OPTIONS FOR REFORMING AUSTRALIA'S GOODS AND SERVICES TAX

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Abstract

The Goods and Services Tax (GST) was introduced in Australia in July 2000 modelled on the European Union's value-added tax (VAT) system at a relatively lower and flat rate of 10%. In recent years, debate over the efficacy of the GST, and the tax system in general, has intensified. This paper analyses the economics of alternative tax policy scenarios for the purpose of informing the tax debate in Australia. Our analytical framework applies a dynamic computable general equilibrium model of the Australian economy that has been specifically designed for policy analysis.

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1. Introduction

The Goods and Services Tax (GST) was introduced in Australia in July 2000 and was modelled on the European Union's value-added tax (VAT) system but at a lower and flat rate of 10%. In recent years, the debate in Australia over the efficacy of the tax system in general, and the GST in particular, has intensified. There is a growing consensus that GST and general tax reform is an essential component of broader economic reform necessary to underpin economic activity in Australia as the economy enters a phase of non-resources driven growth.

Australian has one of the lowest GST rates and one of the highest dependencies on income taxes in the OECD; further, a significant proportion of goods and services in Australia are GST-free (including food, health, education and housing). This suggests that there is the capacity to broaden the GST base and raise the GST rate, and use the additional revenue to reduce other taxes, e.g., personal income tax (PIT). In this paper we focus on the economics of alternative tax policy scenarios with the purpose of informing the tax debate.

In this study the potential impacts on the economy of four changes to the GST are examined:

1. extending the GST coverage to include fresh food, health and education;
2. increasing the GST rate to 12.25% on the current base;
3. increasing the GST rate to 15.2% on the current base but removing it from investment expenditure;
4. increasing the GST rate to 11.9% while extending the base to include fresh food, health and education and removing it from investment expenditure.

In each scenario the additional GST revenue is returned to households through a reduction in PIT.

To quantify the tax mix changes, we apply a dynamic economywide framework with a high degree of sectoral detail and intersectoral linkages: i.e., computable general equilibrium (CGE).

2. Tax reform in Australia

Tax reform has been at the forefront of Australian government policy over the last two decades. In 1998 the government released its comprehensive A New Tax System (ANTS) plan that was the first step towards the introduction of the 10% GST, the removal of wholesale sales tax, personal tax cuts and the abolition of a raft of other taxes, along with changes to Australia's welfare payments system and pensions in 2000. Around the same time the government instigated a Review of Business Taxation ("the Ralph Review"). This inquiry resulted in a number of recommendations around business taxation reform, including the reduction in the headline company tax rate and changes to depreciation, capital gains, and fringe benefits taxation.

In May 2010, the Australian Treasury released the Henry Tax Review: a comprehensive study into Australia's tax and transfer system (AFTS, 2009). This review provided numerous recommendations for further taxation reform in Australia, including the recommendation that efforts to raise government revenue should be focused on four efficient tax bases - personal income, business income, private consumption expenditure and economic rents from natural resources and land. Despite the inclusion of consumption expenditure in this list, the GST was specifically excluded from assessment under the Henry Tax Review and the subsequent 2011 government-hosted Tax Forum.

2.1 Taxation revenue

A recent OECD study OECD (2014b) shows that tax revenues in many OECD countries are now back above their pre-global financial crisis (GFC) levels. While personal and company income taxes are still the main contributors to government revenues across most of these countries, the OECD continues to warn against the distortionary nature of these taxes. The new OECD research also finds that there is a general trend towards consumption taxes among its member countries. Many countries, particularly those in the European region, have increased their standard VAT over the last few years, with an increase of 1.5% in the average standard VAT observed between January 2009 and 2014. While there is also a potentially significant boost to revenue associated with VAT base-broadening, this remains a less popular approach to increasing taxation revenues (OECD 2014a).

The OECD and the Korea Institute of Public Finance recently undertook a joint study into the distributional effects of consumption taxes in 20 OECD countries (OECD/Korea Institute of Public Finance, 2014). Consumption taxes are generally seen as regressive. The poor are believed to be most affected by taxes on consumption, as a greater proportion of their incomes is spent on necessities such as food. While this is true when measured as a percentage of income, the study shows that the opposite is true in most cases when measured as a percentage of expenditure from a lifetime perspective. The study also suggests that reduced VAT rates which are aimed to benefit the poor and promote social welfare may not always work as expected in practice. In some cases, the rich benefit more from reduced rates on items such as hotel accommodation and restaurant food.

Like many other OECD countries, PIT, company tax and GST are the three major sources of tax revenue for the Australian (federal) government. Table 1 shows the level of tax revenue raised by Australian Governments across these three taxes. Studies have shown that income taxes levied on individuals and on consumption are relatively efficient taxes, while those levied on highly mobile bases (such as capital – or company – taxes) are less efficient (Cao *et. al.*, 2015).

Table 1. Australian taxation revenue ($ million)

	2009-10	2010-11	2011-12	2012-13
Personal income tax	124,941	138,532	153,760	162,993
Company income tax	54,490	57,071	66,435	70,117
GST	46,553	48,093	48,849	50,313
Crude oil and LPG excise	15,766	16,305	16,924	17,839
Other excises	8,781	9,497	8,557	7,871
Income tax paid by superannuation funds	6,164	6,683	7,838	7,574
Taxes on international trade	5,762	5,839	7,117	8,181
Other federal taxes	5,221	7,100	8,068	13,476
Total federal government	267,678	289,120	317,548	338,364
Payroll tax	16,761	17,955	19,747	20,752
Stamp duties on conveyances	12,292	12,430	11,658	12,841
Municipal rates	11,669	12,506	13,290	14,192
Motor vehicle taxes (including stamp duty on registration)	6,992	7,461	7,884	8,532
Land taxes	5,767	6,005	6,103	6,192
Gambling taxes	5,054	5,147	5,370	5,493
Insurance taxes	4,597	5,035	5,394	5,526
Other state and local taxes	3,064	4,112	3,521	3,883
Total state and local government	66,196	70,651	72,967	77,411
Total	**333,874**	**359,771**	**390,515**	**415,775**

Source: Australian Bureau of Statistics, Taxation Revenue, Australia.

