The National and Regional Consequences of Australia's Goods and Services Tax

CoPS Working Paper No. G-278, October 2017

J.A. Giesecke

And

N.H. Tran

Centre of Policy Studies, Victoria University

ISSN 1 031 9034

ISBN 978-1-921654-86-2

The Centre of Policy Studies (CoPS), incorporating the IMPACT project, is a research centre at Victoria University devoted to quantitative analysis of issues relevant to economic policy. Address: Centre of Policy Studies, Victoria University, PO Box 14428, Melbourne, Victoria, 8001 home page: www.vu.edu.au/CoPS/ email: copsinfo@vu.edu.au Telephone +61 3 9919 1877

The National and Regional Consequences of Australia's Goods and Services Tax

J.A. Giesecke and N.H. Tran

Centre of Policy Studies, Victoria University, 300 Flinders St., Melbourne, Victoria, 3000

James.Giesecke@vu.edu.au, Nhi.Tran@vu.edu.au.

Abstract

Previous modelling of the Australian goods and services tax (GST) has: (a) used models of the national economy; and (b) modeled the GST as an indirect tax on various tax bases (like consumption and investment) without taking formal account of the complex underlying details of the operations of the GST system as they relate to its legislated features and its interactions with the structure of economic activity. In this paper we improve on previous modelling by: (a) modelling the GST within a multi-regional framework that allows for the identification of the commodity-, source-, user-, and region-specific details of economic transactions; (b) modelling the legislated details of the GST as it relates to the commodity-, source-, user-, and region-specific details of legislated GST rates, legislated GST exemptions, agent- and region-specific details of entities registered for GST, multiproduct detail as it relates to the capacity of agents to reclaim GST paid on inputs, informal economic activity, the low value import threshold, transaction-specific compliance rates, and taxation of on-shore purchases by non-residents. In a model like this, when we change any individual element of the GST (for example, by raising existing rates, taxing currently GST-free goods like basic foods, removing exemptions such as on finance, removing the low value import threshold) the economic effects are informed by regional differences in economic structure and their interactions with the commodity- user- and source-specific details of our GST theory. In this paper, we report on the effects of a rise in the standard GST rate from 10% to 11%. We decompose regional and national effects into six components: (i) The effects of the GST rate rise with endogenous state and federal public sector borrowing requirements (PSBRs) and endogenous balance of trade to GDP ratio; (ii) The effects of the federal government granting to each state the amount of GST collected within each state; (iii) The effects of a correction to the state grant allocations under (ii) to reflect the effects of Commonwealth Grants Commission (CGC) allocation on a per-capita basis; (iv) The effects of state governments returning their PSBR's to baseline via endogenous adjustment of lump sum payments to households; (v) The effects of the federal government returning its PSBR to baseline via adjustment of lump-sum household taxes and transfers; (vi) The effects of adjustments to the average propensity to save required to leave the national balance of trade to GDP ratio unaffected by the shocks described by (i)-(v).

JEL codes: C68, H25, H73, R13, D57.

Key words: Goods and services tax; value added tax; dynamic CGE, regional CGE.

Contents

1 Introduction 3
2 The model 6
2.1 The Victoria University Regional Model (VURM) 6
2.2 Introduction to the GST theory 7
2.3 Modelling the GST on domestic users 7
2.4 Modelling the GST on exports 11
3 Data 11
4 Simulation 22
4.1 Simulation design 22
4.2 Results 24
4.2.1 A back of the envelope model 24
4.2.2 National results 27
4.2.3 Industry results 29
4.2.4 Regional results 30
5 Concluding remarks 33
6 REFERENCES 34

1 INTRODUCTION

The goods and services tax (GST) is Australia's third-largest tax revenue source. In 2015-16 it accounted for 13% of the total taxation revenue collected by all Australian governments. The Commonwealth Government, which is responsible for administering and collecting the tax, distributes all GST revenue to Australia's states and territories as untied grants. For state and territory governments, GST grant revenue represents approximately one quarter of total government revenue (ABS 2017a, 2017b, Australian Government 2016).

Recently, the manner in which GST revenues are distributed to the Australian states has raised concerns among policy makers in some Australian states, particularly Western Australia (Freebairn 2015). These concerns relate to the differential impacts across states of GST revenue distribution under the Commonwealth's horizontal fiscal equalisation system. This has led the Commonwealth Government to ask the Productivity Commission to investigate the horizontal fiscal equalisation system that determines the distribution of GST revenue across states and territories. In this paper, we are concerned with a different, but related, inter-jurisdictional distribution question: how does the raising of a given level of GST by the Commonwealth Government affect the distribution of economic activity across Australia's states and territories? To examine this question, we introduce to a multi-regional model of the Australian economy detailed modelling of the implemented features of Australia's GST system. This includes detailed modelling of the many of the departures from an "ideal" GST system of Australia's GST system as legislated and implemented.

An ideal GST system (that is, one imposing the lowest allocative efficiency and compliance costs) is characterised by a single rate on domestic sales, a zero rate on exports, and no exemptions (Tait, 1988 and Ebrill et al., 2001). Under this system, producers and importers charge GST on sales to all users (producers, capital creators, exports and consumers). However, the GST rate charged on exports is zero, and the effective rates are zero on inputs to production and capital formation because producers can fully reclaim GST paid on inputs. Only on consumption are effective tax rates the same as legislated tax rates. Hence, a GST with these characteristics acts like a consumption tax. Early CGE studies of the effects of a GST modelled the tax in this way (see, for example Ballard et al., 1987; Kehoe et al., 1988). However, in practice, GST systems depart from the ideal system in many respects. Implemented GST systems can have multiple tax rates, multiple exemptions, different registration rates across sectors, sectoral limitations on GST refunds, informal activity, taxation of some exports, and undeclared imports.

In broad terms, the Australian GST system follows the general pattern of the ideal system. For most commodities, a single 10% rate is levied on domestic sales, exports are taxed at 0%, and producers and investors can reclaim the GST they pay on inputs. However, there are a number of departures from the ideal system:

1. Domestic sales of a number of commodities have GST-free status. That is, they are taxed at 0%. Producers collect no GST on sales of GST-free commodities, but can still claim GST paid on inputs to their production. Examples of GST-free supplies under the Australian GST system include: the majority of basic foods, educational courses, health services, health insurance, many medical aids and appliances, religious services, water services, sewerage and drainage services, and transport of passengers to and from Australia.

2. Supplies of a number of goods and services are input-taxed. Input-taxed services include finance, life insurance, and the selling or renting of existing residential premises. For these services, producers charge no GST, but they are simultaneously unable to reclaim

the GST paid on inputs to their production. GST on inputs to production of exempt commodities passes into the input cost stream for these commodities, and is passed on as higher purchaser prices to users of the commodities, irrespective of whether they consumers, foreigner buyers, another domestic producer, or a capital creator. This creates tax cascading effects, with positive effective GST rates faced by all producers and foreigners purchasing the exempt goods, and concessional (i.e.<10%) rates for households. This input taxation is called "exemption" in the value added tax systems around the world, and hence will be referred to as "exemption" in the remainder of this paper.

3. Producers with turnover of $AUD 75,000 or less can choose whether to register for the GST. Unregistered producers cannot charge GST on their sales and also cannot reclaim GST paid on their inputs. This creates an additional source of input-taxed sales. Because non-registered producers can exist in any industry, sales of all products have the potential to be input-taxed to some extent.

4. A number of imported goods are exempt from the GST. These include imports falling below the low value import threshold of $AUD1000,[1] and a number of goods with import-duty-free status.[2]

5. Not all exports are taxed at the zero rate. In particular, GST is collected on commodities purchased locally by non-residents (such as foreign tourists and students). A refund for GST under the Tourist Refund Scheme can only be claimed for a small subset of goods purchased locally by non-residents (DIBP 2017).

The first efforts to model the implemented features of the Australian GST system were undertaken by Dixon and Rimmer (1999). Dixon and Rimmer used the publicly available price results from the Australian Treasury's price input-output model (PRISMOD) to infer the publicly unavailable Treasury assumptions about the net effects for commodity and user-specific indirect tax rates implied by the removal of the wholesale sales tax and the implementation of the GST. Dixon and Rimmer (1999) thus carried assumptions about changes in indirect tax rates on intermediate inputs, capital formation, and exports, and hence represented a departure from the traditional CGE modelling of GST systems based on the ideal system. However, the Dixon and Rimmer modelling did not explicitly model the details of the Australian GST system. There have been some general equilibrium studies which account for different VAT rates and exemptions, albeit assuming that given sectors are either fully taxed or fully exempt (Gottfried and Wiegard 1991, Marks 2005, Toh and Lin 2005). Giesecke and Tran (2010) account for multi-production, differentiated degrees of exemption by commodity and user, and hence industry-specific differences in the refundability of VAT paid on inputs to production and investment. Giesecke and Tran (2012) further developed the system to include differentiated VAT registration rates, undeclared imports, unclaimed tax on purchases by tourists, and general and transaction-specific tax compliance rates. While noting the model's potential for embedding within a wider CGE framework, Giesecke and Tran (2012) used their model to examine VAT compliance rates outside of a CGE system. In this paper, we extend the Giesecke and Tran (2012) system by adding regional detail. We then embed the system within a multi-sectoral multi-regional model of the Australian economy. As we shall see, this

[1] From 1 July 2018, GST will be imposed on low value imports of physical goods imported by consumers (Source: https://www.ato.gov.au/General/New-legislation/In-detail/Indirect-taxes/GST/GST-on-low-value-imported-goods/).

[2] These include goods of a scientific, educational or cultural kind; goods for international bodies or persons for goods relating to offshore areas; and goods that are personal effects.

allows us to examine the consequences for Australia and its regions of the full details of the GST system as legislated.

As discussed in Giesecke and Tran (2012), a detailed GST modelling framework is important in CGE analysis of GST issues for two reasons. First, it allows GST payments to be correctly represented in the CGE model database. This is important for two reasons. First, ensuring that the database correctly represents the GST payment system is essential if we are to have an initial solution to our CGE model that is consistent with a theory of the GST as implemented. The alternative is to implement a naive GST theory that explains disaggregated "observed" (i.e. database value) GST revenues as a simple product of the tax base and legislated tax rate, when the legislated reality is far more complex. Second, and irrespective of whether the model contains sophisticated GST theory, the correct representation of the distribution of indirect taxation in the model's initial database is important for welfare analysis. An important influence on the overall welfare consequences of policy change are allocative efficiency effects. These allocative efficiency effects depend on changes in economic activity across sectors with different rates of net indirect taxation. As such, accurate calculation of allocative efficiency effects depend on accurate calculation and representation of the distribution of indirect tax liabilities within the CGE model's database. The measured allocative efficiency effects from varying the GST will be miscalculated if GST is distributed across the wrong bases in the initial database. There is evidence of this in the ABS-supplied input-output data (ABS 2016a). The ABS data shows differentiated tax rates across products, the input-taxed status of financial services and dwelling services, and collection of GST on certain exports. However, the data show no GST imposed on intermediate inputs to any industries other than the financial and dwelling sectors. This implies 100% GST registration rates across all industries and no informal activity. This effectively narrows the GST base, and as a result, we see in the ABS data implied GST rates that exceed the legislated 10% rate for many product flows.

Second, it allows the model's tax theory to carry the full details of the GST system as actually implemented. This potentially improves the modelling of the relative price consequences of changes in the GST system, whether these changes come in the form of changes in rates, exemptions, registration rates, or other factors. This is so for two reasons. First, without theory describing the full detail of the GST, modellers must calculate changes in effective indirect tax rates outside of the model. Such calculations can easily overlook the interplay between legislated rates, exemptions, and refund rates. Second, GST theory that is embedded within a wider CGE framework allows effective GST rates to be influenced by endogenous changes in economic structure as depicted in the model. For example, the effective input taxation of a sector can be influenced by endogenous changes in the division of the sector's activity across production of exempt and non-exempt commodities.

A third benefit from explicit modelling of GST detail emerges when we investigate the regional consequences of changes in the GST system. While the GST Act does not provide for differential treatment for GST purposes across regions, as we discuss in Section 2, there are a number of ways in which region-specific detail bear on the operations of the GST. These include the potential for regionally differentiated registration rates and propensities to import low value items, and the possibility that commodity and industry aggregation choices lead to the same sectors carrying different modelled legal GST rates and exemption factors across regions.

The remainder of this paper is structured as follows. Section 2 describes the model. We begin with a brief overview of the Victoria University Regional Model (VURM) in Section 2.1. VURM is the multi-regional CGE model into which we build our GST detail. The equation system describing the GST is presented in Sections 2.2 - 2.4. The data sources for implementing the GST components of the VURM theory are discussed in Section 3. Section 4 presents results of a simulation in which we raise the standard rate of GST from 10% to 11%. Section 5 concludes the paper.

2 THE MODEL

2.1 The Victoria University Regional Model (VURM)

The modelling reported in this paper is undertaken using a version of the Victoria University Regional Model (VURM) augmented with GST theory as outlined in the remainder of this section, and with regional labour market theory as described in Giesecke and Madden (2013). VURM's database is calibrated to fully reflect ABS national accounts data and government financial statistics for 2015-16. For a detailed description of VURM, we refer the reader to Adams, et al (2015). In the remainder of this section we provide a brief overview of VURM, before moving to a detailed discussion of the GST theory.

VURM is a dynamic multi-regional CGE model. It explicitly models the behaviour of economic agents within each of Australia's 8 states and territories and features a large number of industries and commodities. The model contains 76 industries operating in each region. All but two of the industries produce a single commodity. The exceptions are Low-density dwellings and High-density dwellings which each produce two commodities: Owner-occupied and Rental.

Neoclassical assumptions govern the behaviour of the model's economic agents. Each of the 76 representative industries operating within each region is assumed to minimise costs subject to constant-returns-to-scale production technologies and given input prices. A representative utility-maximising household resides in each of the model's regions. Investors allocate new capital to industries on the basis of expected rates of return. Units of new capital are assumed to be a cost-minimising combination of inputs sourced from each of the model's sources of supply (the domestic regions plus imports). Imperfect substitutability between the imported and domestic sources of supply for each commodity are modelled using the constant elasticity (CES) assumption of Armington. In general, markets are assumed to clear and to be competitive. Purchaser's prices differ from basic prices by the value of indirect taxes and margin services. Taxes and margins can differ across commodity, user, region of source and region of destination. Foreign demands for each of the 78 commodities from each domestic region are modelled as inversely related to their foreign currency prices. The model includes details of the taxing, spending and transfer activities of two levels of government: a regional government operating within each region, and a federal government operating Australia-wide. Inter-governmental transfer payments and personal transfer payments to households are also modelled. Dynamic equations describe stock-flow relationships, such as those between regional industry capital stocks and regional industry investment levels. Dynamic adjustment equations allow for the gradual movement of a number of variables towards their long-run values. In this regard, we allow region-specific employment rates to temporarily depart from baseline values under an assumption of short-run wage stickiness. Over time, regional wage adjustment gradually returns region-specific employment rates to baseline values. Similarly, we allow regional per capita real disposable income relativities to temporarily depart from baseline values, under an assumption of stickiness in rates of inter-regional migration. Over time, gradual adjustment of rates of inter-regional migration returns inter-regional per capita real disposable income relativities back to baseline.[3] Regional economic linkages arise from

---

[3] See Giesecke and Madden (2013) for a description of the model's regional labour market and inter-regional migration theory.

inter-regional trade, factor mobility, the taxing and spending activities of the federal government, and long-run economy-wide employment and balance of trade constraints. The model also evaluates a full set of national and regional income accounts, and associated deflators. The model is solved with the GEMPACK economic modelling software (Harrison and Pearson, 1996). In solving the model, we undertake two parallel model runs: a baseline simulation, and a policy simulation (as discussed in Section 4.1, we also undertake a number of decomposition simulations of the policy simulation). The baseline simulation is a business-as-usual forecast for the period 2017 to 2030. The policy simulation is identical to the baseline simulation in all respects other than the addition of the exogenous shocks describing the policy under investigation. We report model results as percentage (and in some cases, \$m) deviations in the values of variables in each year of the policy simulation away from their baseline values.[4]

2.2 Introduction to the GST theory

Following Giesecke and Tran (2010, 2012), our detailed generalised GST model recognises: differentiated legislated tax rates across commodities; differentiated legislated GST exemption statuses across commodities; differentiated legislated capacities to reclaim GST paid on inputs to production and investment; differentiated rates of registration for GST purposes across industries; effective taxation of exports via application of GST on domestic purchases by non-residents; and, the potential for incomplete GST collections due to non-compliance. We also require the generalised GST model to carry sufficient detail to be embedded within a multi-regional model. As such, we require the model to describe details of the legislated GST system as it relates to all commodities, from all sources, used by agents in all regions. The agents comprise industries, capital creators, and final demanders. The regions comprise the eight states and territories. The sources comprise the eight domestic regions plus imports.

