personal income tax' throughout this paper) which ignores heterogeneity in labour supply across different groups of taxpayers and the progressive individuals' income tax scale;

10 The marginal excess burden would likely be higher if tax changes caused the firm's debt equity funding choice to change.

- the goods and services tax (GST) on the current base, with fresh food, health services, education, childcare, as well as water, sewerage and drainage services, GST-free;
- a hypothetical broad-based land tax, similar to municipal rates levied by local governments (and the Australian Capital Territory), but not reflective of the current state land tax regimes; and
- stamp duty on conveyances.

Payroll taxes are also a significant source of taxation revenue to state governments in Australia. Payroll taxes were not examined in this paper because of the complexity of exemptions and concessions across different states. Other studies that have examined payroll taxes using a CGE framework include KPMG (2010 and 2011).[11]

Company income taxation

The model reflects many features of the company tax system, including: deductibility of interest payments; revenue clawback through dividend imputation; depreciation allowances that reflect an historical cost basis and other aspects of tax laws; expensing of certain investments; and foreign tax credit arrangements. As such it captures the effects of the company tax system on: the size of the capital stock in each industry; the mix of capital types; labour supply (for a single representative household); the location of multinational profits; and the location of multinational firm-specific assets, such as intellectual property.

Profit-shifting is also incorporated in the model. This is done by allowing companies to reduce their business tax liability by shifting profits from Australia to countries with lower rates of business tax. Following De Mooij and Devereux (2011) we model profit shifting that captures both transfer pricing and tax havens. All else equal, the existence of profit shifting implies a smaller company income tax base. Achieving a given amount of revenue, therefore, requires a higher company income tax rate under profit-shifting. This implies a higher marginal excess burden for the company income tax.

Personal income taxation on labour and capital

Personal income tax is modelled as a flat rate equal to the effective average tax rate on household income. This simplification is a by-product of the design of the CGE model, which includes a single representative household. A major limitation with the modelling is that it does not capture the progressive individuals' income tax scales in Australia, which is expected to have implications for the efficiency of personal income taxation. The transfer system and the impacts of the withdrawal of payments on effective marginal tax rates is also beyond the scope of this paper, but is nevertheless important in broader discussions about the economic effect of different taxes.

We model both the labour income and capital income component of the personal income tax system, with a common flat tax rate applied to labour and capital income.[12] Capital income is assumed to be

11 In a CGE model, a broad-based payroll tax would be expected to have a similar economic incidence as the flat personal income tax captured in this model. See KPMG (2010) for more information. The flat labour income tax captured in our CGE model is not calibrated to capture payroll tax receipts.

12 We leave it to future research to model observed differences in the effective tax rates of capital and labour incomes.

received by capital owners (domestic and foreign households) wholly in the form of dividends.[13] The household utilises franking credits against tax paid under the company income tax, with the balance taxed at the flat personal income tax rate. The model does not capture deductions claimed against assessable income or the concessional tax treatment of some forms of income. This means that the average flat tax on labour and capital income calculated within our model is lower than the observed average tax rate on taxation income in administrative data. However, the model does incorporate income received in the form of transfer payments from Government and assumes that these payments are not subject to personal income tax.

The distortions and efficiency costs arising from tax planning and minimisation are also outside the scope of this analysis.

The personal income tax is a balancing item in the model.[14] Personal income tax receipts in the model are estimated to be $5 billion higher than the reported total personal income tax revenue of around $160 billion in the ABS Taxation Revenue, Australia 2012-13 (ABS Cat. No. 5506.0). The model derived average tax rate on personal income is estimated to be 16.7 per cent.

Goods and services taxation

The model separately identifies the goods and services tax (GST) from general indirect taxation.[15] The effective GST rates are based on product-based tax receipts from the ABS Input-Output tables (ABS Cat. No. 5209.0.55.001). These tables cover taxed intermediate inputs, household final consumption expenditure and private gross fixed capital formation. This treatment allows us to analyse the effect of both rate changes and base-broadening.

Hypothetical broad-based land tax

Land taxes are modelled as a stylised broad-based land tax which is calibrated to include municipal rates on all properties and a broad-based land tax on all investment properties levied on the unimproved value of land. The model recognises that the value of land is determined by the flow of services from its use, which means the broad-based land tax can be modelled in the long-run as a tax on the rental income from land. Working towards that end, the current version of the model has been extended to include a broad-based land tax in the form of a rental income tax on land which is collected before company income tax.

The model has two types of land: residential and non-residential land.[16] Residential land is only used by the Ownership of Dwellings sector, while non-residential land is used by all other industries. While the total supply of each type of land is fixed, the utilisation of land can be increased through greater investment in structures. Finally, the supply of non-residential land at the sectoral level can vary, with land allocated via the rental market to its most productive use.

13 There is no 'retained capital earnings' in the model, as it represents a long-run steady-state of the economy.
14 This is required for the government's budget to be balanced in the model. Other taxes are calibrated to administrative or statistical data.
15 The earlier version of the model used for the BTWG included the GST into a general indirect tax.
16 Residential land includes owner occupied housing land and rented residential land, while non-residential land includes urban land for commercial use and land for primary production.

The effective rate of the broad-based land tax is calculated based on land and municipal tax revenue, with different effective tax rates for residential and non-residential land. However, the rate of the non-residential broad-based land tax is uniform across all industries as more detailed data do not exist. The model incorporates foreign ownership of non-residential land, but there is currently no allowance for foreign ownership of residential land. The foreign ownership share of total factor income from land is estimated to be around 10 per cent.[17]

Stamp duties on conveyances

Stamp duties are a tax paid on the value of an asset when ownership is transferred, often inclusive of the value of any capital improvements. Stamp duty on conveyances is currently levied on the transfer of motor vehicles, insurance, and land and structures. The analysis reported here only focuses on stamp duty on conveyances levied on the transfer of land and structures.

It is inherently difficult to capture this type of capital transaction tax in a model with a single representative agent. The approach adopted here treats real estate services as an investment good which improves the productivity of the firms, including the housing sector. One way of thinking about this is that real estate agents play a valuable role in finding producers that value the capital the most. Therefore a potential owner will be willing to pay a real estate fee equal to the profit they will enjoy over the previous owner. Within this setting the conveyance duty is treated as a tax on the value of investment and subsequent productivity gains facilitated by the transfer of land and structures. We demonstrate that the return on investment is the same for a tax on investment or a tax on capital income (for example, company income tax) with the same rate. However, the investment tax will collect less revenue than the capital income tax and is therefore less efficient (that is, implies a larger marginal excess burden).

It is important to keep in mind that the approach taken here captures some of the efficiency costs of stamp duties associated with the distortion to value creating transactions. As such, the analysis aims to illustrate the potential efficiency impacts of stamp duties.

Model calibration and key economic parameters

To a large extent the model used in this paper relies on the calibration of the model used for the BTWG. Details of that calibration are reported in Independent Economics (2012).

The model is broadly calibrated to the 2007-08 Input-Output Tables (ABS Cat. No. 5209.0.55.001), and further uprated to the 2013-14 National Accounts (ABS Cat. No. 5206.0). These data determine the baseline distribution of income across factors of production, and the distribution of household expenditure and international trade in goods and services. Where possible, elasticities of substitution incorporated in the representative household's utility function and various production functions are based on published empirical studies.

We highlight some of the key business and household modelling assumptions below.

17 The after-tax rate of return on land is invariant to the tax change. Hence, it is assumed that foreign and domestic land owners do not alter their holdings in response to a tax change.

Degree of international capital mobility

Our baseline parameterisation assumes perfect international capital mobility. This is consistent with the typical approach of long-run CGE analysis. We demonstrate in Appendix A that the marginal excess burden of the company income tax rate is sensitive to this assumption, with imperfect capital mobility implying a lower marginal excess burden for the company income tax.

Share of foreign ownership of firms

The share of foreign ownership of firms in the model is calibrated using gross foreign ownership of businesses. This requires us to calculate foreign liabilities excluding households and government. We do so by estimating the indirect liabilities of households and governments to foreigners through banks, securitises and central borrowing authorities using historical data from ABS National Financial Accounts (ABS Cat. No. 5232.0).

We estimate that gross foreign liabilities excluding those of households and government were $637 billion at June 2008. Given a total capital stock of roughly $3 trillion, this implies that 20.7 per cent of domestic firms were owned by foreigners.

Data limitations force us to assume homogenous foreign ownership shares of firms across the economy. We undertake sensitivity analysis for the share of foreign ownership of firms in Appendix A.

Share of factor income earned by fixed factors

In addition to land, the model includes both location- and firm-specific fixed factors of production. The firm-specific fixed factors reflect the rents generated by intangible assets such as brand names, patents and market power. Location-specific fixed factors are inputs that are fixed in supply to any particular industry, such as natural resources. Each industry uses a different type of location-specific fixed factor. For example, each industry within the mining sector will use a different type of natural resource — the coal industry requires coal resources and the iron-ore industry requires iron-ore resources. Fixed factors generate location-specific economic rents, which are unable to be obtained unless they are exploited within Australia.

Generally, returns to location- and firm-specific fixed factors are those that are not able to be attributed to other forms of capital. Hence these fixed factors are often referred to as excess returns or economic rents.

To estimate the excess returns on the measured stock of capital we first calculate the normal returns and assume any remaining returns are due to the location- and firm-specific fixed factors. In calculating the normal return we use the economy-wide after-tax required rate of return from the model. This is used to calculate the before-tax required rate of return for each industry. The before-tax required rate of return differs across industries because their capital structure and debt levels vary.

Estimating the magnitude of excess returns for different industries and in the whole economy is difficult. Furthermore, the existence of rents in any particular year may be due to temporary factors. This effect is somewhat mitigated by calculating the excess returns over a 20 year period.

Based on detailed industry data reported by the ABS in Capital Stock by Industry (ABS Cat No. 5204.0) and Factor Incomes by Industry (ABS Cat. No. 5204.0), location-specific fixed factors are estimated to account for just over 5 per cent of GDP (or around a seventh of total gross operating surplus) in the

baseline calibration. For comparison, factor income derived from land accounts for around 3 per cent of GDP.

The elasticity of consumption and leisure

Conditional on the labour-leisure ratio, the elasticity of substitution between consumption and leisure is calibrated to achieve an uncompensated elasticity of labour supply with respect to the after-tax wage that is broadly in line with econometric estimates (see Table 1).

Specifically, the uncompensated elasticity of labour supply is given by:

$$\varepsilon_{N,w} = \frac{\gamma}{1-\gamma}\left(\sigma(1-\beta)+\beta-\frac{H}{(H+M)}\right) \quad (1)$$

where σ is the elasticity of substitution between consumption and leisure in the CES utility function (equal to 1.2 in the baseline), γ is the share of total hours devoted to leisure (equal to 33 per cent in the baseline), β is leisure's share of utility (equal to around 30 per cent), H is the after-tax value of total household hours and M is other income from capital and transfers. The choice of 1.2 for the consumption-leisure elasticity gives an uncompensated elasticity of labour supply of 0.15, which is slightly lower than the 0.2 assumed in Independent Economics (2014).

We undertake sensitivity analysis for the substitution between consumption and leisure in Appendix A.

Table 1: Published labour supply elasticities

Population group	Studies	Estimates	Range	Mean	Median	Standard Deviation
Married men	5	14	-0.19 to 0.26	0.00	0	0.13
Married women	11	27	-0.19 to 1.3	0.30	0.18	0.35
Single men	1	1	0.28	0.28	0.28	-
Single women	1	1	0.34	0.34	0.34	-
Lone parents	3	6	-0.15 to 1.48	0.52	0.2	0.75

Source: Dandie and Mercante (2007)

Debt equity ratio

The model incorporates a different tax treatment for debt and equity financed investment. In particular, the current tax system allows for deductions on the interest paid on debt financed investment, with no similar allowance for equity financed investment.

While in practice firms receive deductions for interest paid on all debt, or on their gross debt position, some of these are offset by the additional tax liability faced as a result of holding debt of other entities. The deductions on debt repayments reduce tax liability while interest received on debt held increases it. As a result the net debt position of a firm or industry is used as the base from which the effect of deductions can be calculated. The net debt position for each broad industry is calculated from unpublished ATO administrative data.

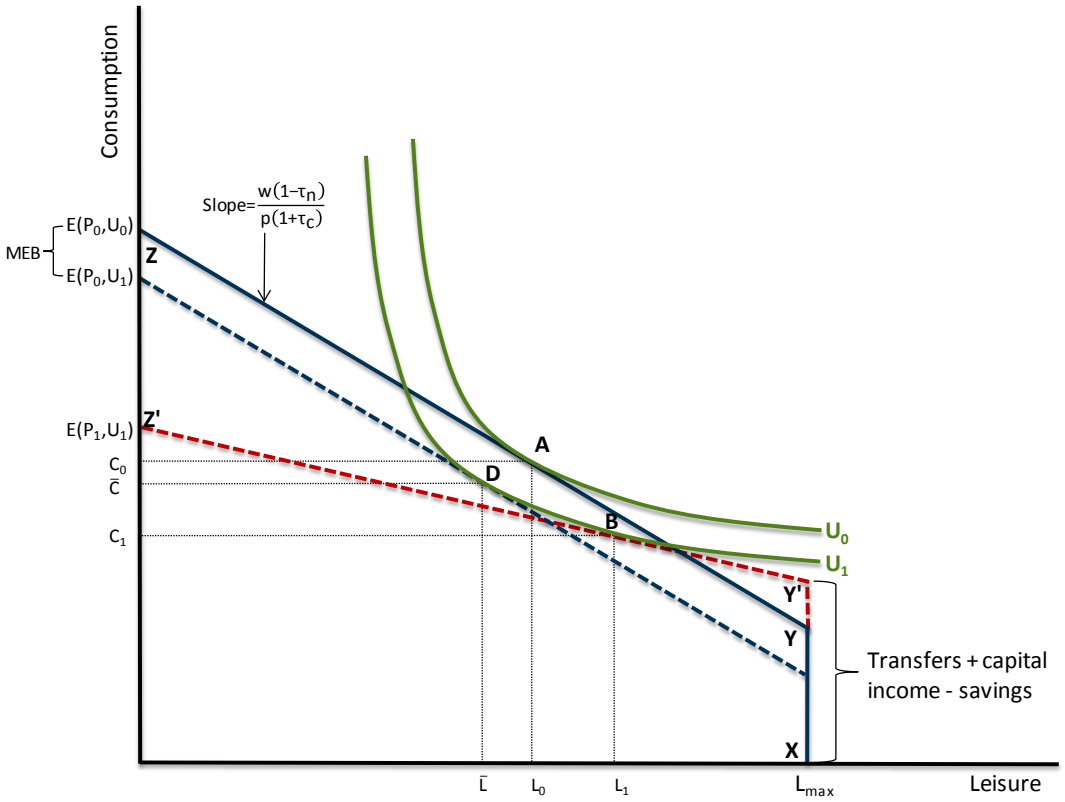
Measuring the marginal excess burden of taxation

The representative household captured in the model maximises its utility by consuming a variety of goods and services (hereafter their consumption bundle) and leisure time subject to a budget constraint. Figure 1 demonstrates the typical utility maximising solution for the representative household. The household effectively faces the budget constraint represented by: the vertical segment XY equal to the sum of the household's net transfer receipts and after-tax capital income less savings, with the total expressed in terms of after-tax consumption prices; and the sloped segment YZ, which reflects after-tax labour income, with the slope equal to the after-tax real wage:

$$\frac{w(1-\tau_N)}{p_C(1+\tau_C)} \tag{2}$$

where: w is the wage; p_c is the price of consumption goods and services; τ_N is the flat labour income tax rate payable by the household; and τ_c is the consumption tax rate payable by the household.

Figure 1: Measuring the marginal excess burden of taxation



The optimal consumption-leisure bundle is given by the tangency of the highest feasible indifference curve U_0 and the household's budget constraint, with the utility maximizing outcome given by A. At this point the household's consumption is equal to C_0 and leisure is equal to L_0.

The value of the household's consumption-leisure bundle in terms of consumption units can also be measured via the household's expenditure function. The expenditure function, denoted by $E(P_0,U_0)$, gives the minimum value of the optimal consumption-leisure bundle (that is, A) associated with price

vector P_0 and utility level U_0.[18] The value is expressed in terms of the model's numeraire which is the after-tax consumption price.

Following the broader tax literature we estimate the marginal excess burden of a tax by raising the rate of an existing tax, which is part of a broader tax system, by an amount sufficient to generate one dollar of additional net revenue (that is, enough to increase government tax revenue across all taxes by one dollar).[19] The additional net tax revenue is redistributed to the household via a lump-sum transfer.

We can use Figure 1 to analyse the effects of a marginal tax change on household welfare. With the exception of the land tax, the typical marginal tax change implies a lump-sum transfer of tax revenue that exceeds the fall in the after-tax capital income less savings, which increases the vertical segment of the household's budget constraint. The typical tax change also directly or indirectly causes the household's after-tax real wage to fall. These effects are captured in the budget constraint given by XY' and Y'Z', with the consumption axis intercept at $E(P_1,U_1)$. The optimal consumption-leisure bundle under the marginal tax change is given by the tangency of the highest feasible indifference curve U_1 and the household's budget constraint (that is, XY' and Y'Z'), with the utility maximizing outcome given by B. Under the tax change the relative price of consumption rises, so the household substitutes away from consumption (that is, consumption falls from C_0 to C_1) towards leisure (that is, leisure rises from L_0 to L_1). The value of this consumption-leisure bundle in terms of consumption units is $E(P_1,U_1)$, with P_1 denoting the price vector after the marginal tax change.

We follow the CGE tax analysis literature by measuring the marginal excess burden (MEB) of a marginal tax rate change as the negative of the increment to the total welfare cost of the tax system. The additional welfare cost is measured by the equivalent variation (EV) which is defined as follows:

$$EV = E(P_0,U_1) - E(P_0,U_0) \tag{3}$$

where: P_0 is the vector of prices, including taxes, before the tax change; U_0 is the maximum level of household utility achieved before the tax change; and U_1 is the maximum level of utility achieved after the marginal tax change.

This implies the marginal excess burden is:

$$MEB = -EV = E(P_0,U_0) - E(P_0,U_1) \tag{4}$$

The marginal excess burden can be thought of as the amount (in consumption units) that the household would be indifferent about paying in lieu of the marginal tax change.

The marginal excess burden associated with the marginal tax rate change analysed in Figure 1 can be represented graphically. The value of the expenditure function $E(P_0,U_1)$ is reflected by the consumption axis intercept of the dashed blue line, which is parallel to the pre-tax change budget constraint (that is, the expenditure function is evaluated at the pre-tax change prices P_0) and tangent to the post-tax change indifference curve at D (that is, the expenditure function is evaluated at the post-tax change

18 For more detailed discussion of the properties of the expenditure function, see Mas-Colell, Whintson and Green (Section 3, 1995).

19 Specifically, the rate of the tax under consideration is increased by 0.1 per cent. The resulting estimates are then scaled by the change in the lump sum transfer, which ensures the MEB is normalised to a one dollar increase in the lump sum transfer to the household.

utility U_1). The marginal excess burden associated with the marginal tax change is then the vertical distance between $E(P_0,U_0)$ and $E(P_0,U_1)$, that is, using the notation in Figure 1 the marginal excess burden can be expressed in consumption units as follows:

$$MEB = (C_0 - \overline{C}) + \frac{w_0(1-\tau_{n0})}{p_{c0}(1+\tau_{c0})} \cdot (L_0 - \overline{L}) \quad (5)$$

where $w_0(1-\tau_{n0})/(p_{c0}(1+\tau_{c0}))$ is the after-tax real wage under the baseline prices (that is, the prices before the marginal tax change). It also is important to note that the after-tax consumption price is calibrated to be 1 in the baseline (that is, $p_{c0}(1+\tau_{c0})=1$), which means the marginal excess burden is measured in dollars.

Identifying the economic incidence of taxation

An important consideration in taxation design is the economic incidence of a tax change. The legal and economic incidence of a tax does not always coincide: agents that are legally responsible for paying a tax can directly or indirectly pass the tax burden on to other agents. In a general equilibrium framework tax changes affect not only supply and demand in the market directly affected by a tax, but potentially demand and supply in other markets. For example, an increase in the tax on the income of an elastically supplied factor of production will reduce its demand and will in turn reduce the demand for complementary factors of production, which will cause their rental prices (and factor incomes) to fall. If one were to analyse just the buyers and sellers in the first factor market, they would ignore the economic costs borne by buyers and sellers in the other factor markets.

This paper exploits the expenditure function approach underlying the marginal excess burden calculation by further decomposing the value of household consumption into changes in after-tax factor incomes, savings and transfers. As such the tax incidence is notionally measured in terms of the effect on workers and capital owners.

3. COMPANY INCOME TAX

The legal incidence of the company income tax is on firms who own both variable capital and fixed factors of production such as land and economic rents.[20] Under a company income tax firms pay a percentage of their profits, allowing for various deductions, to government. Firms themselves are owned by both domestic residents and foreign investors. Domestic residents receive franking credits for company income tax paid on dividends, which means company income tax is essentially a withholding tax.

20 The model has two types of land: residential and non-residential land. Residential land is only used by the Ownership of Dwellings sector, while non-residential land is used by all other industries. While the total supply of each type of land is fixed, the utilisation of land can be increased through greater investment in structures. Finally, the supply of non-residential land at the sectoral level can vary, with land allocated via the rental market to its most productive use.

Theory and key assumptions

We assume that Australia is a small open economy with a fixed domestically owned capital stock.[21] Importantly we assume that Australia faces a perfectly elastic supply of international capital at the global required rate of return (r_w). We consider this to be a reasonable assumption for a static analysis of the long run impacts of taxes on welfare (we explore the sensitivity of this assumption in Appendix A).

The company income tax drives a wedge between the before-tax rate of return and after-tax rate of return. In the case of a small open economy subject to perfect capital flows, the before-tax rate of return will be high enough to ensure the after-tax rate of return equals the global required rate of return:

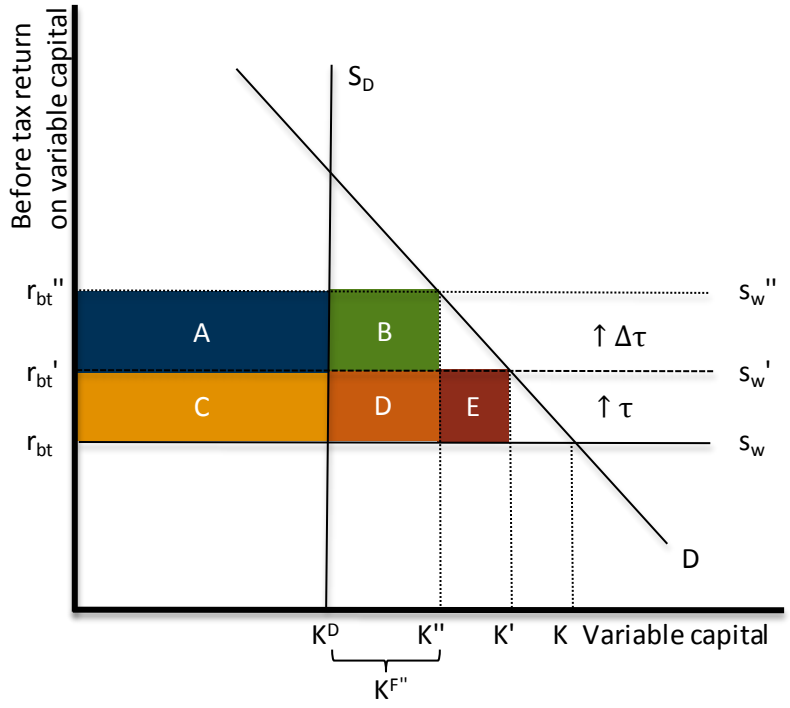
$$r_{bt} = \frac{r_w}{(1-\tau_K)} \tag{6}$$

In other words, the after-tax return of foreign investors is always the global rate of return. This effect is captured in Figure 2. Starting at the global supply curve S_W without tax, the before-tax rate of return r_{bt} is equal to r_w, with total capital equal to K. With the fixed domestic savings assumption, the capital stock held by Australian residents does not change. The domestic savings schedule is captured by S^D, with the domestically owned capital stock equal to K^D. This implies foreign owned capital is equal to $K\text{-}K^D$. The imposition of a tax causes the after-tax rate of return of Australian capital to fall below the global rate of return. This will cause a capital outflow. Assuming diminishing returns to variable factors, the lower capital stock will result in higher productivity of capital and a higher after-tax rate of return. The capital outflow will end when the after-tax rate of return is equal to the global rate of return required by foreigners, which implies the higher before-tax rate of return r_{bt}' at the new equilibrium capital stock of K'< K. The company tax revenue in this case is equal to sum of C, D and E.

Figure 2 also plots the response of the Australian variable capital market to a marginally higher company tax rate. Starting at the effective global supply curve S_W' at the before-tax rate of return r_{bt}' a higher company income tax rate will cause the after-tax rate of return of Australian capital to fall below the global rate of return. Again, this will cause a capital outflow. The lower capital stock will result in higher productivity of capital and a higher before-tax rate of return, with the new equilibrium at r_{bt}" and K".

21 Our sensitivity analysis shows that the rival assumption of a fixed domestic savings rate yields very similar outcomes.

Figure 2: Company income tax — Variable capital market response



A higher tax rate implies the change in company income tax revenue from foreign owned variable capital is B minus E, while company income tax revenue from domestically owned variable capital rises by A.

It is important to keep in mind that the company income tax revenue from domestically owned capital is largely returned in the form of franking credits, with the resulting income taxed at the personal income tax rate. Holding the personal income tax rate constant, this analysis implies a higher company income tax rate raises the return to domestic owners of variable capital.

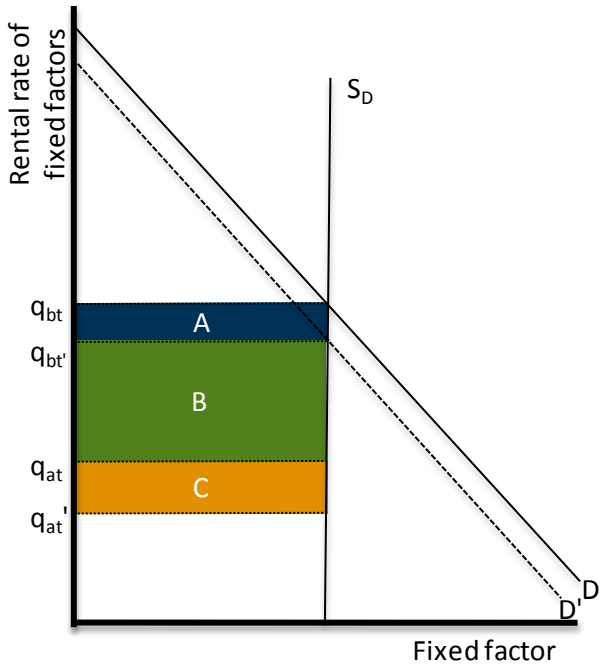
Consistent with the variable capital analysis reported here, Johansson, et al. (2008), in their survey of taxation and economic growth note that raising sourced-based capital income (such as the company income tax) in an open economy tends to reduce and distort domestic investment. In contrast, they note that resident-based capital income tax (such as the franked company income tax through the personal income tax system) may discourage saving without affecting domestic investment. They go on to state that taxes on personal income may affect investment decisions by small firms that can only access domestic saving. Given that most investment is undertaken by large firms with access to international funds, changes to personal income taxes are likely to have a small effect on investment. At the same time, they note that empirical evidence on the sensitivity of savings to the change of the after-tax rate of return on capital is inconclusive. This suggests that the assumption of a fixed domestic owned capital stock is reasonable.