Government budget statistics indicate that federal government taxation revenue was estimated to be around 22.1% of GDP in 2014-15, an increase of 1.7 percentage points from the previous year. Despite this increase, total taxation revenue was still less than total federal government spending, which was estimated at 25.4% of GDP. Based on Treasury's budget projections, this fiscal gap will remain in the outer years of the budget despite expected small increases in total taxation revenue, with total government expenditure remaining relatively stable at around 25.3% of GDP in 2017-18.

Demographic change, mainly driven by an ageing population, is expected to raise future fiscal pressures. Slower economic growth resulting from a shrinking working-age population and higher costs of healthcare will continue to worsen the fiscal budget position in the long run. According to Treasury's 2010 Intergenerational Report, ageing and health pressures will cause total government spending to reach 27.1% of GDP by 2049-50, exceeding total government revenue by almost 3% of GDP.

As mentioned above, amongst the different taxes implemented in Australia, the GST is recognised as one of the more efficient. Further, in comparison to other OECD countries, Australia's GST rate of 10% is relatively low compared to the unweighted average GST rate of 19.2% amongst the OECD member countries. In fact, Australia's GST rate is one of the lowest in this group of countries, making this tax a potential candidate to be included in a package of taxation reform.

Table 2. GST rates in OECD member countries in 2014

Australia	10.0	Japan	8.0
Austria	20.0	Korea	10.0
Belgium	21.0	Luxembourg	15.0
Canada	5.0	Mexico	16.0
Chile	19.0	Netherlands	21.0
Czech Republic	21.0	New Zealand	15.0
Denmark	25.0	Norway	25.0
Estonia	20.0	Poland	23.0
Finland	24.0	Portugal	23.0
France	20.0	Slovak Republic	20.0
Germany	19.0	Slovenia	22.0
Greece	23.0	Spain	21.0
Hungary	27.0	Sweden	25.0
Iceland	25.5	Switzerland	8.0
Ireland	23.0	Turkey	18.0
Israel	18.0	United Kingdom	20.0
Italy	22.0	USA (Combined State & Local Sales Tax)	1.69 to 9.45
Unweighted average (excluding US)			**19.2**

Source: Tax Foundation, www.VATlive.com.

OECD data on taxation compositions across different countries shows that Australia's total taxation mix is skewed towards direct taxes (individuals and corporations). According to the OECD, these taxes contributed almost 60% of total Australian tax revenue in 2013, compared to an OECD average of just over 30%.

Table 3. 2013 tax revenue as a share of total taxation

	Individuals	Corporate	Social Security Contributions	Value Added Taxes	Other goods and services	Payroll and workforce	Property	Other taxes
Australia	39.2	18.9		12.1	16.0	5.2	8.6	
Canada	36.6	9.5	15.5	13.7	10.8	2.1	10.6	1.2
New Zealand	37.7	14.1		30.0	8.3		6.2	
Greece	20.6	3.3	32.0	21.2	16.6		5.6	0.4
Iceland	37.4	5.4	10.4	22.8	12.3	0.9	7.1	3.8
United Kingdom	27.5	8.1	19.1	20.8	12.1		11.9	
Switzerland	31.7	10.5	24.9	13.0	9.9		6.6	3.4
Turkey	14.4	7.4	27.2	20.8	24.2		4.2	1.7
United States	37.7	10.2	22.3		17.9		11.8	
OECD - Average	**24.5**	**8.5**	**26.2**	**19.5**	**13.3**	**1.1**	**5.5**	**1.5**

Source: OECD, OECD.StatExtracts, http://stats.oecd.org/.

Notes: (1) "Individuals" includes taxes on income, profits and capital gains paid by individuals. (2) "Corporate" includes taxes on income, profits and capital gains paid by corporations. (3) "Other taxes" include those not already identified, unallocated taxes on income, profits and capital gains and unallocated social security payments.

3. Analytical framework

3.1 Overview

To analyse the tax policy changes here we employ KPMG-CGE: a dynamic multi-sectoral model of the Australian economy that has been specifically designed for policy analysis. KPMG-CGE belongs to the CGE class of models exemplified by the world-leading ORANI (Dixon et al., 1982) and MONASH (Dixon and Rimmer, 2002) models. KPMG-CGE builds on the ORANI and MONASH traditions by incorporating a number of theoretical and empirical advancements.

KPMG-CGE represents the supply and demand side of commodity and factor markets. There are five broad categories of representative agents – producers, physical capital investors, households, governments and foreigners. KPMG-CGE distinguishes 114 sectors and commodities based on the 2009/10 input-output tables published by the Australian Bureau of Statistics (ABS) (2013). Primary factors are distinguished by 114 types of capital (one type per industry), nine occupations, two types of land, and natural resource endowments (one per industry). A representative firm in each sector produces a single commodity. Commodities are distinguished between those destined for export markets and those destined for domestic sales. Production technology is represented by nested CRESH functions (Hanoch, 1971) allowing a high degree of flexibility in the parameterisation of substitution and technology parameters. Energy goods are treated separately to other intermediate goods and services in production, and are complementary to primary factors.

There is a single representative household that owns the major share of factors of production with foreigners owning the remainder; the representative household can either spend or save its factor income. There is a single government sector representing all levels of government in Australia. KPMG-CGE includes detailed government fiscal accounts including the accumulation of public assets and liabilities; these are based on the ABS's Government Finance Statistics (ABS, 2015). On the revenue side, detailed modelling of over 20 direct and indirect taxes and income from government enterprises is included. On the expenditure side, government consumption, investment and payments of various types of transfers (such as pensions and unemployment benefits) are modelled.

Foreigners supply imports to each region at fixed c.i.f. prices, and demand commodities (exports) from each region at variable f.o.b. prices. Investment behaviour is industry specific and is positively related to the expected rate of return on capital. This rate takes into account company taxation and a variety of capital allowances, including the structure of the imputation system.

Foreign asset and liability accumulation is explicitly modelled, as are the cross-border income flows they generate and that contribute to the evolution of the current account. Along with other foreign income flows like labour payments and unrequited transfers, KPMG-CGE takes account of primary and secondary income flows in Australia's current account; these are particularly important for Australia as they typically comprise the significant share of the balance on the current account.