2.3 Modelling the GST on domestic users

We begin by considering GST on domestic users (GST on exports is a special case and is discussed in Section 2.4). We assume that the GST collected on sales of commodity *c* from source *s* to domestic user *u* in region *r* is:

$$GST_{c,s,u,r} = LR_{c,s,u} \times TRBASE_{c,s,u,r} \times [1 - EEX_{c,s,u,r}][1 - REF_{u,r}] \times CR_{c,s,u,r} \qquad \text{(E.1)}$$

$(c \in COM;\ s \in SRC;\ u \in DOMUSER,\ r \in REG)$

where:

COM	is set of the model's 78 commodities.
REG	is the set comprising Australia's eight states and territories.
SRC	is the union of the set of eight domestic sources (REG) and the single foreign source (*foreign*).
DOMUSER	is the set of all domestic users, comprising the union of the set of domestic industries (IND), creators of industry specific capital (INV), households, state and local government, and the federal government.[5]

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

[5] We exclude "changes in inventories" from the DOMUSER set because in the National Accounts, the ABS records inventories at GST-exclusive values (ABS 2000). The ABS also records general government expenditure at GST-exclusive values. We represent this in our model via a refund factor of 1 for government users.

IND	is the set of the model's 76 producers.
INV	is the set of the model's 76 creators of industry-specific capital.
$LR_{c,s,u}$	is the legislated rate of GST levied on the sale of commodity *c* from source *s* to user *u* in all regions.[6]
$GST_{c,s,u,r}$	is the GST revenue collected on sales of commodity *c* from source *s* to user *u* in region *r*.
$TRBASE_{c,s,u,r}$	is the value of the transaction base on which the GST is levied, i.e. the ex-GST margin and (non-GST) sales tax inclusive value of commodity *c* from source *s* sold to user *u* in region *r*.
$EEX_{c,s,u,r}$	is the proportion of sales of commodity *c* from source *s* to user *u* in region *r* that is effectively GST exempt.
$REF_{u,r}$	is the proportion of GST paid on sales to user *u* in region *r* that is refundable.
$CR_{c,s,u,r}$	is the GST compliance rate for user *u* in region *r* with respect to purchases of commodity *c* from source *s*.

In (E.1), $LR_{c,s,u}$ and $CR_{c,s,u,r}$ are exogenous. $TRBASE_{c,s,u,d}$ is endogenous and calculated as the sum of other standard endogenous variables in VURM via:

$$TRBASE_{c,s,u,r} = VBAS_{c,s,u,r} + VTAX_{c,s,u,r} + \sum\nolimits_{m \in MAR} VMAR_{c,s,u,r,m} \tag{E.2}$$

($c \in COM$; $s \in SRC$; $u \in DOMUSER$, $r \in REG$)

where $VBAS_{c,s,u,r}$ is the basic value of source-specific commodity *c,s* purchased by region specific user *u,r*; $VTAX_{c,s,u,r}$ is the value of non-GST indirect taxes paid on these purchases, and $VMAR_{c,s,u,r,m}$ is the value of margin service *m* used to facilitate these purchases.

We endogenously determine the effective exemption rate ($EEX_{c,s,u,r}$) as a function of: (i) the exogenously determined legal exemption rate ($LEX_{c,s,u,r}$), i.e., the share of sales of commodity *c* from source *s* to user *u* in region *r* that are GST exempt by law;[7] and (ii) the endogenously

[6] The GST Act describes GST rates in terms of particular commodities. Hence the reader might wonder why the (s) and (u) dimensions appear in our definition of LR. The (s) and (u) dimensions arise because commodities in a model are an aggregation of many detailed products, which may have different GST characteristics. For example, the model commodity "insurance services" is an aggregation of health insurance, life insurance and many other types of insurance. Health insurance is GST-free, life insurance is input-taxed, and other types of insurance are taxable. The proportions of total insurance services that these individual insurance products represent can differ across producing regions. Hence the (s) dimension on LR is needed. The proportions of these types of insurance demanded by different users may also differ. For example, input-output data for the year 2013-14 (ABS 2016a) show that life and health insurance constitute 68% of all household purchases of insurance, whereas they are not purchased at all by other users. As a result, the LR on insurance services in the model will be 3.17% for households, and 10% for other users.

[7] The GST Act describes GST exemptions in terms of supply of particular commodities that are input-taxed. The reader may wonder why the (s), (u) and (r) dimensions appear in our definition of LEX. Like our explanation in footnote 6 for variable LR, the dimensions (s) and (u) arise because the model commodities may embody different proportions of exempt and non-exempt sales depending on the source and the user. Again using the model's "insurance services" as an example. Life insurance is GST-exempt (i.e. having LEX=1), whereas all other types

determined de-facto exemption rate ($\mathrm{DEX}_{c,s,u,r}$) arising from unregistered businesses, underground economic activity[8], household production for own use, and undeclared high-value imports.[9] That is,

$$\mathrm{EEX}_{c,s,u,r} = \mathrm{LEX}_{c,s,u,r} + (1-\mathrm{LEX}_{c,s,u,r}) \cdot \mathrm{DEX}_{c,s,u,r} \qquad \text{(E.3)}$$

$(c \in \mathrm{COM};\ s \in \mathrm{SRC};\ u \in \mathrm{ALLUSER},\ r \in \mathrm{REG})$

where the set ALLUSER comprises DOMUSER and exports.

In calculating $\mathrm{DEX}_{c,s,u,r}$, we distinguish between domestically produced commodities and imports. For domestic commodities $(s \in \mathrm{REG})$, the de-facto exemption proportion depends on the proportion of activity within the industries producing the commodities that is undertaken by businesses that are unregistered for GST purposes. As outputs of registered businesses are taxable, the share of de-facto exemption for domestic good *c* in region *r* for all users will be one less the share of registered businesses in the production of *c*. That is, $\mathrm{DEX}_{c,s,u,r}$ is endogenously calculated as:

$$\mathrm{DEX}_{c,s,u,r} = 1 - \sum_{i \in \mathrm{IND}} \mathrm{SJ}_{c,s,i} \times \mathrm{REGIST}_{i,s} \qquad \text{(E.4)}$$

$(c \in \mathrm{COM};\ s \in \mathrm{REG};\ u \in \mathrm{DOMUSER},\ r \in \mathrm{REG})$

where:

$\mathrm{REGIST}_{i,s}$ is the proportion of the output of industry *i* in region *s* produced by businesses that are registered for the purposes of GST.

of insurances are not (i.e. having LEX=0). Input-output data for the year 2013-14 (ABS 2016a) show that life insurance constitutes 44% of all household purchases of insurance, whereas life insurance is not purchased by other users. As a result, the LEX value for insurance services will be 0.44 for households, and 0 for all other users. Another reason for the inclusion of the (u) dimension in LEX is that in some countries, different users may have differentiated GST-exemption statuses under tax law, even for the same detailed commodity. For example, in the Vietnamese VAT laws (GOV 2008, 2016), exports of mining products are VAT-exempt, whereas the sales of mining products to other users are not. Including the (u) dimension extends the generality of our GST modelling framework. The (r) dimension appears on LEX because when we come to handling exempt imports, we are open to the possibility that the propensity to import low value items might differ across users and regions. For example, households in remote regions with limited local retail opportunities might have a higher propensity to import low value items relative to households in capital cities with diverse shopping opportunities.

[8] ABS (2013) identifies 5 types of unobserved economic activity: “[i] underground production or "the cash economy" involving deliberate concealment of legal activities to avoid tax payments; [ii] illegal production covering activities forbidden by law where there is mutual consent (e.g. illegal drug production); [iii] informal production broadly characterised as consisting of units engaged in the production of goods or services with the primary objective of generating employment and incomes to the persons concerned; [iv] household production for own final use including production of goods such as crops, livestock and construction of owner–built houses, and excludes all domestic services except for owner occupied housing; and [v] the statistical underground including production missed due to deficiencies in data collection e.g. under coverage of enterprises, non–response, under reporting.” We account for items [i] and [iv] only, because they are the only items which the ABS takes into account when producing its national account estimates.

[9] For example, undeclared jewellery, cameras and other overseas purchases of value above A$1000 by Australian tourists.

$SJ_{c,s,i}$ is the share of the output of commodity *c* from domestic source *s* produced by industry *i* in region *s*. $SJ_{c,s,i}$ is an endogenous variable, which can change in a multi-product environment with changing relative production costs and prices.

Note that DEX is uniform across the destination regions for each of the domestic (c,s,u) categories.

For imports, $DEX_{c,foreign,u,r}$ is calculated via:

$$DEX_{c,foreign,u,r} = ILM_{c,u,r} \tag{E.5}$$

where $ILM_{c,u,r}$ is the proportion of imports of commodity *c* by user *u* in region *r* that are undeclared high-value imports (i.e. value of above $AUD1000).

$REGIST_{i,s}$ is the proportion of the output of industry *i* in region *s* produced by businesses that are registered for GST purposes. Via equation (E.6), we identify two possible sources of non-registration: businesses who are not required by law to register for the GST, and businesses who operate informally:

$$REGIST_{i,s} = (1\text{-}NRL_{i,s})(1\text{-}NRI_{i,s}) \quad (i \in IND,\ s \in REG) \tag{E.6}$$

where

$NRL_{i,s}$ is the proportion of the output of industry *i* in region *s* that is produced by firms that are legally permitted not to register for the GST; and,

$NRI_{i,s}$ is the proportion of the activity of industry *i* in region *s* that is generated by firms legally-required to register but who choose to operate informally and are not registered for the GST.

$REF_{u,r}$ is the proportion of GST paid on purchases by user *u* in destination region *r* that is refundable. For industries undertaking current production, we recognise that the GST legislation only allows firms to claim refunds on GST to the extent that they are producing commodities that are not GST exempt. Hence, we calculate the industry refund factor via:

$$REF_{i,s} = REGIST_{i,s} \times \sum_{c \in COM} SO_{c,i,s} \sum_{u \in USER} \sum_{r \in REG} SS_{c,s,u,r}[1\text{-}LEX_{c,s,u,r}] \tag{E.7}$$

$$(i \in IND,\ s \in REG)$$

where

$LEX_{c,s,u,r}$ is the share of sales of commodity *c* from domestic source *s* to user *u* in region *r* that are GST exempt by law.

$REF_{i,s}$ is the proportion of GST paid on intermediate inputs into production that is refunded.

$SO_{c,i,s}$ is the share of the value of regional industry (i,s)'s output accounted for by production of good c.

$\mathrm{SS}_{\mathrm{c,s,u,r}}$ is the share of sales to user *u* in region *r* in total sales of domestic commodity *c* produced in region *s*.

For investors, the refund proportions are the same as those for intermediate inputs into production by the same industry. That is:

$$\mathrm{REF}_{\mathrm{k,r}} = \sum_{i \in IND} \delta_{k,i} \mathrm{REF}_{\mathrm{i,r}} \qquad (k \in INV) \tag{E.8}$$

where $\delta_{k,i}$ is 1 for $i = k$ and 0 otherwise.

For households, there is no GST refund, hence $\mathrm{REF}_{\mathrm{households,r}} = 0$. Government can claim all GST on their general expenditure, hence $\mathrm{REF}_{\mathrm{State\ gov,r}} = \mathrm{REF}_{\mathrm{Fed\ gov,r}} = 1$.

2.4 Modelling the GST on exports

For exports, we must simultaneously account for the zero rating of sales to offshore customers and the possibility that onshore sales to domestic non-residents, like foreign tourists and students, attract standard GST rates. Hence, we calculate GST collections on exports via:

$$\begin{aligned} \mathrm{GST}_{\mathrm{c,s,export}} &= \mathrm{CR}_{\mathrm{c,s,export}} \times \\ &\left\{ \begin{array}{l} \left[\mathrm{LR}_{\mathrm{c,s,household}} \times \mathrm{SHNRES}_{\mathrm{c,s}} \times \mathrm{TRBASE}_{\mathrm{c,s,export}} \times (1 - \mathrm{EEX}_{\mathrm{c,s,household}}) \times (1 - \mathrm{REFEXP}_{c,s}) \right] + \\ \mathrm{LR}_{\mathrm{c,s,export}} \times \left[(1 - \mathrm{SHNRES}_{\mathrm{c,s}}) \times \mathrm{TRBASE}_{\mathrm{c,s,export}} \times (1 - \mathrm{EEX}_{\mathrm{c,s,export}}) \right] \end{array} \right\} \end{aligned} \tag{E.9}$$

where:

$\mathrm{SHNRES}_{\mathrm{c,s}}$ is the share of total exports of commodity *c* from source *s* represented by on-shore sales to non-residents (like tourists).

$\mathrm{REFEXP}_{c,s}$ is the proportion of domestic sales of commodity *c* to non-residents in region *s* that is refunded under the Tourist Refund Scheme.

3 DATA

We calculate the initial values of the variables in VURM's GST equations using the following data sources:

1. GST Act 1999 (ALII 2000). The Act is used to determine the GST base, GST rates and the level of input taxation for each product.
2. The Australian Taxation Office webpage on the GST (ATO 2016), particularly the GST food guide, and information on GST and residential premises. These guides provide more detailed guidance on the taxable, tax-free or input-tax status of food items and residential premises.
3. ABS supply, use and tax data for 1267 IOPC commodities for 2013-14 (ABS 2016a), and ABS input-output tables for 2013-14 (ABS 2016c)
4. ABS business count data (ABS 2015). These data are used to estimate the share of businesses that are registered for the GST for each industry in the model.

5. ABS data on the underground economy (ABS 2013). These data are used to estimate the share of businesses that are not registered for the GST because they operate underground.

6. Productivity Commission (2011) report on the retail industry. This report contains information on the low value imports that are exempt from the GST.

7. ABS Tourism Satellite Account (ABS 2016b) and Tourism Research Australia (2017). These data are used to estimate the value of domestic sales to visitors in Australia.

8. Department of Immigration and Border Protection (DIBP) webpage on Tourism Refund Scheme (DIBP 2017). This information is used to estimate the degree of GST refund for different tourism-related sales.

9. ABS Taxation Revenue (ABS 2017), which reports GST revenues for the period 2006/07 – 2015/16. When brought together with the VURM database and VURM GST theory, the GST revenue data is used to calculate the economy-wide GST compliance rate.

Table 1 describes in detail our data sources and procedures for the setting of the initial values for the variables of VURM's GST theory. In general, we first calculate values for all variables at the 114 input-output commodity level (and in the case of legal rates and exemptions, at the 1267 input-output commodity level), before aggregating to VURM's 78 commodity level.

Table 1: ***Variable names, descriptions, closure and data sources***.