Firms also use fixed factors such as land, firm-specific and location-specific factors.[22] The fixed factor markets are affected by a change in the company income tax rate in two ways: directly by driving a

22 These factors are assumed fixed in the long-run. However, factors such as the firm-specific factor could vary in the short run.

wider wedge between the before- and after-tax rental rates; and indirectly by lowering the demand for fixed factors.

Figure 3: Company income tax — Fixed factor market response



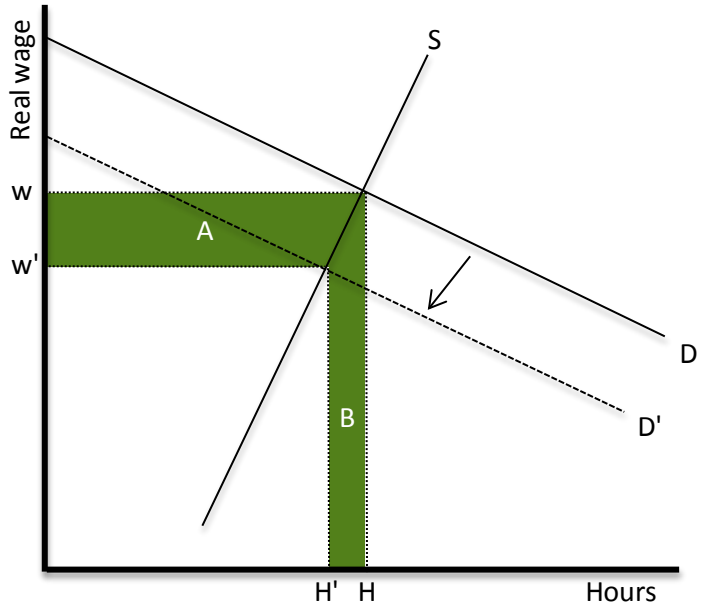
The reduction in the variable capital stock, caused by a higher rate of company income tax, reduces the productivity of fixed factors and thus the demand for fixed factors. The change in demand in Figure 3 is captured by the shift in the demand curve from D to D'. This leads to a reduction in the before-tax rental rate with equilibrium restored at $q_{bt}' < q_{bt}$. The owners of fixed capital are also subject to the capital income tax. At the initial before-tax rental rate of q_{bt} the revenue collected by the government is equal to A and B, implying an after-tax rental rate of q_{at}. Capital income will fall with the tax change, with the new after-tax rental rate of $q_{at}' < q_{at.}$ The change in tax revenue is equal to C minus A, with total revenue being C plus B. Again, it is important to keep in mind that the capital income tax paid by domestic capital owners is largely returned through franking credits, which offsets the direct effect on the proportion of domestically owned fixed factors.

While the company income tax is directly levied on firms the second round effects in the labour market are generally important for economic welfare.[23] The smaller capital stock following the tax change reduces the productivity of labour and therefore the demand for labour, which is captured in Figure 4 by the shift in demand from D to D'. Equilibrium is restored in the labour market at lower real wages given by w'<w, which in turn causes labour supply to fall to H'<H.

Empirical studies find that labour supply is relatively inelastic, which implies the decline in real wages will be proportionately larger than the reduction in hours. Overall, the loss in labour income is represented by the sum of A and B in Figure 4. In terms of the welfare effect on the labour market, the decrease in hours implies an increase in leisure.

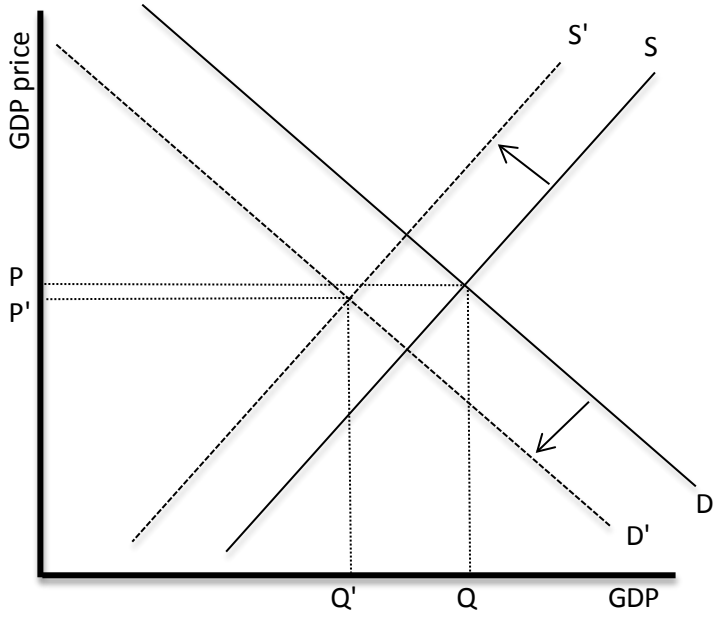
23 See, for example, the seminal study by Lucas (1990).

Figure 4: Company income tax — Labour market response



In aggregate we would expect a capital tax change such as a change to the company income tax to ultimately cause a decrease in both the supply of and demand for goods and services as shown in Figure 5. This implies an aggregate reduction in activity and therefore GDP. As detailed above the decreased supply is caused by a lower capital stock and also lower working hours, while the decreased demand is caused by a lower labour income. Given that both supply and demand decline, the aggregate price effect is uncertain. In Figure 5 we assume a slight decrease in the aggregate price, which is consistent with the results reported below and suggests the demand effect is larger than the supply effect.

Figure 5: Company income tax — Goods market response



This discussion demonstrates the complex nature of identifying incidence in an economy-wide setting, with a direct tax on capital income affecting labour income, and ultimately the supply and demand of goods and services.

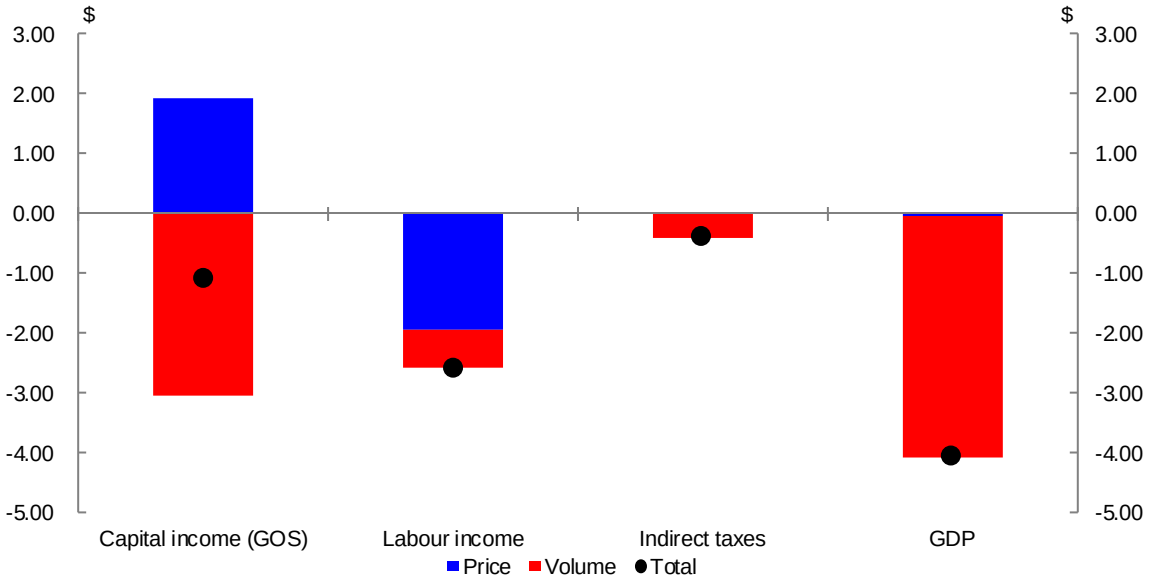
Results

We analyse the marginal excess burden and incidence of the company income tax by modelling a marginal increase in the company income tax rate sufficient to raise one dollar of revenue from all taxes, holding all other tax rates unchanged. Consistent with the marginal excess burden discussion in Section 2, all prices and values are denominated in after-tax consumption prices (that is, the model's numeraire is the after-tax consumption price).

Activity

The model's measure of before-tax capital income is the gross operating surplus (GOS). Chart 1 plots the change in GOS due to the change in the rental price of capital and in the real capital stock (that is, volume). In the long run, a higher company income tax rate causes a comparatively larger decrease in the capital stock which can be seen by the volume decrease (also see Figure 2). This is partially offset by the rise in the before-tax rental price of capital. Overall the value of before-tax capital income is down by around one dollar per dollar of net revenue raised.

Chart 1: Company income tax — Income from GDP response



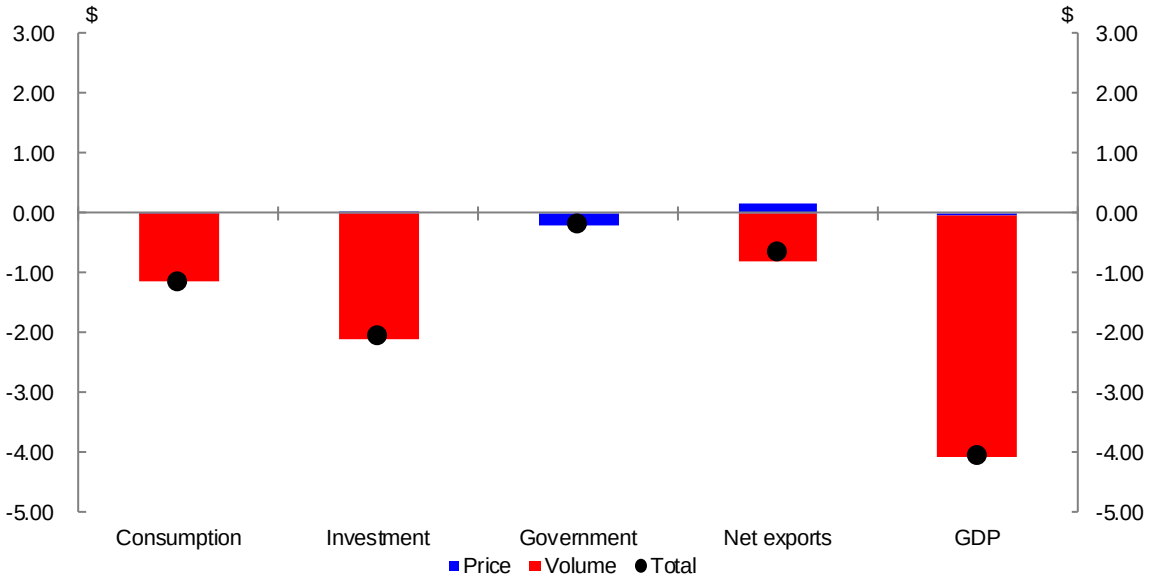
Source: Treasury estimates.

As noted above, the decrease in the capital stock drives down the productivity of labour and therefore the demand for labour and before-tax real wages (also see Figure 4). The reduction in the demand for labour means less labour is employed resulting in a decrease in working hours. Overall, before-tax labour income (that is, the compensation of employees — COE) falls by around three dollars per dollar of net revenue raised.

The combined decrease in labour and capital incomes implies a decrease in real and nominal GDP of around four dollars per dollar of revenue raised.

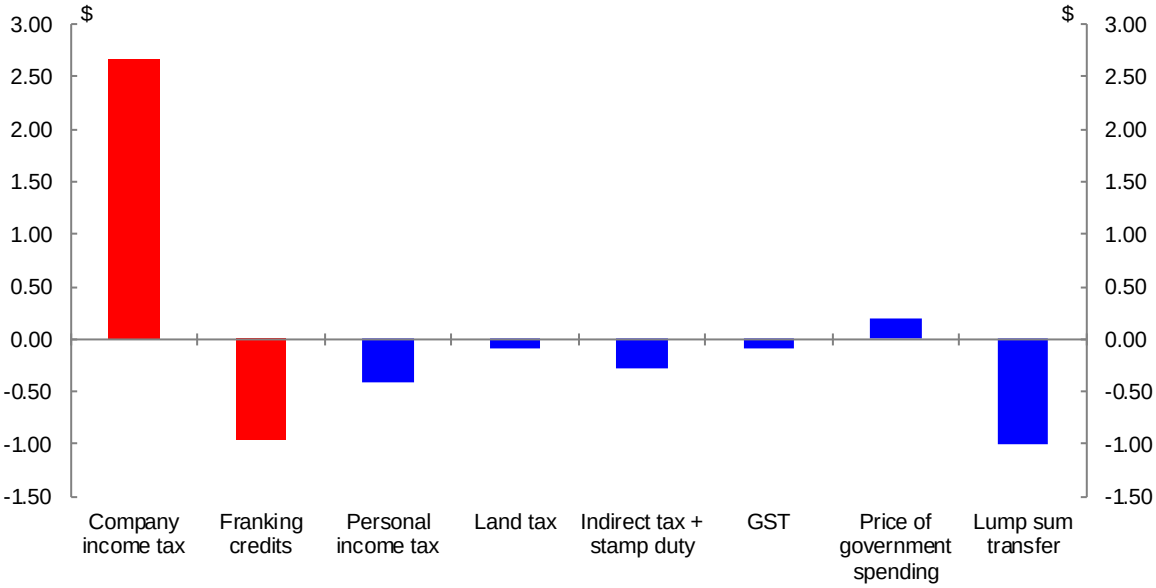
On the expenditure side, much of the decreased activity flows from lower investment (Chart 2). This reflects the fact that a lower level of investment is required to maintain the reduced long-run capital stock. Consumption falls by over a dollar per dollar of revenue raised. There is also a small decline in the value of government spending (that is, General Government final demand). Since the volume of government spending is fixed, this result is driven entirely by the decline in the price of government expenditure. This price fall reflects the fact that the government expenditure basket is biased towards more labour intensive services and the real wage falls relative to the after-tax consumption price.

Chart 2: Company income tax — Expenditure on GDP response



Source: Treasury estimates.

Chart 3: Company income tax — Government budget response



Source: Treasury estimates.

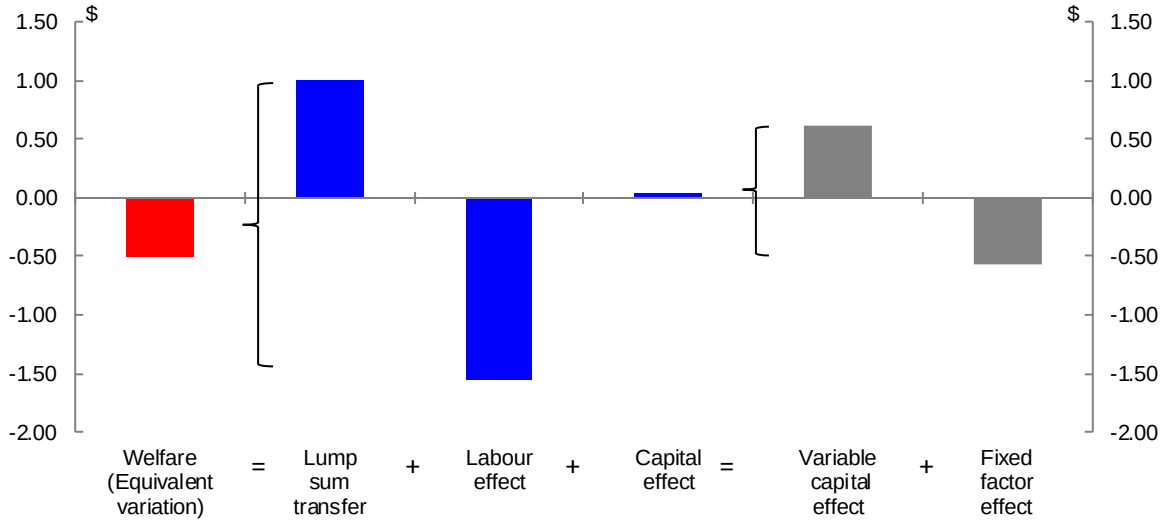
The changes to incomes and activity allow us to identify changes to the government's budget position via its income account. Chart 3 shows that around 2.7 dollars of company income tax must be collected

per dollar of net revenue. However, one dollar of this additional company income tax revenue is lost immediately through increased franking credits, so the net company tax revenue is roughly 1.7 dollars. The decline in wages and working hours causes a fall in the revenue from the flat personal income tax of around 40 cents per dollar of net revenue. This is accompanied by a smaller decline in indirect tax, including GST, and also the broad-based land tax driven by the general decline in activity. The one dollar increase in net revenue is used to fund a one dollar increase in lump-sum transfers to the household, which returns the governments' budget to balance.

Marginal excess burden and incidence

Household welfare is derived from the consumption of goods and services, and leisure. Consistent with Section 2, changes to leisure are measured by pricing leisure at the baseline after-tax wage. An increase in the company income tax rate implies an overall welfare loss of around 50 cents per dollar of net revenue (Chart 4). When viewed from the standpoint of the notional owners of the factors of production, we find that the marginal excess burden is largely borne by workers through lower real wages. Domestic capital owners on the other hand, receive a welfare improvement due to the slight increase in after-tax capital income net of savings.

Chart 4: Company income tax — Marginal excess burden and incidence

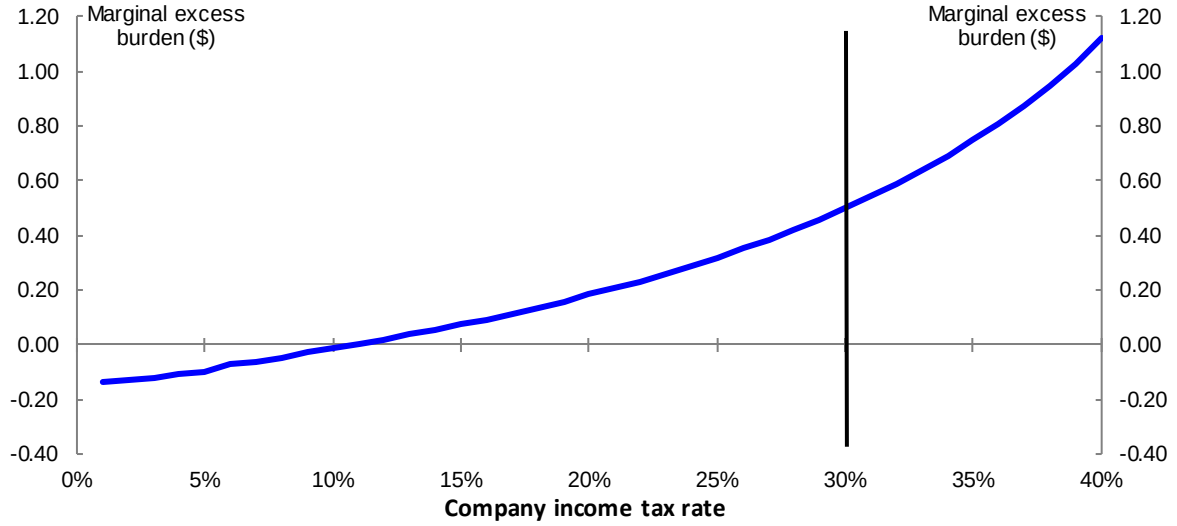


Source: Treasury estimates.

After-tax capital income, which in net terms is slightly greater than zero, can be decomposed into two components: returns to variable capital and returns to fixed factors. Incomes accruing to fixed factors decrease by around 57 cents. The tax increase lowers the demand for the fixed factors, decreasing both the before- and after-tax rates of return. Conversely, the return on variable capital increases by around 62 cents. This result is driven by the small open economy assumption and franking credits. An increase in the company income tax rate means that the before-tax rate of return on capital has to rise so that the after-tax rate of return received by foreign investors matches the globally available rate of return. However, as domestic residents receive franking credits they effectively receive the before-tax rate of return meaning their return increases with the before-tax rate of return. A fixed domestically owned variable capital stock combined with a higher before-tax return and franking credits implies domestic income from variable capital increases despite the increase in the company income tax rate.

Previous empirical research has shown that the marginal excess burden of a tax rises as the tax rate increases, with marginal excess burdens rising more steeply as tax rates are raised higher (see, for example, Creedy, 2003). Chart 5 reports the results of model simulations that suggest this result extends to company income tax in Australia.[24] We also find that below a certain rate the company income tax has a negative marginal excess burden, which implies that the company income tax is welfare improving at these low rates. This result is driven by the foreign ownership of fixed factors of production. Specifically, taxing the returns on foreign-owned fixed factors results in a transfer of income from foreigners to domestic residents which improves the welfare of the domestic household. At low company income tax rates this welfare gain outweighs any welfare cost caused by the distortion inherent in the company income tax. However, the rate at which the company income tax diminishes welfare is sensitive to some of the parameters in the model.

Chart 5: Company income tax — Marginal excess burden at varying rates



Source: Treasury estimates.

Comparison with other studies

Table 2 reports the marginal excess burden based on the baseline calibration, along with the results of the sensitivity analysis (see Appendix A for details). The highest and lowest estimates from the sensitivity analysis are highlighted in red and green respectively. The high sensitivity result comes from altering the calibration of fixed factors in the model by assuming there are no location- or firm-specific fixed factors. The low sensitivity result comes from assuming a low elasticity of substitution between consumption and leisure.

24 Chart 5 is generated by changing the model's initial company tax rate, while holding revenue constant via either a lump-sum transfer for tax rate increases or a lump-sum tax for tax rate decreases. The marginal excess burden of the company tax is then calculated at the new tax rate.

Table 2: Company income tax — Marginal excess burden comparison

	Company income tax MEB ($)
Baseline	0.50
Sensitivities: Parameters governing firm behaviour	
Economic rents	
Low rent share	**1.35**
High rent share	0.32
Foreign ownership of firms	
Low foreign ownership	0.71
High foreign ownership	0.28
Capital mobility	
Imperfect capital mobility	0.30
Profit shifting	
Low profit shifting	0.42
High profit shifting	0.62
Structures-land substitution elasticity	
Low elasticity	0.21
High elasticity	0.55
Capital-labour substitution elasticity	
Low elasticity	0.30
High elasticity	0.79
Sensitivities: Parameters governing household behaviour	
Labour-leisure ratio (N:L = 2:1)	
Medium (N:L = 1:1)	0.65
Low (N:L = 1:2)	0.82
Consumption-leisure substitution elasticity	
Low elasticity	**0.20**
High elasticity	0.90
Consumption good substitution elasticity	
Low elasticity	0.49
High elasticity	0.51
Savings decision (fixed domestically owned capital stock)	
Fixed saving rate	0.50
Literature estimates	
KPMG (2010)	0.40
KPMG (2011)	0.37
Independent Economics (2014)	-

Source: KPMG (2010), KPMG (2011) and Treasury estimates.
Note: Independent Economics (2014) does not report a marginal excess burden for the company income tax.

Table 2 also compares the results from this paper with estimates from other recent Australian studies.[25]

25 Estimates from Access Economics (2008 and 2011) are not included in Table 2 as they only report relative marginal excess burdens of taxes rather than absolute marginal excess burdens.

The results from the baseline calibration suggest the marginal excess burden of the company income tax is higher than that estimated by KPMG (2010 and 2011). This is likely due to the fact that the model used in this paper incorporates features which tend to raise the marginal excess burden, such as international profit-shifting, that were not common in earlier studies.

4. PERSONAL INCOME TAX ON LABOUR AND CAPITAL INCOME

The personal income tax system includes the taxation of both labour and capital income. It is difficult to incorporate progressivity in a model with a representative household, so the modelling reported here assumes a single effective tax rate (hereafter a flat personal income tax) that is applied to labour income and capital income after franking credits. In general progressivity raises the marginal excess burden of a tax, which implies the marginal excess burden of the modelled personal income tax will understate the welfare cost of raising revenue via the actual personal income tax.

As noted in Section 3, the perfect capital market and fixed domestic capital stock assumptions imply the capital income component of the personal income is invariant to changes in personal tax rates. Therefore, the distortionary part of the personal income tax modelled in this paper is effectively the labour income tax component. Given this observation we analyse the labour income tax component separately.

Theory for a flat labour income tax

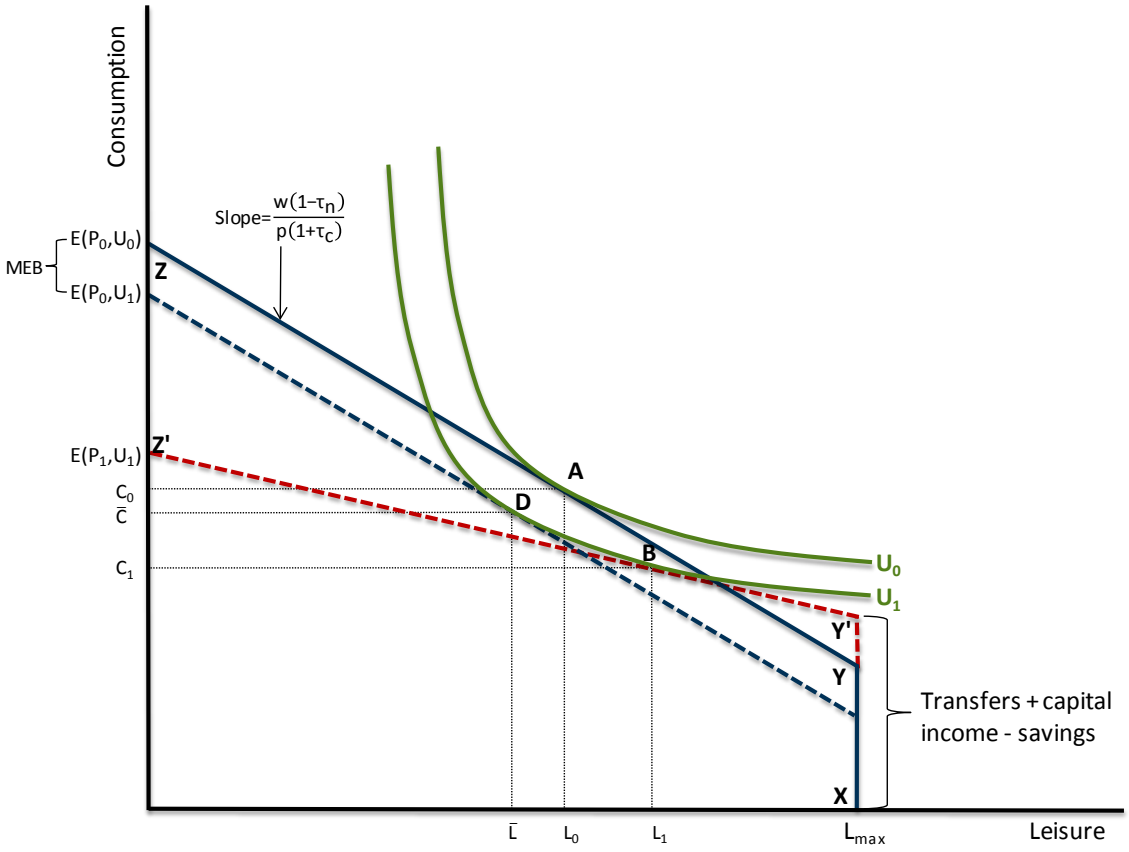
The primary distortionary effect of a labour income tax is on the household's choice between the consumption of goods and services and leisure. Following Section 2, the feasible set of consumption/leisure bundles is defined by the household's budget constraint, which reflects household income from all sources and the relative prices between the two options, which is the after-tax real wage:

$$\frac{w\left(1-\tau_N\right)}{p_C\left(1+\tau_C\right)} \tag{7}$$

where: w is the wage; p_c is the price of consumption goods and services; τ_N is the flat labour income tax rate payable by the household; and τ_c is the consumption tax rate payable by the household.

Figure 6 demonstrates the utility maximising solution for the representative household. The household effectively faces the budget constraint represented by: the vertical segment XY equal to the sum of the household's net transfer receipts and after-tax capital income less savings, with the total expressed in terms of after-tax consumption prices; and the sloped segment YZ, which reflects after-tax labour income, with the slope equal to the after-tax real wage.