3.2 Theory

KPMG-CGE is represented by equations specifying behavioural and definitional relationships. There are m such relationships incorporating a total of p variables and these can be compactly written in matrix form as

$$A\boldsymbol{v} = \boldsymbol{0}, \tag{1}$$

where A is an $m \times p$ matrix of coefficients, $\boldsymbol{v}$ is a $p \times 1$ vector of percentage changes in model variables and $\boldsymbol{0}$ is the $m \times 1$ null vector. Of the p variables, e are exogenous (e.g., input-output coefficients). The e variables can be used to shock the model to simulate changes in the $(p-e)$ endogenous variables. Many of the functions underlying (1) are highly nonlinear. Writing the equation system like (1) allows us to avoid finding the explicit forms for the nonlinear functions and we can therefore write percentage changes in the $(p-e)$ variables as linear functions of the percentage changes in the e variables: this reduces the computational burden. Although (1) is linear, accurate solutions are computed by allowing the coefficients of the A matrices to be nonconstant through a simulation. This is accomplished by using a multistep solution procedure.[1] Below we present the behavioural equations that are important for the analysis undertaken here.

3.2.1 Input technology: current production

The representative firm in each sector produces a single commodity. The model recognises two broad categories of inputs: intermediate inputs and primary factors. Representative firms choose inputs of primary factors and intermediate inputs to minimise costs subject to given production technology and given factor and commodity prices. Primary factors include two types of land, natural resources, 10 types of labour and physical capital. Intermediate inputs consist of 114 domestically-produced commodities and 114 foreign substitutes. In addition, commodities destined for export are distinguished from those for local use. Demands for primary factors and intermediate inputs are modelled using nested production functions with four tiers.

At the top level, the j (=1,…,114) firms decide on the (percentage change in) demand for the non-energy composite (*NE*) and the primary factor-energy composite (*PF-E*) q_{ij}^{P1} applying CRESH (constant ratios of elasticities of substitution, homothetic) production technology:

$$q_{ij}^{P1} = q_j + a_{ij}^{P1} - \sigma_{ij}^{P1}\left(p_{ij}^{P1} + a_{ij}^{P1} - pa_j^{P1}\right),\ i = NE,\ PF\text{-}E. \qquad (2)$$

The non-energy composite is an aggregate of non-energy intermediate inputs and the factor-energy composite is an aggregate of primary factors and energy intermediate inputs. In (2), q_j is (the percentage change in) the j-th industry's activity level, a_{ij}^{P1} is technical change specific to the i-th composite, p_{ij}^{P1} is the price of the i-th composite, pa_j^{P1} is the average price of composite i (= *NE, PF-E*), and σ_{ij}^{P1} is the elasticity of substitution for composite i.

[1] The model is implemented and solved using the multistep algorithms available in the GEMPACK economic modelling software (Harrison and Pearson, 1996).

Unlike CES (constant elasticity of substitution) functions, CRESH functions allow the elasticity of substitution to vary across pairs of inputs. This allows a high degree of flexibility in parameterisation. σ_{ij}^{P1} is set to 0.1 for all industries; this assumes that firms' use of the non-energy composite and the primary factor-energy composite is close to a fixed share of output. This reflects the idea that the output share of these two composites is nearly invariant to changes in relative prices and reflects characteristics intrinsic to the production of each good. Note that these shares will vary if there is a change in production technology $\left(a_{ij}^{P1}\right)$, e.g., innovation that allows less use of non-energy intermediate inputs per unit of output. Equation (2) consists of a scale term $\left(q_{jr}^{F}+a_{ijr}^{F}\right)$ and a substitution term $\left(p_{ijr}^{F}+a_{ijr}^{F}-p_{jr}^{F}\right)$. Thus, with no change in relative prices, changes in output will lead to changes in factor demands. With output fixed, changes in relative prices will lead to changes in factor demands; this effect will be larger the greater the value of σ.

At the second level of the production nest, j (=1,…,114) firms choose the optimal mix of the primary factor (PF) and energy (E) composites. The primary factor composite is an aggregation of all primary factors and the energy composite is an aggregation of energy intermediate inputs. These composites are also combined using CRESH production technology. In percentage-change form, the demand equations are:

$$q_{ij}^{P2}=q_{j}+a_{ij}^{P2}-\sigma_{ij}^{P2}\left(p_{ij}^{P2}+a_{ij}^{P2}-pa_{j}^{P2}\right), i=PF, E. \qquad (3)$$

Equation (3) has the same form as (2) and the same parameterisation (σ_{ij}^{P2} = 0.1); it thus represents the same behaviour by firms.

At the third level of the production nest, firms choose cost-minimising combinations of constituents in each of the non-energy intermediate inputs composite(NE), energy intermediate inputs composite (E) and primary factor composite(PF). The optimal mix of non-energy intermediate inputs is determined subject to CRESH production technology where the elasticity of substitution across all pairs of non-energy intermediate inputs is 0.1 for all industries. Analogously, the optimal mix of energy intermediate inputs is determined subject to CRESH production technology with an elasticity of substitution across all pairs of energy intermediate inputs of 0.25 for all industries. This choice of parameter value for substitution across energy intermediate inputs reflects the idea that firms have some flexibility with respect to energy technology and will alter the pattern of energy usage in production if relative prices change.

At level three, firms also determine the optimal mix of primary factors (capital, natural resources and owner-operator labour) and the land and labour composites. We assume firms are more responsive to relative price changes at this level of the production nest and thus apply an elasticity of 0.4.[2] The exception is owner-operator labour where we apply an elasticity of zero.

At the lowest level of the production nest, firms decide on the optimal mix of domestic and imported intermediate inputs subject to CRESH technology. We assume firms are responsive to relative price changes between domestic and foreign goods and therefore apply an elasticity of substitution of 5. At this level, firms also choose the optimal mix of the nine labour types (i.e., occupations) subject to CRESH technology with an elasticity of substitution of 0.25. They also decide on their use of two land types (agricultural and non-agricultural) using CRESH technology. Because each industry uses only one type of land, the elasticity of substitution is set to zero for all industries; thus, individual land usage moves with demand for the land composite.

All firms are assumed to operate in perfectly competitive markets and so we impose a zero-pure-profits condition that is expressed as equating revenues with costs; this condition determines each industry's activity level $\left(q_j\right)$. Output prices are then determined by a market-clearing condition for each commodity.