Variable	Description	Data sources	Procedures
$LR_{c,s,u}$	Legislated rates on (c,s,u) At the very detailed product level, LR are mostly 10% or 0%. As discussed, they can depart from this on a weighted average basis at the level of commodity aggregation recognised in the model.	• GST Act 1999 (ALII c2000). • Supply, use and tax data for 1267 IOPC commodities from the ABS for 2013-14 (ABS 2016a) • ATO GST guide (e.g. food guide) (ATO 2016) • Input-output tables for 2013-14 (ABS 2016c)	We first assigned GST rates at the national level for 1267 IOPC commodities as follows: 1. We examine each element of the full list of 1267 IOPC commodities, and assign a legal rate for each commodity for households and industries according to the GST Act. We assigned the 0% rate to basic food items. The 10% rate is assigned to the majority of other items which are clearly taxable. 2. For IOPC items which can be a mix of GST-free and GST-taxable items, we used the GST rates implied in the ABS' IOPC data. For example, the commodities "Wadding, pad, cotton wool, gauze and bandages" and "Hearing aids and accessories" are GST-free when they are supplied to participants under the National Disability Insurance Scheme, but are taxable otherwise. The ABS implied rates for the IOPC commodities were 8.6% and 5.35% respectively. We adopted these rates. 3. In general, at this detailed level of commodity disaggregation tax rates are the same for any given commodity across households and industrial users. One difference is in agricultural items (such as crops, livestock and fishery). According to ATO's food guide, while these items are mostly taxed at 0% for households, they are mostly taxed at 10% for industries. 4. Having assigned GST rates at the national level for 1267 IOPC commodities and users, we then aggregated these IOPC rates to GST rates for 114 input-output commodities and users as in ABS 2016c) using GST-exclusive sales values in the USE table at the IOPC level as weights. 5. At the regional level, we assume GST rates are the same at the level of IO 114 commodities, but they may differ at the regional level for more aggregated 78 VURM commodities, if the compositions of the aggregated commodities differ between regions.

Variable	Description	Data sources	Procedures
$TRBASE_{c,s,u,r}$	GST transaction base, which is the GST-exclusive sales values of (c,s,u,r).	These are standard data items in the VURM database (V1GSTBASE – V4GSTBASE)	Calculated as the basic value plus trade and transport margins plus net non-GST taxes on the product.
$EEX_{c,s,u,r}$	The share of sales of commodity *c* from source *s* to user *u* in region *r* that are effectively GST exempt.		$EEX_{c,s,u,r} = LEX_{c,s,u,r} + (1 - LEX_{c,s,u,r}) \cdot DEX_{c,s,u,r}$ (see below for the calculation of LEX and DEX).
$LEX_{c,s,u,r}$ $(s \in REG)$	The share of sales of commodity *c* from source *s* to user *u* in region *r* that are legally GST exempt. LEX=0 for non input taxed items. LEX=1 for fully input-taxed items.		1. Like our assignment of values for $LR_{c,s,u}$, we carefully went through the 1267 IOPC commodities, assigning values for LEX of 0 in cases of no GST exemption, and 1 for full exemption. 2. We then aggregated the LEX values at the 1267 IOPC level to values for LEX at the 114 IO commodity level, using GST transaction bases as weights. 3. At the national level, LEX rates are assumed to be the same at the level of IO 114 commodities, but can differ at the regional level for more aggregated commodities, if the compositions of the aggregated commodities differ between regions.
$LEX_{c,foreign,u,r}$	Proportion of imports of commodity c used by user u in region r that are legally exempt from the GST (for example, because of the low value threshold).	Productivity Commission's report on the retail industry (PC 2011), which provides data on: • Retail sales including domestic and overseas online spend in 2010 (Table 4.1, p. 87) • Online penetration of domestic sales by retail	According to the PC report, in 2010 there was a loss of \$480m. in GST collections due to low value threshold imports. We began by calculating the aggregate value of low value threshold imports as LVTM = \$480m / 10% = \$4,800 m. Next, we estimated $LEX_{c,foreign,u,r}$ by commodity as follows: • We assume that the low value imports mostly arise via online overseas sales. • The PC report covers 9 retail categories, which correspond to 15 commodities out of 114 IO commodities, namely: wine, spirits and tobacco; leather products; knitted products; clothing; footwear; publishing; human medicines; veterinary medicines; toiletries; motor vehicles, parts and other transport equipment; scientific, computer and other electronic equipment; electrical equipment;

Variable	Description	Data sources	Procedures
		categories in 2010 (Figure 4.9, p.98) • Domestic and overseas shares of online sales by retail category, 2010-2011 (Figure 4.10, p.99) • Estimated number and value of international mail parcels entering Australia in2010-11. • Low value consignments for individuals and businesses • Estimate of the loss of GST to low value threshold imports in 2010. Data on Australian production and Imports of 1267 IOPC in IO tables for 2013-14 (ABS 2016a)	household appliances; other manufacturing; movies and audio recordings. For these commodities, we calculated shares of low value imports in total imports as follows: • Share of online overseas sale in total sale of *retail category (g)* = Online penetration of domestic sales of (g)* Overseas shares of online sales of (g) • Share of online overseas sale in total imports of *commodity (c)* = Share of online overseas sale in total sale of retail category *(g)* * share of retail category (g) in total imports of commodity (c). For example, the share of low value imports in the total import of the IO commodity "publishing" was calculated as follows: • Online penetration of domestic sales of book (a retail category) was 10% (average of different estimates from different market analysts cited in the PC (2011) report). • Overseas shares of online sales of books was 81% (Figure 4.1, PC (2011) report). → The share of online overseas sales in total sale of books = 81% * 10% = 8.91%. • Share of books in total imports of *publishing* sector in the IO data was 34.9% (ABS IOPC data). → The share of online overseas sale in total imports of the *publishing* commodity = 8.91% * 34.9% = 3.11%. • We identified 32 commodities for which low value imports are most likely to happen. For the commodities outside of the 15 commodities for which there are online sales data, we adopted the shares of 2%*55% based on the PC's estimates that overseas online purchases comprise 2% of total retail sales, and the value of low value threshold imports by air consignment is 55% of the air consignment valued between 0 - $5000. We do not have the share of low value threshold imports in total value of air consignment, but it is likely that goods sent by air would not have too high a value per consignment. As stated by the PC "There are very few international mail items with a value above the threshold" (p.230).

Variable	Description	Data sources	Procedures
			• Finally, we calculated the value of low value threshold imports by multiplying the low value threshold import share with the value of imports by households and businesses. We then scale the low value import shares in order to match the PC's estimate of aggregate GST loss arising from the low value import threshold. • The resulting share of low value threshold imports in total imports of (c,u) is adopted as $LEX_{c,foreign,u,r}$.
$DEX_{c,s,u,r}$	The de-facto exemption rate, arising from unregistered businesses, underground economic activity, household own-use production, and undeclared high value imports.		$DEX_{c,s,u,r} = 1 - \sum_{i \in IND} SJ_{c,s,i} \times REGIST_{i,s}$ $(c \in COM;\ s \in REG;\ u \in DOMUSER,\ r \in REG)$ $DEX_{c,foreign,u,r} = ILM_{c,u,r}$ $(c \in COM;\ u \in DOMUSER,\ r \in REG)$
$REGIST_{i,r}$	The proportion of the output of industry *i* in region *s* produced by businesses that are registered for GST purposes.		$REGIST_{i,r} = [1-NRL_{i,r}] \times [1-NRI_{i,r}]$
$NRL_{i,r}$	The share of output by industry (i) in region (r) that is produced by businesses that are legally non-GST registered.	ABS business count data (ABS 2015), which contain the number of businesses by state, 446 industry class, and operating turnover ranges (0-less than 50K;	1. We calculated the total revenue of businesses with operating turnover below $50K in 2014 by multiplying the number of businesses with the mid-point of the turnover range (25K) for the 446 industry class in 8 states. We assumed that these businesses are not registered for the GST. 2. We then aggregated the revenue of the small businesses from 446 industry classes to VURM's 76 industries.

Variable	Description	Data sources	Procedures
		50K – 200K; 200K-2M; 2M or more) at June 2014.[10]	3. Finally, we calculated the shares of revenue by small businesses in total output by the 76 industries, and adopt them as the NRL_i. However, we assumed that heavy industries (mining, many manufacturing, utilities, rail transport, air transport) and government-dominated industries (such as government administration, defence, public safety, and education) are fully registered and thus have NRL = 0;
$NRI_{i,r}$	The share of output by industry (i) in region (r) that is produced by businesses which are operating under-ground (the cash economy)	ABS (2013) provides data on underground economy, reporting gross value added (GVA) adjustments for 20 one digit industries arising from understatement of revenue and overstatement of expenses.	ABS (2013) reports value added adjustments by ANZSIC division in 2010/11 arising from understatement of income and overstatement of expenses. In our GST model, we wish to take account of that proportion of each industry's sales that are de-facto GST exempt because firms are either not required to register for GST purposes (i.e. they fall below the turnover threshold for mandatory GST registration) or they under-report sales (i.e. they engage in underground production as defined by ABS 2013). In our GST model, we define the latter via $NRI_{i,r}$. We begin with the following definition for gross value added as reported by the ABS: $$GVA_{i,r}^{(ABS)} = SALES_{i,r}^{(ABS)} - INT_{i,r}^{(ABS)}$$ $GVA_{i,r}^{(ABS)}$, $SALES_{i,r}^{(ABS)}$ and $INT_{i,r}^{(ABS)}$ are ABS estimates of gross value added, sales, and intermediate input costs, after taking into account estimated underground activity in each sector. ABS values for sales and intermediate inputs reflect adjustments for under-reported sales and over-reported expenses. We define the proportion of ABS recorded sales and expenses that represent adjustments for mis-reporting via $U_{i,r}^{(S)}$ and $U_{i,r}^{(E)}$. Hence, we can define misreported gross value added via: $$GVA_{i,r}^{(Mis)} = SALES_{i,r}^{(ABS)} \cdot (1 - U_{i,r}^{(S)}) - INT_{i,r}^{(ABS)} (1 - U_{(i,r}^{(E)}),$$

[10] There are no data on business GST registration status since 2001. There are data on the number (not revenue) of businesses active or non-active for GST in 2001 for 17 one-digit industries, but these data could not be used to calculate NRL because typically the share of small businesses in total *number* of businesses in any industry would far exceed their share in total *revenue* of the industry.

Variable	Description	Data sources	Procedures
			where $U_{i,r}^{(S)}$ and $U_{i,r}^{(E)}$ measure propensities to understate sales and overstate expenses, and $GVA_{i,r}^{(Mis)}$ is the value of GVA reported by firms to the ABS. Consistent with the ABS' observations on the propensity of the construction sector to overstate expenses and understate sales, we assume that $U_{i,r}^{(S)} = -2 \cdot U_{i,r}^{(E)}$. Hence $GVA_{i,r}^{(Mis)} = SALES_{i,r}^{(ABS)} \cdot (1 - U_{i,r}^{(S)}) - INT_{i,r}^{(ABS)}(1 + 0.5 \cdot U_{i,r}^{(S)})$ Solving for $U_{i,r}^{(S)}$ we have: $U_{i,r}^{(S)} = [GVA_{i,r}^{(ABS)} - GVA_{i,r}^{(Mis)}] / [SALES_{i,r}^{(ABS)} + 0.5 \cdot INT_{i,r}^{(ABS)}]$ The term $[GVA_{i,r}^{(ABS)} - GVA_{i,r}^{(Mis)}]$ is the ABS' adjustment to sectoral value added. ABS (2013) reports percentage adjustments in sectoral value added relative to the ABS reported base, i.e.: $pAdjGVA_{i,r} = 100 \cdot [GVA_{i,r}^{(ABS)} - GVA_{i,r}^{(Mis)}] / GVA_{i,r}^{(ABS)}$ Substituting $pAdjGVA_{i,r}$ into the previous equation we have: $U_{i,r}^{(S)} = [0.01 \cdot GVA_{i,r}^{(ABS)} \cdot pAdjGVA_{i,r}] / [SALES_{i,r}^{(ABS)} + 0.5 \cdot INT_{i,r}^{(ABS)}]$ In general, we assume that the ABS sectoral values for $pAdjGVA_{i,r}$ are relevant for calculating the under-reporting propensities for all industries within the sector. The exception is those industries for which we have set NRL=0, for which we also assume NRI=0. We inform values for $GVA_{i,r}^{(ABS)}$, $SALES_{i,r}^{(ABS)}$, and $INT_{i,r}^{(ABS)}$ using VURM input-output data. The values we thus calculate for $U_{i,r}^{(S)}$ are then used to inform our initial values for $NRI_{i,r}$.
$REF_{i,r}$	The proportion of GST paid on intermediate	The model database, and values for REGIST and	$REF_{i,s} = REGIST_{i,s} \times \sum_{c \in COM} SO_{c,i,s} \sum_{u \in USER} \sum_{r \in REG} SS_{c,s,u,r}[1\text{-}LEX_{c,s,u,r}]$

Variable	Description	Data sources	Procedures
($i \in$ IND, $r \in$ REG)	inputs into production of industry i in region r that is refunded. Ideally, REF = 1. But REF may be < 1 due to non-registration and production of GST exempt products.	LEX as calculated above.	($i \in$ IND, $s \in$ REG) where $SO_{c,i,s}$ is the share of the value of regional industry (i,s)'s output accounted for by production of good c. $SS_{c,s,u,r}$ is the share of sales to user *u* in region *r* in total sales of domestic commodity *c* produced in region *s*.
$REF_{i,r}$ ($i \in$ INV, $r \in$ REG)	The proportion of GST paid on inputs into investment of industry i in region r that is refunded.	Current production values for $REF_{i,r}$ as calculated above.	We assume that regional industry refund factors for GST paid on inputs to capital creation are they the same as those GST paid on inputs to current production (as calculated above) because there is no distinction in the GST Act between the GST credit for intermediate inputs to production and inputs to investment.
$SHNRES_{c,s}$	The share of total exports of commodity c from region s represented by onshore sales to non-residents (like tourists).	ABS Tourism Satellite Account for 2009-2010, with data on expenditure by international visitors in Australia classified by 18 commodity groups, which are aggregates of 50 IO commodities. Tourism Research Australia (TRA) data from International Visitor Survey on international visitors' expenditure by state and territory.	To calculate this parameter, we first identified 50 IO commodities which can be mapped to the 18 commodity groups reported in ABS Tourism Satellite Accounts, and then calculated the value of expenditure on these commodities by international visitors in Australia as follows: 1. We identified 23 IO exports, which, due to their nature, are likely to be wholly or largely consumed within Australia by international visitors. We assigned SHNRES =1 for the following such commodities: retail trade, accommodation, food and beverage services, library and information, rent and hire services, dwelling services, other property services, employment, travel and administration, building support services, government administration, public safety, primary education, residential care, sport and recreation, gambling, repair services, and personal services. Taking into account the fact that Australian universities do have campuses in other countries, and art services do travel to perform abroad, we assumed SHNRES = 0.9 for these services. 2. We then aggregated the value of expenditures by IO commodities in step 1 to TSA commodity groups, and deducted them from the expenditure by TSA commodity groups. The residuals were then allocated to the remaining 27 (=50-23) IO commodities within each TSA group proportionately to household consumption