Figure 6: Flat labour income tax — Marginal excess burden and activity response



The optimal consumption-leisure bundle is given by the tangency of the highest feasible indifference curve U_0 and the household's budget constraint, with the utility maximizing outcome given by A. At this point the household's consumption is equal to C_0 and leisure is equal to L_0. The value of this consumption-leisure bundle in terms of consumption units is $E(P_0,U_0)$, with P_0 denoting the price vector before the tax change.

Similar to the discussion regarding company income tax on page 11, we demonstrate below that a labour income tax change leads to a lump-sum transfer that exceeds the fall in after-tax capital income less savings, which increases the vertical segment of the household's budget constraint, and directly or indirectly causes the household's after-tax real wage to fall. These effects are captured in the budget constraint given by XY' and Y'Z', with the consumption axis intercept at $E(P_1,U_1)$. The optimal consumption-leisure bundle under this budget constraint is given by the tangency of the highest feasible indifference curve U_1 and the household's budget constraint, with the utility maximizing outcome given by B. Under the marginal tax change the relative price of consumption rises, so household's substitute away from consumption (that is, consumption falls from C_0 to C_1) towards leisure (that is, leisure rises from L_0 to L_1). The value of this consumption-leisure bundle in terms of consumption units is $E(P_1,U_1)$, with P_1 denoting the price vector after the marginal tax change.

The marginal excess burden associated with the labour income tax change is equal to the vertical distance between $E(P_0,U_0)$ and $E(P_0,U_1)$, denoted by MEB.

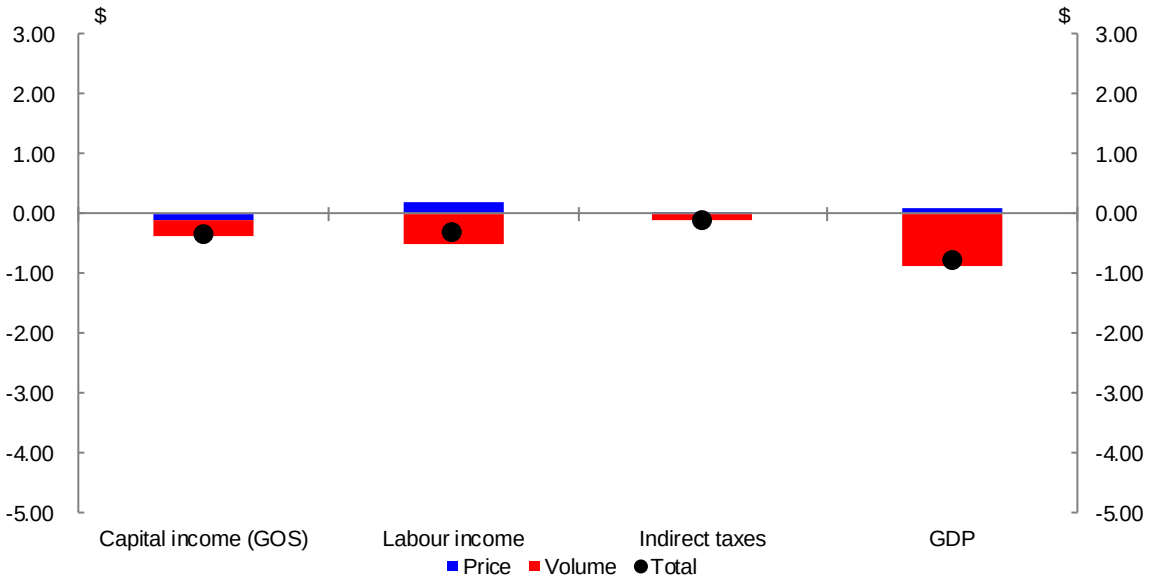
Results for a flat labour income tax

We analyse the marginal excess burden and incidence of the labour income tax component of the personal income tax system by modelling a marginal increase in the flat tax rate applied to labour income sufficient to raise one dollar of net revenue from all taxes.

Activity

Chart 6 suggests that the long run effect of raising the flat labour income tax rate on factor incomes is smaller than the change of the company income tax rate scenario. The initial decrease in the supply of labour is partially offset by a slight rise in the before-tax real wage, with an overall fall in before-tax labour income. Labour and capital are complements, so the lower labour input also reduces the marginal product of capital and its rate of return, which results in an outflow of capital from the domestic economy. This is reflected in the fall in before-tax capital income (that is, GOS) in both volume and price terms. Similarly, reduced consumption has a negative effect on indirect taxes. In aggregate, there is a modest decline in real GDP compared to the company income tax rate scenario and a slight increase in the GDP deflator.

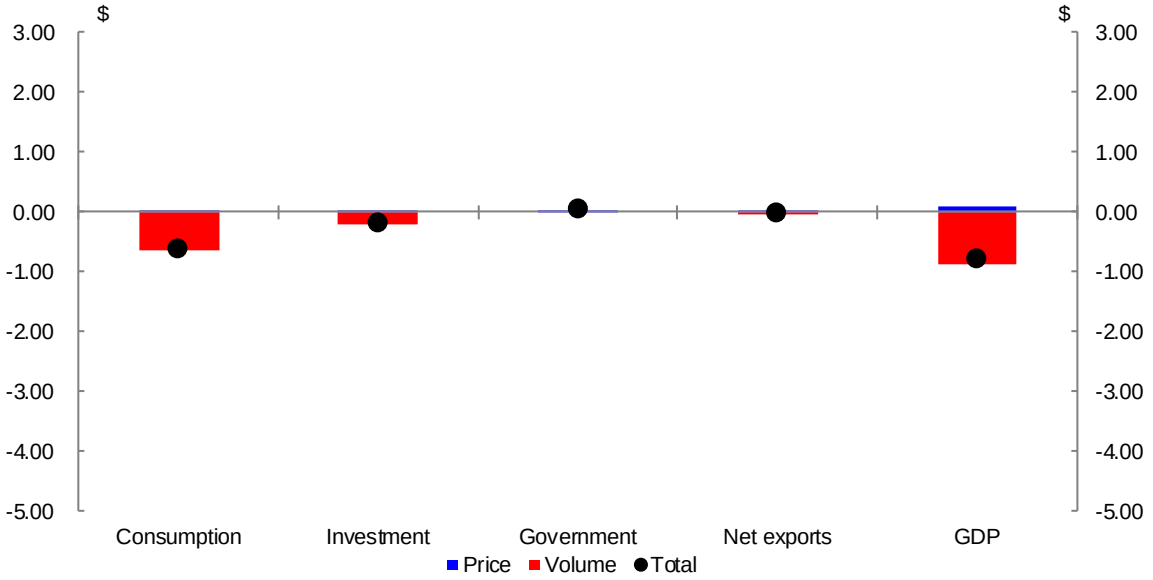
Chart 6: Flat labour income tax — Income from GDP response



Source: Treasury estimates.

On the expenditure side, much of the decreased activity flows from a reduction in consumption. This is complemented by a small decrease in investment due to the fall in the capital stock (Chart 7). Both consumption and investment fall by less than one dollar per dollar of revenue raised, while government spending and net exports are largely unaffected.

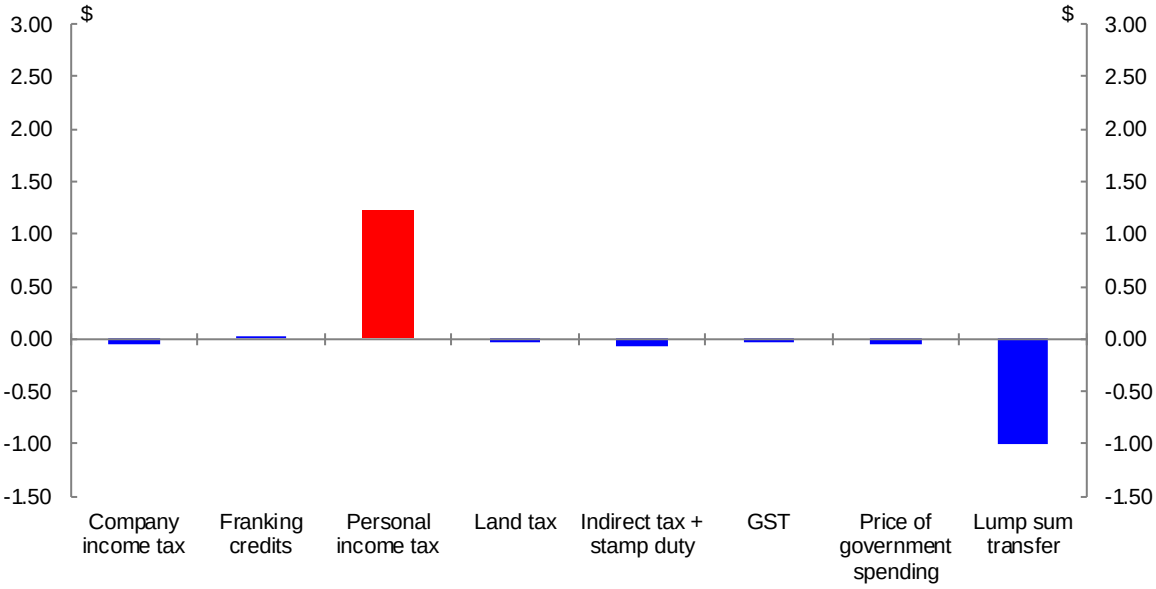
Chart 7: Flat labour income tax — Expenditure on GDP response



Source: Treasury estimates.

Unlike the case of the company income tax, the flat labour income tax rate increase has a relatively small effect on other revenue sources (Chart 8).

Chart 8: Flat labour income tax — Government budget response

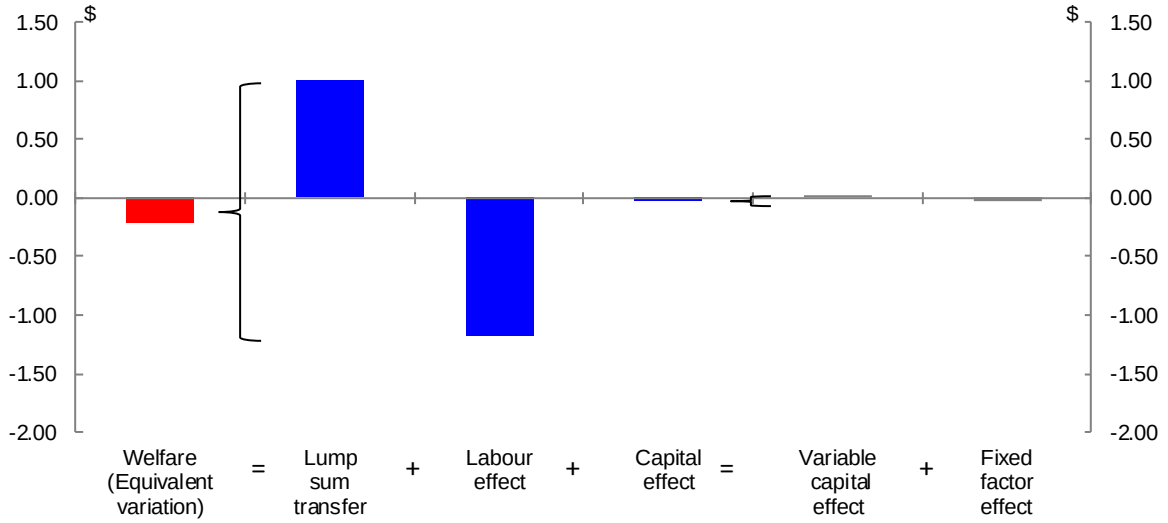


Source: Treasury estimates.

Marginal excess burden and incidence

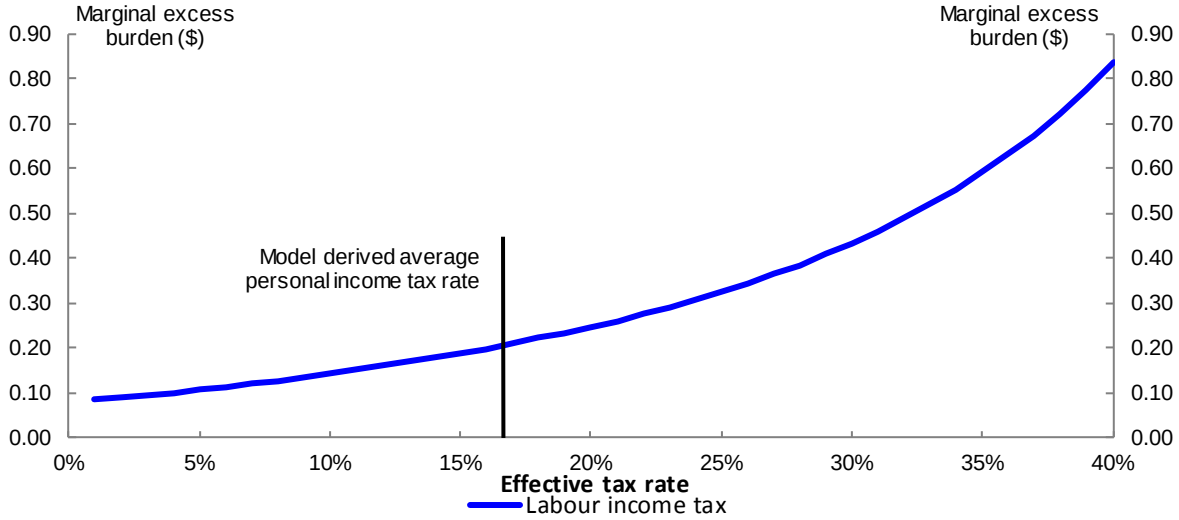
Household welfare declines as a result of this tax increase, with the marginal excess burden of the flat labour income tax equal to 21 cents per dollar of the net revenue raised (Chart 9). Again, the incidence is largely borne by workers with the welfare loss driven by the fall in after-tax labour income as a result of the decrease in the after-tax real wage rate. This is partially offset by the increased lump-sum transfer from the government to the household. The effect on after-tax capital income, albeit small, is also negative, reflecting lower fixed capital income.

Chart 9: Flat labour income tax — Marginal excess burden and incidence



Source: Treasury estimates.

Chart 10: Flat labour income tax — Marginal excess burden at varying rates



Source: Treasury estimates.

Chart 10 reports the results of model simulations which show how the marginal excess burden of a flat labour income tax increases as the rate rises. The chart also shows that the marginal excess burden does not tend towards zero as the rate goes to zero. This reflects the fact that the marginal excess burden of a tax also depends on other taxes in the economy. In particular, the labour income tax component of the personal income tax system and the GST distort the economy through changes in the after-tax real wage, which can be rewritten as an additive labour-consumption tax:

$$\frac{w(1-\tau_N)}{p_c(1+\tau_C)} \approx \frac{w(1-(\tau_N+\tau_C))}{p_c} = \frac{w(1-\tau_{NC})}{p_c} \qquad (8)$$

where $\tau_{NC} = \tau_N + \tau_C$.

This suggests that the marginal excess burdens of the labour income tax and the GST are broadly additive: as the rate of the flat labour income tax goes to zero, the ongoing presence of the GST means that the marginal excess burden of the flat labour income tax tends to 8 cents, which is approximately

equal to the change in the marginal excess burden of the GST from reducing the GST rate from 10 per cent to slightly above zero (see Chart 20 below).

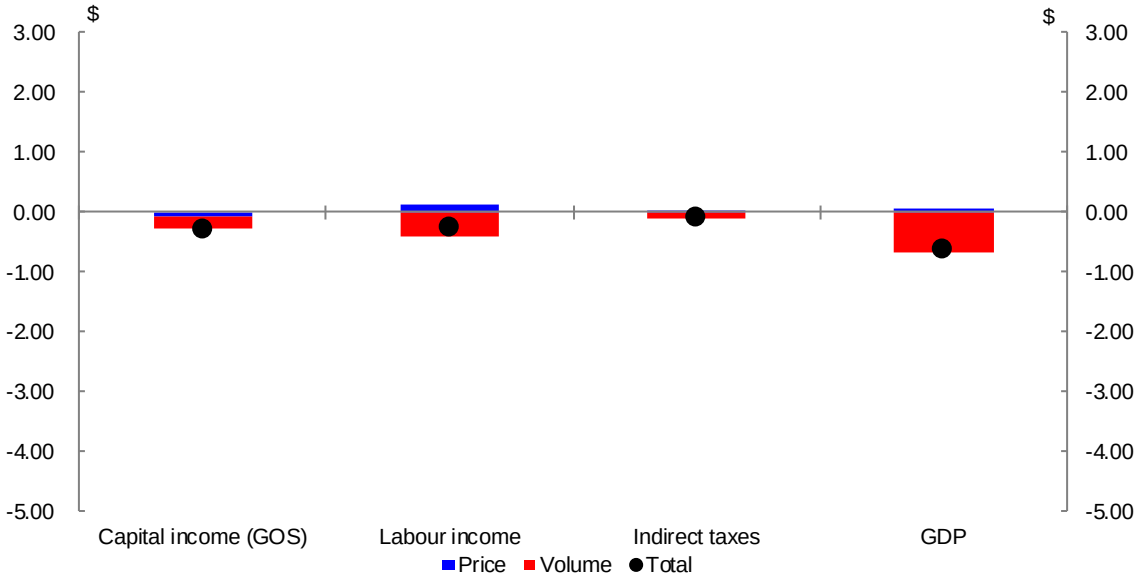
Results for the flat personal income tax

We analyse the marginal excess burden and incidence of the flat personal income tax by modelling a marginal increase in the effective personal income tax rate on both labour and capital income sufficient to raise one dollar of net revenue from all taxes.

Activity

Chart 11 reveals that the long-run effect of raising the flat personal income tax rate on factor income is slightly smaller than that from the change to the labour income tax rate component.

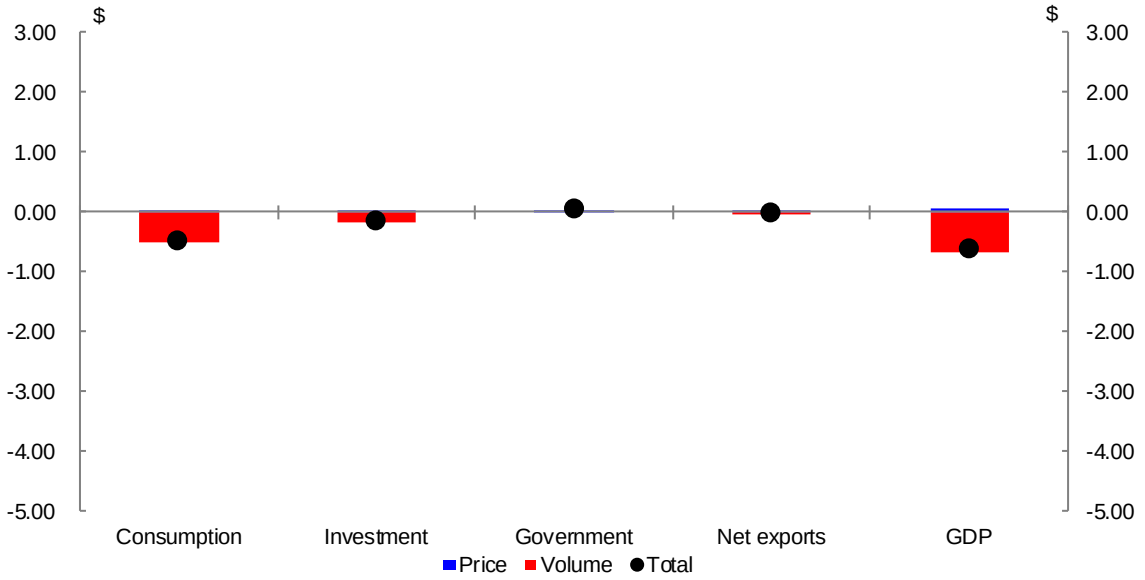
Chart 11: Flat personal income tax — Income from GDP response



Source: Treasury estimates.

On the expenditure side, Chart 12 reveals slightly smaller responses when compared with the flat labour income component tax change.

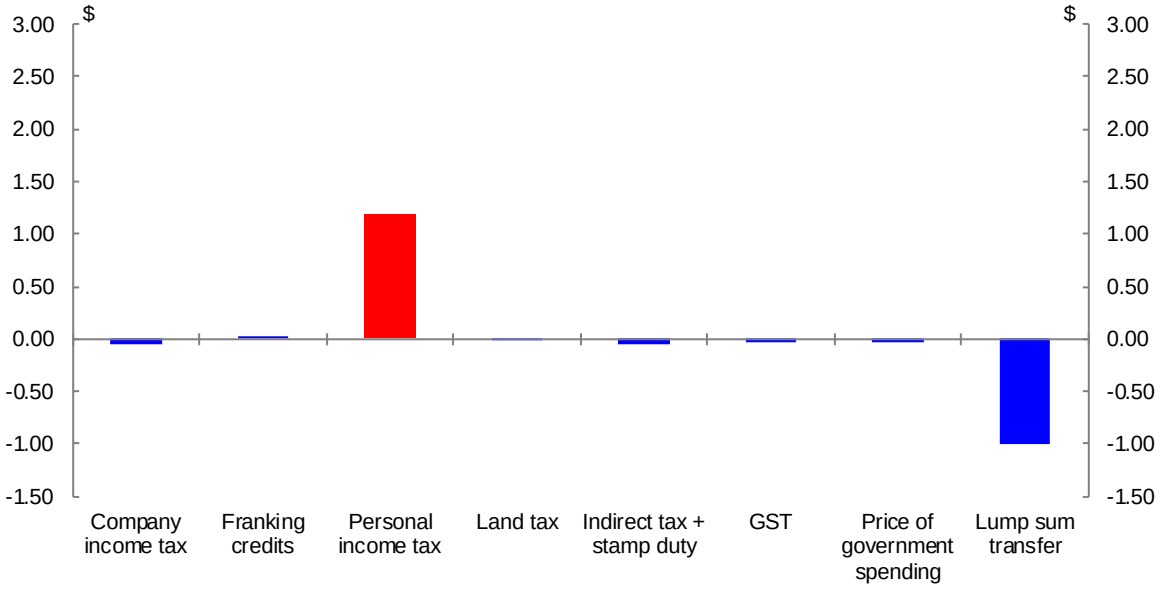
Chart 12: Flat personal income tax — Expenditure on GDP response



Source: Treasury estimates.

Similarly, an increase to the flat personal income tax rate applied to both labour and capital income has a relatively small effect on other revenue sources (Chart 13).

Chart 13: Flat personal income tax — Government budget response

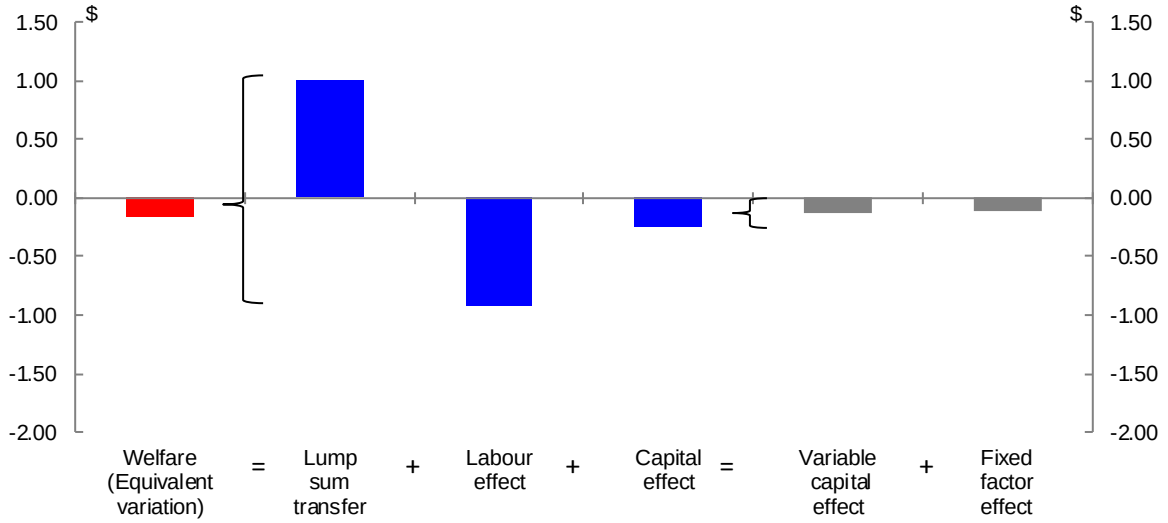


Source: Treasury estimates.

Marginal excess burden and incidence

Household welfare declines as a result of this tax increase, with the marginal excess burden of the flat personal income tax equal to 16 cents per dollar of net revenue raised. This is 5 cents per dollar of revenue raised lower than the flat labour income tax scenario (Chart 14). This is due to two critical assumptions in the model: the after-tax rate of return on capital is equal to the global rate of return, which implies the before-tax return on domestic capital is invariant to changes in the personal income tax system; and the fixed domestic capital stock assumption. Together these assumptions imply that before-tax domestic capital income is invariant to changes in the personal income tax system.

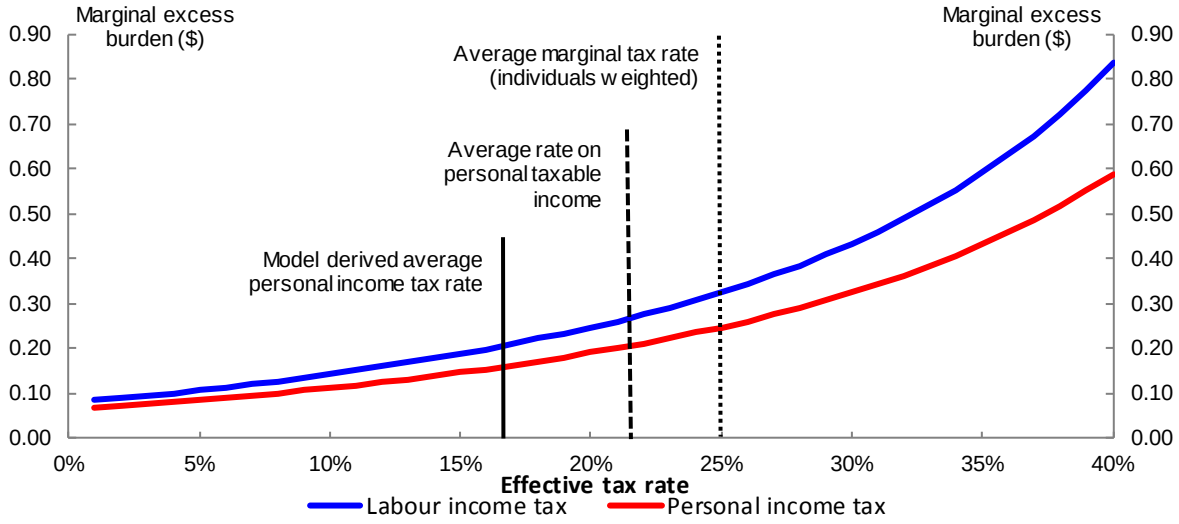
Chart 14: Flat personal income tax — Marginal excess burden and incidence



Source: Treasury estimates.

Chart 15 reports the results of model simulations which demonstrate that the marginal excess burden of the flat personal income tax also decreases as the rate declines, albeit at a slightly lower level than the flat labour income tax component. The difference between the marginal excess burden of the flat labour and personal income taxes increases as the tax rate rises.

Chart 15: Flat personal income tax — Marginal excess burden at varying rates



Source: Treasury estimates.

The average personal income tax rate estimated in the model for the representative household is 16.7 per cent (solid line). Using this average tax rate as the average marginal tax rate gives a marginal excess burden for the taxation of labour income of 21 cents. The marginal excess burden for the same rate applied to both labour and capital income (that is, personal income) is 16 cents. The average tax rate on individuals' taxable income in 2011-12 based on tax return data for resident individuals was around 21.5 per cent (see Appendix B). Using this average tax rate as the average marginal tax rate gives a marginal excess burden for the taxation of labour income of 27 cents (dashed line).