3.2.2 Supply of primary factors

3.2.2.1 Land

KPMG-CGE distinguishes two types of land: agricultural and non-agricultural. Agricultural land is used only by the agricultural industries. Non-agricultural land consists of commercial land and residential land. Non-agricultural land used by the dwellings sector represents residential land; non-agricultural land used by all other sectors represents commercial land. For a given supply of each land type, inter-sectoral movements are governed by a CRETH (constant ratio of elasticities of transformation, homothetic) function (Vincent *et al.*, 1980). The CRETH land supply response functions solve for revenue maximisation by allocating the supply

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[2] Elasticities of primary factor substitution in this range have been extensively applied in applications of the MONASH, MMRF and TERM models; see, for example, Adams *et al.* (2000), Dixon and Rimmer (2002), Dixon *et. al.* (2011), Dwyer *et al.* (2003), Horridge *et al.* (2005), Wittwer *et al.* (2005), and Ye (2008).

of the n land types across the j industries $\left(p_{nj}^F\right)$ according to the industry-specific relative after-tax rental price of land $\left(p_{nj}^F - pa_n^F\right)$:

$$x_{nj}^F = x_n^F + \sigma_{nj}^F\left(p_{nj}^F - pa_n^F\right). \tag{4}$$

In (4), the elasticity of transformation $\left(\sigma_{nj}^F\right)$ is set to -0.1 for agricultural land making it relatively immobile across agricultural industries. The elasticity of transformation is set to -0.2 for non-agricultural land used by the non-dwellings sectors, and to -0.1 for non-agricultural land used by the dwellings sector. This means that non-agricultural land is more mobile across the non-dwellings sectors than it is between the dwellings and non-dwellings sectors. The underlying assumption is that non-agricultural land cannot be easily transferred between commercial and residential uses. p_{nj}^F is determined by a market-clearing condition. Note that the overall supply of each land type $\left(x_n^F\right)$ is usually fixed except in the baseline of a dynamic simulation where the supply of all factors of production grow at a predetermined rate.

3.2.2.2 Labour

KPMG-CGE distinguishes o (=9) labour types (occupations) the supply of which are determined by a labour-leisure trade-off that allows workers in each occupation to respond to changes in after-tax wage rates, thus determining the hours of work they offer to the labour market:

$$x_o^F = pop + \varphi * prw_o \tag{5}$$

Thus, the supply of each occupation $\left(x_o^F\right)$ is a function of population and real after-tax wage rates by occupations $\left(prw_o\right)$, adjusted by the relevant compensated labour supply elasticity (φ). The elasticity of labour supply is set at 0.15 reflecting econometric evidence on labour supply in Australia (Kalb, 1997; Dandie and Mercante, 2007).

For each type of occupation, there is an occupation-specific wage rate that is usually determined by a market-clearing condition. When simulating policy changes, wage rates are subject to a partial adjustment mechanism that reflects (i) non-market clearing wage-setting behaviour in the short run, (ii) market clearing in the long run at a non-accelerating inflation rate of unemployment (NAIRU), which is set at 6%:

$$\left\{\frac{RW^t}{RW_b^t}-1\right\}=\left\{\frac{RW^{t-1}}{RW_b^{t-1}}-1\right\}+\beta\left\{\frac{E^t}{E_b^t}-\frac{LS^t}{LS_b^t}\right\}+\gamma\left\{\frac{E^{t-1}}{E_b^{t-1}}-\frac{LS^{t-1}}{LS_b^{t-1}}\right\},\ \forall t. \tag{6}$$

In (6), RW^t and RW_b^t are the real wage rates in year *t* in policy and baseline simulations, E^t and LS^t are employment and labour supply in year *t* in the policy simulation, E_b^t and LS_b^t are employment and labour supply in year *t* in the baseline simulations, and β and γ are positive parameters. The relationship between real wage and employment deviations from baseline is mainly controlled by β. If $\beta = 0$, the real wage stays at its baseline level regardless of labour market conditions in the current period; if $\beta = 1$, the real wage responds to non-zero excess demand for labour in the current period. The third term on the right-hand side of (6) ensures that real wage rates set in period *t* also partly reflect deviations away from the NAIRU in previous periods, thus $\gamma = 0.125$. This last term provides a tendency for unemployment rates to return to NAIRU levels in the long-run. The approach embodied in (6) contains elements of that adopted by Dixon and Rimmer (2002) and Powell and Murphy (1995).

3.2.2.3 Capital

Each industry uses capital specific to its own production process. Thus, the supply of capital is specified separately for the *j* (= 114) industries as

$$KE_j^t = KB_j^t\left(1-\delta_j\right)+I_j^t,\ \forall t. \tag{7}$$

Thus, end-of-period capital stocks $\left(KE_j^t\right)$ are a function of beginning-of-period capital stocks $\left(KB_j^t\right)$, investment in the current year $\left(I_j^t\right)$ and the depreciation rate $\left(\delta_j\right)$. I_j^t is a function of the expected rate of return on capital as applied in Dixon and Rimmer (2002). For each type of capital, there is an industry-specific rental rate that is determined by a market-clearing condition.

3.2.3 Household demand

Household behaviour is determined by a representative agent that maximises utility subject to a budget constraint. The utility function is of a two-level nested form. At the first level, consumer preferences by commodity composites are modelled by maximisation of a Stone-Geary utility function subject to the budget constraint that is consistent with the linear expenditure system (LES) (Stone, 1954). An advantage of the LES over other popular utility functions used to represent consumer preferences, e.g., Cobb-Douglas and CES, is that it allows non-unitary expenditure elasticities (Shoven and Whalley, 1992). The Stone-Geary utility function takes the form:

$$U^H = \prod_i \left(Q_i^H - QSUB_i^H\right)^{\alpha_i}, \; 0 < \alpha_i < 1, \; \sum_{i=1}^{n} \alpha_i = 1. \tag{8}$$

where U_i^H, is household utility, and Q_i^H and $QSUB_i^H$ are household demand for the *i*-th commodity composite and subsistence consumption of the *i*-th commodity. The subsitence quantities are purchased regardless of price. The consumer first allocates an amount of income for subsistence bundle; the α_i parameters give the shares of this remnant allocated to each good (the marginal expenditure shares). Maximisation of the LES utility function subject to the income constraint yields the LES Marshallian demand function, which in percentage-change form is

$$q_i^H = \left[1 - \alpha_i\right] hou + \alpha_i [qlux^H - p_i^H], \tag{9}$$

where hou is the number of households, $qlux^H$ is total luxury (or supernumerary) expenditure. Thus, demand for the *i*-th good is a positive function of hou and $qlux^H$ and a negative function of p_i^H, the purchaser's price for commodity *i*. The sum of these two effects on household demand is controlled by α_i, which is defined as $\alpha_i = \alpha * \varepsilon_i$, where α is the 'Frisch parameter' and ε_i is the expenditure elasticity for the *i*-th good.