Variable	Description	Data sources	Procedures
			shares in the IO data. There were, however, 8 out of 18 TSA groups where the values estimated in step 1 exceeded the values provided in TSA accounts. For example, in the IO data, the exports of accommodation services were \$5,337m, whereas they are only \$3,113 in the TSA accounts. In these cases, we adopted the IO values. 3. For the IO commodities which do not belong to any TSA groups, we assume that they have no onshore exports. These included products from primary and material production industries, such as agriculture, mining, metal processing, cement and other non-metal mineral products. 4. After step 3 we have national values for on-shore exports by IO commodity. Dividing these values by the total value of exports by commodity gives us the national values for SHNRES by commodity. 5. At the regional level, we scale the onshore export matrix to make sure that it conforms to both national targets calculated in previous step, and state shares in TRA data. This gives us SHNRES values by commodity and region.
$REFEXP_{c,s}$	The proportion of the GST paid on onshore export sales of (c) in region (s) that is refunded via the Tourism Refund Scheme (TRS).	Tourism Research Australia (TRA) data on shopping for consumption in Australia and shopping to take home, from International Visitor Survey 2016. Information on the Tourist Refund Scheme from DIBP (2017). Personal communication with an Assistant Director of the National Accounts Benchmarks Section, ABS, on the total value of GST refund under the TRS,	According to DIBP (2017), the Tourist Refund Scheme allows overseas visitors to claim a refund of GST on their purchases which are taken out of Australia. The two main conditions for the refund are (i) the goods must be purchased in the 60 days before being taken out of Australia; and (ii) they must be valued at \$300 or more, and bought from a single business. Therefore, only goods that can be classified as "shopping" could potentially be included in the scheme, and the GST would be claimed on only a proportion of them. We calculated the REFEXP as follows. 1. We identified goods that could be classified as "shopping" by international visitors. These include: sugar and confectionary; wine, spirits and tobacco; leather products; textile products; knitted products; clothing and footwear; human medicines; toiletries; scientific, computer and electronic equipment; electrical equipment; and household appliances. We calculated the values of purchases that are being taken out of Australia, using information from TRA (2016) that 70% of the "shopping" items were for taking home. We, however, assumed a lower share of 40% for sugar, confectionary, wine, spirits and tobacco products. 2. As not all items taken out of Australia are eligible for GST refund, and not all international visitors want to apply for GST refund even for eligible items, we

Variable	Description	Data sources	Procedures
		which is around $25m per year.	make initial assumptions about the proportion of purchases that are taken home for which the GST would actually be claimed. The proportions are 50% for sugar and confectionary; wine, spirits and tobacco; leather products ; textile products; knitted products; clothing and footwear; human medicines; 80% for toiletries and household appliances; and 100% for scientific, computer and electronic equipment; and electrical equipment. Multiplying these proportions to the value of take-home onshore exports calculated in step 1 above gives us the initial value of goods on which GST would be reclaimed. 3. We then scaled these values so that the total GST refunded under the TRS was $25m as estimated by the ABS (Weeden, J., personal communication, 9 May 2017). Dividing these values by the total value of onshore exports gave the share of onshore exports on which GST was refunded. The resulting REFEXP values are 2.8% for sugar and confectionary; wine, spirits and tobacco; 5% for leather products; textile products; knitted products; clothing and footwear; human medicines; 10% for toiletries and household appliances; scientific, computer and electronic equipment; electrical equipment.
$CR_{c,s,u,r}$	The GST compliance rate for user *u* in region *r* with respect to purchases of commodity *c* from source *s*.	Evaluated endogenously in the initial data calibration step.	The commodity, source, user and regional dimensions of $CR_{c,s,u,r}$ allow the possibility of calibrating initial values for all elements of $CR_{c,s,u,r}$ if we have official values for all elements of $GST_{c,s,u,r}$. However for Australia, we know only the aggregate value of GST collections published by the ATO, i.e. we know $\sum_c \sum_s \sum_u \sum_r GST_{c,s,u,r}$. In the initial calibration, we exogenously determine $\sum_c \sum_s \sum_u \sum_r GST_{c,s,u,r}$, set all values for all other variables as described in this table, and then endogenise a scalar shift variable FCR in equation $CR_{c,s,u,r}$ = FCR to ensure that the full GST system raises GST revenue consistent with ATO statistics. The value for FCR calculated by this procedure is 0.977. Hence, we set $CR_{c,s,u,r}$ = 0.977 for all c,s,u,r.

4 SIMULATION

4.1 Simulation design

As discussed in Section 2, the full VURM database recognises 8 states and territories and over 70 sectors. For this application, we have for expository purposes reduced VURM's number of regions to two: Australia's largest state, New South Wales, and the rest of Australia, (hereafter, NSW and RoA). However, we retain the full industrial and commodity disaggregation, with 76 industries producing 78 commodities.

We raise the standard GST rate from 10% to 11%, or more formally, we raise by 0.01 those elements of $LR_{c,s,u}$ that have an initial value of 0.10. We do this under a model closure in which:

(1) Regional labour markets are characterised by short-run stickiness of the real wage with endogenous regional unemployment rates, transitioning to a long-run environment in which regional real wages are endogenous and regional unemployment rates return to baseline levels. In formulating their short-run wage demands, we assume that workers understand that they will be compensated for changes in the GST via lump sum transfer (see points 4 and 5 below). Hence the real wage measure that we assume is sticky in the short-run is defined as the nominal wage deflated by the CPI evaluated at prices that exclude the GST. This is similar to the central scenario of Dixon and Rimmer (1999), in which it is assumed that the real after-tax wage is sticky in the short-run.

(2) Regional migration rates are sticky in the short-run, but adjust gradually in order to ensure that regional real disposable income per capita relativities return to baseline levels.

(3) Capital and investment is specific to each industry in each region. Investment in each regional industry responds to movements in rates of return relative to required rates of return that are specific to each regional industry.

(4) The federal government borrowing requirement is exogenously held at baseline values via endogenous adjustment of a lump sum tax on households across the nation.

(5) State government borrowing requirements are exogenously held at baseline values via endogenous adjustment of lump sum taxes on households within each state.

(6) The additional GST raised by the federal government is allocated to state governments on the basis of population shares.[11]

(7) The ratio of the balance of trade to GDP is exogenously held at its baseline value via movements in the economy-wide average propensity to consume.

(8) Subject to the movements in the economy-wide average propensity to consume given by (6) above, region-specific household consumption spending is determined as a fixed proportion of region-specific household disposable income.

(9) Real public consumption spending by federal and state governments is exogenously held at its baseline value.

[11] As outlined in Productivity Commission (2017, p.7), GST revenue remaining after applying Commonwealth Grant Commission horizontal fiscal equalisation (HFE) formulae is distributed on an equal per capita (EPC) basis. The proportion of total GST revenue required for HFE has fluctuated between 0.14 and 0.7 between 2000/01 and 2016/17, that is, it has been less than 1 (PC 2017, p.7). As such, we assume that the additional GST raised in this simulation will be distributed on an EPC basis.

As described by points (1)-(9) above, it is clear that the simulation involves a number of policy adjustments (like changes in fiscal transfers and lump sum taxes) in addition to the rise in the GST rate. Hence, we undertake a decomposition simulation to distinguish the effects of raising the GST rate from the other policy adjustments that occur in parallel with this. Relevant aspects of the model closure under the decomposition simulation are described in Error! Reference s ource not found.. Column (A) describes the model closure under the full standard simulation (as described by points 1-9 above). To understand the simulation described by column (A), begin first with row (1), the rise in the GST rate. We assume that the GST revenue is distributed to the states, while at the same time dividing these state-specific distributions into two components: a return to each state of the GST collected within each state (row 2), and an adjustment to the collections-basis distribution of row (2) to reflect the population shares basis used by the Commonwealth Grants Commission for distributing additional GST revenue (row 3). We hold the PSBRs of all state governments exogenously on baseline (row 9), which requires endogenous adjustment of state government transfers to households (row 4). We assume that the federal government PSBR is also exogenously held on baseline (row 8), which is achieved via endogenous determination of federal government grants to households (row 5). Finally, we assume that the ratio of the balance of trade to GDP remains on baseline (row 7), via endogenous adjustment of the economy-wide household savings rate (row 6).

In economic terms, the simulation described by the closure in Column B (the full decomposition simulation) is the same as the simulation described by the closure in Column A (the full simulation), except we determine exogenously the additional policy adjustments that are implicit in the endogenous determination of a number of key variables in Column A. That is, the closure in Column B makes explicit that the closure in Column A describes an economic environment in which:

(i) the federal government raises the GST rate (row 1);

(ii) the federal government begins by granting to each state government the additional GST that is collected within each state (row 2);

(iii) the federal government then makes an adjustment to the grant given by (ii) in order to bring the total grant in line with the Commonwealth Grant Commission's (CGC's) allocation of additional GST revenue on an equal per capita (EPC) basis (row 3);

(iv) state governments adjust state-specific lump-sum household taxes/transfers by an amount sufficient to leave their PSBRs unaffected by all the shocks described by items (i)-(vi) in this list (row 4);

(v) the federal government adjusts economy-wide lump-sum household taxes/transfers by an amount sufficient to leave its PSBR unaffected by all the shocks described in this list by items (i)-(vi) (row 5);

(vi) households adjust their average propensity to save by an amount sufficient to leave the ratio of the balance of trade to GDP unaffected by the shocks described in this list by items (i) – (vi) (row 6).

When we run the Column (B) simulation, we shock exogenous policy variables by their deviation values under the Column (A) simulation, irrespective of whether the variable was endogenous or exogenous under the Column (A) simulation. The Column (B) simulation thus achieves two things: first, at a trivial level, it exactly reproduces the results for all variables in the Column (A) simulation; secondly, and more importantly, it allows us to decompose the results from the Column (A) simulation into the individual contributions made by movements in all relevant policy variables. This is the purpose of the simulations described by Columns

(C) – (H). Each of these simulations applies only one policy shock from the full set of policy shocks described by Column (B). Results for any given policy variable, when summed across the results for the simulations described by Columns (C) – (H), will be very close to results for the simulation described by Column (A).[12] This allows the results for any variable in Column (A) to be explained in terms of the individual contributions made by each of the policy shocks.

Table 2: Relevant aspects of model closure under the Full and Decomposition simulations.

	(A) Full sim	(B) Full decomp	Components of decomposition simulation						
			(C) Decomp 1	(D) Decomp 2	(E) Decomp 3	(F) Decomp 4	(G) Decomp 5	(H) Decomp 6	(I) Modified decomp
(1) GST rate	X	X	X	X	X	X	X	X	X
(2) Additional GST granted to states on the basis of state-specific GST collections.	N	**X**	X	**X**	X	X	X	X	X
(3) CGC per-capita adjustment to the pure collection share grant rule given by (2) above.	N	**X**	X	X	**X**	X	X	X	**X**
(4) State transfers to households	N	**X**	X	X	X	**X**	X	X	N
(5) Federal transfers to households	N	**X**	X	X	X	X	**X**	X	X
(6) National propensity to save	N	**X**	X	X	X	X	X	**X**	X
(7) Balance of trade : GDP ratio	X	N	N	N	N	N	N	N	N
(8) Federal PSBR	X	N	N	N	N	N	N	N	N
(9) State PSBRs	X	N	N	N	N	N	N	N	X
"X" denotes exogenous, "N" denotes endogenous, "**X**" denotes exogenous and shocked relative to baseline									

4.2 Results

4.2.1 A back of the envelope model

Figure 1 reports the full simulation results for the national deviations in employment, the capital stock, real GDP, and two real wage measures. Figures 2 –4 decompose the employment, capital and GDP deviations into the individual contributions of the six decomposition factors discussed in Section 4.1. These decomposition figures make clear that, of the six decomposition factors, the rise in the GST rate is the dominant influence on the macroeconomy. Hence, we begin our discussion of the results with this factor.

In analysing the impact of the GST in their 1999 paper, Dixon and Rimmer proposed a simple but highly illuminating back-of-the-envelope (BOTE) model for understanding the results of their full CGE model. Like the model employed by Dixon and Rimmer (1999), VURM is also built on constant returns to scale production functions, optimising behaviour, competitive

[12] Because the model is non-linear, there are interactions between the simultaneous shocks occurring in the Column (A) and Column (B) simulations that are not captured when the shocks are delivered individually in the Column (C) – (H) components of the decomposition simulations. These residuals are very small. Hence, to reduce clutter, we do not report these small residuals in the decomposition figures.

markets, and factor market closures characterised by sticky real wages and capital stocks in the short-run, and given unemployment rates and rates of return in the long run. This makes Dixon and Rimmer's BOTE model helpful in understanding the VURM GST results. We reproduce key elements of Dixon and Rimmer's (1999) BOTE model below.

Assume the economy produces one good and imports one good. Production of the domestic good is a Cobb-Douglas (CD) function of labour and capital. Units of consumption and investment are produced via CD functions of inputs of the domestic good and the foreign good.[13] Under zero pure profit and cost-minimising assumptions in the production and distribution of the domestic good, the consumption good, and the investment good, we have:

$$P_C = P_D^{\alpha_D^C} \cdot P_M^{\alpha_M^C} \cdot T_C \tag{E.10}$$

$$P_I = P_D^{\alpha_D^I} \cdot P_M^{\alpha_M^I} \cdot T_I \tag{E.11}$$

$$MP_L(K/L) = T_D \cdot (W/P_D) \tag{E.12}$$

$$MP_K(K/L) = T_D \cdot (Q/P_D) \tag{E.13}$$

$$\rho = Q/P_I \tag{E.14}$$

$$W_R^{(A)} = W \cdot T_C / P_C \tag{E.15}$$

$$W_R^{(B)} = W / P_C \tag{E.16}$$

Where P_D and P_M are the basic price of the domestic good and the c.i.f. price of the imported good; P_C and P_I are the purchasers' prices of a unit of consumption and investment; T_C, T_I, and T_D are the powers (1 plus the rates) of indirect tax on consumption, investment and production; $W_R^{(A)}$ is the nominal wage deflated by the GST-exclusive consumption price deflator; $W_R^{(B)}$ is the nominal wage deflated by the GST-inclusive consumption price deflator; Q is the rental price of a unit of capital; ρ is the gross rate of return on a unit of capital; α_D^C and α_M^C are the cost shares of domestic and imported goods in a unit of consumption (with $\alpha_D^C + \alpha_M^C =1$); and α_D^I and α_M^I are the cost shares of domestic and imported goods in a unit of investment (with $\alpha_D^I + \alpha_M^I =1$). Equations (E.10) and (E.11) are CD unit cost functions. Equations (E.12) and (E.13) describe optimising demands for labour and capital. Equation (E.14) defines the rate of return on capital Equations (E.15) and (E.16) define two real wage measures.

Via equations (E.10) – (E.15) we have:

$$MP_L(K/L) = T_D \cdot W_R^{(A)} \cdot (P_M / P_D)^{\alpha_M^C} \tag{E.17}$$

$$MP_K(K/L) = \rho \cdot T_D \cdot T_I \cdot (P_M / P_D)^{\alpha_M^I} \tag{E.18}$$

Via equations (E.16) and (E. 17) we have:

[13] VURM's production theory is based on nested constant returns to scale Leontief and Constant Elasticity of Substitution (CES) production functions. For the purpose of constructing BOTE, Cobb-Douglas is an effective simplification of this structure.

$$MP_L\,(K/L) = T_D \cdot T_C \cdot W_R^{(B)} \cdot (P_M / P_D)^{\alpha_M^C} \tag{E.19}$$

In (E.17) – E.19), the ratio P_M / P_D is a function of the terms of trade. As will be discussed, movements in this ratio can be understood as second round outcomes arising from the first round effects on K and L of movements in T_C , T_D , and T_I . Equation (E.19) is helpful in elucidating the consequences of alternative assumptions about real wage stickiness. If short-run real wage negotiations are undertaken without recognition that changes in GST rates are to be accompanied by lump-sum return of GST revenue, then this can represented in BOTE by short-run exogeneity of $W_R^{(B)}$ in (E.19). In this situation, a rise in T_C causes short-run MP_L to rise, requiring short-run employment losses as W is forced upwards to compensate for the rise in T_C . However, as discussed earlier, in this experiment we assume that workers and firms understand that the rise in GST is accompanied by a return of the GST revenue, and thus undertaken short-run wage setting in terms of $W_R^{(A)}$.