A feature of Australia's current progressive income tax system, however, is that the marginal tax rate faced by individuals is higher than their average tax rate. We do not capture this feature directly within

our model. However, we illustrate how the marginal excess burden would rise at a higher average marginal tax rate on labour (and individuals' labour and capital income). The average marginal tax rate on taxable income in 2011-12 (with each taxpayer's approximate marginal tax rate weighted equally, described further in Appendix B) is estimated to be around 25 per cent. The marginal excess burden for a marginal tax rate on labour income of 25 per cent is around 32 cents (dotted line).[26] If the elasticity of labour supply, which is 0.15 in our baseline calibration, was similar across the income distribution, this marginal excess burden estimate might be a reasonable approximation of the efficiency of a progressive income tax structure (but ignoring interactions between the tax and transfer systems that affect effective marginal tax rates). However, empirical research has shown that labour supply elasticities do significantly vary across the population, particularly between men and women (see Table 1 sourced from Dandie and Mercante, 2007). Thus the marginal excess burden for a tax rate of 25 per cent is presented as an illustration only (and not an alternative estimate).

Comparison with other studies

Table 3 reports the marginal excess burden based on the baseline calibration, along with the results of the sensitivity analysis (see Appendix A for details). The highest and lowest estimates from the sensitivity analysis are highlighted in red and green respectively. Estimates for the flat personal income tax are always lower than for the flat labour income tax component. The high sensitivity estimate results from a high elasticity of substitution between consumption and leisure. Similar to the corporate tax rate sensitivity, the lower estimate (a zero marginal excess burden) assumes no substitution between consumption and leisure.

Estimates of the marginal excess burden of the personal income tax published by KPMG (2010 and 2011) and Independent Economics (2014) reported in Table 3 are limited to the labour income tax component. Our baseline calibration generates an marginal excess burden for the flat labour income tax that is slightly lower than estimates reported in these earlier studies, which likely reflects the fact that KPMG and Independent Economics assume a higher tax rate of labour income, which raises the marginal excess burden (see Chart 15). In particular, these earlier studies ignore the capital income component and calibrate the model's effective tax rate to only the labour income component.

26 Alternatively, the effective tax rate can be constructed using income rather than individual weights. This implies an average marginal tax rate of 34.5 per cent and a marginal excess burden of 59 cents for labour income tax and 43 cents for personal income tax.

Table 3: Flat personal income tax — Marginal excess burden comparison

	Personal income tax MEB ($)	Labour income tax MEB ($)
Baseline	0.16	0.21
Average tax rate on personal taxable income	0.21	0.27
Average marginal tax rate (individuals weighted)	0.25	0.32
Sensitivities: Parameters governing firm behaviour		
Economic rents		
Low rent share	0.20	0.25
High rent share	0.15	0.20
Foreign ownership of firms		
Low foreign ownership	0.17	0.23
High foreign ownership	0.16	0.19
Capital mobility		
Imperfect capital mobility	0.15	0.19
Profit shifting		
Low profit shifting	0.17	0.22
High profit shifting	0.16	0.20
Structures-land substitution elasticity		
Low elasticity	0.12	0.16
High elasticity	0.17	0.22
Capital-labour substitution elasticity		
Low elasticity	0.17	0.22
High elasticity	0.16	0.20
Sensitivities: Parameters governing household behaviour		
Labour-leisure ratio (N:L = 2:1)		
Medium (N:L = 1:1)	0.25	0.33
Low (N:L = 1:2)	0.34	0.46
Consumption-leisure substitution elasticity		
Low elasticity	**0.00**	**0.00**
High elasticity	**0.35**	**0.48**
Consumption good substitution elasticity		
Low elasticity	0.16	0.21
High elasticity	0.16	0.21
Savings decision (fixed domestically owned capital stock)		
Fixed saving rate	0.16	0.21
Literature estimates		
KPMG (2010)	-	0.24
KPMG (2011)	-	0.24
Independent Economics (2014)	-	0.22

Source: KPMG (2010), KPMG (2011), Independent Economics (2014) and Treasury estimates.

5. GOODS AND SERVICES TAX

In this section, we examine the marginal excess burden of an increase in the GST rate on the current base (that is, a marginal increase in the current 10 per cent rate on the current base). We also examine the marginal excess burden for an alternative GST base that covers fresh food, health services, education, childcare, as well as water, sewerage and drainage services. For this scenario we maintain the current level of revenue and harmonise the rate across new and existing taxable goods and services.

Theory

The theory governing the impact of the GST is virtually identical to the labour income tax component of the personal income tax. In particular, the direct effect on the household from a change to the labour income tax and GST is through the after-tax real wage:

$$\frac{w(1-\tau_N)}{p_C(1+\tau_C)} \tag{9}$$

where: w is the wage; p_c is the price of consumption goods and services; τ_N is the flat labour income tax rate payable by the household; and τ_c is the GST tax rate payable by the household.

A common change to either the flat labour income tax or the broad-based consumption tax will have the same proportional effect on the slope of the household's budget constraint.

Given that the current GST is applied to a narrow-base which means it imposes greater distortions than a homogeneous goods and services tax, so we would expect a change to the GST to have a slightly larger effect on welfare and activity than was reported above for a change in the flat labour income tax.

Results

We analyse the marginal excess burden and incidence of the goods and services tax by modelling a marginal increase in the goods and services tax rate sufficient to raise one dollar of revenue from all taxes.

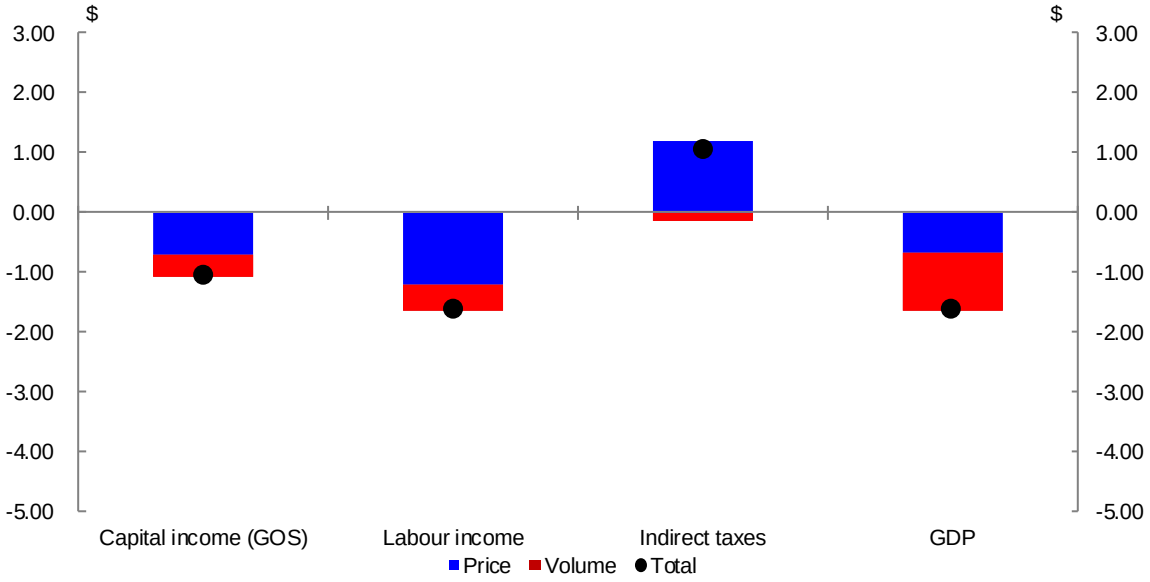
Activity

Chart 16 shows that the long-run effect of raising the GST rate on factor income is larger than in the case of the change in the flat labour income tax rate. The difference is largely due to the price effect with the volume effects roughly similar. The larger price response reflects the fact that the numeraire is the after-tax consumption price which rises in the GST scenario, but not in the flat labour income tax scenarios.

The same factors underlying the flat labour income tax scenario are at work in this scenario. The initial decrease in the supply of labour due to the lower after-tax real wage is partially offset by a slight rise in the before-tax real wage. Again, labour and capital are complements so the decreased labour input lowers the marginal product of capital and its rate of return, which results in an outflow of capital from the domestic economy. This is reflected in the fall in GOS in both volume and price terms. The tax rate

change has a positive effect on indirect taxes. In aggregate there is a similar decline in real GDP relative to the flat labour income tax scenario and a relatively larger decrease in the GDP deflator due to the change in the numeraire.

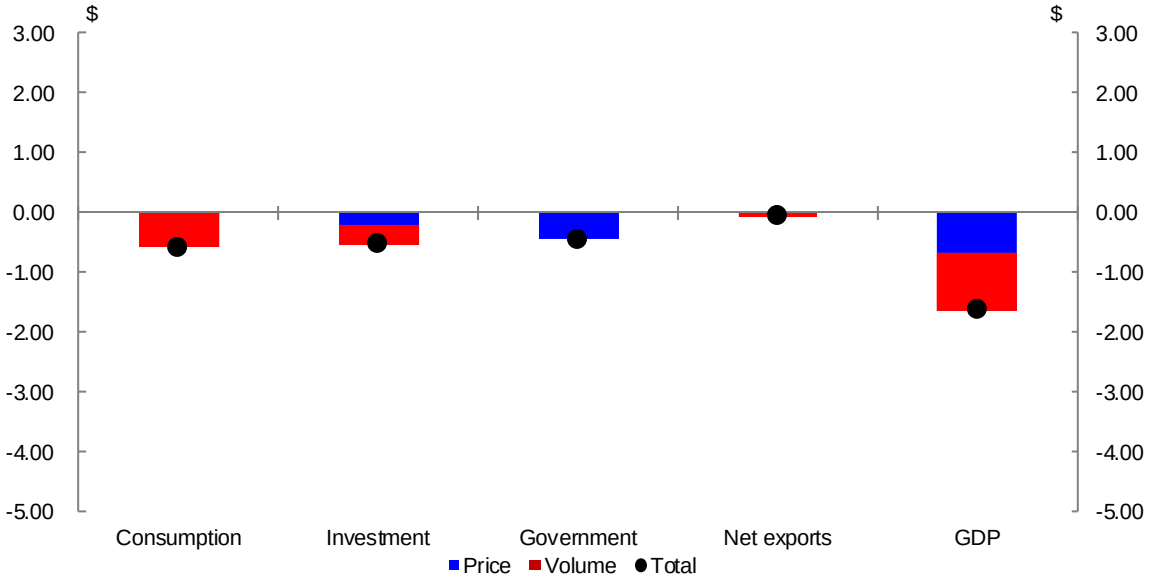
Chart 16: Goods and services tax — Income from GDP response



Source: Treasury estimates.

Turning to the expenditure side, the volume responses are similar to the flat labour income tax, with the large price effects reflecting the change in the numeraire (Chart 17).

Chart 17: Goods and services tax — Expenditure on GDP response

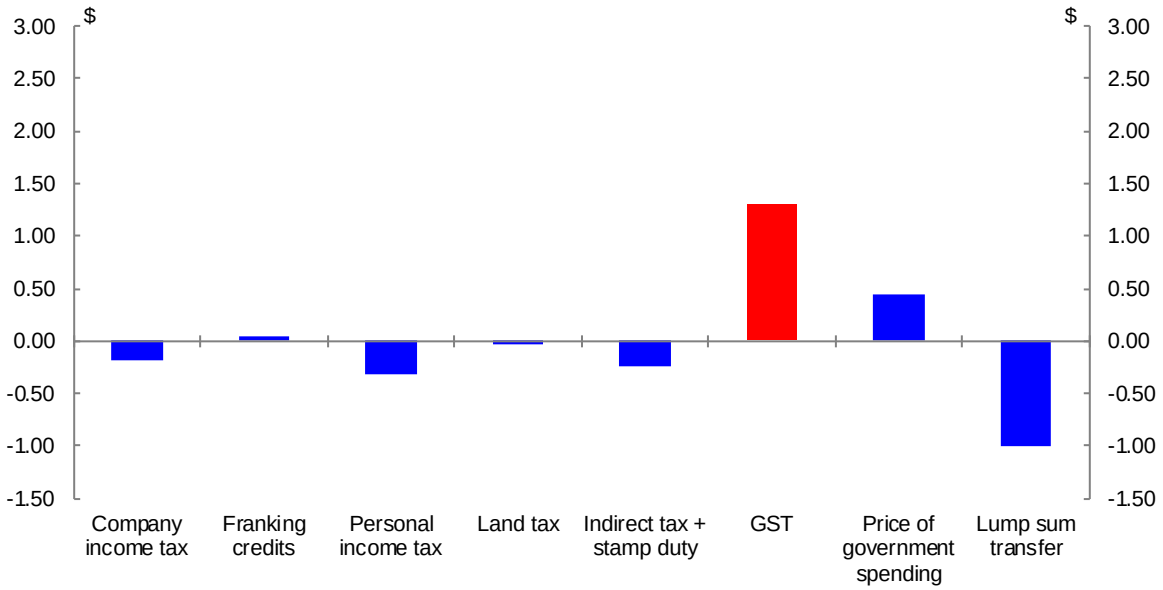


Source: Treasury estimates.

Chart 18 shows that around 1.30 dollars of GST revenue must be raised to offset the fall in revenue to other tax heads. Again the response of other tax heads is somewhat larger than reported for the flat labour income tax scenario, which reflects changes in the numeraire. These differences are largely

offset by the positive contribution from the price of government expenditure, which also reflects the change in the numeraire.

Chart 18: Goods and services tax — Government budget response

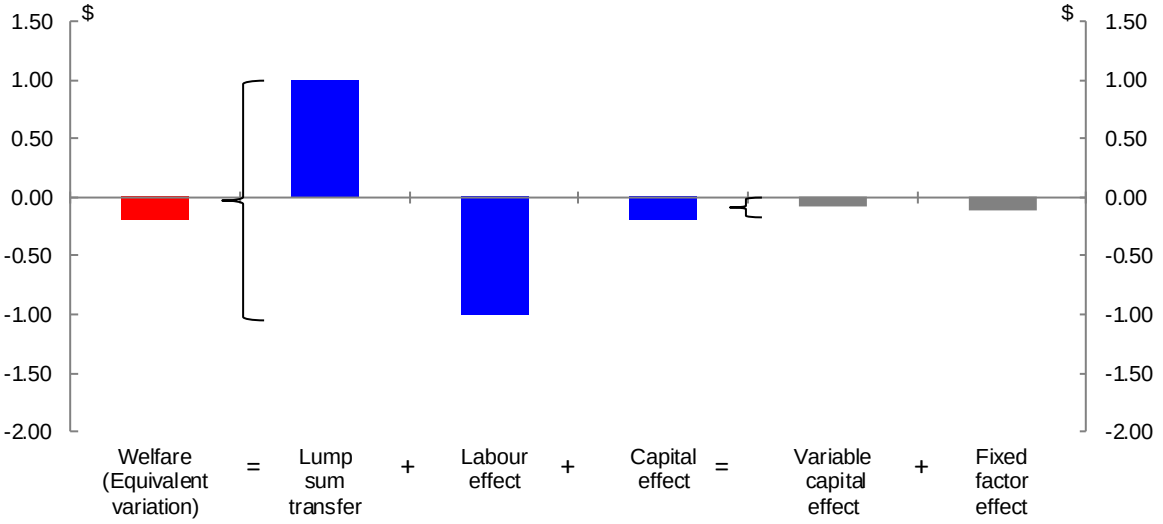


Source: Treasury estimates.

Marginal excess burden and incidence

The increase in the rate of the GST causes household welfare to decline, with the marginal excess burden of the GST estimated to be 19 cents per dollar of net revenue raised, which is lower than the marginal excess burden of 21 cents per dollar of net revenue under the flat labour income tax scenario (Chart 19).

Chart 19: Goods and services tax — Marginal excess burden and incidence

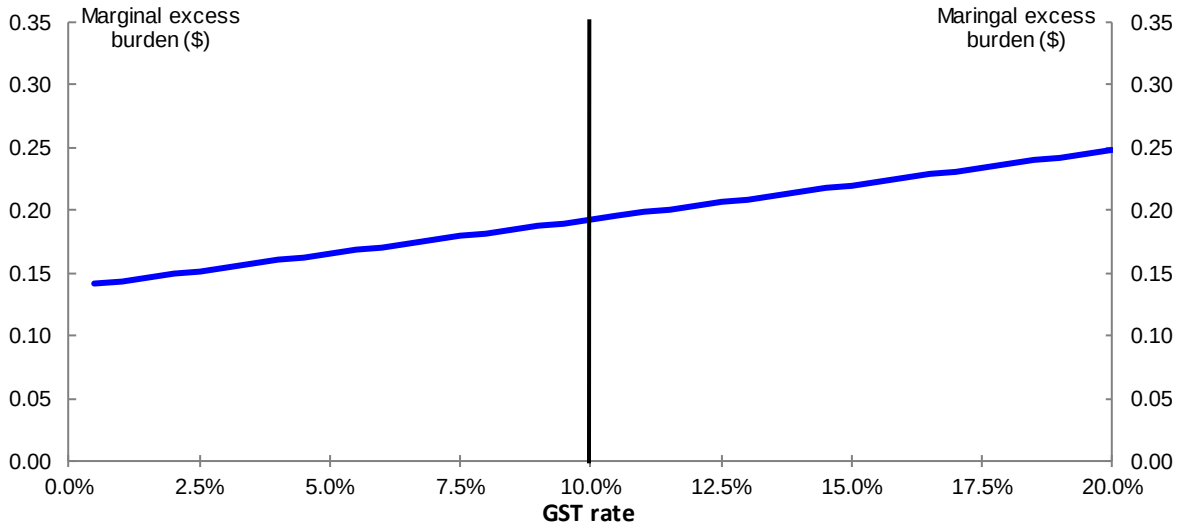


Source: Treasury estimates.

As discussed for the personal and company income taxes, the marginal excess burden of the GST also declines at lower rates as shown in Chart 20. As the GST rate approaches zero the marginal excess burden of the GST falls by around 5 cents to 14 cents. As outlined above, this residual value largely reflects the ongoing presence of the flat labour income tax. In particular, we show above that as the flat

labour income tax rate approaches zero its marginal excess burden falls from 21 cents to 8 cents, which suggests it is responsible for around 13 cents of the marginal excess burden of the GST.

Chart 20: Goods and services tax — Marginal excess burden at varying rates



Source: Treasury estimates.

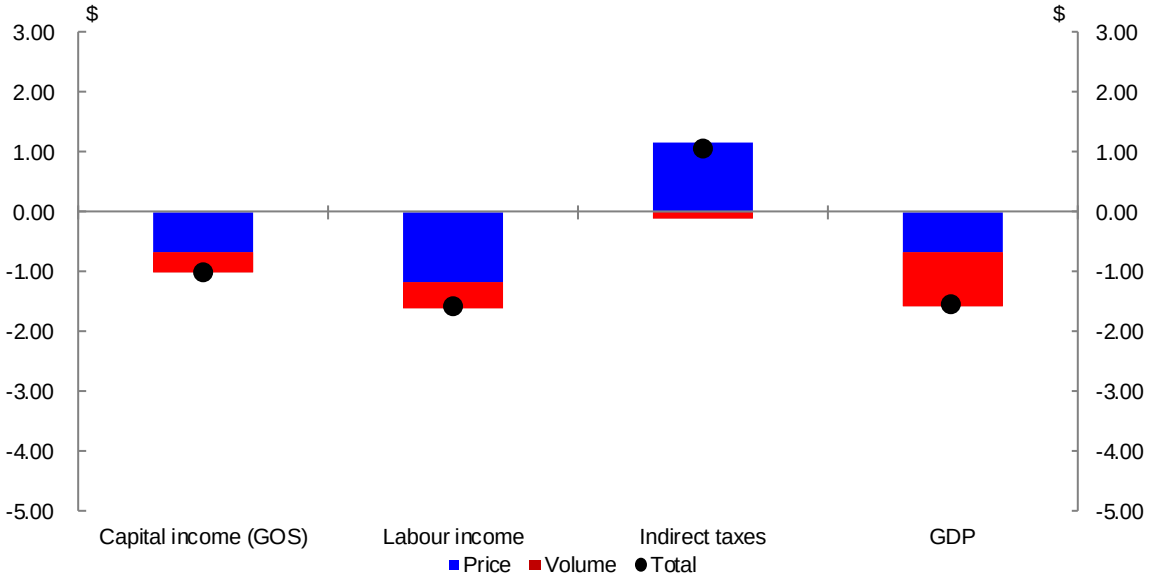
Results for a broad-based goods and services tax

Next we analyse the marginal excess burden and incidence of a hypothetical broad-based goods and services tax by recalibrating the model to a harmonised tax rate across non-rental consumption goods and services, and then modelling a marginal increase in the goods and services tax rate sufficient to raise one dollar of revenue from all taxes.

Activity

Chart 21 reveals that the long run effect of raising a broad-based GST rate on factor income is smaller than for the current GST base. The difference reflects the fact that calibrated GST rate is lower which implies a lower marginal excess burden.

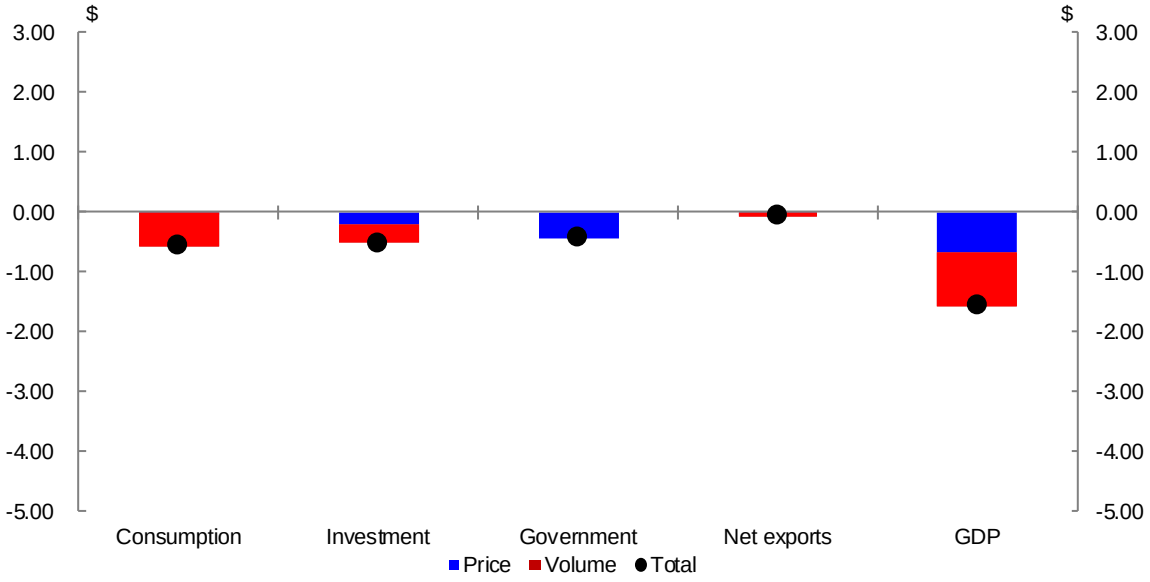
Chart 21: Broad-based GST — Income from GDP response



Source: Treasury estimates.

Turning to the expenditure side, the volume responses are also smaller than under the current base (Chart 22).

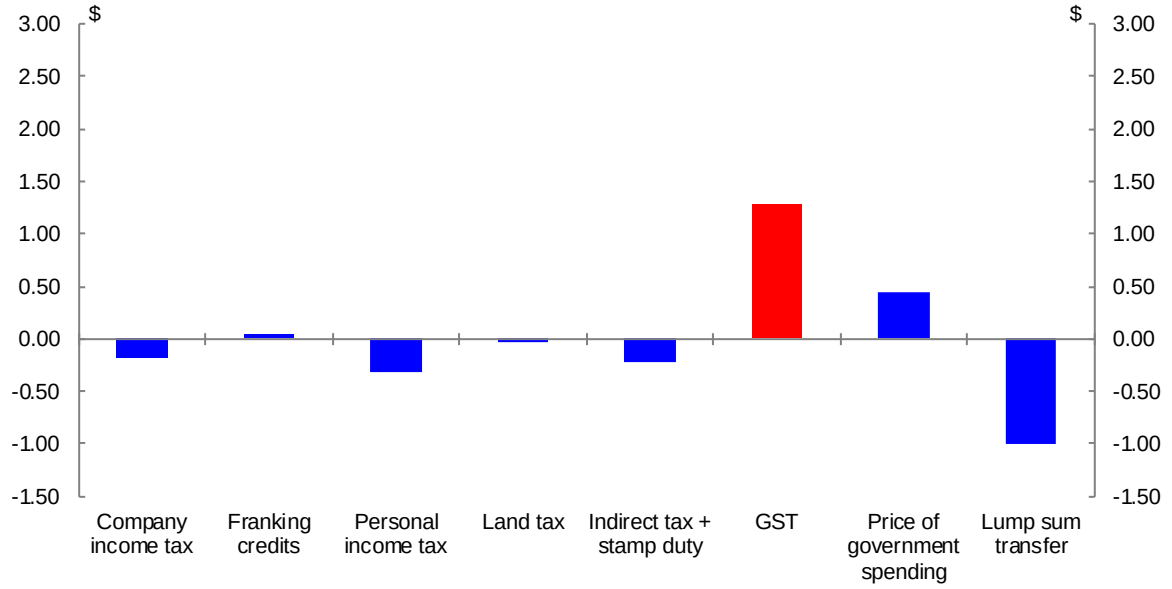
Chart 22: Broad-based GST — Expenditure on GDP response



Source: Treasury estimates.

Chart 23 reveals that around 1.30 dollars of GST revenue must be raised to offset the fall in revenue to other tax heads.

Chart 23: Broad-based GST — Government budget response

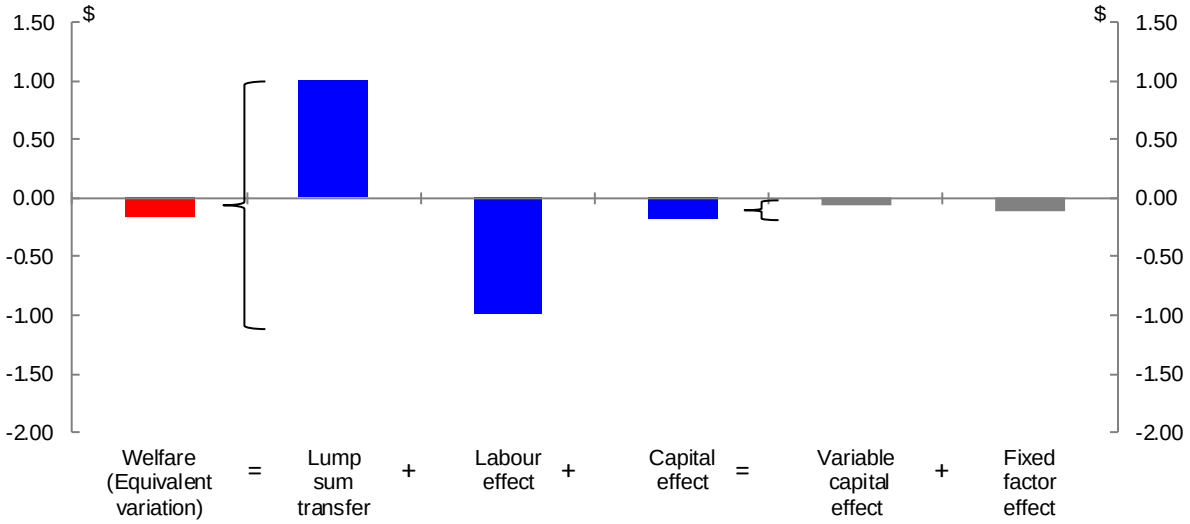


Source: Treasury estimates.