At the second level, consumer preferences for domestic and imported commodities are represented by a CES utility function. Thus, domestically-produced and imported versions of the *i*-th good are considered to be imperfect substitutes.

3.2.4 Taxes

The model has a comprehensive treatment of the Australian tax system. All taxes are treated in *ad valorem* terms. For a given transaction, taxes represent a wedge between the price paid by the demanding agent and the price received by the supplying agent.

3.2.4.1 Personal income tax

Two categories of personal income taxes (PIT) are specified in KPMG-CGE. Households pay taxes on labour income and on franked dividends. Labour income taxes consist of taxes on regular labour income and taxes on fringe benefits. Taxes on regular labour income are distinguished by industry and by occupation. The labour income tax rates vary by occupation and are positively related to the level of skill as a proxy for higher marginal and average tax rates. Taxes on fringe benefits apply only to the three higher skilled occupations: *Managers and administrators*, *Professionals*, and *Associate professionals*.

Dividend imputation is determined as the difference between the PIT rate and the company income tax (CIT) rate on dividends paid to domestic capital owners. If the PIT rate exceeds the CIT rate, the domestic capital owner pays extra PIT on franked dividends. If the PIT rate is less than the adjusted CIT rate, the capital owner receives franking credits that reduce the PIT rate paid. The taxation of dividends is differentiated by industry and by capital owner. The model identifies four types of capital owners: domestic corporations, foreign corporations, superannuation funds and 'closely-held' enterprises. Distinguishing different categories of capital owners is important as tax rates vary by capital owner. The share of company profits paid as dividends also varies across capital owners and determines the size of the base for dividend imputation.

3.2.4.2 Company income tax

Company income tax (CIT) is defined across industries and capital owner. The CIT rate varies across these dimensions. The CIT rate is highest for domestic corporations and foreign corporations, lower for 'closely-held' enterprises, and lowest for superannuation funds. In all cases, the CIT base is company profit.

3.2.4.3 Goods and services tax

The goods and services tax (GST) for each commodity is specified as the product of the statutory GST rate (10%), the coverage rate, and the value of expenditure in purchaser's prices.[3] The coverage rate reflects the degree to which a commodity is subject to the GST. Although the model distinguishes 114 commodities, there is insufficient detail to seamlessly reflect GST exemptions for certain items. For example, fresh food is exempt from the GST, but food commodities that include some processed and some fresh food will show a coverage rate of less than one. The GST mainly falls on household consumption. Nevertheless, ABS input-output data for 2009/10 (upon which the model data is based) shows GST applied to investment, and to

[3] Expenditure at purchaser's prices includes basic values, the value of margins, and non-GST sales taxes.

a lesser extent intermediate inputs and exports. This reflects the nature of the GST as a VAT that does not fully exempt capital expenditures (Musgrave and Musgrave, 1973).

3.2.4.4 Limitations

With regard to tax policy analysis, KPMG-CGE's main limitation is in the treatment of households as a single representative agent. The representative household is calibrated using aggregate data on expenditure patterns, income patterns, and taxes paid by households. This approach ignores heterogeneity across household types. This means that the PIT system can only be represented by an average tax rate and ignores the progressivity in tax rates on household income. Ignoring progressivity in personal income tax rates underestimates the marginal excess burden of the PIT system.

A related limitation is that labour supply responses in KPMG-CGE also do not reflect heterogeneity across households; this will also underestimate the marginal excess burden of the personal income tax system. However, the limitation here is less severe as we allow labour supply responses to vary by occupation (of which there are nine). In this case, there will be some heterogeneity in labour supply responses across occupations depending on how relative pre-tax wage rates respond to a tax policy change.

Another limitation of representing households using a single agent is that it ignores the heterogeneity of expenditure patterns and saving rates across households. Increasing GST revenues, either by increasing the GST rate or by broadening the GST base, has two effects: it represents a higher tax on consumption relative to saving; it also represents an increase in the relative price of some commodities. This can affect the marginal excess burden of the GST. Ignoring the heterogeneity of expenditure patterns and saving rates across households will underestimate the marginal excess burden of the GST.

3.2.4 Dynamic mechanisms

KPMG-CGE includes three types of dynamic mechanisms: capital accumulation; liability accumulation; and lagged adjustment processes. Capital accumulation has been described in Section 3.2.2.3. Liability accumulation is specified for the public sector and foreign accounts. Public sector liability at the start of year t+1 is public sector liability at the start of year t plus the public sector deficit incurred during year t. Net foreign liabilities at the start of year t+1 are net foreign liabilities at the start of year t plus the current account deficit in year t plus the effects of revaluations of assets and liabilities caused by changes in price levels. Lagged adjustment processes are specified for the response of wage rates to gaps between the demand for and the supply of labour by occupation as described in Section 3.2.2.2.

3.2.5 Macroeconomic closure

As the model is dynamic, simulating the effects of each scenario involves running the model twice: once for a baseline (or business-as-usual) simulation and again for a policy (or tax scenario) simulation. The baseline simulation is designed to be a plausible forecast of how the economy will evolve in the short run in the absence of the policy shock of interest. Over the short run, the paths of most macroeconomic variables are exogenous in the baseline and set in accordance with forecasts made by KPMG-MACRO, KPMG's macroeconomic model. For example, in the baseline the average propensity to consume out of household disposal income is endogenous in order to allow the model to accommodate exogenous forecasts for real household consumption. In the long-run, the baseline simulation converges to a steady-state where all real variables grow by 2.5% and all price variables grow by 2.5%. These assumptions lead to almost balanced trade by 2047/48. These assumptions also lead to industry investment-capital ratios and rates of return converging to long-run levels by 2047/48.

In the policy simulation, the household consumption function allows the trade balance as a share of GDP to vary in the shortrun; in the longrun, we impose a path on household consumption that ensures that the trade balance as a share of GDP returns to its initial level. This imposes an economywide budget constraint that ties down the ratio of net foreign liabilities to GDP. Similarly, we impose a longrun government budget constraint by imposing a path on personal income tax rates to ensure that government debt as a share of GDP returns to its initial level.