When we raise the standard GST rate to 11% in VURM, in BOTE this can be viewed as raising the values of T_C , T_D , and T_I . The explanation for the rise in the value of T_C is straightforward: in terms of equation (E.1), for the household user, values for EEX tend to be low, the value of REF is 0, and values for CR are close to 1. Hence, the rise in LR translates strongly into a rise in the rate of indirect tax on household consumption. This is clear in Figure 5, which reports the decomposition of the ratio of: (i) the deviation in the national household consumption deflator as normally defined; and (ii) a measure of the household consumption deflator that excludes the GST.[14]

The rise in the value of T_D arises from non-unitary values for $REF_{u,r} = 1$, $u \in IND$, $r \in REG$. In a theoretically pure GST system, $REF_{u,r} = 1$, $\forall u \in IND$, $\forall r \in REG$. But equation (E.7) reminds us that producers can only reclaim GST paid on inputs to the extent that they: (i) produce goods that are not GST exempt, and (ii) register for GST. The exempt status of banking, finance and elements of insurance render these sectors input-taxed, which in our GST model is represented by very low $REF_{i,s}$ values for those industries primarily producing these commodities. As discussed in Section 3 in reference to Table 1, we account for industry-specific registration rates by informing values for $NRI_{i,r}$ and $NRL_{i,r}$ with ABS data on business counts and the informal economy (ABS 2015, 2013) and ATO data on GST registrations. Values for $NRL_{i,r}$, are low, and often 0, with an average value around 0.005. Values for $NRI_{i,r}$ are also low (around 0.004 on average), with many 0 values for sectors dominated by large regulated organisations, and with a handful of sectors in which ABS data suggests the extent of informality is relatively high (construction, accommodation services, food manufacturers). Hence, in terms of equation (E.7), while values for REGIST tend to be close to 1, it remains that they are not all 1, hence values for $REF_{i,s}$ are less than 1 for many industries. Via equation (E.1), this has the effect of introducing low levels of input taxation of the activities of the majority of industries. Via these two routes, production of exempt commodities and non-registration, an increase in the GST rate has the effect of raising taxes on production. In BOTE, this is represented by a rise in T_D . In the VURM simulation, it is apparent in the positive deviation in the ratio of (i) an

[14] This ratio, and similar ones reported for the prices of investment, intermediate input costs, and exports elsewhere in this paper, are helpful in discerning the direct effect of the GST on relative outcomes for macro prices. In the outcomes for the deflators themselves, these direct effects can be obscured by changes in underlying cost conditions in industries producing the constituent commodities.

intermediate input cost index at purchasers' prices as normally defined; and (ii) an intermediate input cost index that excludes GST but is otherwise at purchasers' prices (Figure 6).

Finally, a number of elements of the GST system result in taxation of investment, which in BOTE is represented by a rise in T_I. In terms of the GST model, under a pure GST system $REF_{u,r} = 1$, $\forall u \in INV$, $\forall r \in REG$. But as already discussed above, firms are unable to reclaim GST on inputs to the extent that they produce exempt commodities or are not registered for GST purposes. This is reflected in equation (E.8) of the GST model. (E.6)-(E.8) have the effect of introducing very low levels of investment taxation to many industries via non-registration, and high levels of investment taxation for banking, finance, insurance and dwellings via the exempt status of most or all of the products that these sectors produce. At the level of the macroeconomy, this is reflected in the positive deviation in the ratio of (i) the investment price deflator as normally defined, and (ii) the investment price deflator excluding the GST but otherwise at purchasers' prices in all other respects (Figure 7).

4.2.2 National results

We use equations (E.17) and (E.18) to understand the short-run and long-run outcomes reported in Figure 1. In the short-run, with the real wage ($W_R^{(A)}$) and the capital stock (K) sticky, the rise in production taxes (T_D) causes the marginal product of labour (MP_L) to rise. With K sticky, this requires L to fall. This accounts for the short-run negative deviation in employment (Figure 1).[15] The short-run negative employment deviation accounts for the short-run negative deviation in real GDP (Figure 1).

Turning to equation (E.18), the short-run negative deviation in L causes a short-run negative deviation in the marginal product of capital (MP_K). Ceteris paribus, this causes the rate of return on capital (ρ) to fall relative to baseline. The short-run downward pressure on ρ via the negative deviation in MP_K is reinforced by the rise in indirect taxation of investment and production (T_I and T_D). This accounts for the sharp negative deviation in real investment in the short-run (Figure 9).

As discussed in Section 4.1, VURM's capital and labour markets transition in the long-run to an environment in which capital adjustment returns rates of return on capital to industry-specific required rates of return, and real wage adjustment returns the unemployment rate to its baseline value. In BOTE equations (E.17) and (E.18), these long-run outcomes can be described by the exogenous status of L and ρ and the endogenous status of $W_R^{(A)}$ and K. In

[15] Figure 2 shows that another important contributor to the short-run negative employment deviation is the state government lump-sum transfer to the household sector. With the real consumer wage sticky, lump-sum return of GST revenue to the household sector proves an ineffective way of offsetting the short-run employment losses generated by raising GST revenue. This reflects the relative capital intensity of household consumption, because of the high share of consumption represented by dwellings. The lump sum transfer buoys private consumption spending. By pushing up dwelling rental prices, this raises the CPI, and thus the nominal wage in the short-run, relative to output prices in labour intensive sectors. This is particularly important in Western Australia, which is more trade exposed than the rest of Australia, and thus has more limited capacity to pass on cost increases to buyers of its products. The sticky short-run inter-regional migration response essentially segments regional labour markets in the short-run. Hence in the simulation's first year, the effect of decomposition factor 4 alone is to reduce employment in rest of Australia by 0.1 per cent, while raising employment in NSW by 0.04 per cent. The net national result is the -0.05 per cent contribution to the year 1 negative deviation in employment reported in Figure 2.

equation (E.18), with L and ρ exogenous, the rise in indirect taxation of investment and production (T_I and T_D) causes the long-run marginal product of capital (MP_K) to rise . With L given in the long-run, the rise in MP_K requires K to fall. This accounts for the long-run negative deviation in capital reported in Figure 1. With the long-run capital stock below baseline, and employment returning to baseline, real GDP must be below baseline in the long-run (Figure 1). Turning to equation (E.17), with K below baseline in the long-run, and L returning to baseline, the long-run deviation in MP_L must be negative. Ceteris paribus, this damps the long-run real wage ($W_R^{(A)}$) deviation relative to baseline. This pressure for negative deviation in $W_R^{(A)}$ arising from the long-run negative deviation in K is reinforced in equation (E.17) by the rise in indirect taxation of intermediate inputs. Via equation (E.19) we see that the negative deviation in uncompensated measure of the real wage ($W_R^{(B)}$) is reinforced by the rise in the taxation of consumption (T_C).

Figure 9 reports deviations in the expenditure side components of real GDP. As discussed with reference to equation (E.18), in the short-run the real investment deviation is sharply negative due to the negative effects on rates of return arising from the short-run fall in employment and the rise in indirect taxation of production and investment. Investment is relatively import intensive. At the same time, the rise in the GST on export tourism depresses trade relative to GDP. Both factors account for the sharp negative deviation in import volumes in the simulation’s first year. With the balance of trade to GDP ratio exogenous, the negative deviation in import volumes requires there be a simultaneous negative deviation in export volumes. The negative export volume deviation generates a positive deviation in the terms of trade. The path of the positive terms of trade deviation mirrors the path of the negative export volume deviation. This follows from VURM’s export theory, which carries the assumption that commodity- and source-specific export volumes are negatively related to commodity- and source-specific foreign currency export prices. The positive deviation in the terms of trade lifts national income relative to GDP. This accounts for why the real private consumption deviation lies above the real GDP deviation in the short-run.

In the long-run, with regional industry rates of return on capital gradually returning towards baseline via gradual adjustment of regional industry capital stocks, the negative real investment deviation gradually attenuates (Figure 9). However, the long-run real investment deviation remains negative, because the long-run capital stock deviation is negative (Figure 1). Because of the relative import intensity of investment, the long-run attenuation of the negative investment deviation causes a long-run attenuation of the negative import deviation. Via the closure assumption that the balance of trade to GDP ratio remains on baseline, the long-run negative deviation in import volumes requires a long-run negative deviation in export volumes. The negative export volume deviation lies below the negative import volume deviation for two reasons: (i) the terms of trade deviation is positive; and (ii) the baseline level of the balance of trade is in deficit. Despite the long-run investment deviation moving towards the real GDP deviation in the long-run, the import volume deviation remains below the real GDP deviation in the long-run. This reflects the taxation of export tourism, which depresses trade relative to GDP. The long-run reduction in export volumes relative to baseline generates a small long-run positive deviation in the terms of trade. However, the long-run terms of trade deviation is less than the short-run terms of trade deviation, reflecting the attenuation in the export volume deviation over the medium- to long-run. The attenuation of the terms of trade deviation accounts for the gradual reduction of the gap between the real private consumption deviation and the real GDP deviation. This effect is reinforced by the fixity of real public consumption at baseline levels, which has the effect of leaving private consumption to adjust to movements in real national income.

A measure of the welfare impact of the change in the GST rate is the deviation in aggregate (private and public) real consumption. Real public consumption spending is held on baseline throughout the simulation. Private consumption is approximately 75% of aggregate consumption. The private consumption deviation reaches its lowest point in 2021 (at -0.054 per cent), and ends the simulation period -0.032 per cent below baseline. Hence aggregate real consumption reaches its lowest point in 2021 at 0.04% below baseline, and ends the simulation period 0.024% below baseline.

4.2.3 Industry results

For reporting purposes we aggregate the VURM results for output by industry to outcomes for 17 broad sectors. Figures 10 – 12 report the output deviations for the top six, middle five, and bottom six industries ranked by 2030 output deviation.

In Figure 10 we see that health and education are among the two top-ranked sectors in the long-run. Sales to public consumption expenditure represent high shares of the output of both sectors. As discussed in Section 4.1, we assume that real public consumption spending remains on baseline. This supports the output deviations of sectors like health and education, even in the presence of the general reduction in economy-wide activity implied by the negative GDP deviation (reported in Figure 10 for comparative purposes). It also accounts for the presence of public administration and defence among the top ranked sectors reported in Figure 10. A second factor supporting the output of health and education is their GST status. The outputs of both sectors are zero rated. When we raise the standard rate of GST from 10% to 11%, this has the effect of reducing the relative consumer price of zero rated education and health, inducing some substitution in consumption towards these commodities. Similarly, the presence of the utilities sector among the top-ranked sectors is due to the zero rating of water and drainage services. The remaining two sectors in Figure 10 are mining and agriculture. As discussed in Section 2.4, part of the rise in the GST falls on exports of tourism services. For any given level of aggregate export volumes, taxation of export tourism crowds out tourism exports and crowds in traditional zero-rated exports like mining and agriculture. The output deviations of mining and agriculture are also somewhat constrained by the fixity of natural resource endowments in both sectors.

Figure 11 reports output deviations for the middle five sectors ranked in terms of 2030 output deviations. These sectors tend to subsume industries that are: (i) not characterised as having dominant sales shares to any one particular final demand category (manufacturing, finance and insurance, other services); (ii) important as intermediate inputs (manufacturing, other business services); and (iii) important as margin services in facilitating transactions across many production sectors and final demand categories (wholesale trade). These characteristics make the output of these sectors correlated with a summary measure of economy-wide economic activity, like real GDP. This renders them middle-ranked in terms of output deviations when compared with real GDP.

Figure 12 reports output deviations for the bottom six sectors ranked in terms of 2030 output deviation. The two sectors that experience the largest negative deviations in output (accommodation and food, and transport) are important providers of services to foreign tourists. As discussed in Section 2.4, when making on-shore purchases of commodities like hotel stays and restaurant meals, tourists must pay the GST and are unable to claim a refund on departure. In VURM, export demands are modelled as particularly price sensitive, and thus the effective export taxation of tourism-related sales by these two sectors generates comparatively large contractions in their output. This is also a factor in the negative output deviations for retail trade and communications. For both sectors, there is a strong propensity to track the real GDP deviation: approximately half of communications output is used as intermediate input to other production sectors, and approximately one-third of retail margins facilitate intermediate input purchases. However, both sectors have some exposure to export tourism, which damps their output deviations relative to real GDP. Retail margins attach to tourism-related export sales of food, beverages, and other items that are subject to GST because the purchases are made on-shore. Hence the rise in the GST rate damps retail trade relative to other sectors, because export sales of tourism-related commodities (like food and beverages) relying on retail margins are adversely affected by the rise in the GST rate. Approximately 7% of communications services are export sales, and of these, we assume that 11% are on-shore sales to non-residents, and thus subject to the household GST rate.[16] Construction services is a key input to investment, and as a result, its output deviation is highly correlated with the deviation in aggregate real investment. This accounts for the sharp negative deviation in construction output in the short-run, and gradual attenuation of the construction output deviation in the long-run. The deviation in dwellings output is small in the short-run, consistent with the capital intensity of this sector. Over the medium- to long-run, the dwellings output deviation is negative and lies slightly below the real GDP deviation. This reflects the relatively high expenditure elasticity for dwellings services. With the long-run real consumption deviation being approximately the same as the long-run real GDP deviation (Figure 9), the relatively high household expenditure elasticity for dwellings services causes the dwellings output deviation to lie below the real GDP deviation.

4.2.4 Regional results

Figure 13 reports real GDP deviations for NSW, the rest of Australia (RoA) and Australia as a whole. As is clear from Figure 13, relative to Australia as a whole, NSW is adversely affected by the rise in the standard GST rate. To understand why, we begin by decomposing the difference between the real GDP deviations of NSW and Australia (Figure 14). Figure 14 shows that the difference is largely attributable to the rise in the standard rate of GST, with some offset provided by state grants to households.

To understand why the rise in the standard GST rate adversely affects NSW relative to Australia as a whole, we begin by examining the impact of the GST on purchasers' prices in NSW relative to the rest of the country. As discussed in Section 4.2.2, we calculate the ratios of certain national deflators (private consumption, investment, exports and intermediate input costs) calculated with and without GST at the national level. We also calculate these ratios at the regional level, and report them, together with their national counterparts, in Figures 15 – 18. Figure 15 reports NSW, RoA and Australia outcomes for the ratio of the consumer price index as normally defined (i.e. inclusive of GST) to a measure of the consumer price index that excludes GST. The outcomes for this measure are very similar for NSW, RoA and Australia throughout the simulation period. This suggests that differences between NSW and RoA in the

[16] We calculate on-shore export shares of communication services using two sources (i) data on internet and phone expenditure by international visitors from the 2016 International Visitor Survey conducted by Tourism Research Australia (2017); and (ii) data on international visitors' expenditure by 18 commodity groups from ABS's Tourism Satellite accounts (ABS 2016b). See Table 1 for details.

GST load on consumption is not an important factor in explaining the difference between the NSW and RoA outcomes for real GDP.[17]

This is not the case for the remaining three deflators, which show sizeable differences in the direct effect of the GST on purchasers' prices for investment, intermediate inputs and exports in NSW relative to the rest of Australia. Turning first to the investment deflator outcomes (Figure 16), we find that the gap between the NSW and RoA outcomes for the direct contribution of the GST to the investment deflator deviations is approximately 0.1 percentage points. We can trace this to the higher proportion of activity in NSW in input-taxed industries, in particular banking, finance, insurance and dwellings. Approximately 6.2% of NSW investment is in banking, finance and insurance, while the corresponding number for the RoA is 3.3%. This reflects the status of NSW as a financial centre. Approximately 28.7% of NSW investment is in dwellings construction, while the corresponding number for the RoA is 20.4%. As discussed in Section 2, much of banking, finance, insurance and dwellings is GST exempt, rendering the industries producing these commodities input-taxed. Because NSW has a higher share of its investment activity in industries producing GST exempt commodities, when we raise the GST, this has a larger direct effect on the investment price deflator in NSW relative to the RoA.