Marginal excess burden and incidence

Increasing the broad-based GST causes household welfare to decline by less than under the current base, with the marginal excess burden of the GST estimated to be 2 cents per dollar of net revenue raised lower than under the current base (Chart 24).

Chart 24: Broad-based GST — Marginal excess burden and incidence



Source: Treasury estimates.

Comparison with other studies

Table 4 reports the marginal excess burden based on the baseline calibration, along with the results of the sensitivity analysis (see Appendix A for details). The highest and lowest estimates from the sensitivity analysis are highlighted in red and green respectively. The high sensitivity estimate results from a high elasticity of substitution between consumption and leisure, while the lower estimate assumes no substitution between consumption and leisure. In contrast to the flat personal income tax,

the latter sensitivity implies a marginal excess burden greater than zero due to the fact that the GST base does not include all consumption goods and services.

Table 4 also reports results from earlier studies. We find that our estimate of the marginal excess burden of the GST is higher than estimates reported by KPMG (2010 and 2011) and Independent Economics (2014). Despite having similar underlying models, it is difficult to isolate the precise reasons for differences between the Independent Economics (2014) and the current study because Independent Economics and the Treasury updated the calibration of the model to latest data and implemented their GST modules separately. However, earlier analysis by KPMG (2010 and 2011) suggests that updating the calibration of the model to latest data can yield somewhat different results for the GST. For example, KPMG (2010) estimated a GST marginal excess burden of 8 cents whereas KPMG (2011) estimated a GST marginal excess burden of 12 cents, while maintaining a marginal excess burden for the labour income tax of 24 cents. This suggests that subtle variations in model calibration can affect the relative marginal excess burden of the GST.

Table 4: Goods and services tax — Marginal excess burden comparison

	Current-base GST MEB ($)	Broad-based GST MEB ($)
Baseline	0.19	0.17
Sensitivities: Parameters governing firm behaviour		
Economic rents		
Low rent share	0.25	0.22
High rent share	0.18	0.15
Foreign ownership of firms		
Low foreign ownership	0.20	0.18
High foreign ownership	0.19	0.16
Capital mobility		
Imperfect capital mobility	0.17	0.15
Profit shifting		
Low profit shifting	0.20	0.18
High profit shifting	0.19	0.16
Structures-land substitution elasticity		
Low elasticity	0.15	0.12
High elasticity	0.20	0.17
Capital-labour substitution elasticity		
Low elasticity	0.18	0.16
High elasticity	0.20	0.18
Sensitivities: Parameters governing household behaviour		
Labour-leisure ratio (N:L = 2:1)		
Medium (N:L = 1:1)	0.27	0.25
Low (N:L = 1:2)	0.36	0.33
Consumption-leisure substitution elasticity		
Low elasticity	**0.03**	**0.01**
High elasticity	**0.37**	**0.34**
Consumption good substitution elasticity		
Low elasticity	0.17	0.17
High elasticity	0.22	0.17
Savings decision (fixed domestically owned capital stock)		
Fixed saving rate	0.19	0.17
Literature estimates		
KPMG (2010)	0.08	-
KPMG (2011)	0.12	-
Independent Economics (2014)	0.13	-

Source: KPMG (2010), KPMG (2011), Independent Economics (2014) and Treasury estimates.

6. BROAD-BASED LAND TAX

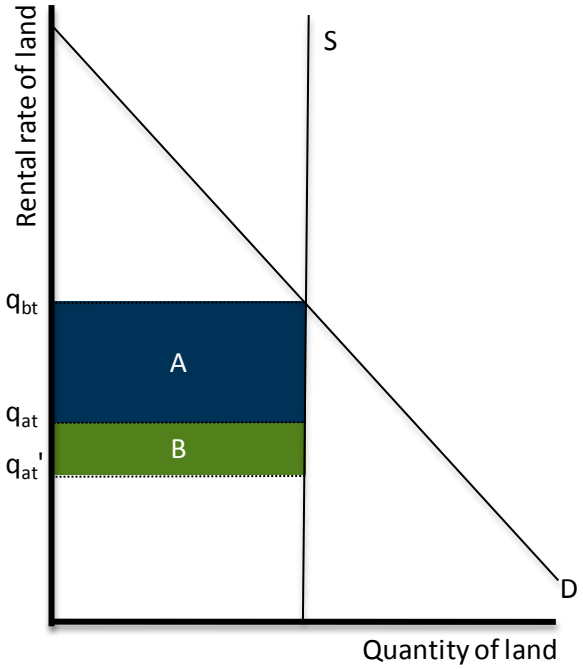
Land tax is modelled as a hypothetical broad-based land tax similar to municipal rates.

Theory and assumptions

Figure 7 describes the land market. The total amount of each type of land (residential and non-residential) is assumed to be in fixed supply. Land users pay the before-tax rental rate given by the intersection of demand and supply at q_{bt}. Prior to the tax change, land-owners receive the after tax rental rate of q_{at}. This implies tax revenue equal to A. This figure shows that an increase in the land tax is completely borne by the land-owners. The after-tax rental rate falls to q_{at}' and the land tax revenue increases by B.

In a closed economy model in which the tax revenue is returned as a lump-sum transfer, this would imply no change to the economy. However, taxing land in an open economy with foreign ownership will have aggregate welfare impacts. Since the revenue collected from foreign and domestic land owners is only redistributed to the domestic household, an increase in land tax results in a net transfer to the domestic household. The domestic household will receive a net windfall gain from the lump-sum transfer that exceeds its tax expense. This increase in income is expected to result in both increased consumption and increased leisure.

Figure 7: Broad-based land tax — Land market response



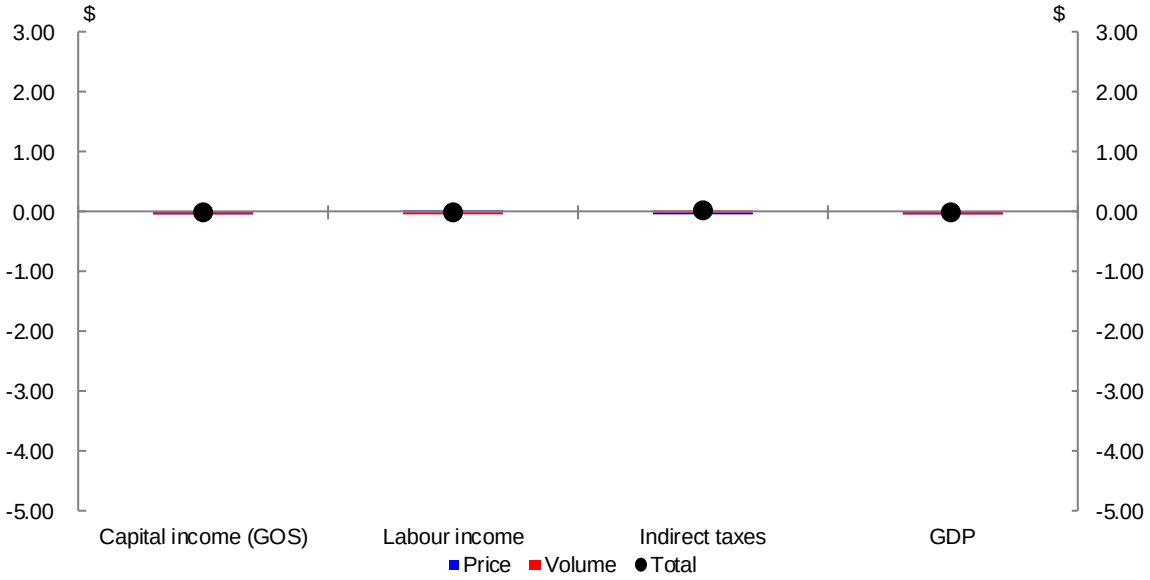
Results

We analyse the marginal excess burden and incidence of the broad-based land tax by uniformly increasing the rate on both residential and non-residential land by an amount sufficient to raise one dollar of revenue from all taxes.

Activity

As suggested by the theory broad-based land tax has a very slight impact on factor income as seen in Chart 25.

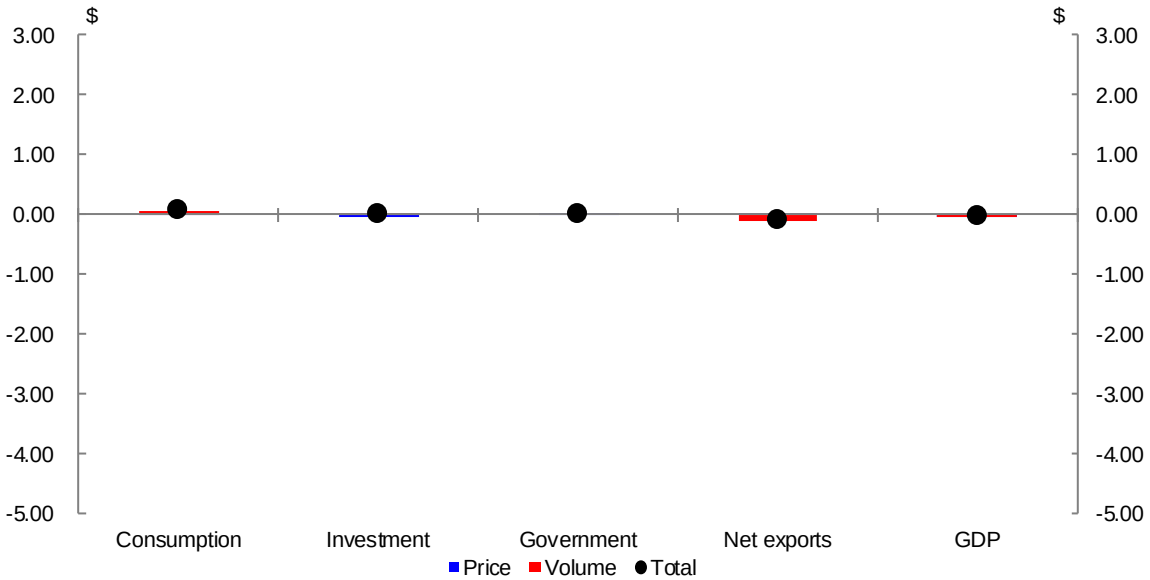
Chart 25: Broad-based land tax — Income from GDP response



Source: Treasury estimates.

The foreign ownership of land means that increasing broad-based land tax results in a small income transfer to domestic residents, which is reflected by a small increase in consumption (Chart 26). The small increase in consumption is largely offset by a decline in net exports, with a negligible effect on GDP.

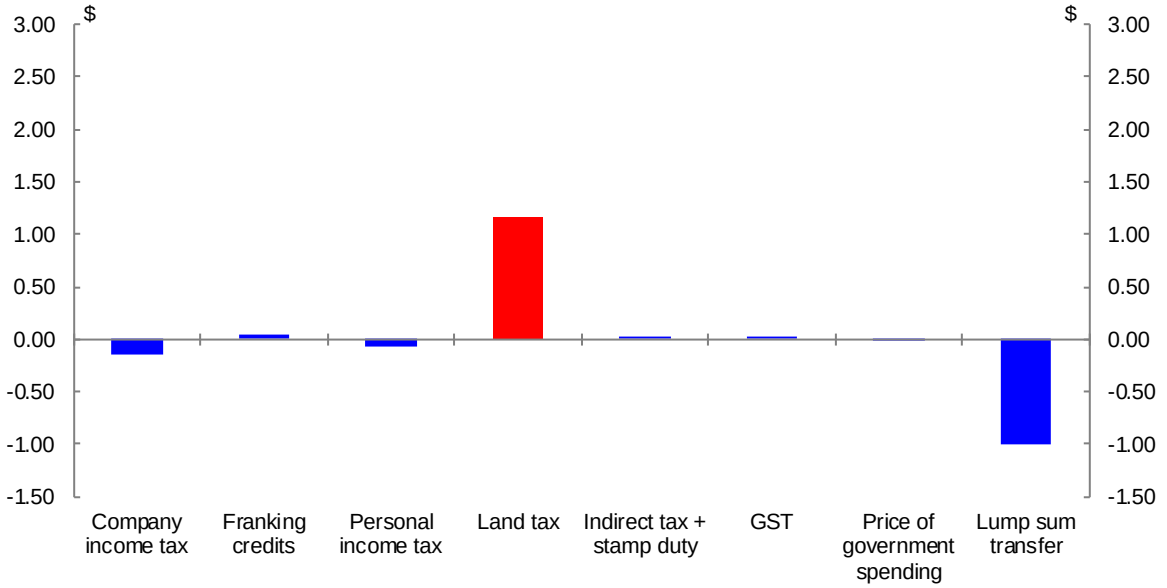
Chart 26: Broad-based land tax — Expenditure on GDP response



Source: Treasury estimates.

A change in broad-based land tax causes few distortions in the economy and therefore implies little change to revenues from other tax heads. Broad-based land tax is, however, a tax deduction for firms and households which requires around 1.15 dollars of revenue to be raised from the broad-based land tax to achieve a net revenue increase of one dollar (Chart 27).

Chart 27: Broad-based land tax — Government budget response

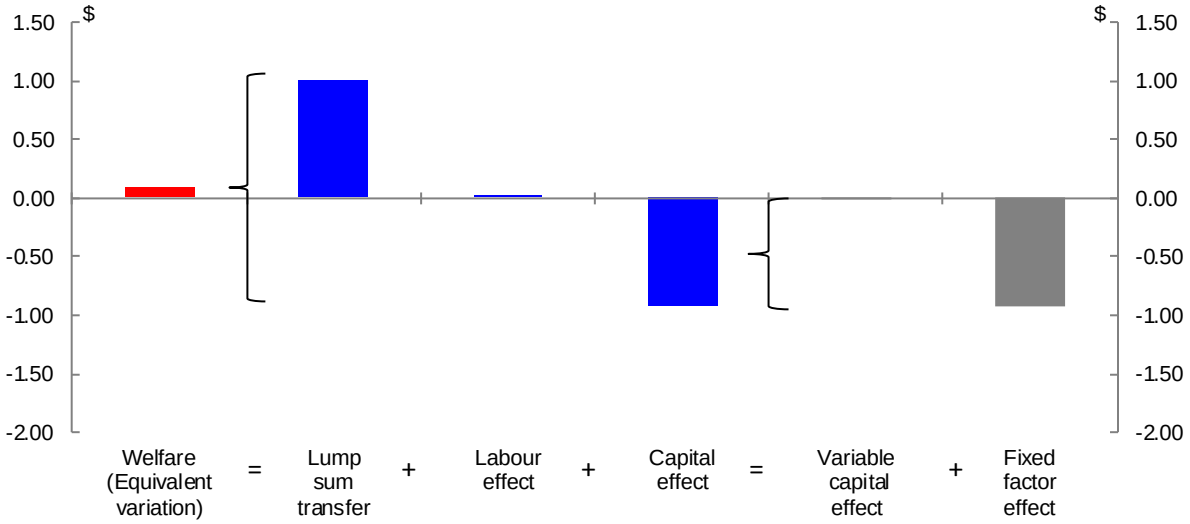


Source: Treasury estimates.

Marginal excess burden and incidence

The net transfer of income between foreign and domestic households raises welfare (Chart 28). As detailed above, the total foreign ownership share of factor income from land is estimated to be around 10 per cent. Consistent with that, welfare improves by 10 cents per dollar of net revenue raised. In other words, the broad-based land tax change implies a loss of income to the domestic household of 90 cents, while the lump-sum transfer increases their income by one dollar, which implies a net income gain of 10 cents.

Chart 28: Broad-based land tax — Marginal excess burden and incidence



Source: Treasury estimates.

Comparison with other studies

Table 5 reports the marginal excess burden based on the baseline calibration, along with the results of the sensitivity analysis (see Appendix A for details). The highest and lowest estimates from the sensitivity analysis are highlighted in red and green respectively. The baseline negative marginal excess burden reported here is driven by the assumption of foreign ownership of land. The lowest estimate is due to doubling the foreign ownership share which broadly doubles the benefit to Australians of taxing land. The highest estimate assumes there is no foreign ownership in Australia which implies broad-based land tax has a zero marginal excess burden.

While the modelling reported here focuses on a broad-based tax on land, earlier economy-wide studies, such as the CGE analysis of the Current Australian Tax System report (KPMG, 2010) analysed land taxes and municipal rates separately. Both were found to be relatively efficient, with municipal rates being slightly more efficient due to its broader base. In a recent report for the Housing Industry Association, Independent Economics (2014) used a similar framework to this paper, which yielded an estimated a negative marginal excess burden for land-tax that is similar to the estimate reported here.

The 2011 NSW Financial Audit examined land tax, as currently legislated, and found it to have a marginal excess burden of 9 cents per dollar of net revenue (see New South Wales Treasury, 2011). They acknowledge that a well-designed land tax could achieve a zero excess burden, and attribute the higher distortionary impact of the real world tax to its narrow base. Land tax does not apply to the principal place of residence, which discourages the provision of rental accommodation. Further, the application of land tax to the aggregate holdings combined with a tax free threshold discourages investment by institutional investors, such as superannuation funds.[27] Consistent with our analysis they find the marginal excess burden of slightly lowering the tax free threshold to be negative 8 cents per dollar of net revenue.

27 The analysis presented here does not capture the progressivity of land taxation.

Table 5: Broad-based land tax — Marginal excess burden comparison

	Municipal rates and land tax MEB ($)
Baseline	-0.10
Sensitivities: Parameters governing firm behaviour	
Economic rents	
Low rent share	-0.14
High rent share	-0.07
Foreign ownership of firms	
Low foreign ownership	**0.00**
High foreign ownership	**-0.20**
Capital mobility	
Imperfect capital mobility	-0.12
Profit shifting	
Low profit shifting	-0.09
High profit shifting	-0.10
Structures-land substitution elasticity	
Low elasticity	-0.09
High elasticity	-0.10
Capital-labour substitution elasticity	
Low elasticity	-0.09
High elasticity	-0.10
Sensitivities: Parameters governing household behaviour	
Labour-leisure ratio (N:L = 2:1)	
Medium (N:L = 1:1)	-0.09
Low (N:L = 1:2)	-0.09
Consumption-leisure substitution elasticity	
Low elasticity	-0.09
High elasticity	-0.10
Consumption good substitution elasticity	
Low elasticity	-0.10
High elasticity	-0.10
Savings decision (fixed domestically owned capital stock)	
Fixed saving rate	-0.10
Literature estimates	
KPMG (2010)	0.08
KPMG (2011)	0.09
Independent Economics (2014)	-0.08

Source: KPMG (2010), KPMG (2011), Independent Economics (2014) and Treasury estimates.

7. STAMP DUTY ON CONVEYANCES

Stamp duties are a tax paid on the value of an asset when ownership is transferred, often inclusive of the value of any capital improvements. Stamp duty on conveyances is currently levied on the transfer of motor vehicles, insurance, and land and structures. The analysis reported here only focuses on stamp duty on conveyances levied on the transfer of land and structures.

Theory and assumptions

It is difficult to capture a capital transactions tax in a model with a single representative agent. The approach adopted here is to treat real estate services as an investment good which improves the productivity of the firm. One way of thinking about this is that real estate agents play a valuable role in finding producers that value the capital the most (that is, the producer with the highest productivity). Therefore a potential owner will be willing to pay a real estate fee equal to the profit they will enjoy over the previous owner. Within this setting the conveyance duty is treated as a tax on the value of investment.

Following the ABS's National Accounting definition real estate services are referred to as ownership transfer costs (OTCs). As with other types of capital, OTCs depreciate over time, which implies a constant long-run ratio of OTCs to capital stock (that is, the quality of the match between producer and capital depreciates over time).

Increasing stamp duty on conveyances increases the cost of transferring property and reduces the number of property transfers. This leads to a lower demand for OTCs. Since OTCs improve the productivity of firms by allocating the capital stock to the producers with higher productivity, a lower level of OTCs is expected to decrease labour productivity, and in turn real after-tax wages and household welfare.

It is important to recognise that a tax on investment will raise less revenue than a tax on capital income that has an equivalent tax rate. This implies an investment tax that raises the same amount of revenue as a company income tax, imposes a higher user cost of capital and is therefore less efficient (that is, implies a larger marginal excess burden).

To see why an investment tax generates a higher marginal excess burden we consider a simplified example of a company income tax with no deductions. Theory suggests that investors will buy capital until the expected return on capital or present value of revenue is equal to the cost of investment. Hence in equilibrium we have:

$$PV\left(earnings\right) = Cost\,of\ investment \tag{10}$$

The present value of earnings from the investment is given by the sum of the after-tax returns in each year discounted by the real interest rate denoted by r and allowing for economic depreciation denoted by δ. Using q to denote the real rental rate of capital and τ_K the company income tax, the expected return is given by:

$$PV\left(earnings\right) = \int_0^\infty \left(1-\tau_K\right) q.e^{-t(\delta+r)}dt = \frac{\left(1-\tau_K\right)q}{\delta+r} \tag{11}$$

The cost of investment is given by the price of investment plus any tax applied to investment:

$$Cost\,of\ investment = \left(1+\tau_I\right)p_I \tag{12}$$

where τ_I is the investment tax rate and p_I is the price of investment.

In equilibrium the present value of the earnings must equal the cost of investment:

$$\frac{(1-\tau_K)q}{\delta+r} = (1+\tau_I)\,p_I \tag{13}$$

which implies the return on investment under both investment and capital taxation is:

$$\frac{q}{p_I} = \frac{(1+\tau_I)}{(1-\tau_K)}(\delta+r) \tag{14}$$

For equal investment and capital tax rates (that is, $\tau_I=\tau_K$) it follows that:

$$\frac{1}{(1-\tau_K)} \approx (1+\tau_K) = (1+\tau_I) \tag{15}$$

This implies that an investment tax has the same effect on the required return on investment as a capital tax:

$$\frac{q}{p_I} = (1+\tau_I)(\delta+r) = \frac{1}{(1-\tau_K)}(\delta+r) \tag{16}$$

which implies equal investment and capital tax rates impose the same partial equilibrium distortion in the capital market. However, it is relatively easy to show that an investment tax raises less revenue than a capital tax, which suggests the former imposes a greater burden in general equilibrium.

For example, the revenue from the capital tax is given by:

$$R_K = \tau_K.q.K \tag{17}$$

and from the investment tax:

$$R_I = \tau_I.p_I.I \tag{18}$$

In the long-run the investment (I) to capital (K) ratio is equal to:

$$\frac{I}{K} = (\delta+g) \tag{19}$$

where g is the long-run growth rate of GDP.

The revenue ratio implies:

$$\frac{R_K}{R_I} = \frac{\tau_K}{\tau_I}.\frac{qK}{p_I I} \tag{20}$$

When combined with the return on investment and investment to capital ratio relationships from above, this implies:

$$\frac{R_K}{R_I} = \frac{\tau_K}{\tau_I} \cdot \frac{(1+\tau_I)}{(1-\tau_K)} \cdot \frac{(\delta + r)}{(\delta + g)} \tag{21}$$

Equal tax rates imply $(1+\tau_I)/(1-\tau_K)>1$, while dynamic stability requires the return on capital to be higher than the long-run growth rate of output (that is, r>g), so it follows that the revenue from the capital tax will be greater than that for an investment tax with an equivalent rate (that is, $R_K>R_I$). Given the earlier analysis, this means that an investment tax that raises the same revenue as a capital income tax must have a higher tax rate, which implies it has a greater distortion in the capital market.

The baseline calibration of stamp duty on conveyances follows the ABS National Accounts in modelling stamp duty as a component of OTCs. The value of indirect taxes on OTCs is calculated from ABS Input-Output Table (ABS Cat. 5209.0) for 2007-08. Based on these data, stamp duty accounts for around 45 per cent of ownership transfer costs.

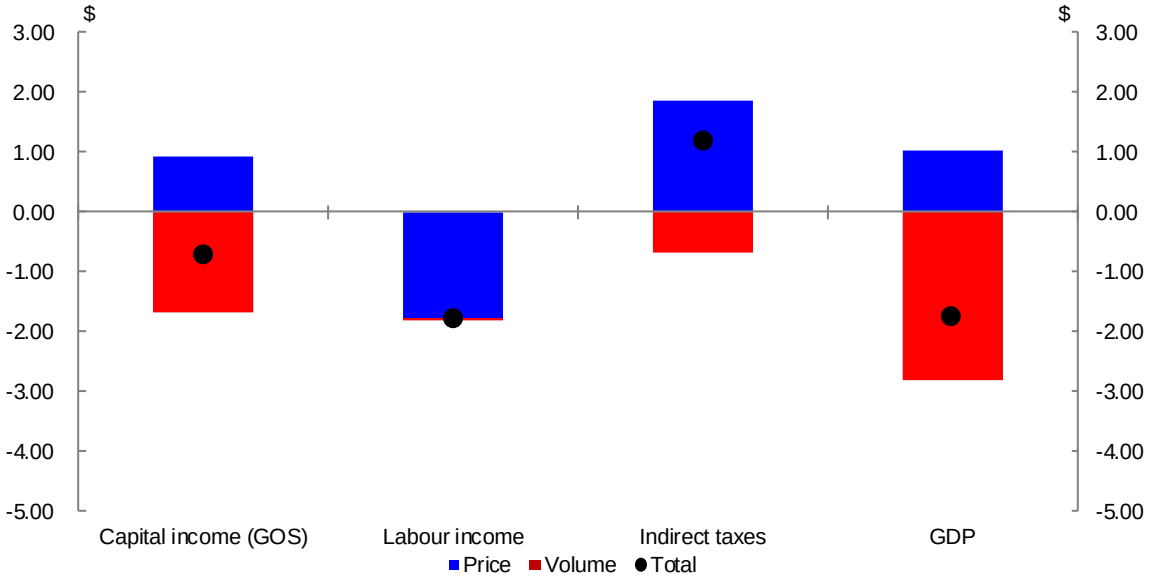
Results

We analyse the marginal excess burden and incidence of stamp duty on conveyances by increasing the tax rate on investment in structures modelled as OTCs.

Activity

Increasing stamp duty increases the cost of investing in OTCs which leads to a substitution away from transferring property and also a rise in the before-tax rental rate of structures. A higher rental rate causes the quantity demanded to fall, which implies lower structures investment and a smaller capital stock. The overall effect on GOS is negative, with the lower volume of capital more than offsetting the increased before-tax return (Chart 29). The decrease in capital leads to lower labour productivity and labour demand, which in turn implies lower real wages and lower hours worked. Increasing stamp duty raises the price of indirect taxes and therefore the price of GDP relative to consumption prices, however the reduction in volume due to the smaller capital stock and decline in working hours dominate which implies a fall in the value of GDP (Chart 30).

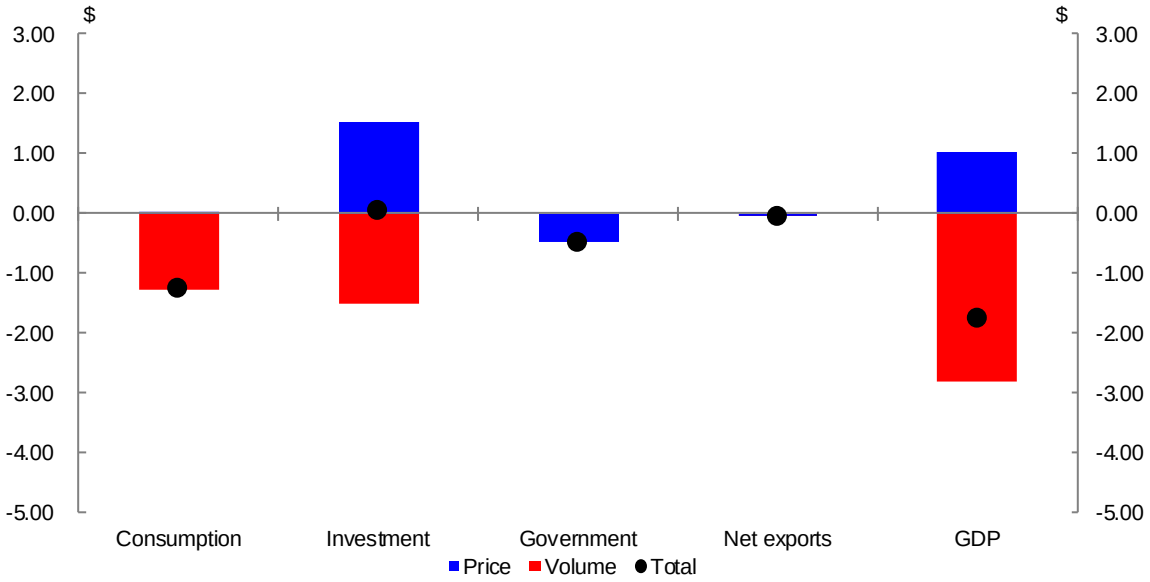
Chart 29: Stamp duty — Income from GDP response



Source: Treasury estimates.