The policy simulation comprises the baseline simulation plus the changes in policy variables of interest (e.g., tax variables). That is, all exogenous variables in the policy simulation are assigned the values they had in the baseline simulation and variables of interest (e.g., tax rates) are altered in accordance with the tax scenarios. Then, the differences in the values of variables in the policy and baseline runs quantifies the effects of moving the variables of interest away from their baseline values.

4. Results

We analyse the potential impacts on the economy of four tax reform scenarios.

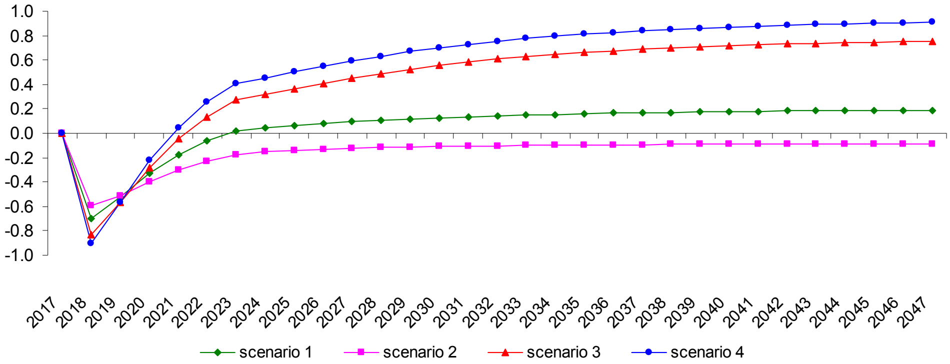
1) 10% GST on a broader base, i.e., including fresh food, health and education.
2) 12.25% GST on the current base.
3) 15.2% GST on non-investment expenditure – removal of the GST from investment expenditure and an increase in the rate to 15.2% on non-investment expenditure on the current base.
4) 11.9% GST on non-investment expenditure and a broader base – removal of the GST from investment expenditure, an increase in the rate to 11.9% on other expenditure and a broadening of the base to include fresh food, health and education.

We impose all scenarios in 2018-19. Scenario 1 is estimated to raise an additional $14.1 billion in GST revenue. The tax rates in scenarios 2-4 have been calibrated to raise the identical amount of extra GST revenue as scenario 1. In this way, the scenarios are equivalent in terms of the first-order effects on government revenue. The additional GST revenue is returned to households through PIT cuts in order to maintain the government budget balance as a share of GDP at its initial level. As the extra GST revenue is returned to households as lower personal income taxes, the scenarios are also equivalent in terms of the first-order effect on post-tax wages. This equivalence across scenarios means that the real output and welfare effects across scenarios will largely reflect the marginal excess burden of each tax change. This provides a guide on which tax changes are to be preferred on an efficiency basis.

4.1 Shortrun results

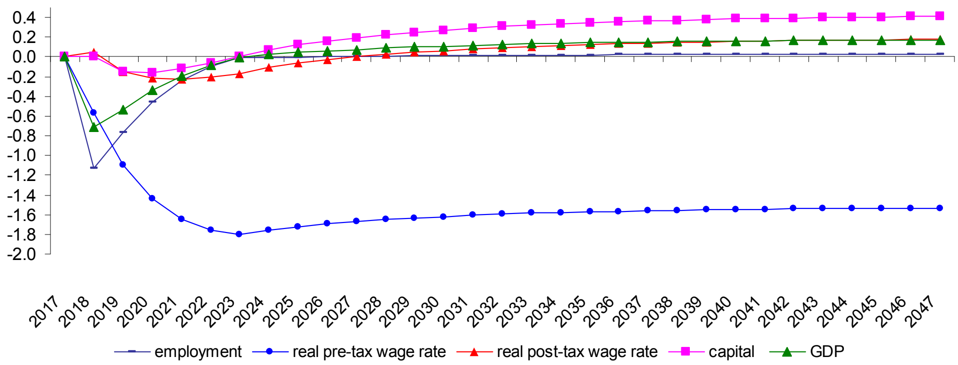
Figure 1 presents the effects on real GDP for each scenario. All scenarios lead to a contraction in economic activity in 2018/19. From 2019/20 real GDP moves back toward baseline in all scenarios. One of the main initial effects in all scenarios is to increase the consumption price index (CPI) due to the increase in the GST rate or the broadening of the GST base. The increase in the CPI reduces the demand for household consumption and the derived demand for all primary factors. The labour market dynamics in KPMG-CGE assume that wage rates are sticky in the short run and flexible in the long run; this mechanism is specified in terms of real pre-tax wage rates by occupation. This means that the employment effects of any shock will greater in the short run than in the long run, with the opposite being true for wage rates.

Figure 1. GDP effects – all scenarios (percentage change)



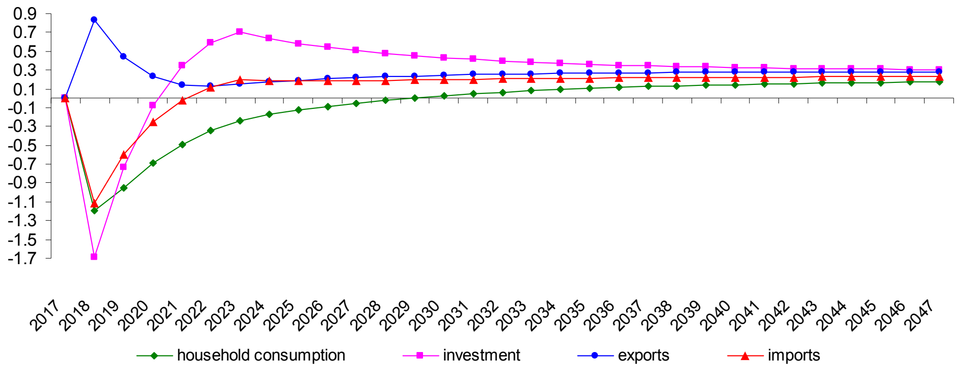
The labour market dynamics for Scenario 1 are presented in Figure 2. The rise in the CPI causes the average real pre-tax wage rate to fall by 0.6% in 2018/19. Despite this, the post-tax real wage rate rises slightly due to the fall in PIT rate. The short-run stickiness in wage rates means that employment falls by more than real wage rates: 1.1% cf. 0.6%. The decrease in employment implies there is an excess supply of labour at initial wage rates and so real wage rates fall. From 2019/20, employment begins to move back toward baseline as real wage rates slowly respond to the excess supply of labour by moving further below baseline.