Production of GST exempt commodities also accounts for the gap between the NSW and RoA outcomes for the contribution of the GST to regional intermediate input price indices (Figure 18). Payments of GST on intermediate inputs to insurance, banking and finance explain about half the gap between the NSW and RoA series reported in Figure 18. The remainder is due to taxation of intermediate inputs to current production of dwelling services. Insurance, banking and finance services are themselves important intermediate inputs in current production, and the input-taxation of production of these commodities leads to some indirect tax cascading. This effect is more important in NSW than in the RoA. In NSW, inputs of banking, finance and insurance are a higher share of production costs relative to RoA (5.2% v. 4.2%).

In Figure 17 we see that the direct effect of the GST on regional export prices accounts for approximately 0.1 percentage points of the gap between the export price deviations for NSW and RoA. We trace this to the greater importance of export tourism to NSW relative to the RoA. As discussed in Section 2.4, a rise in the GST rate translates to a rise in export taxation to the extent that it falls upon commodities purchased on-shore by non-residents, and to the extent that the GST collected in this way is not refunded upon departure. Reflecting NSW's status as an important destination for foreign visitors, the proportion of NSW exports accounted for by such tourism-related commodities as accommodation and food, air transport, beverages, water transport, communications, gambling, rail passenger transport, and culture, is 25%. The corresponding figure for RoA is 10%. However, as is clear from equation (E.9), we must account for the proportions of each export commodity sold onshore to non-residents, and the proportion of GST paid on such transactions that are refunded. Hence a more general measure of NSW's relative sensitivity to the export taxation elements of the GST can be calculated as the difference between the NSW and RoA values for $\sum_c \left(\mathrm{TRBASE}_{\mathrm{c,s,export}} \big/ \sum_i \mathrm{TRBASE}_{\mathrm{i,s,export}} \right) \cdot \mathrm{SHNRES}_{\mathrm{c,s}} \cdot (1 - \mathrm{REFEXP}_{c,s})$, that is, as the difference between the proportion of exports from each region that are subject to non-refunded GST.

[17] While this factor proved unimportant in this simulation, it is of potential importance because inter-regional migration is determined by regional real (CPI-deflated) per capita income. Under this closure, a GST-induced rise in the CPI in one state relative to another, should it occur, will be met with gradual reduction in inter-regional migration to the state in question until the relative regional wage has risen sufficient to offset the relative CPI increase.

Using the VURM database to evaluate these terms, we find that the difference between NSW and RoA is 0.081 (=0.176-0.095). Hence, we see that, relative to RoA, NSW exports are more heavily weighted towards commodities which incur GST when purchased onshore by non-residents.

We conclude with a discussion of NSW and RoA fiscal impacts. These reveal a final source of additional damage to the NSW economy relative to that of RoA. Figures 19 and 20 report the net lending / borrowing outcomes for NSW and RoA, decomposed into the individual contributions of our six factors. As discussed in Section 4.1, for the purposes of our decomposition analysis, we divide the federal grant of GST revenue to the states into two components: (i) an allocation equal to the amount of GST revenue collected within the state; and, (ii) a correction to (i) sufficient to bring the net grant in line with CGC allocations of additional revenue on a per-capita basis. Figure 19 reports the NSW net lending / borrowing outcome. Consistent with our assumption of no change in state PSBRs relative to baseline, the net impact of the six decomposition factors on the NSW net lending / borrowing outcome is zero throughout the simulation. There are two sources of positive contribution to the NSW PSBR deviation: federal GST grants to the states calculated on a collection basis, and the effects of the GST rate rise itself. Taken on its own, the rise in the GST rate generates two sources of small positive contribution to the NSW net lending outcome. First, the negative deviation in NSW investment is assumed to affect both private and public investment. Ceteris paribus, the negative deviation in NSW public investment reduces net acquisitions of non-financial assets by the NSW government relative to baseline, moving the NSW budget balance towards surplus relative to baseline. Second, we hold real state government public consumption spending on baseline throughout the simulation. However, the unit cost of public expenditure falls relative to baseline, due to the fall in wages (Figure 1). These two factors move the NSW government's net lending / borrowing position towards net lending, even though no GST revenue is being allocated to the states by the federal government under decomposition factor 1.

Two factors return the NSW net lending / borrowing position to zero deviation: (i) a correction to the collection-basis allocation of GST revenue to the state sufficient to bring the net grant of additional GST revenue to the state in line with that determined by population shares; and (ii) state government transfers to households. For NSW, the population share correction to the collection basis for grant allocation is negative (Figure 19). It is positive by the same ollar amount for the RoA (Figure 20). The grant adjustment for NSW thus reduces the grant allocation relative to the amount of GST collected from NSW, while for RoA, the reverse is the case, with RoA receiving more in GST grants than GST collected within the region.

Under the decomposition simulation as described by Table 2, it is not possible to identify the impact on the state GSP deviations of the GST grant correction (i.e. decomposition factor 3), because its effect is to alter the state government net lending / borrowing position only. That is, under decomposition simulation 3, the GST grant correction factor alters the amount of funds available to the states for lump-sum distribution to households, but it is not possible to identify the relative GSP consequences of the resulting curtailing of NSW lump sum distributions relative to GST collections, or the augmentation of RoA lump sum distributions relative to GST collections.

To identify the GSP consequences of the GST grant correction, we must run a side simulation under a modified decomposition closure (Table 2, column I). The modified decomposition closure is the same as the decomposition closure in all respects, other than the exogenous status of state government PSBRs and the endogenous status of state transfers to households. In the side simulation, we shock federal government grants to the states by the same values as under column (E) of Table 2. That is, we raise grants to RoA, and lower grants to NSW by the same amount, with the amount reflecting the CGC population share adjustment to a collections-basis allocation to the states of the additional GST raised by the 1 percentage point increase in the standard GST rate. Under the modified decomposition closure, these federal grant reallocations pass through the state government level (because regional government PSBRs are exogenous) and flow directly to the household level, where they affect regional disposable income, and thus regional private consumption. Hence, under the modified decomposition closure, the grant correction can affect relative state economic outcomes. This is clear in Figure 21, which reports the deviations in state real GSP at market prices in the side simulation under the modified decomposition closure. For comparison purposes, we also reproduce the Figure 13 outcomes for state GSP under the full simulation. Figure 21 makes clear that, relative to a collections basis for distributing additional GST revenue, the CGC per capita correction damps the NSW GSP deviation relative to that for RoA. The contribution made by the grant correction to the difference between NSW and RoA GSP outcomes grows over time because the correction affects regional GSP largely via inter-regional migration. In the short-run, inter-regional migration is sticky. It gradually adjusts to the inter-regional post-tax income differential created by the pass-through of the grant correction to the household sector via state lump sum transfers. By the simulation's final year, the gap between the full simulation outcomes for NSW and RoA GSP deviations is -0.055 (=-0.081 - -0.026) per cent. The gap between the GSP deviations attributable to the CGC correction shock alone is -0.041 (=-0.029 – 0.012) per cent. Hence, relative to a situation in which GST grants to the states are made on the basis of GST collections within each state, the per capita adjustment explains about three quarters (-0.041/-0.055) of the gap between the long-run NSW and RoA real GSP deviations.

5 CONCLUDING REMARKS

Despite the relative efficiency of raising tax revenue via the GST, GST reform options were not on the Australian political agenda for some time (Freebairn 2011). However, GST reform options in the form of widening the tax base, lifting the rate, and reducing exemptions, returned to a prominent position on the political agenda with the release of the Commonwealth Government's Tax Discussion Paper in March 2015 (Australian Government 2015). Freebairn (2011) suggests that a rise in revenue from a modified GST could be used to finance a revenue neutral tax mix change, involving reduced reliance on distorting taxes like state stamp duties, coupled with targeted income tax cuts, social security payments, and commodity-specific consumption subsidies to ameliorate the equity impacts of the package. While there is no constitutional impediment to the Commonwealth Government changing the GST system (Boccabella and Bain 2015), the major political parties continue to support the requirement that changes to the GST need the unanimous support of state and territory governments. This position was explicit in the Tax Discussion Paper (Australian Government 2015) which noted "the Australian Government will not support changes to the GST without a broad political consensus for change, including agreement by all state and territory governments." One input to state and territory government deliberation on whether they should support GST change is likely to be analysis of the economic consequences for their state or territory of such change.

In this paper, we have examined the consequences for Australia's regional and national economies of a rise in the standard rate of GST from 10% to 11%. Our model, VURM, is bottom-up multi-regional, explicitly modelling the details of economic activity within each region. The model also carries detailed modelling of the legislated complexity of the GST as it relates to differentiated tax rates, legal exemptions, refund rates, registration rates, export taxation and the low value import threshold. In the current paper, we implement a two region (NSW and rest of Australia) version of VURM. When we raise the standard GST rate and distribute the resulting revenue to the regional government level, our model quantifies and confirms a well understood dimension to the regional economic consequences of the GST: i.e. under current CGC arrangements, a donor state like NSW is likely to be adversely affected by a rise in the GST rate. As discussed in the paper, relative to a collections basis for distributing the GST raised in each state, distribution of additional revenue on an equal per capita basis reduces long-run NSW real GDP by approximately 0.04 per cent. However, our regional model with GST detail identifies other factors that also bear on the size of the NSW economy. In particular, we identify the relative importance of input-taxed activities in NSW (particularly banking, finance, insurance, and dwellings construction) and export tourism as factors that cause a rise in the GST rate to damp economic activity in NSW relative to the rest of Australia. Taken together with the CGC elements of GST revenue distribution, we find that a one percentage point increase in the standard rate of GST reduces long-run NSW real GSP by -0.081 per cent. The corresponding figures for the rest of Australia, and Australia as a whole are -0.026 per cent and -0.044 per cent. A straightforward change in the GST rate thus has consequences for the distribution of economic activity across Australia's states and territories. More complex changes, involving broadening the base and changing exemptions, are likewise likely to cause changes in relative economic activity across states and territories. Under the current arrangements requiring unanimous support for GST change, consideration of such impacts will need to inform inter-governmental deliberations on GST reform proposals. For expository purposes, the current paper has focused on economic consequences for Australia's largest state, New South Wales, and the rest of Australia. In future work, we plan to: (i) analyze results for the fully disaggregated VURM model for Australia's eight states and territories; and (ii) investigate a wider range of reform options, including broadening of the base, modifying exemptions, and removing the low value import threshold. We expect this analysis to reveal further interesting insights into how the legislated details of the GST, together with features of region-specific economic activity, interact to generate regionally differentiated impacts from various GST reform options.

6 REFERENCES

Adams, P., J. Dixon and M. Horridge (2015), The Victoria Regional Model (VURM): Technical Documentation, 1.0, CoPS Working Paper No. G-254, Centre of Policy Studies, Victoria University, Melbourne. http://www.copsmodels.com/ftp/workpapr/g-254.pdf.

ALII (Australian Legal Information Institute) (c 2000) *A New Tax System (Goods and Services Tax) Act 1999. Commonwealth Consolidated Acts*. Accessed 4/5/2017 at http://www.austlii.edu.au/au/legis/cth/consol_act/antsasta1999402/.

ATO (Australian Taxation Office) (2016) GST. Accessed 17 May 2017 at https://www.ato.gov.au/Business/GST/

ATO (Australian Taxation Office) (2017) GST on low value imported goods. Accessed 20 May 2017 at https://www.ato.gov.au/Business/International-tax-for-business/GST-on-low-value-imported-goods/

Australian Bureau of Statistics (2000) "Australian National Accounts and the GST", Appendix 5 in "Australian System of National Accounts: Concept, Sources and Methods". Accessed 10 May 2017 at http://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/28AFE69D44DA09B6CA2569BB0082B173/$File/52160_2000.pdf.

Australian Bureau of Statistics (2013) *Information Paper: The Non-Observed Economy and Australia's GDP*, 2012, cat. no. 5204.0.55.008. Accessed 10 May 2017 at http://www.abs.gov.au/ausstats%5Cabs@.nsf/0/C337805DECD9BF29CA257BE3001DCA2D?Opendocument.

Australian Bureau of Statistics (2015) *Counts of Australian Businesses, including Entries and Exits*, Jun 2010 to Jun 2014, cat. no 8165.0. Accessed 10 May 2017 at http://www.abs.gov.au/AUSSTATS/abs@.nsf/allprimarymainfeatures/0D77E085E7DC9A2BCA257F640011DE7C?opendocument.

Australian Bureau of Statistics (2016a) *Australian National Accounts: Input-Output Tables (Product Details)*, 2013-14, cat. no. 5215.0.55.001. Accessed 4/5/2017 at http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5215.0.55.0012013-14.

Australian Bureau of Statistics (2016b) 5249.0 - *Australian National Accounts: Tourism Satellite Account*, 20092015-1016, cat. No. 5249.0. Accessed 10 May 2017 at http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5249.02015-16?OpenDocumenthttp://www.abs.gov.au/ausstats/abs@.nsf/mf/5249.0.

Australian Bureau of Statistics (2016c) *Australian National Accounts: Input-Output Tables*, 2013-14, cat. no. 5209.0.55.001. Accessed 7/2/2017 at http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5209.0.55.0012013-14?OpenDocument

Australian Bureau of Statistics (2017a) *Taxation Revenue, Australia, 2015-16*, cat. no. 5506.0. Accessed 5/5/2017 at http://www.abs.gov.au/ausstats/abs@.nsf/mf/5506.0.

Australian Bureau of Statistics (2017b) Government Finance Statistics, 2015-16, cat. No. 5512.0. Accessed 20/5/2017 at http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5512.02015-16?OpenDocument.

Australian Government (2015) “Re:think - Tax Discussion Paper”, Commonwealth of Australia, March 2015.

Australian Government (2016) Final Budget Outcome. Accessed 20/5/2017 at http://www.budget.gov.au/2015-16/content/fbo/html/index.htm.

Ballard, C. L., Scholz, J. K., Shoven J. B., 1987a. The Value-Added Tax: A General Equilibrium Look at Its Efficiency and Incidence. In: Feldstein (Ed.) *The effects of taxation on capital accumulation*. University of Chicago Press, Chicago, 105-107.

Ballard, C. L., Shoven J. B., 1987b. The Value-Added Tax: The Efficiency Cost of Achieving Progressivity by Using Exemptions. In: Boskin, M.J (Ed.) *Modern developments in public finance: Essays in honor of Arnold Harberger*. Blackwell, New York and Oxford, 109-129.

Boccabella, D. and K. Bain, (2015) “Why the Commonwealth can change the GST without the states”, *The Conversation*, January 28, 2015, http://theconversation.com/why-the-commonwealth-can-change-the-gst-without-the-states-36298.

Department of Immigration and Border Protection (DIBP) (2017) Tourist Refund Scheme. Accessed 14 May 2017 at https://www.border.gov.au/Trav/Ente/Tour/Are-you-a-traveller.

Dixon, P.B. and M.T. Rimmer (1999), “Changes in indirect taxes in Australia: a dynamic general equilibrium analysis”, *The Australian Economic Review*, vol. 22, no. 4, pp. 327-48.

Dixon, P.B. and M.T. Rimmer (2002), *Dynamic general equilibrium modelling for forecasting and policy*, Contributions to Economic Analysis No. 256, North-Holland, Amsterdam.

Ebrill, L., M., Keen, M., Bodin, J.-P., Summers, V., 2001. *The modern VAT*. International Monetary Fund, Washington, D.C.

Freebairn, J. (2011) "A better and larger GST?", *The Economic and Labour Relations Review*, Vol. 22, No. 3, pp. 85-100.