As discussed above increasing the price of investment in OTCs decreases investment with the majority of the total decline in investment coming from the investment in OTCs. Lower real wages and working hours also result in lower consumption.

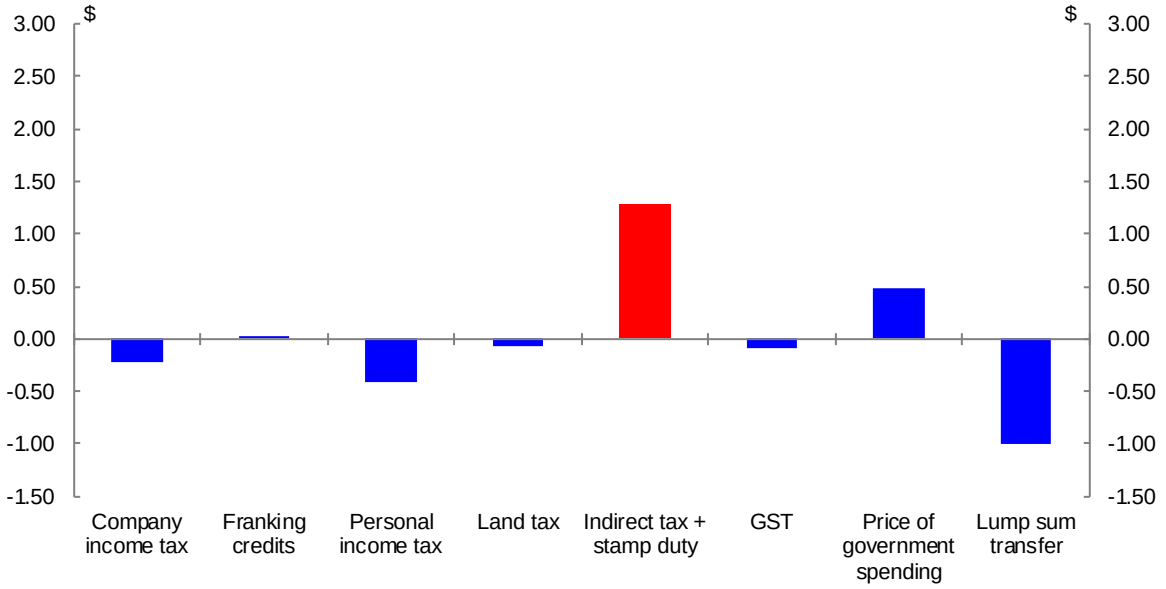
Chart 30: Stamp duty — Expenditure on GDP response



Source: Treasury estimates.

Chart 31 reveals that around 1.30 dollars of stamp duties must be raised to offset the declines in revenues from other sources.

Chart 31: Stamp duty — Government budget response

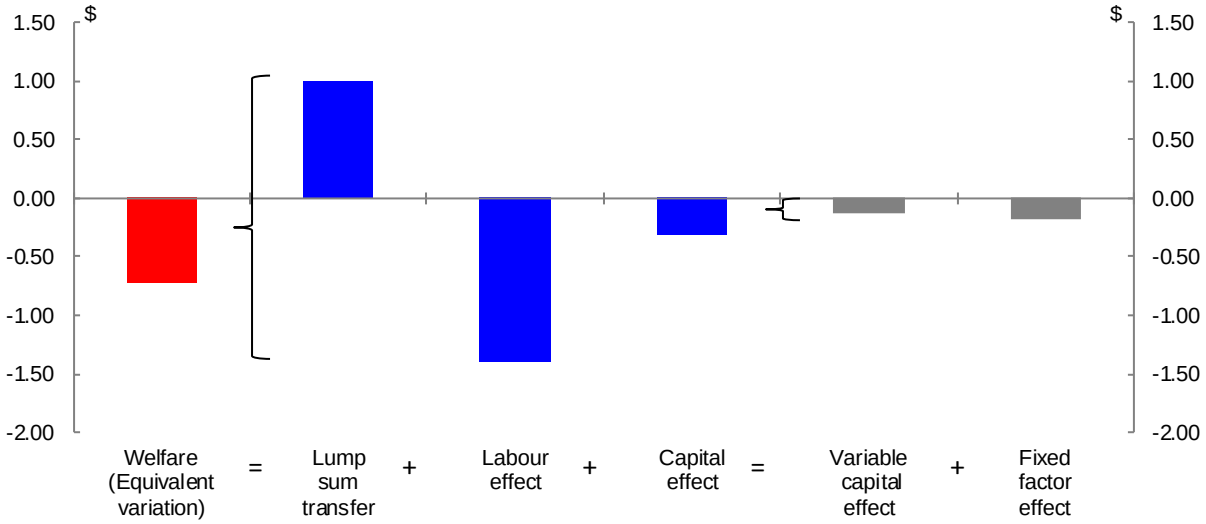


Source: Treasury estimates.

Marginal excess burden and incidence

In aggregate the stamp duty change reduces welfare by 72 cents per dollar of revenue raised (Chart 32). This suggests that stamp duty is less efficient than the company income tax. This result is consistent with the theoretical analysis reported above. The difference is largely due to the fall in after-tax capital income, which leads to a greater capital income effect than under the company income tax.

Chart 32: Stamp duty — Marginal excess burden and incidence



Source: Treasury estimates.

Comparison with other studies

Table 6 reports the marginal excess burden based on the baseline calibration, along with the results of the sensitivity analysis (see Appendix A for details). The highest and lowest estimates from the sensitivity analysis are highlighted in red and green respectively. The marginal excess burden of stamp duty is largely driven by the distortion it causes in the decision to transfer property. The responsiveness

of transferring property to changes in stamp duty in the model is largely determined by the elasticity of substitution in the structures and land bundle. Under a zero elasticity of substitution between structures and land, the marginal excess burden of stamp duties falls to just under 10 cents, while assuming that the elasticity of substitution is double that in the baseline calibration increases the marginal excess burden by 45 cents.

Table 6: Stamp duty — Marginal excess burden comparison

	Stamp duties on conveyances MEB ($)
Baseline	0.72
Sensitivities: Parameters governing firm behaviour	
Economic rents	
Low rent share	0.98
High rent share	0.64
Foreign ownership of firms	
Low foreign ownership	0.72
High foreign ownership	0.72
Capital mobility	
Imperfect capital mobility	0.66
Profit shifting	
Low profit shifting	0.75
High profit shifting	0.69
Structures-land substitution elasticity	
Low elasticity	**0.10**
High elasticity	1.15
Capital-labour substitution elasticity	
Low elasticity	0.69
High elasticity	0.75
Sensitivities: Parameters governing household behaviour	
Labour-leisure ratio (N:L = 2:1)	
Medium (N:L = 1:1)	0.85
Low (N:L = 1:2)	0.99
Consumption-leisure substitution elasticity	
Low elasticity	0.38
High elasticity	**1.17**
Consumption good substitution elasticity	
Low elasticity	0.58
High elasticity	0.84
Savings decision (fixed domestically owned capital stock)	
Fixed saving rate	0.72
Literature estimates	
KPMG (2010)	0.34
KPMG (2011)	0.80
Independent Economics (2014)	0.71

Source: KPMG (2010), KPMG (2011), Independent Economics (2014) and Treasury estimates.

Our central estimate of the marginal excess burden for conveyancing stamp duties is broadly similar to estimates reported by KPMG (2011) and Independent Economics (2014). This reflects the fact that these earlier studies also treat conveyancing stamp duties as a tax on OTCs. In contrast, KPMG (2010) reported a lower marginal excess burden of 34 cents, but with a caveat that this was an underestimate because the model only captured the impact of conveyancing duties on prices (and not the frequency of transactions).

Turning to the broader literature on stamp duties, Davidoff and Leigh (2013) find that a 10 per cent increase in stamp duty lowers house prices by 3 per cent. Stamp duty accounts for 2 to 4 per cent of the value of a house, so these findings suggest an increase in stamp duty is equal to 0.2 to 0.4 of the value of a house which implies a decrease in the price of a house of 3 per cent. This suggests that changes in stamp duty are more than fully borne by sellers of houses. This is in line with international studies by Kopczuk and Munroe (2013) who find that transaction taxes in New York State are borne by sellers, with the fall in price exceeding the rise in the value of the tax. Consistent with these studies, our model generates a fall in the house price, albeit modest, following an increase in the stamp duty rate.

Davidoff and Leigh (2013) also find that a 10 per cent increase in stamp duty lowers turnover by 3 per cent in the first year and by 6 per cent over a three-year period. The responsiveness of transferring property to changes in stamp duty in the model is largely determined by the elasticity of substitution in the structures and land bundle. While our model was not directly calibrated to Davidoff and Leigh (2013), we find that our results are broadly consistent with theirs, that is, a 10 per cent increase in the stamp duty rate causes the volume of OTCs to fall by 2.3 per cent.

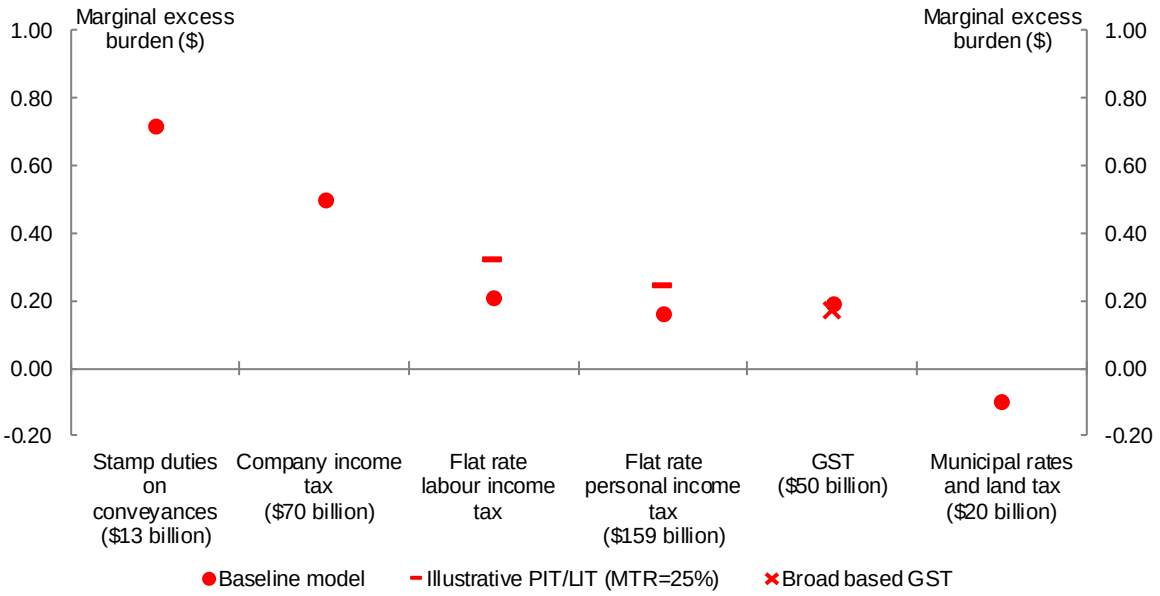
8. CONCLUSION

In recent years, a series of studies have been undertaken in Australia that use static general equilibrium models with a representative household to compare the relative efficiency of different Australian taxes (Access Economics, 2008 and 2011; KPMG, 2010 and 2011; Independent Economics, 2014; and Rimmer et al., 2014). The aim of this paper has been to complement these earlier studies, particularly through detailed analysis of the sensitivity of the estimates and further explanation of the economic incidence. General equilibrium models are necessarily a simplification of the economy and, as such, they can only incorporate a stylised representation of the tax system. This means that the analysis reported here provides an indication of the relative efficiency of different taxes, but not sharp estimates of the overall economic costs.

Our estimates of the marginal excess burden of the five major taxes under study largely align with estimates reported in other Australian studies using a similar modelling framework (see Chart 33 and Chart 34). In addition we find that the relative efficiency of these taxes is robust to a range of model parameters. Our analysis suggests that conveyancing stamp duties and company income tax have high relative marginal excess burdens. Marginal excess burden estimates for company income tax are likely to be higher in this study than KPMG (2010) because of the inclusion of greater complexity in international capital markets in the model used for this paper (also used by Treasury for the Business Tax Working Group). Marginal excess burden estimates for conveyancing stamp duties were also lower in KPMG (2010), but that earlier study noted that the marginal excess burden was underestimated because it did not attempt to capture the impact of stamp duties on the frequency of transactions.

Our analysis suggests that capital taxation via the company income tax is largely borne by workers through lower labour productivity which causes lower after-tax real wages. In contrast, domestic capital owners benefit from higher after-tax real variable capital income (that is, from structures and equipment) which is largely offset by lower after-tax real rental income from fixed factors (that is, land). The economic incidence of a change in stamp duty on conveyances also tends to fall on workers, with fixed and variable capital owners bearing some of the burden.

Chart 33: Marginal excess burden of major Australian taxes



Source: Treasury estimates.

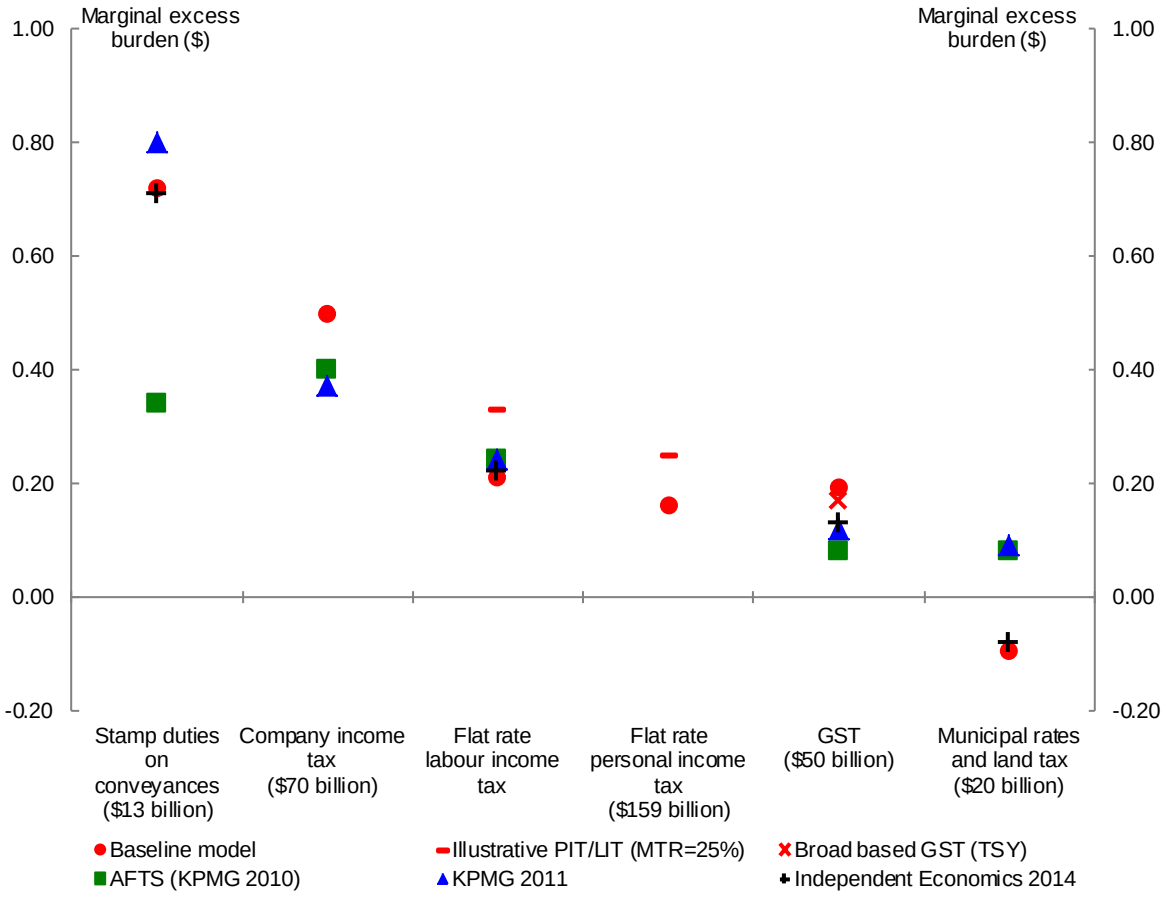
The most efficient tax captured in our model is a hypothetical broad-based land tax, similar to municipal rates. The marginal excess burden estimate for a broad-based land tax is -10 cents. This estimate is a result of the inclusion of the foreign ownership share of factor income from land in the model which is estimated to be around 10 per cent. The current exemptions and concessions to land tax would raise the marginal excess burden from the highly efficient broad-based land tax modelled in this paper. Quantifying the efficiency costs of these exemptions and concessions is challenging in a stylised economy-wide model and outside the scope of this paper.

The other two taxes that we examined in this paper are a stylised personal income tax and the GST. Our model suggests that these taxes are less efficient than a broad-based land tax, but more efficient than company income tax and conveyancing stamp duties. The stylised personal income tax has a lower marginal excess burden than the stylised tax on individuals' labour income. This is due to two critical assumptions in the model: the after-tax rate of return on capital is equal to the global rate of return, which implies the before-tax return on domestic capital is invariant to changes in the personal income tax system; and the fixed domestic capital stock assumption. Together these assumptions imply that before-tax domestic capital income is invariant to small changes in the personal income tax system.

Our estimate of the marginal excess burden on individuals' labour income and GST are very similar at around 21 cents and 19 cents respectively. This aligns with the intuition that the taxation of labour income and GST both affect the real purchasing power of wages, with a similar incidence on labour supply. Nevertheless, previous Australian modelling has estimated a lower marginal burden estimate for the GST than labour income tax. Our marginal excess burden estimate for labour income tax is

similar to previous studies. The marginal excess burden estimate for the GST, however, is higher than previous studies. Despite having similar underlying models, it is difficult to isolate the precise reasons for differences between the Independent Economics (2014) and the current study because Independent Economics and the Treasury updated the calibration of the model to latest data and implemented their GST modules separately. However, earlier analysis by KPMG (2010 and 2011) suggests that updating the calibration of the model to the latest data can yield somewhat different results for the GST. For example, KPMG (2010) estimated a GST marginal excess burden of 8 cents whereas KPMG (2011) estimated a GST marginal excess burden of 12 cents, while maintaining a marginal excess burden for the labour income tax of 24 cents. This suggests that subtle variations in model calibration can affect the relative marginal excess burden of the GST.

Chart 34: Comparison of marginal excess burden estimates



Source: KPMG (2010), KPMG (2011), Independent Economics (2014) and Treasury estimates.

A feature of Australia's current progressive income tax system is that the marginal tax rate faced by individuals is higher than their average tax rate. Also, empirical evidence suggests that the elasticity of labour supply varies across different groups of taxpayers. We are not able to capture these features directly within our model, which has a single representative household. Nevertheless, we have attempted to show how higher marginal tax rates might lift the marginal excess burden using illustrative examples.

This paper is the first step in a research program that is aimed at improving the understanding of the efficiency and incidence of major Australian taxes. The three key limitations of the analysis reported here are that the model only examines long-run impacts, does not capture heterogeneity in labour

supply, and does not incorporate the progressive rates scale applied to personal income. Future research will endeavor to incorporate inter-temporal dynamics that allow us to measure the transitional effects of both marginal and broad tax changes, household heterogeneity, and the progressive tax scales applied to personal income.

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APPENDIX A: BASELINE CALIBRATION AND SENSITIVITY ANALYSIS

As with all analysis based on parameterised theoretical models, the results presented above are sensitivity to parameter assumptions. Where possible the baseline calibration of the model is consistent with estimates of Australian economic activity and industry structure reported by the Australian Bureau of Statistics (ABS). However, there remains a degree of uncertainty around some assumptions, in particular those that relate to the various elasticities of substitution.

The model is calibrated to reflect the structure of the Australian economy in 2013-14. The basic industry structure and expenditure patterns of the economy are initially calibrated to match ABS Input-Output Tables (ABS cat. 5209.0) for 2007-08. The model is calibrated based on the 2007-08 level of the terms of trade and incorporates a range of other data including other ABS data and unpublished Australian Tax Office (ATO) tax statistics. These data are then uprated to allow for growth in wages, prices, productivity and labour supply from 2007-08 to 2013-14, using ABS national accounts (ABS cat. 5206.0), consumer prices (ABS cat. 6401.0) and labour force data (ABS cat. 6291.0.55.003). Finally, the supply of land and fixed factors, the size of the world market, general government final demand and Australian asset ownership are grown in line with Australian real GDP.

The sensitivity analysis presented below highlights that the ranking of the relative marginal excess burden of the fives taxes under study is robust to a broad range of parameter assumptions. In fact, many of the sensitivities detailed below employ extreme parameter choices, which highlights that under most plausible parameterisations the relative efficiency of the taxes is unchanged.

Parameters governing firm behaviour

Share of factor income earned by fixed factors

The model includes both location- and firm-specific fixed factors of production in addition to land. The firm-specific fixed factor reflects the rents generated by intangible assets, such as brand names, patents and market power. Location-specific fixed factors are inputs that are fixed in supply to any particular industry, such as natural resources. Each industry uses a different type of location-specific fixed factor. For example, each industry within the mining sector will use a different type of natural resource — the coal industry requires coal resources and the iron-ore industry requires iron-ore resources. Fixed factors generate location-specific economic rents, which are unable to be obtained unless they are exploited within Australia.

Generally, returns to location- and firm-specific fixed factors are those that are not able to be attributed to other forms of capital. Hence these fixed factors are often referred to as excess returns or economic rents.

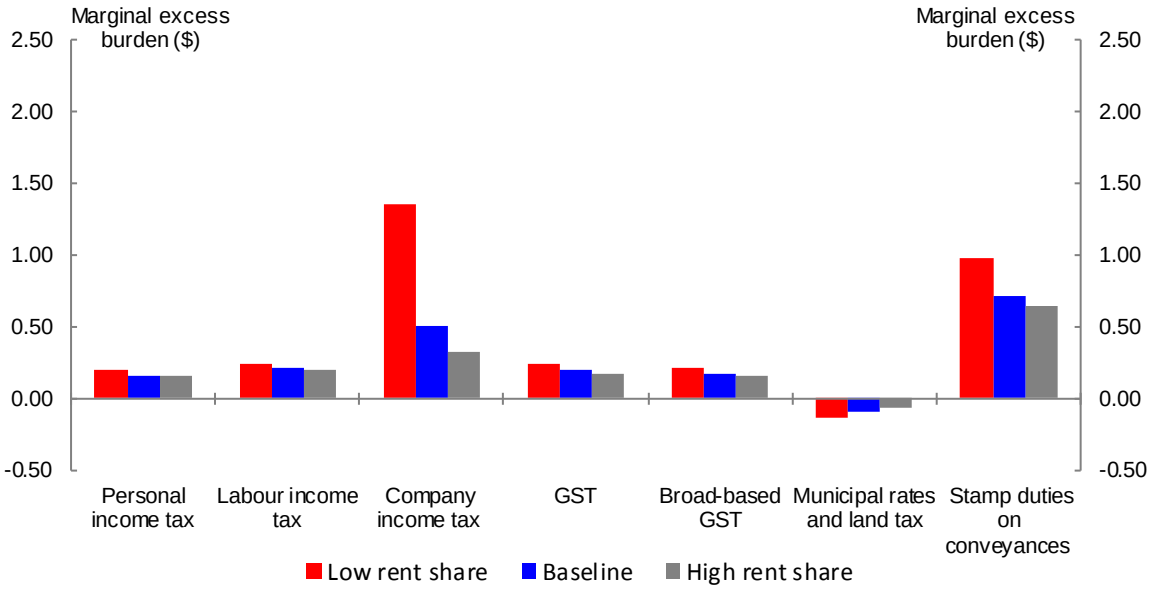
To estimate the normal returns on the measured stock of capital we first calculate the normal return and assume any remaining returns are due to the location- and firm-specific fixed factors. In calculating the normal return we use the economy-wide after-tax required rate of return from the model. This is used to calculate the before-tax required rate of return for each industry. The before-tax required rate of return differs across industries because their capital structure and debt levels vary.

Estimating the magnitude of excess returns for different industries in the whole economy is difficult. Furthermore, the existence of rents in a particular year may be due to temporary factors. This effect is somewhat mitigated in this paper by calculating the excess returns over a 20 year period.

Based on detailed industry data reported in ABS Estimates of Multifactor Productivity (ABS cat. 5260.0.55.002), location-specific fixed factors are estimated to account for just over 5 per cent of GDP or around a seventh of the total gross operating surplus in the baseline calibration. For comparison, land accounts around 3 per cent of GDP. We run two sensitivity analyses, one where we assume there are no firm- or location-specific fixed factors and one where we double the importance of economic rents. The GDP contribution of labour is held constant, so eliminating economic rents increases the importance of other capital types.

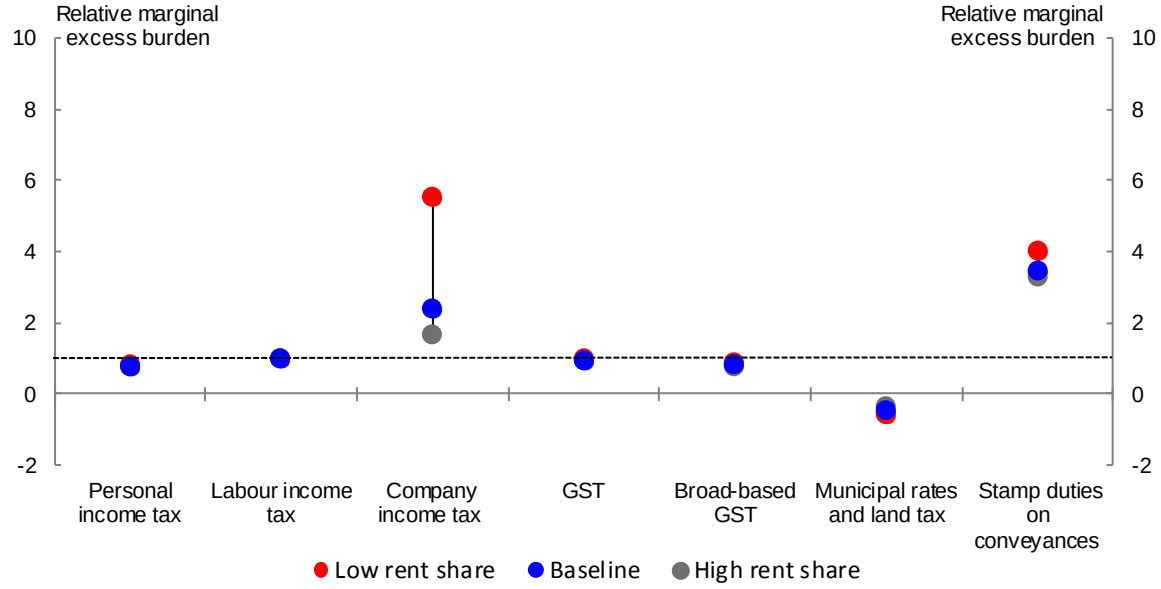
Chart 35 and Chart 35 show that the marginal excess burden of the corporate income tax is much higher in an economy in which more factor income accrues to variable-factors. Increasing variable capital's income share also increases the burden of the flat personal income tax, GST and stamp duty. In contrast, it raises the welfare benefits from a higher broad-based land tax.