Figure 2. Labour market and macro effects - Scenario 1 (percentage change)



Initially capital stocks are slow to respond to the shock due to gestation lags, so they are almost unchanged in 2018/19. From 2019/20, capital stocks contract due to the fall in investment (Figure 3). Investment falls because rates of return move below baseline. Rates of return are driven below baseline because the fall in output reduces the demand for all primary factors; as capital stocks are initially unresponsive to changes in investment, lower demand for capital manifests as a fall in the rental prices of capital and therefore a fall in rates of return.

Figure 3. GDP expenditure-side effects - Scenario 1 (percentage change)



Although consumption and investment are initially lower due to the tax change, the fall in the price of primary factors reduces domestic production costs and makes exports more competitive in foreign markets; thus, exports are higher by 0.8% in 2018/19. With export prices lower and import prices fixed in foreign currency terms, the real exchange rate has depreciated. Thus, imports are below baseline. The increase in the real trade balance helps to cushion the initial effect of lower consumption and investment. As excess supply in the labour market is slowly cleared and employment moves back toward baseline, rates of return and thus investment begin to recover. The recovery in investment allows capital stocks to return to baseline levels by 2023/24 and this puts the economy on an new trajectory whereby capital stocks continue to move above baseline. The trajectory in the capital stock also drags employment and GDP back to baseline by 2023/24, after which all three variables continue to move above baseline.

In the longrun, the saving rate is endogenous and adjusts so as to ensure the trade balance as a share of GDP returns to baseline. Thus, we observe that exports move lower and imports higher so that they are both about 0.2% or more above baseline by 2030/31. This reflects the terms of trade loss (-0.04% by 2047/48) caused by the broadening of the GST base, which decreases domestic costs and export prices. To ensure that the economy's ratio of net foreign liabilities as share of GDP is sustainable, the trade balance as a share of GDP is required to return to baseline levels in the long run. A terms of trade loss implies higher export volumes in the long run, which is what we observe in Figure 3.

The shortrun effects described above for Scenario 1 also reflect the general trajectory of macroeconomic variables in Scenarios 3 and 4. The differences relate to the magnitude of the effects. The difference in magnitudes is reflected in the differences in GDP effects presented in Figure 1: Scenarios 3 and 4 lead to larger positive effects on economic activity in the longrun than Scenario 1. By contrast, Scenario 2 leads to permanently lower economic activity. The reasons for the differences across scenarios is fully explained below.

4.2 Longrun results

The longrun macroeconomic effects of each scenario are reported in Table 6. These reflect the effects once the economy has returned to longrun equilibrium, i.e., the unemployment rate, rates of return, capital growth rates, the ratio of the trade balance and the budget balance to GDP ratio have all returned to baseline. The results show that economic activity and welfare in Scenario 1 is higher. Extending the GST base to include fresh food, health and education increases the maximum potential base of the GST, as measured by the VAT Revenue Ratio, from 49% to 60%.[4] The large increase in VRR reflects a fall in the distortions associated with the GST as there is a decrease in proportion of consumption that is zero-rated versus the proportion rated at 10%. This represents a significant move to a more even GST treatment across commodities. The decrease in the distortions associated with the GST represents an improvement in allocative efficiency and is reflected in the increase in the indirect tax base by 0.41%.

The improvement in allocative efficiency manifests as an increase in GDP by 0.19%. In terms of the use of primary factors, the increase in GDP is mainly a function of an increased use of capital: 0.43%. The increase in capital reflects the longrun increase in investment (0.28%). Although firms increase their demand for labour as their capital stocks expand, this mainly affects real wage rates as labour is rather inelastic in supply in the longrun. However, we observe a large fall in the real pre-tax wage rate (1.52%) rather than an increase. This reflects the strong compositional effects from extending the GST base to include health and education; Figure 4 presents the effects on industry output by broad industry. We see that there is strong relative fall in the output of health and education (about 2%) from extending the GST to these commodities.

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[4] The VAR Revenue Ratio is defined as [VAT revenue] / {[consumption expenditure] - VAT revenue} x VAT rate.} (AFTS 2009).

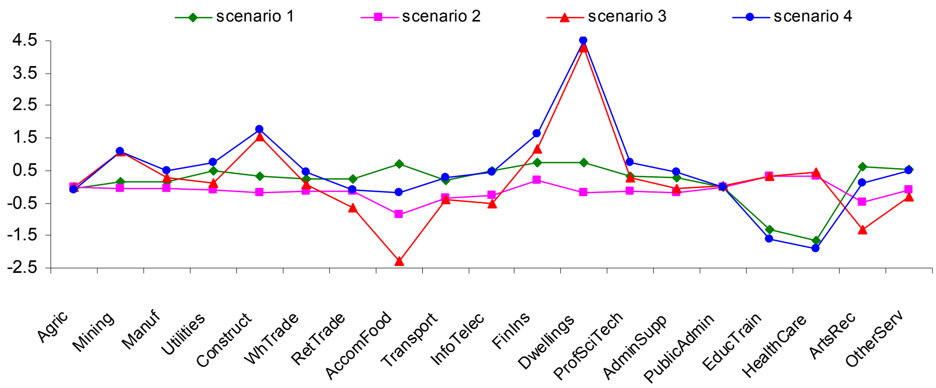
These industries are the largest users of labour representing about 17% of all payments to labour. Thus, the large contraction in these industries drives down the demand for labour and wage rates.

Table 6. Longrun macroeconomic effects (percentage change)

	Scenario			
	(1)	(2)	(3)	(4)
Capital	0.425	-0.184	2.073	2.324
Employment	0.027	-0.005	0.130	0.140
Capital-labour ratio	0.398	-0.179	1.942	2.185
Labour productivity	0.164	-0.078	0.606	0.750
Labour supply	0.027	-0.005	0.130	0.140
Real indirect tax base	0.413	-0.205	0.042	0.737
Real pre-tax wage rate	-1.518	-1.527	-0.712	-0.866
Real post-tax wage rate	0.175	-0.094	0.856	0.974
Investment price index	-0.003	0.502	-2.461	-2.422
Consumer price index	1.282	1.329	0.954	0.962
Real household consumption	0.216	-0.009	0.655	0.785
Real investment	0.282	-0.213	1.524	1.745
Government consumption	0.000	0.000	0.000	0.000
Real exports	0.236	-0.334	-0.033	0.569
Real imports	0.237	-0.183	0.058	0.498
Real GDP	0.192	-0.082	0.738	0.891
Net foreign income ($m)	-312	-414	952	783
Real GNP	0.174	-1.107	0.696	0.821

Source: KPMG-CGE simulations.