Freebairn, J. (2015) "Explainer: COAG and the 'GST carve-up'", The Conversation, 17th April 2015, http://theconversation.com/explainer-coag-and-the-gst-carve-up-40323.

Giesecke, J.A. , N.H. Tran, N.H. (2010) "Modelling value-added tax in the presence of multi-production and differentiated exemptions", *Journal of Asian Economics*, Vol. 21, No. 2, pp. 156-173.

Giesecke, J.A. , N.H. Tran, N.H. (2012) "A general framework for measuring VAT compliance rates", *Applied Economics*. Vol. 44, Issue 15, pp.1867-1889.

Giesecke, J.A. and J.R. Madden (2013), "Regional computable general equilibrium modeling", in P.B. Dixon and D. Jorgenson, editors, *Handbook of Computable General Equilibrium Modeling*, North Holland.

Giesecke, J.A., P.B. Dixon and M.T. Rimmer (2008), "Regional macroeconomic outcomes under alternative arrangements for the financing of public infrastructure", *Papers in Regional Science*, Vol 87(1), March, pp. 3-31.

Gottfried, P., Wiegard, W., 1991. Exemption versus zero rating: a hidden problem of VAT, *Journal of Public Economics*, 46, 2007-328.

Harrison W.J. and K.R. Pearson (1996), "Computing solutions for large general equilibrium models using GEMPACK". *Computational Economics*, Vol. 9, pp. 83–127.

Kehoe, P. J., Manreas, A., Noyolo, P.J., Polo, C., Sancho, F., 1988. A General equilibrium analysis of the 1986 tax reform in Spain. *European Economic Review 32*, 334-342.

Marks, S. V., 2005. Proposed Changes to the Value Added Tax: Implications for Tax Revenue and Price Distortions. *Bulletin of Indonesian Economic Studies, 41*(1), 81-95.

Productivity Commission (2011) Economic structure and performance of the Australian retail industry. Productivity Commission Inquiry Report No. 56, 4 Nov 2011. Accessed 12/5/2017 at http://www.pc.gov.au/inquiries/completed/retail-industry/report/retail-industry.pdf

Productivity Commission. 2017. *Horizontal Fiscal Equalisation*. Productivity Commission Draft Report. October 2017. https://www.pc.gov.au/inquiries/current/horizontal-fiscal-equalisation/draft/horizontal-fiscal-equalisation-draft.pdf.

Tait, A., 1988. *Value Added Tax: International Practice and Problems*. International Monetary Fund, Washington, D.C.

Toh, M.H., Lin Q., 2005 An evaluation of the 1994 tax reform in China using a general equilibrium model. *China Economic Review 16*, 246-270.

Tourism Research Australia (2017) International Visitor Survey results. Accessed 13 May 2017 at https://www.tra.gov.au/Research/International-visitors-to-Australia/international-visitor-survey-results

Figure 1: National employment, capital stock, real GDP, wage deflated by GST-exclusive consumption deflator ($W^{(A)}_R$) (left axis), and wage deflated by GST-inclusive consumption deflator ($W^{(B)}_R$) (right axis) (% deviation from baseline)

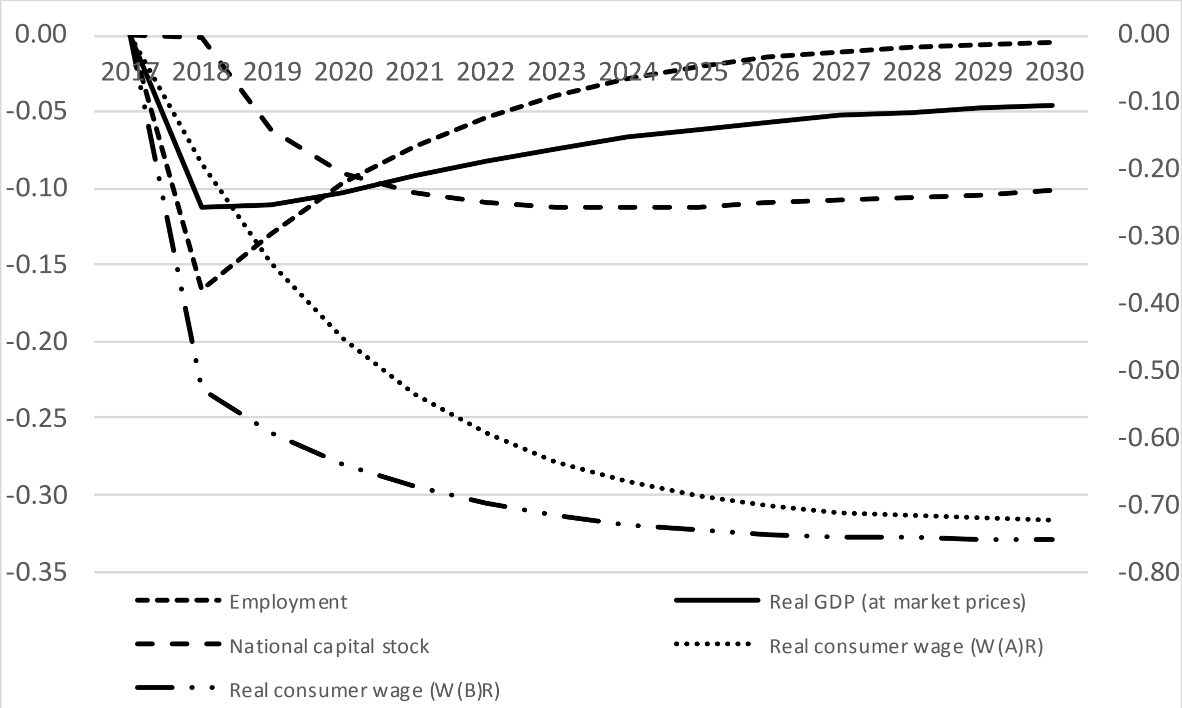

Figure 2: National employment deviation: decomposition into contributing factors (% deviation from baseline)

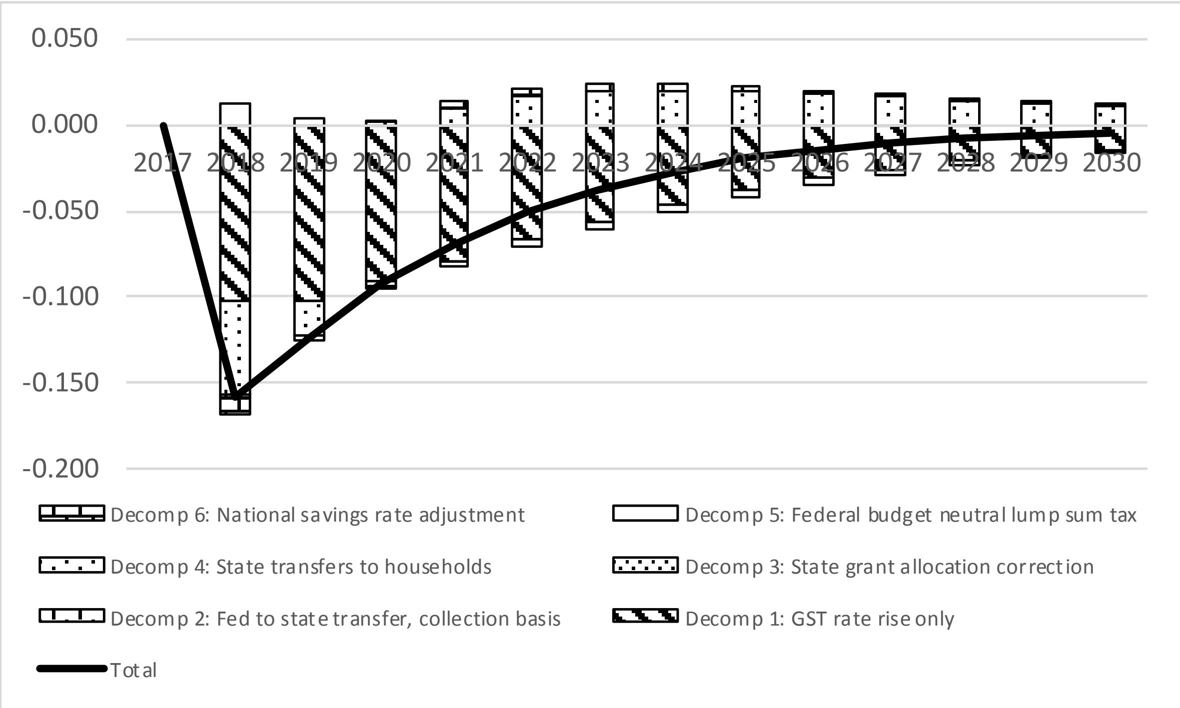

Figure 3: National capital deviation: decomposition into contributing factors (% deviation from baseline)

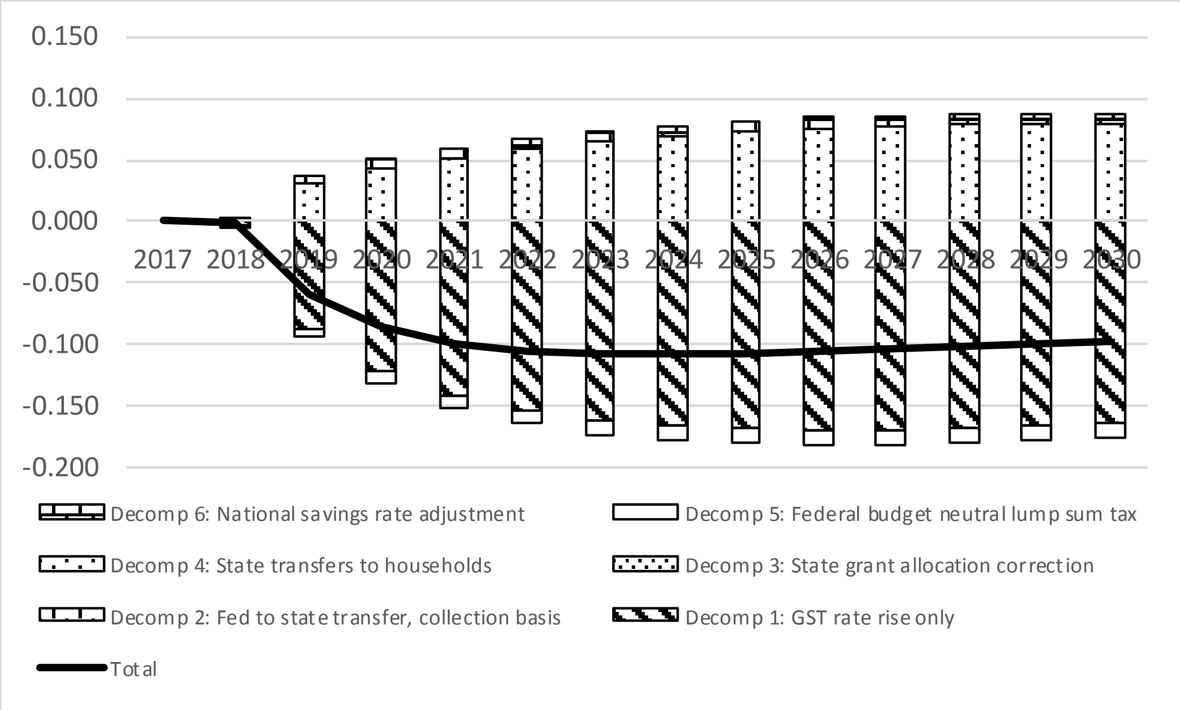

Figure 4: National real GDP deviation: decomposition into contributing factors (% deviation from baseline)

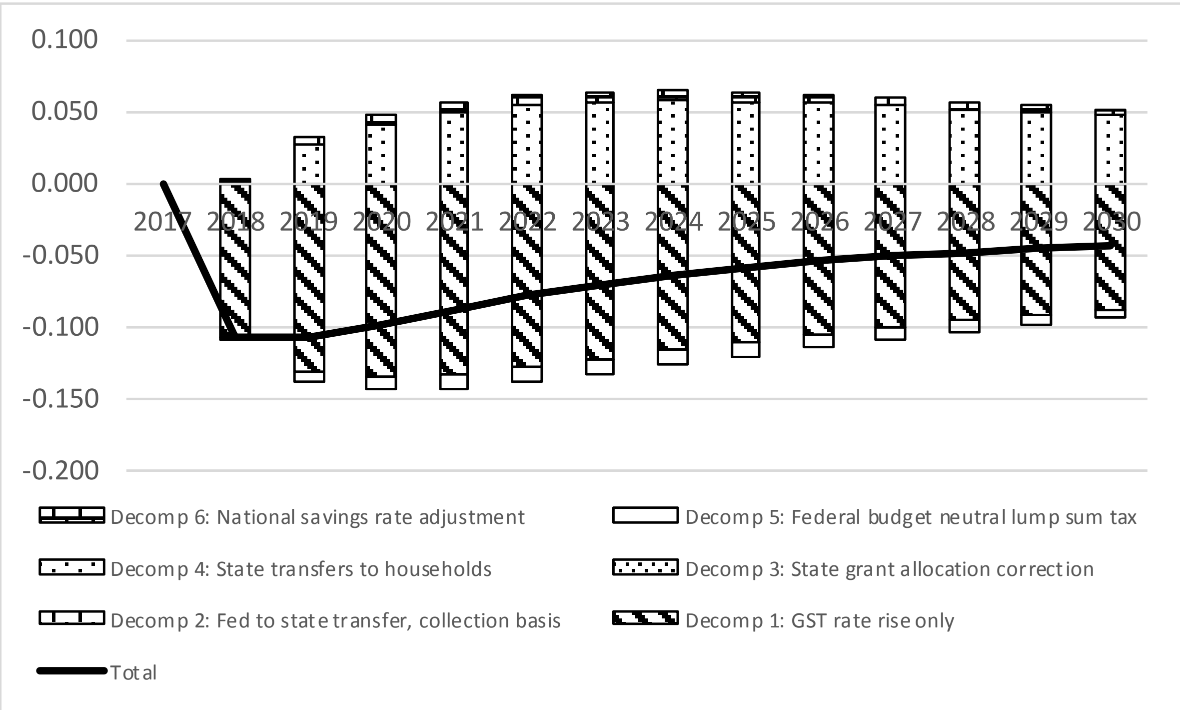

Figure 5: Ratio of household consumption deflator (inclusive of GST) and household consumption deflator (exclusive of GST): decomposition into contributing factors (% deviation from baseline)