Chart 35: Marginal excess burden — Sensitivity to size of economic rents



Source: Treasury estimates.

Chart 36: Relative marginal excess burden — Sensitivity to size of economic rents



Source: Treasury estimates.
Note: Relative marginal excess burdens are reported relative to the flat labour income tax.

Share of foreign ownership of firms

The share of foreign ownership of domestic assets, especially with respect to land and economic rents, has important implications for the efficiency of the company income tax. If the share of land and rents owned by foreigners is greater, raising the company tax rate will give a larger wind fall gain to domestic capital owners.

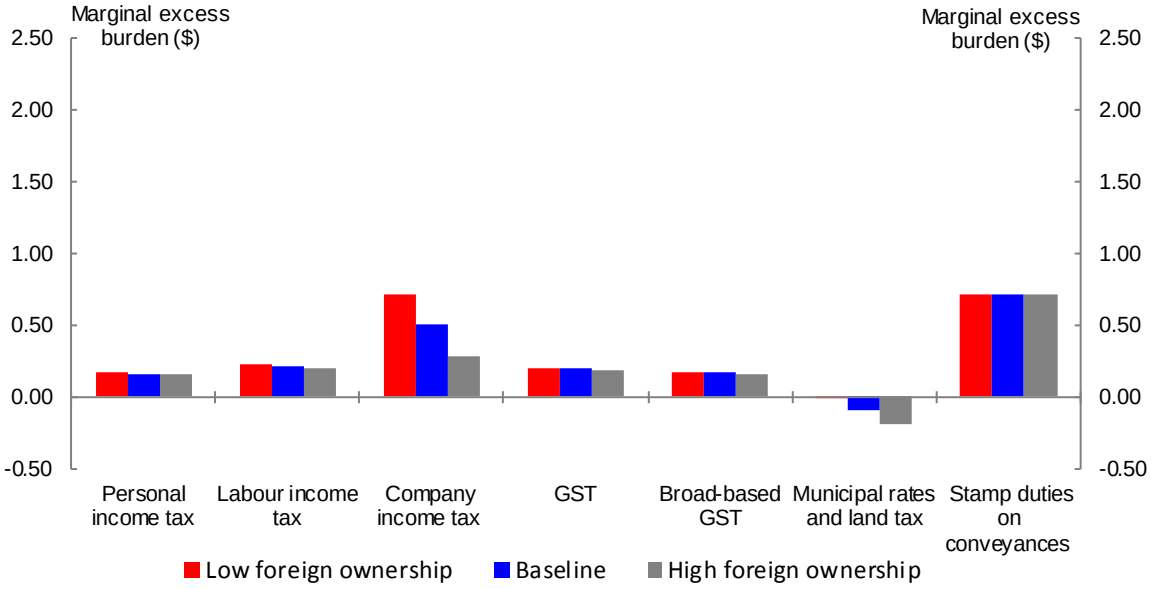
The share of foreign ownership of firms in the model is calibrated using the gross foreign ownership of businesses. This requires us to calculate foreign liabilities excluding household and government liabilities. We do so by estimating the indirect liabilities of households and governments to foreigners through banks, securitises and central borrowing authorities using historical data from ABS National Financial Accounts (ABS Cat. 5232.0).

We have also assumed homogenous foreign ownership shares of firms across the economy. If foreign ownership dominates in particular industries which also have a disproportionally large share of rents then the welfare impacts of the company income tax will vary.

As at June 2008, gross foreign liabilities, excluding those of households and government, was estimated to be $637 billion. Given a total capital stock of roughly $3 trillion, this implies that 20.7 per cent of domestic firms were owned by foreigners.

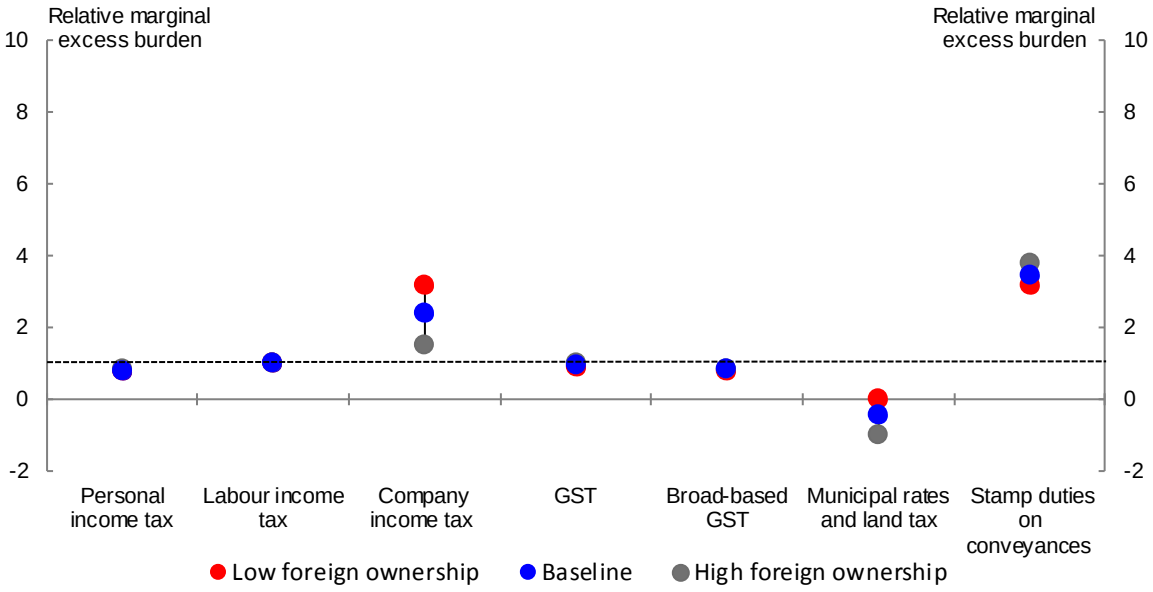
We provide some insight into the implications of higher or lower foreign ownership on the efficiency of various taxes by simulating the model assuming: no foreign ownership; and with foreign ownership of 41.4 per cent, which is double that in the baseline. As predicted, the marginal excess burden rises as the share of foreign ownership falls (Chart 37 and Chart 38).

Chart 37: Marginal excess burden — Sensitivity to foreign ownership share



Source: Treasury estimates.

Chart 38: Relative marginal excess burden — Sensitivity to foreign ownership share



Source: Treasury estimates.

Note: Relative marginal excess burdens are reported relative to the flat labour income tax.

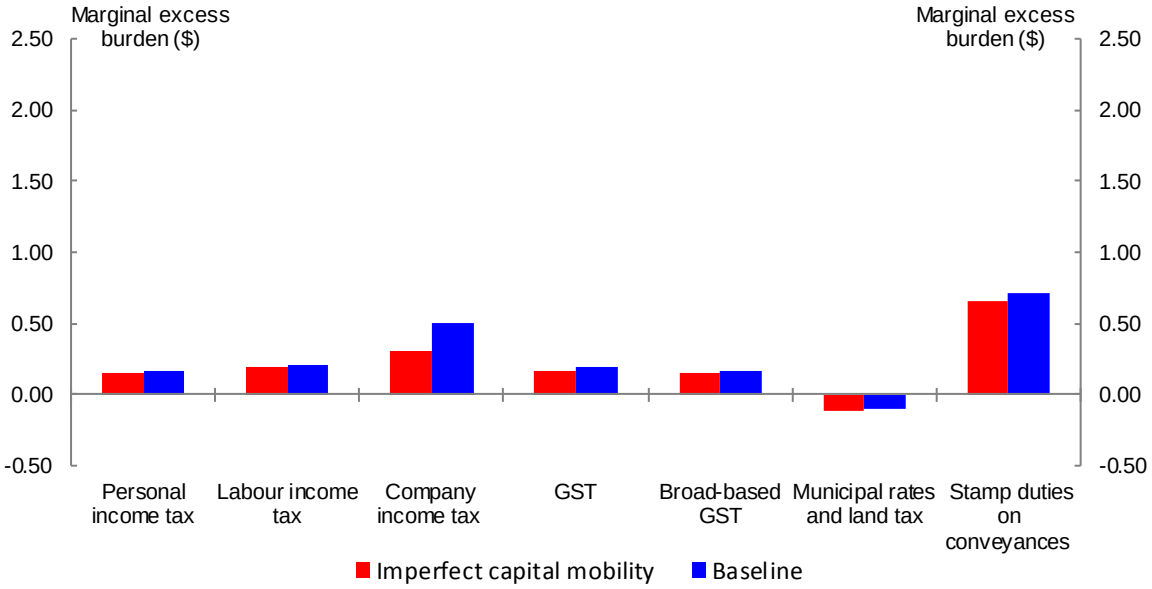
Degree of international capital mobility

The mobility of capital refers to how easily financial capital (debt and equity) flows into and out of a country. Greater capital mobility will shift more of the burden of taxation from capital to labour through larger changes in the domestic capital stock, and hence in domestic labour productivity and wages (Grubert and Mutti, 1985; and Gravelle, 2010). Under perfect capital mobility, an increase in the company tax rate will result in an outflow of foreign capital to ensure that there is no material difference between the after-tax (risk adjusted) rate of return on investment in Australia and the global rate of return. If capital is not perfectly mobile, an increase in the company tax rate will result in a smaller outflow of foreign capital relative to the perfect capital mobility assumption.

The baseline calibration of the model assumes perfect capital mobility. We test the sensitivity of the results to this assumption by imposing lower international capital mobility. Imperfect capital mobility has been implemented in the model by placing a variable premium on the domestic returns to capital required to attract foreign investment. This premium is a positive function of foreign investment: as the stock of foreign investment grows, the premium drives an increasing wedge between the domestic after-tax rate of return and the required rate of return, which moderates capital flows associated with changes in the company income tax rate. The change in risk premium is determined via a premium elasticity which raises the required rate of return with respect to a change in the foreign value of foreign owned capital. Following KPMG (2010), we assume that a 50 basis points increase in the rate of return is required to double the share of foreign ownership of total assets.

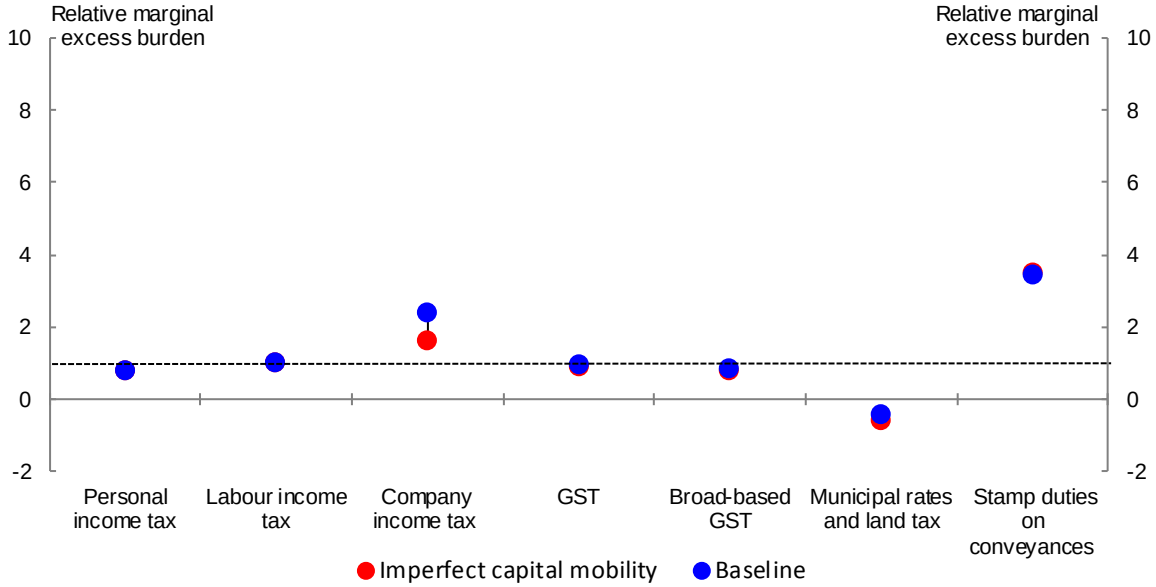
Chart 39 and Chart 40 show that limited mobility of capital results in a smaller welfare loss from a company income tax rate increase because it implies a smaller capital outflow and reduction in the capital stock following a tax increase.

Chart 39: Marginal excess burden — Sensitivity to mobility of capital



Source: Treasury estimates.

Chart 40: Relative marginal excess burden — Sensitivity to mobility of capital



Source: Treasury estimates.
Note: Relative marginal excess burdens are reported relative to the flat labour income tax.

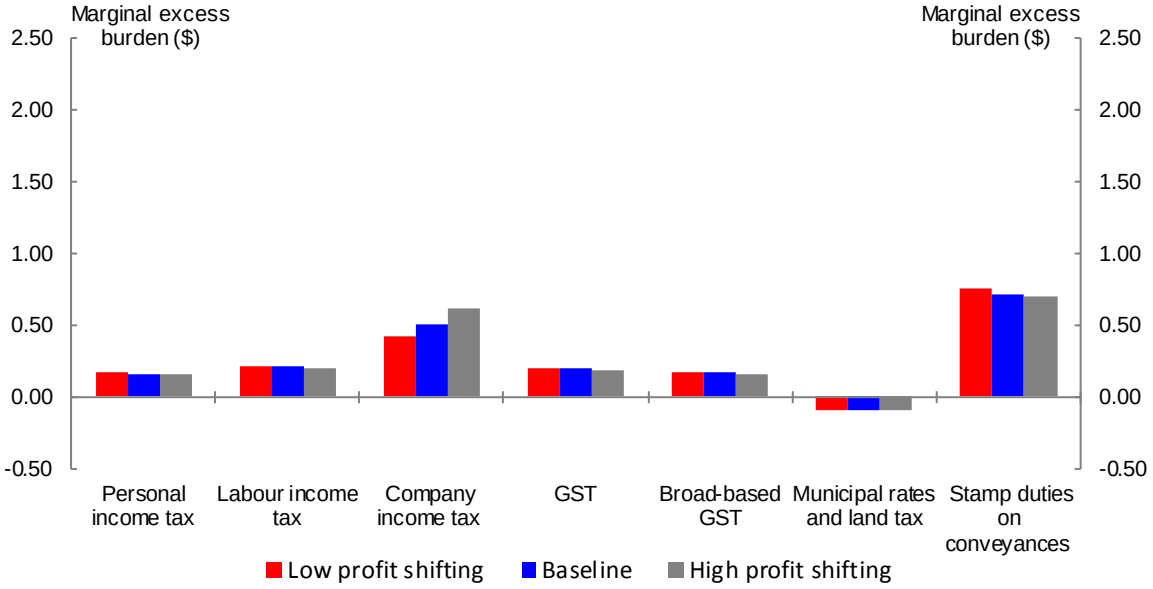
Propensity to shift profit overseas

The model takes into account that companies may seek to reduce their business tax liability by shifting profits from Australia to countries with lower rates of business tax. De Mooij and Devereux (2011) model this profit-shifting in two forms: transfer pricing; and tax havens. They find that tax havens are more important.

Following De Mooij and Devereux (2011), we assume the representative firm in each industry maximises its after-tax profit by choosing the proportion of its tax base to shift to a tax haven. This takes into account the costs and benefits of profit-shifting. De Mooij and Devereux also estimate the extent to which the tax base is eroded when differential tax rates in the home country and the tax haven create an incentive for profit-shifting. They estimate the base-erosion elasticity with respect to the tax rate to be -0.5.

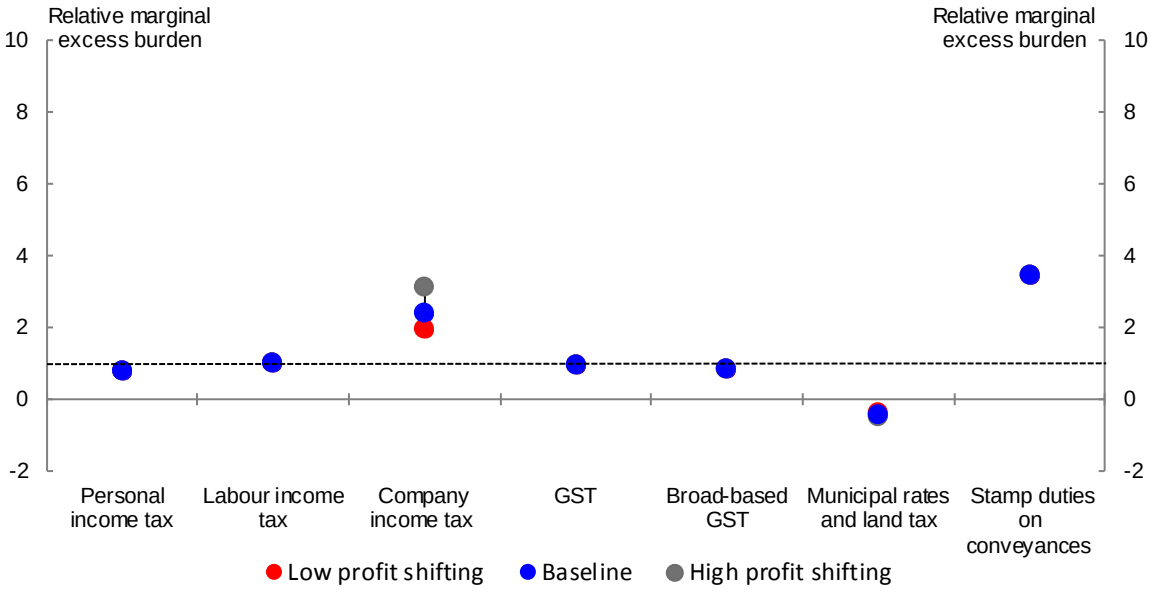
In the baseline we calibrate the profit shifting elasticity to -0.5. We test the sensitivity of the results by assuming no profit-shifting, by setting the base-erosion elasticity to 0, and doubling the base-erosion elasticity to -1.0. In line with expectations, Chart 41 and Chart 42 show that increasing the profit-shifting elasticity raises the marginal excess burden of the corporate income tax, which reflects higher required company tax rates under profit-shifting.

Chart 41: Marginal excess burden — Sensitivity to profit-shifting elasticity



Source: Treasury estimates.

Chart 42: Relative marginal excess burden — Sensitivity to profit-shifting elasticity



Source: Treasury estimates.
Note: Relative marginal excess burdens are reported relative to the flat labour income tax.

Substitutability of structures and land

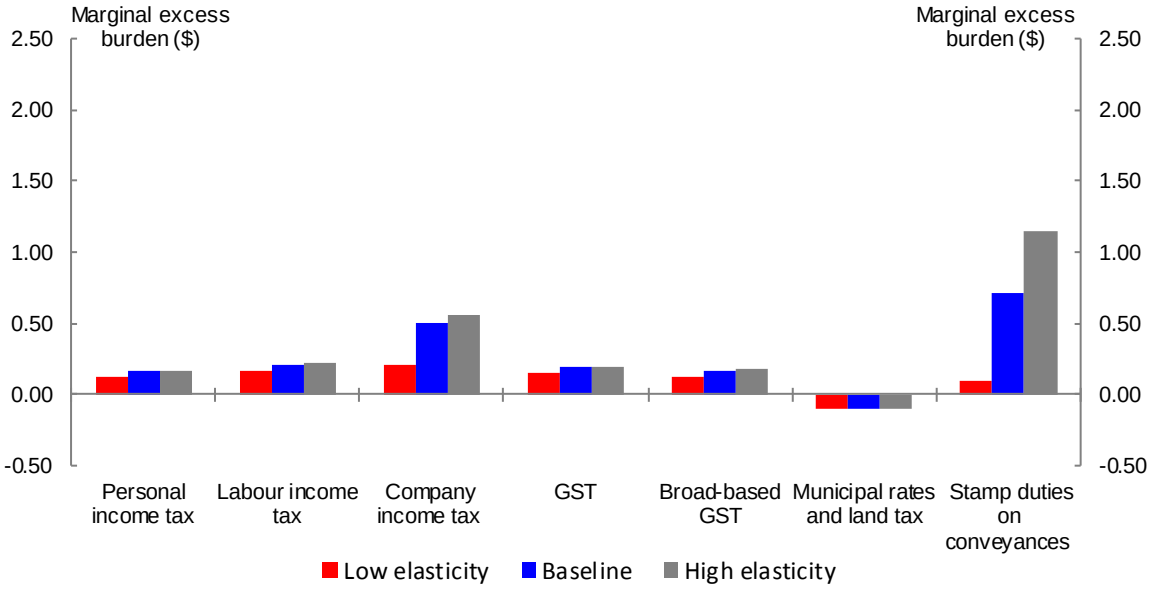
Our modelling assumes goods and services are produced via nested constant elasticity of substitution (CES) production functions.

In particular, the structures and land bundle combines three inputs: non-dwelling structures; non-dwelling land; and ownership transfer costs. These factors are combined to produce a bundled good called structure services. Within this bundle firms can substitute between the three inputs with an elasticity of substitution of 0.5. This elasticity is based on the literature survey of Zhao (2010).

In order to test the sensitivity of the results to this elasticity we simulate the model assuming a low substitutability (an elasticity close to 0) and high substitutability (an elasticity of 1, which is twice the baseline elasticity).

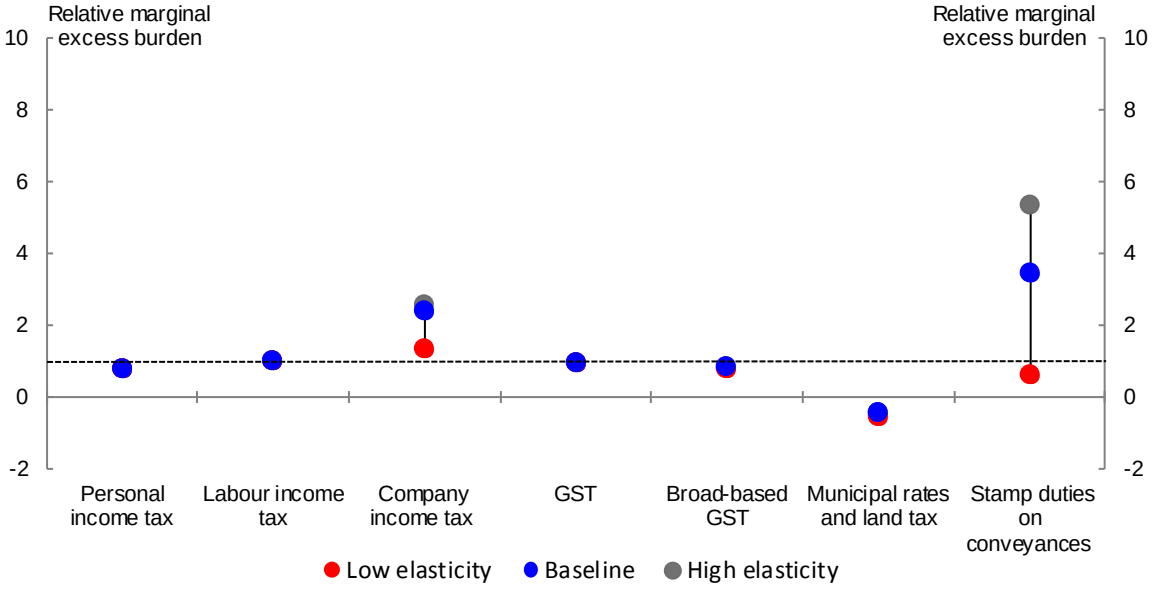
Increasing the elasticity of substitution in the structure services bundles causes the demand for each factor to be more sensitive to own-price changes. Chart 43 and Chart 44 show that greater substitutability between structures and land implies significantly higher marginal excess burdens for the company income tax and stamp duty on conveyances.

Chart 43: Marginal excess burden — Sensitivity to structure-land elasticity



Source: Treasury estimates.

Chart 44: Relative Marginal excess burden — Sensitivity to structure-land elasticity



Source: Treasury estimates.
Note: Relative marginal excess burdens are reported relative to the flat labour income tax.

Substitutability of capital and labour

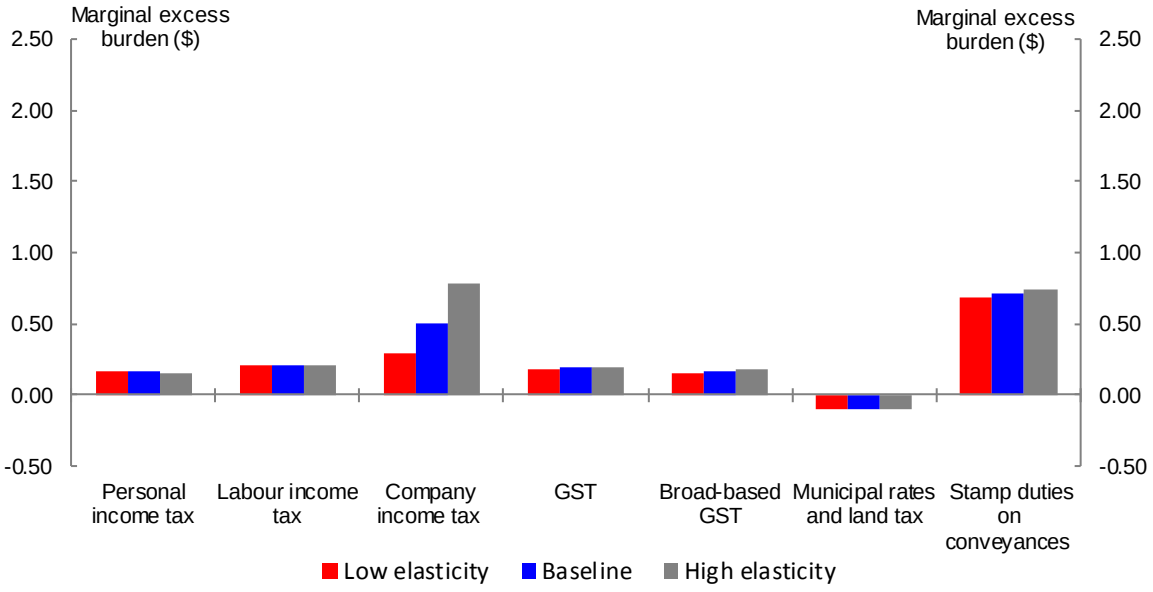
The elasticity of substitution between capital and labour governs the sensitivity of these factors to changes in their own-price. Labour is nested with non-structures capital, and the firm specific fixed factor. Non-structures capital is made up of six capital types: transport equipment; plant machinery and equipment; mineral exploration; research and development; information technology; and other capital.

With an elasticity of 0.9, labour and non-structures capital are modelled as gross complements. This means that a 1 per cent increase in the rental rate of non-structure capital relative to the wage rate will result in a reduction in the demand for both non-structure capital and labour. This elasticity falls within the range of estimates reviewed by Gunning et al. (2007).

In order to test the sensitivity of the results to this elasticity we consider outlier values for the elasticity ranging from a low elasticity of zero to a high elasticity of 1.8.