Figure 4. Industry output effects (percentage change)



Scenario 2 leads to a contraction in GDP (-0.08%) mainly reflecting a fall in the use of capital and a contraction in the indirect tax base. Increasing the GST rate by 25% (from 10% to 12.25%) on the current base increases the distortions associated with the GST because the existing base is not comprehensive (i.e., the VRR is 49%); thus, the differential tax rate between taxed and untaxed commodities has increased from 10% to 12.25. Another effect of the increase in the tax rate to 12.25 is that it increases the cost of capital creation as the GST base includes investment. We see that the contraction in GDP is mainly reflected as a fall use of capital (-0.18%) with little effect on the use of labour (-0.005%). The increase in the GST increases the CPI by 1.3% and the price of investment by 0.5%, whereas in Scenario 1 only the CPI is affected. With rates of return exogenous in the longrun, the rise in the price of investment raises the rental price of capital, which discourages firms from using capital and reduces investment (-0.21%).

The importance of the distorting effect of the GST on investment is reflected in the strength of the increase in GDP in Scenario 3, where the GST is removed from investment but increased to 15.2% on the current base. GDP expands by 0.74% driven by an increased use of capital (2.07%) and labour (0.13%). The indirect tax base also increases but only slightly (0.04%). The strong increase in the use of capital is driven by a fall in the rental price of capital that accompanies the 2.46% fall in the price of investment. With rates of return exogenous in the longrun, the fall in the price of investment decreases the rental price of capital, which encourages firms to use capital and drives a 1.52% increase in investment.

Scenario 4 combines elements of Scenario 1 and 3 by extending the GST to include fresh food, health and education , and removing the GST from investment. The GST rate must only rise to 11.9% in order to raise the same amount of GST revenue as in the other scenarios. Scenario 4 leads to the largest increase in GDP (0.89%) driven by a strong increase in the use of capital (2.32%) and the indirect tax base (0.74%). This is consistent with the results observed for Scenarios 1 and 3.

In all scenarios the employment response small as it is limited by the longrun increase in the labour supply: as the unemployment rate returns to baseline levels in the longrun, the increase in employment matches the increase in labour supply. Labour supply is weakly responsive to real after-tax wage rates.

4.3 Welfare effects

The increase in investment in Scenarios 1, 3 and 4 reflects decreased investment by domestic residents and increased investment by foreigners. Domestic residents decrease their saving rate and decrease their share of the domestically-owned capital stock. The saving rate must fall to prevent the trade balance from moving into surplus in response to the GST changes.

This is because in each scenario the extra $14.1b in GST revenue is returned to households via a lower PIT rate. This allows nominal household disposable income to rise by more than nominal GNP and thus shifts spending towards to household consumption. Foreigners increase investment in Australia in response to changes in the after-tax rate of return. They continue to increase their investment until the after-tax rate of return returns to initial levels: we assume that the after-tax rate of return is exogenous and determined in global capital markets. The increase in foreign investment increases the after-tax dividend payments to foreigners in Scenarios 1 and 2 and reduces it in Scenario 3 and 4 (see Table 6). Increased (decreased) dividend payments to foreigners reduces (increases) net foreign income. In all scenarios real GNP rises by less than real GDP. Thus welfare, as measured by real GNP, also rises in all scenarios.

6. Discussion and concluding remarks

We analyse the potential impacts on the Australian economy of four scenarios involving changes to the GST. To quantify these changes, we apply a dynamic economywide framework with a high degree of sectoral detail and intersectoral linkages. The analysis indicates that the distortionary impact of the GST could be reduced by either broadening the base, by removing the GST from investment expenditure, or a combination of the two.

Broadening the GST base to include fresh food, health and education (Scenario 1) raises real GDP by 0.19% via a larger capital stock (0.43%) and higher employment (0.03%). Employment rises due to a rise in labour supply in response to a rise in the real after-tax wage rate. After-tax wage rates are higher due to a fall in the personal income tax rate that maintains the budget balance as a share of GDP. Raising the GST rate to 12.25% with current base (Scenario 2) reduces real GDP via a smaller capital stock and lower employment. The main negative effect on real GDP (-0.08%) of a higher GST rate is to increase the cost of capital and reduce investment (-0.21%), thus contracting the size of the capital stock (-0.18%).

Removing the GST from investment and raising the rate to 15.2% (Scenario 3) raises real GDP by 0.74% via a larger capital stock (2.07%) and higher employment (0.13%). The removal of the GST on investment reduces the cost of capital and increases investment by 1.5%. Removing the GST from investment, extending the base to include fresh food, health and education, and raising the rate to 11.9% (Scenario 4) gives the greatest benefit in terms of increased economic activity: real GDP rises by 0.9%, the capital stock is higher by 2.3% and employment by 0.14%. Consistent with the Scenario 3, the removal of the GST on investment reduces the cost of capital and increases investment strongly by 1.75%.

The economywide impacts of these scenarios take about 20 years to fully materialise as wage rates and capital take time to adjust to the tax changes. The scenarios suggest that GST revenue can be increased by about 20%, or \$14.1b in 2018/19 dollars. At the same time, these revenues replace personal income tax of about the same dollar magnitude. Thus, the government budget balance as a share of GDP is unchanged.

Our results indicate ways in which the marginal excess burden of the GST can be reduced. Simply raising the GST rate reduces economic activity as the GST base does not apply to large components of expenditure: e.g., fresh food, health and education. Widening the base while collecting the same extra revenue improves allocative efficiency as reflected in an expansion in economic activity. Removing the GST from investment improves allocative efficiency and increases economic activity the most. A key mechanism here is that investment is the most mobile of all tax bases, thus taxing investment is highly distortionary.

Our analysis suggests that the GST can be made less distortionary by focussing on base broadening measures and increasing the exemptions on investment expenditure, e.g., the construction of dwellings. At the same time, a revised GST could collect more revenue and help to reduce the reliance on other taxes such as those on income. It should be noted that changes in compliance costs associated with changes to the application of the GST is beyond the scope of this analysis. While these costs are likely to be one-off and relatively small, they should still be considered as part of any policy design process.

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