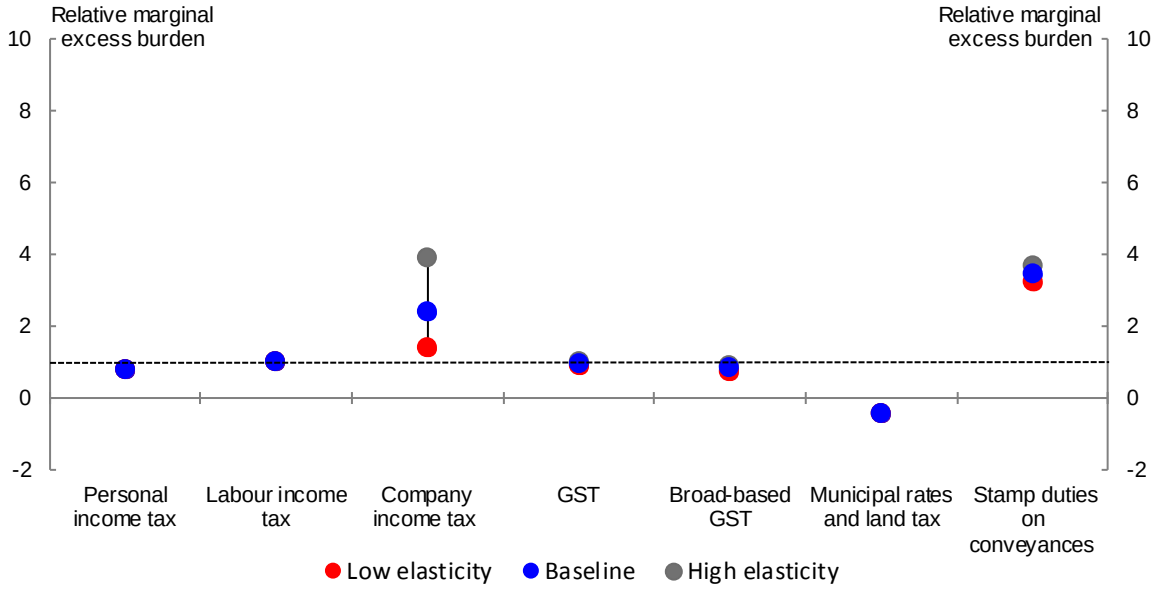
Chart 45 and Chart 46 reveal that the company income tax is somewhat sensitive to this elasticity, with a higher elasticity implying a higher marginal excess burden. The explanation of the effect on marginal excess burdens is similar to the structures and land elasticity discussion: the more elastic demand is the larger is the efficiency cost of a tax.

Chart 45: Marginal excess burden — Sensitivity to capital-labour elasticity of substitution



Source: Treasury estimates.

Chart 46: Relative marginal excess burden — Sensitivity to capital-labour elasticity of substitution



Source: Treasury estimates.
Note: Relative marginal excess burdens are reported relative to the flat labour income tax.

Parameters governing household behavior

Goods and services tax

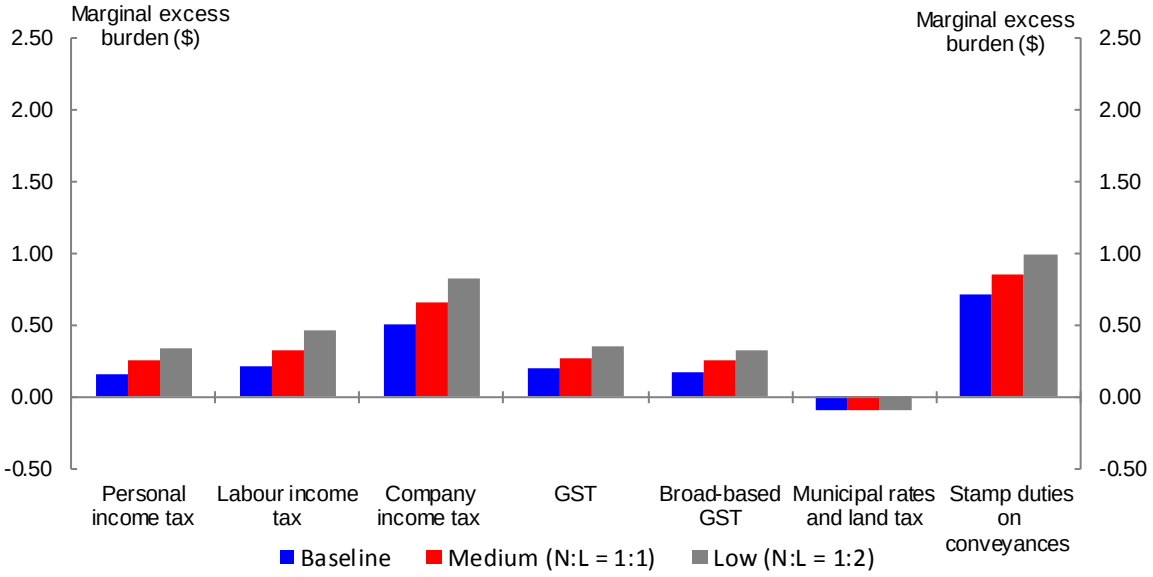
Estimates of the effective GST rate are based on historical estimates of GST tax receipts sourced from the ABS Input-Output tables (ABS Cat. No. 5209.0.55.001) and cover taxed intermediate inputs, household final consumption expenditure and private gross fixed capital formation.

Leisure share of total time

Households maximise their utility, subject to their budget constraint, by choosing the optimal combination of consumption and leisure. The value of consumption is easily measurable; it is the volume of consumption of a bundle of goods and services each evaluated at their individual prices. The value of leisure is based on the share of total non-sleeping time devoted to leisure and the real wage.

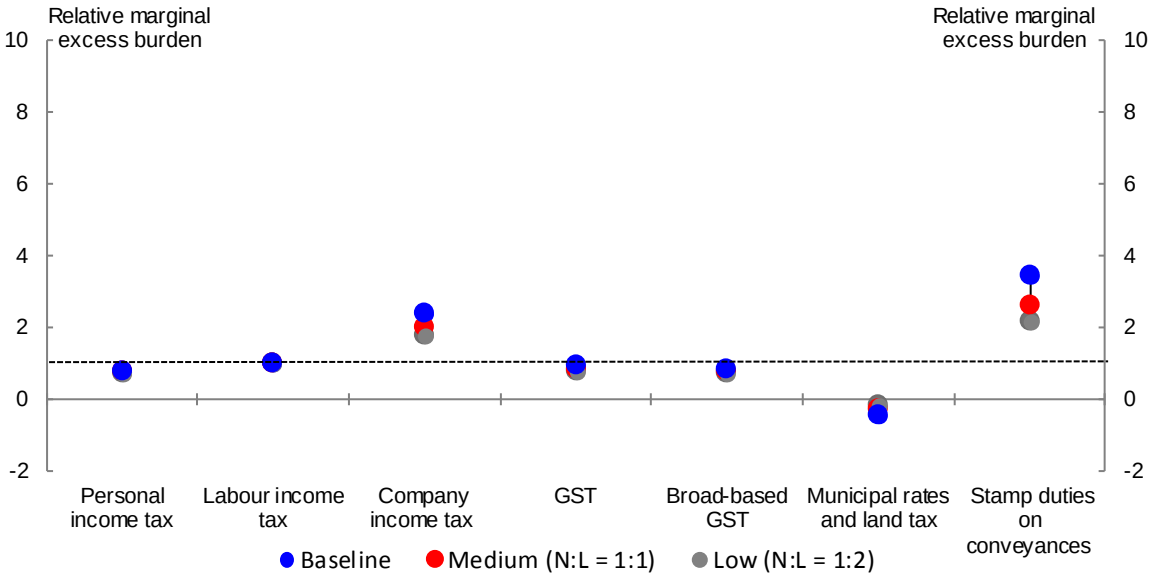
The baseline calibration assumes the ratio of labour supply to leisure is 2 to 1 (that is, households devote one third of their time to leisure). This calibration was adopted to ensure comparability with earlier studies, specifically KPMG (2010 and 2011) and Independent Economics (2014). To test the sensitivity of the results to this calibration assumption we consider two alternatives. First, the leisure share is raised to allow the household to devote half its time to leisure (that is, a ratio of 1 to 1). Second, the leisure share is raised to allow the household to devote two thirds of their time to leisure (that is, a ratio of 1 to 2). Changing this assumption changes the elasticity of labour supply with respect to wages. Chart 47 shows that the results are quite sensitive to this assumption, with the marginal excess burden of all taxes rising with the share of time devoted to leisure. Chart 48, however, shows that these calibration options have little effect on the relative efficiencies of the flat personal income tax, flat labour income tax and GST.

Chart 47: Marginal excess burden — Sensitivity to labour-leisure ratio



Source: Treasury estimates.

Chart 48: Relative marginal excess burden — Sensitivity to labour-leisure ratio



Source: Treasury estimates.
Note: Relative marginal excess burdens are reported relative to the flat labour income tax.

Substitutability of consumption and leisure

Conditional on the labour-leisure ratio, the elasticity of substitution between consumption and leisure is calibrated to achieve an uncompensated elasticity of labour supply with respect to the after-tax wage that is broadly in line with econometric estimates.

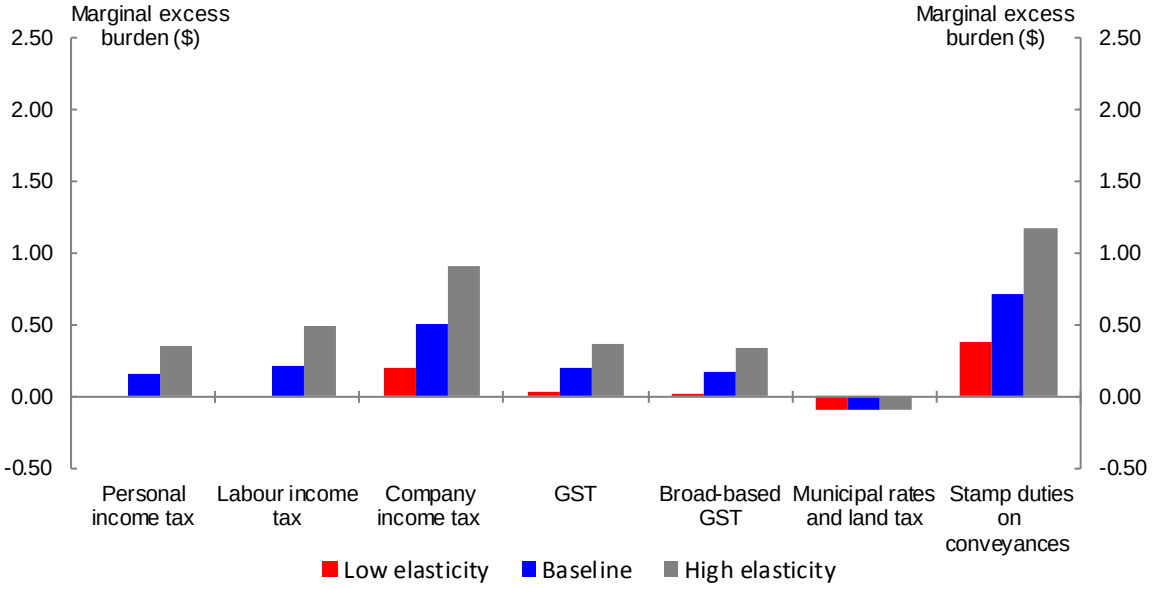
Specifically, the uncompensated elasticity of labour supply is given by:

$$\varepsilon_{N,w} = \frac{\gamma}{1-\gamma}\left(\sigma(1-\beta)+\beta-\frac{H}{(H+M)}\right) \qquad (22)$$

where σ is the elasticity of substitution between consumption and leisure in the CES utility function (equal to 1.2 in the baseline), γ is the share of total hours devoted to leisure (equal to 33 per cent in the baseline), β is leisure's share of utility (equal to around 30 per cent), H is the after-tax value of total household hours and M is other income from capital and transfers. The choice of 1.2 for the consumption-leisure elasticity gives an uncompensated elasticity of labour supply of 0.15, which is slightly lower than the 0.2 assumed in Independent Economics (2014).

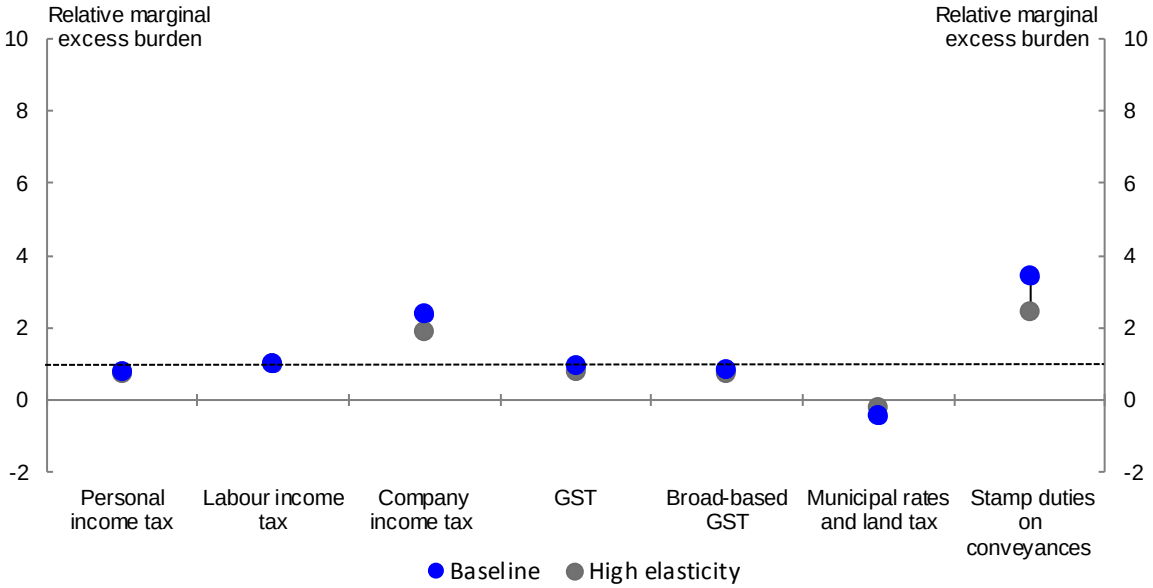
To test the sensitivity of the results to changes in this elasticity, we consider two alternatives: a low elasticity of zero; and a high elasticity of 2.4. As expected, Chart 49 and Chart 50 show that the marginal excess burdens of most taxes rise with the substitutability of consumption and leisure.

Chart 49: Marginal excess burden — Sensitivity to consumption-leisure elasticity



Source: Treasury estimates.

Chart 50: Relative marginal excess burden — Sensitivity to consumption-leisure elasticity



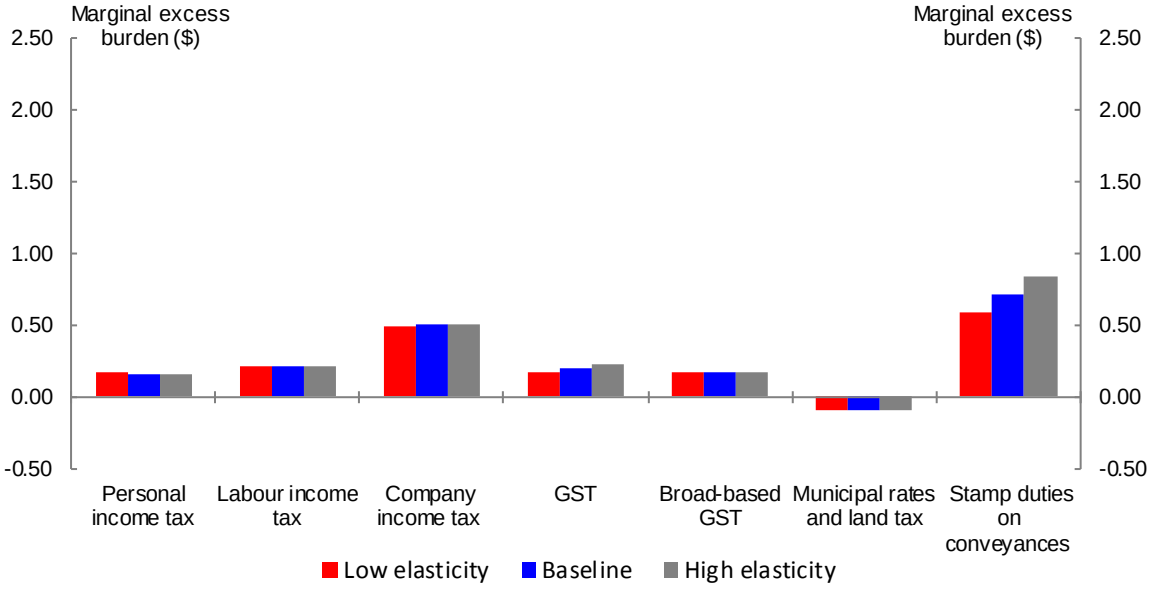
Source: Treasury estimates.
Note: Relative marginal excess burdens are reported relative to the flat labour income tax. The relative marginal excess burden for the low elasticity estimates are not reported because the marginal excess burden of the labour income tax is zero.

Substitutability of different varieties of consumption goods and services

The household has a nested utility function. The top level is a CES function of a consumption bundle and leisure time. The consumption bundle is modelled as a CES aggregate of various types of consumption goods and services. The baseline calibration assumes that the elasticity of substitution across these goods and services is 0.6. To test the sensitivity of the results to this parameter we consider a low elasticity of zero and a high elasticity of 1.2.

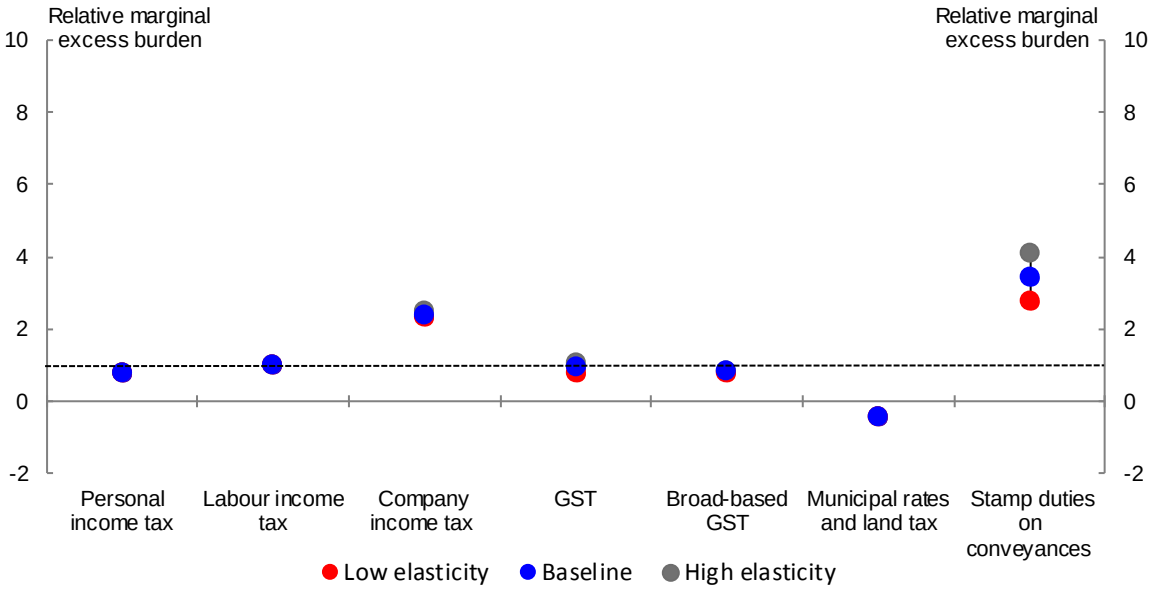
Chart 51 and Chart 52 reveal the marginal excess burdens of the GST and stamp duty on conveyances are sensitive to this parameter: lower elasticities imply lower marginal excess burdens for these taxes.

Chart 51: Marginal excess burden — Sensitivity to consumption good elasticity



Source: Treasury estimates.

Chart 52: Relative marginal excess burden — Sensitivity to consumption good elasticity



Source: Treasury estimates.

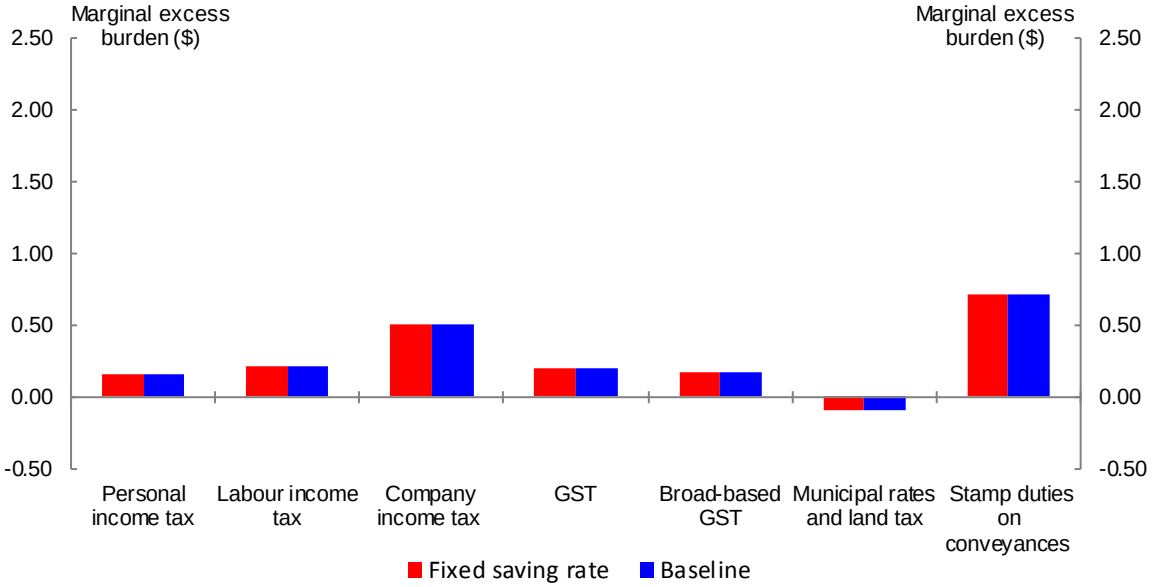
Note: Relative marginal excess burdens are reported relative to the flat labour income tax.

Domestic savings behaviour

The baseline calibration assumes fixed domestic capital holdings. However, a common assumption in static and backward-looking dynamic CGE models is a fixed saving rate (see for example, Adams et al., 2010 and Pant, 2007). To test the sensitivity of the results to this assumption we have implemented a fixed savings rate (that is, the household is assumed to save according to a constant long-run saving rate on after-tax income).[28] Chart 53 and Chart 54 reveal that the savings decision assumption has no significant effect across any of the taxes modelled.

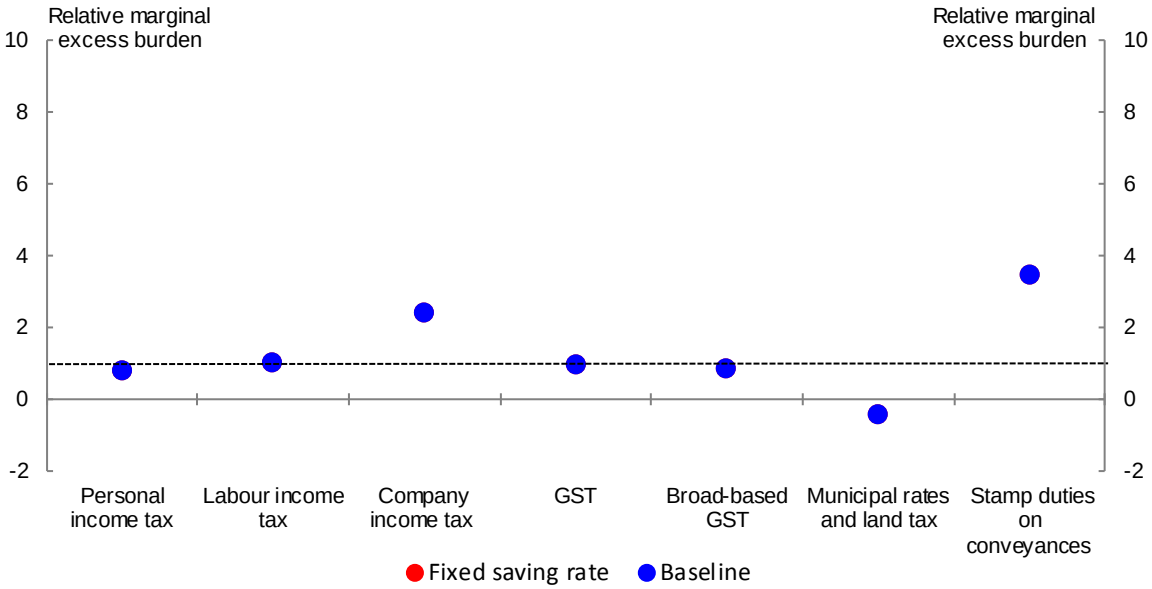
28 Further consideration of intertemporal aspects of taxes is beyond the scope of this paper.

Chart 53: Marginal excess burden — Sensitivity to savings behaviour



Source: Treasury estimates.

Chart 54: Relative marginal excess burden — Sensitivity to savings behaviour



Source: Treasury estimates.

Note: Relative marginal excess burdens are reported relative to the flat labour income tax.

APPENDIX B: CALCULATION OF AVERAGE MARGINAL TAX RATES

The illustrative average marginal tax rates on individual income were prepared using administrative data from individuals' 2011-12 tax returns (Table 7). The average marginal tax rate weighted by (a) individuals and (b) taxable income, are both presented.

Table 7: Derivation of a simple marginal tax rate for 2011-12

Taxable income	**Marginal tax rate** (personal income tax rate, plus LITO and Medicare levy**)**	**Number of individuals**	**Total taxable income $m**	**Total net tax $m**
Up to $16,000	0%	2,307,735	17,931	8
$16,001 to $19,404	15%	601,580	10,653	89
$19,405 to $22,828	25%	567,445	11,970	350
$22,829 to $30,000	16.5%	1,129,690	29,849	1,627
$30,001 to $37,000	20.5%	1,154,595	38,779	3,202
$37,001 to $67,500	35.5%	3,812,000	192,157	32,009
$67,501 to $80,000	31.5%	933,935	68,808	15,364
$80,001 to $180,000	38.5%	1,836,900	200,363	53,973
More than $180,000	46.5%	292,500	100,193	37,714
All		12,636,380	670,703	144,336
a) Average marginal tax rate (individuals weighted)	24.9%			
b) Average marginal tax rate (income weighted)	34.5%			
Average tax rate (net tax divided by taxable income)				21.5%

Source: Treasury calculation using 2011-12 tax return data for resident individuals.
Notes: For the illustrations in this paper, the marginal tax rate calculation does not capture the Temporary Flood and Cyclone Reconstruction Levy that applied in 2011-12. However, taxation revenue collected through this levy will be captured in the average tax rate.

The estimated average tax rate on personal income of 16.7 per cent within the model is significantly lower than the average tax rate on individuals' taxable income of 21.5 per cent. There are two main reasons for this gap. First, the model consistent rate calculates an average tax rate as a function of total labour and domestic capital income (based on National Accounts data) and does not capture deductions that reduce 'taxable income'. Individuals' tax collections expressed as a percentage of total income (before deductions) will be lower than individuals' tax collections as a percentage of taxable income (less deductions). Second, the model consistent rate is based on aggregate labour and domestic capital income data which include income received by individuals that may not be captured in taxation returns (for example exempt income).

APPENDIX C: DATA SOURCES

Australian Bureau of Statistics (2010) Experimental estimates of industry multifactor productivity — 2009-10. ABS Cat. 5260.0.55.002. Australian Bureau of Statistics: Canberra. 07/12/2010.

Australian Bureau of Statistics (2011) Various tables. Australian National Accounts: Input-Output tables — Electronic publication, 2007-08 Final. ABS Cat. 5209.0.55.001. Australian Bureau of Statistics: Canberra. 25/10/2011.

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