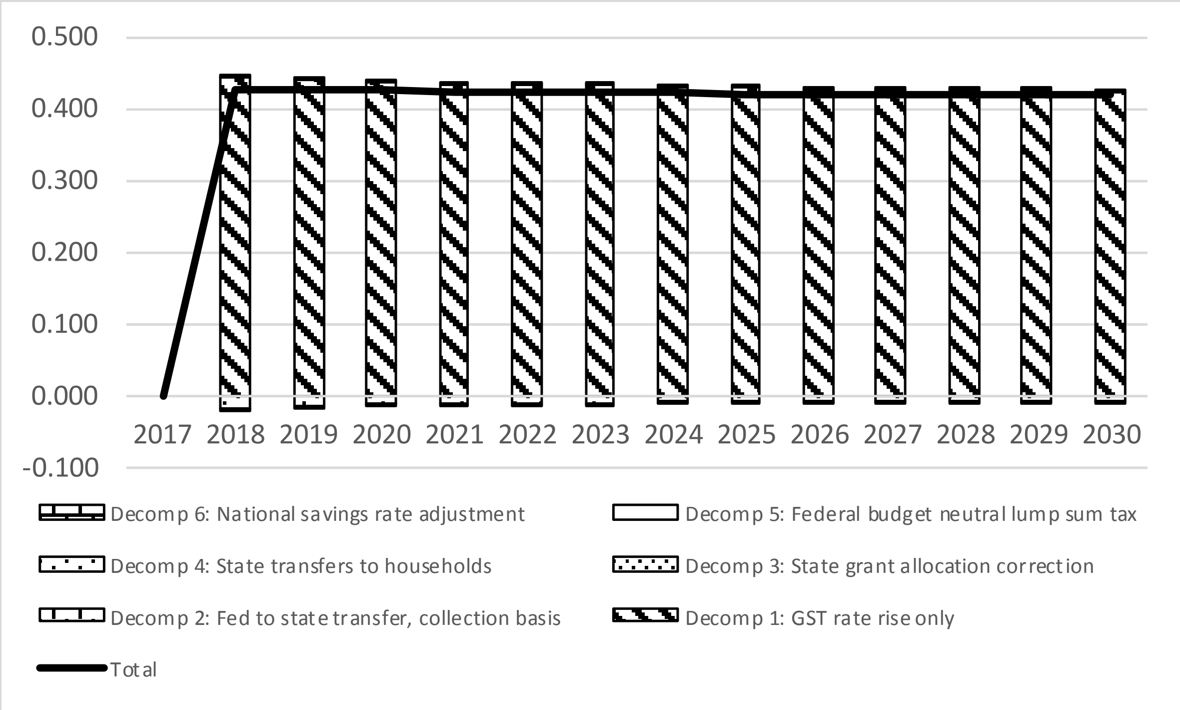

Figure 6: Ratio of intermediate input cost index (inclusive of GST) and intermediate input cost index (exclusive of GST): decomposition into contributing factors (% deviation from baseline)

Figure 7: Ratio of investment deflator (inclusive of GST) and investment deflator (exclusive of GST): decomposition into contributing factors (% deviation from baseline)

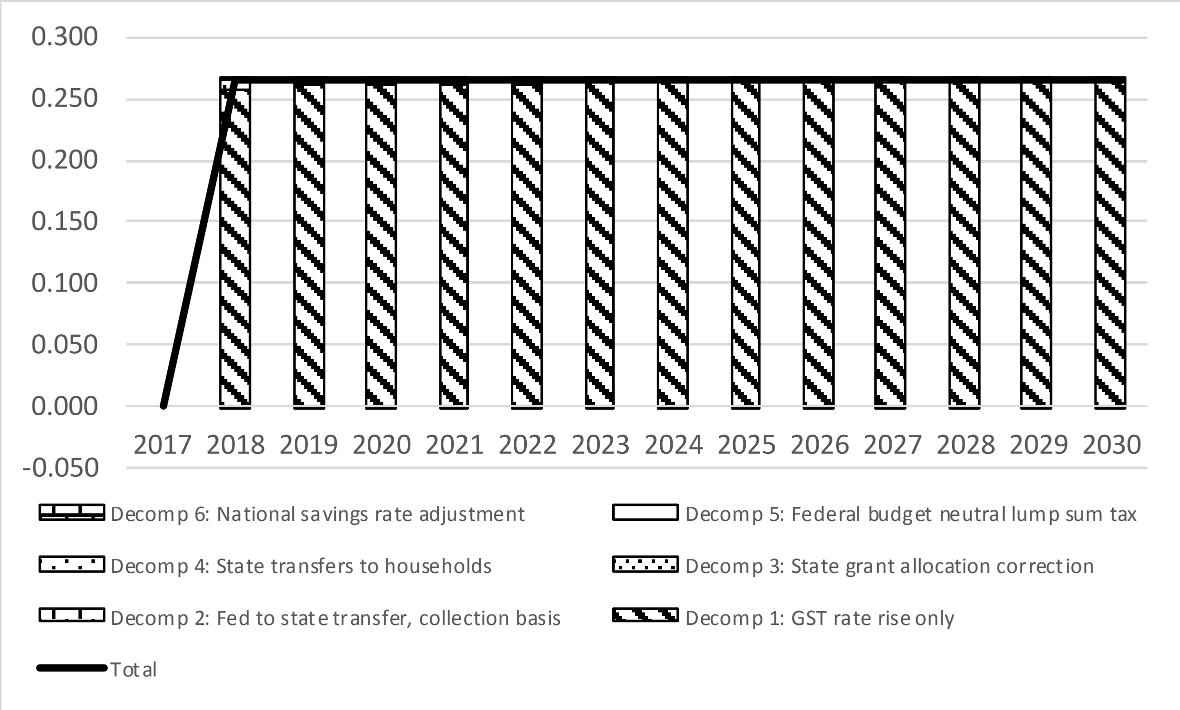

Figure 8: Ratio of export price index (inclusive of GST) and export price index (exclusive of GST): decomposition into contributing factors (% deviation from baseline)

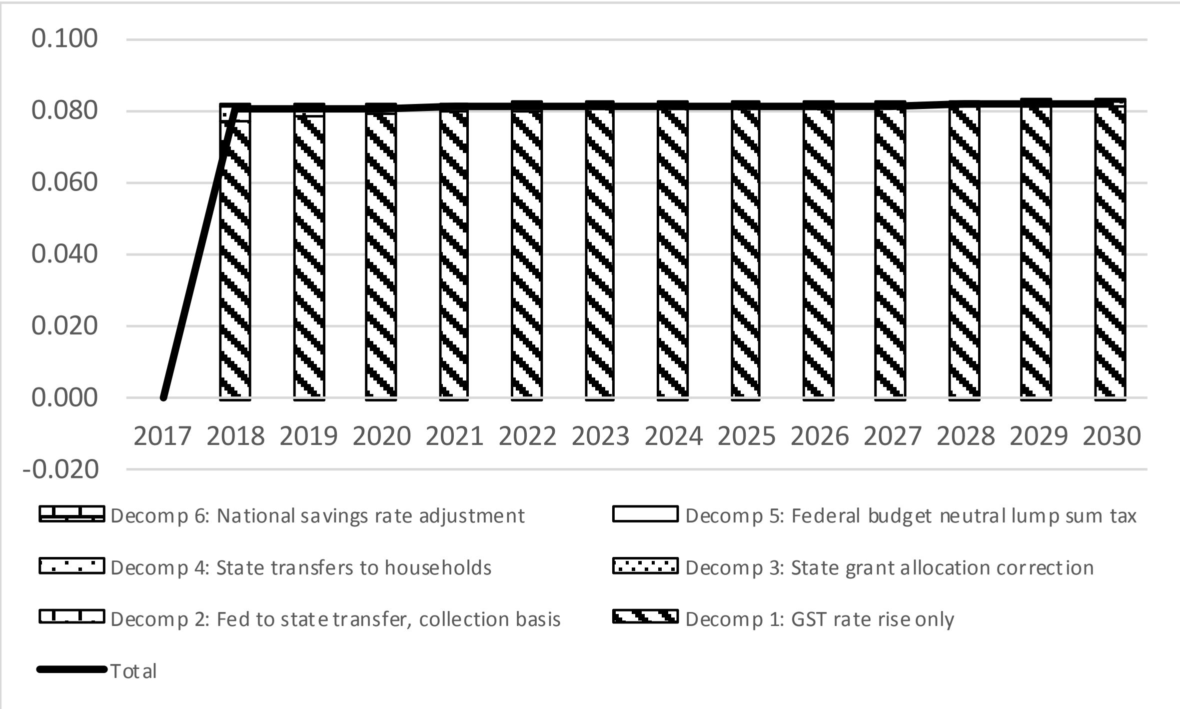

Figure 9: The expenditure side components of real GDP (% deviation from baseline)

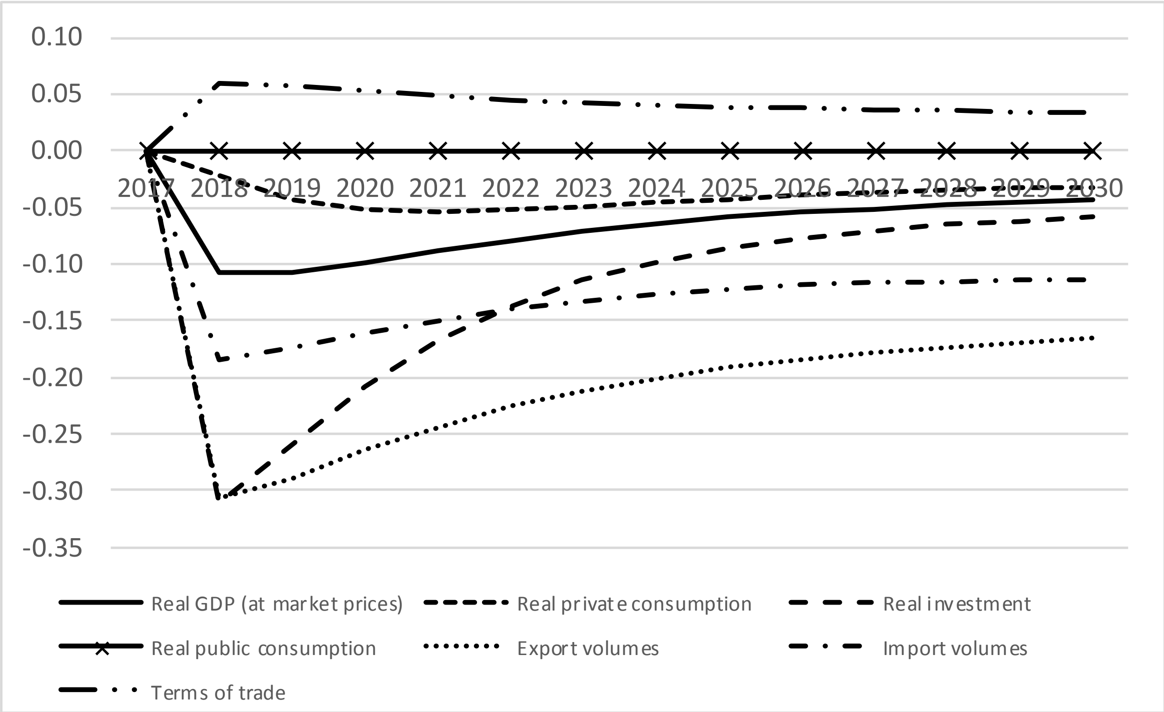

Figure 10: Sectoral output deviations, top six ranked by 2030 deviation (% deviation from baseline)

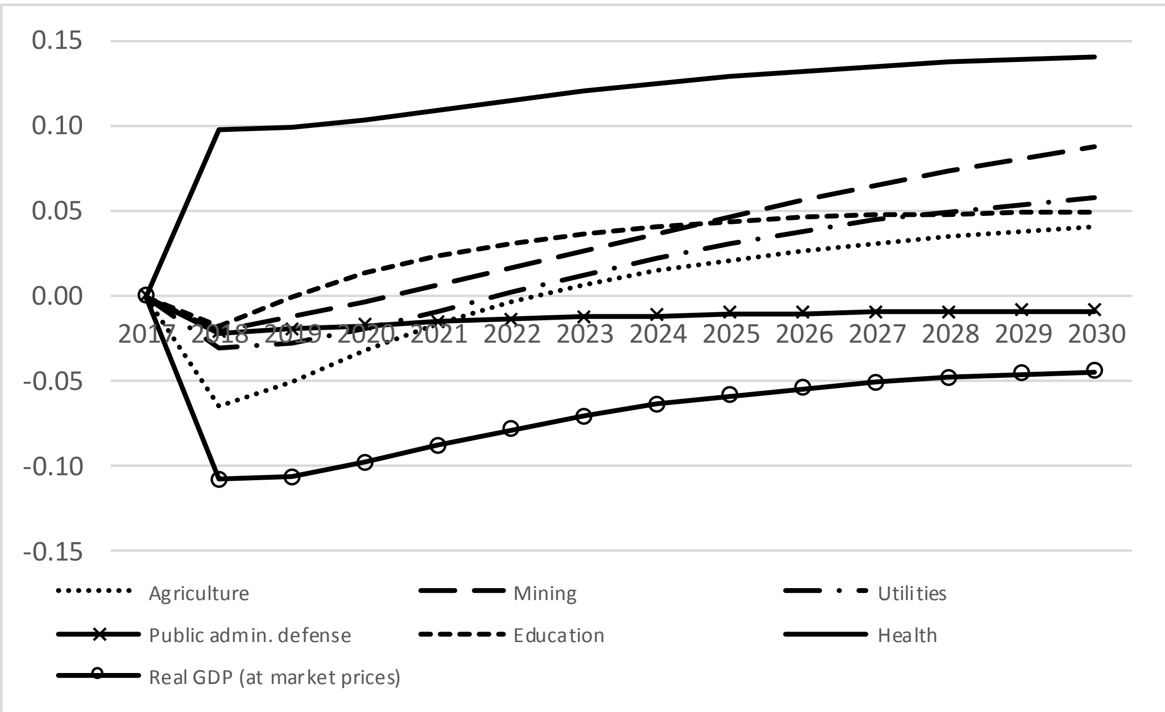

Figure 11: Sectoral output deviations, middle five ranked by 2030 deviation (% deviation from baseline)

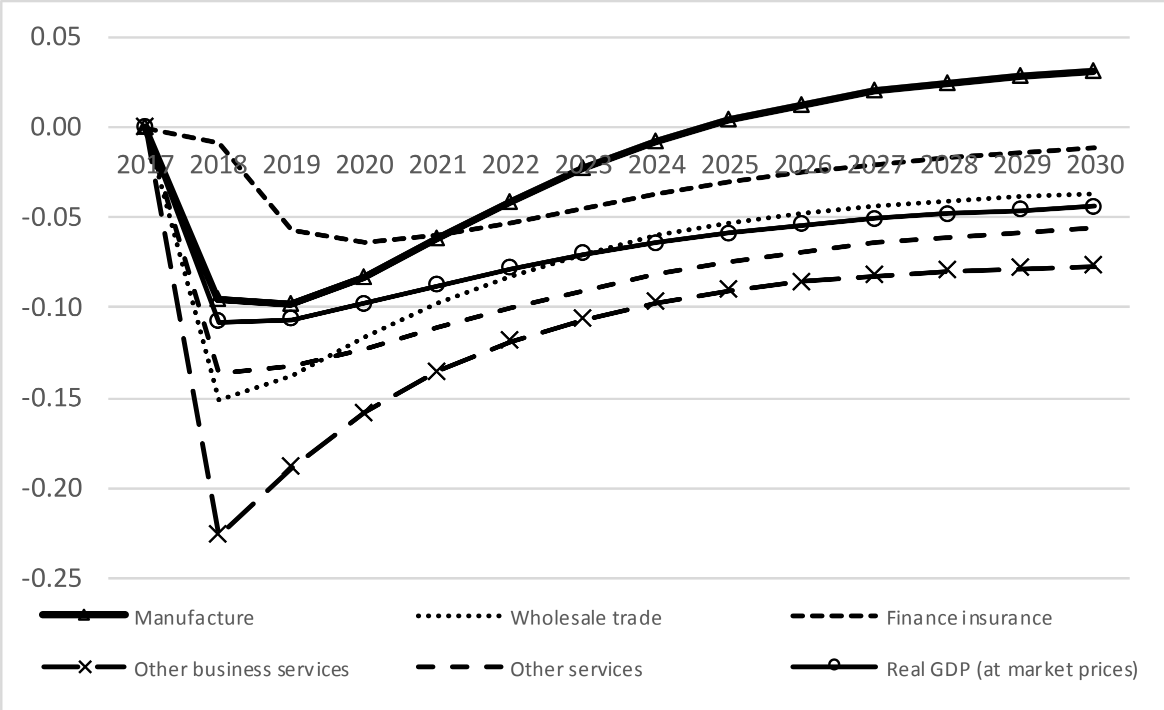

Figure 12: Sectoral output deviations, bottom six ranked by 2030 deviation (% deviation from baseline)

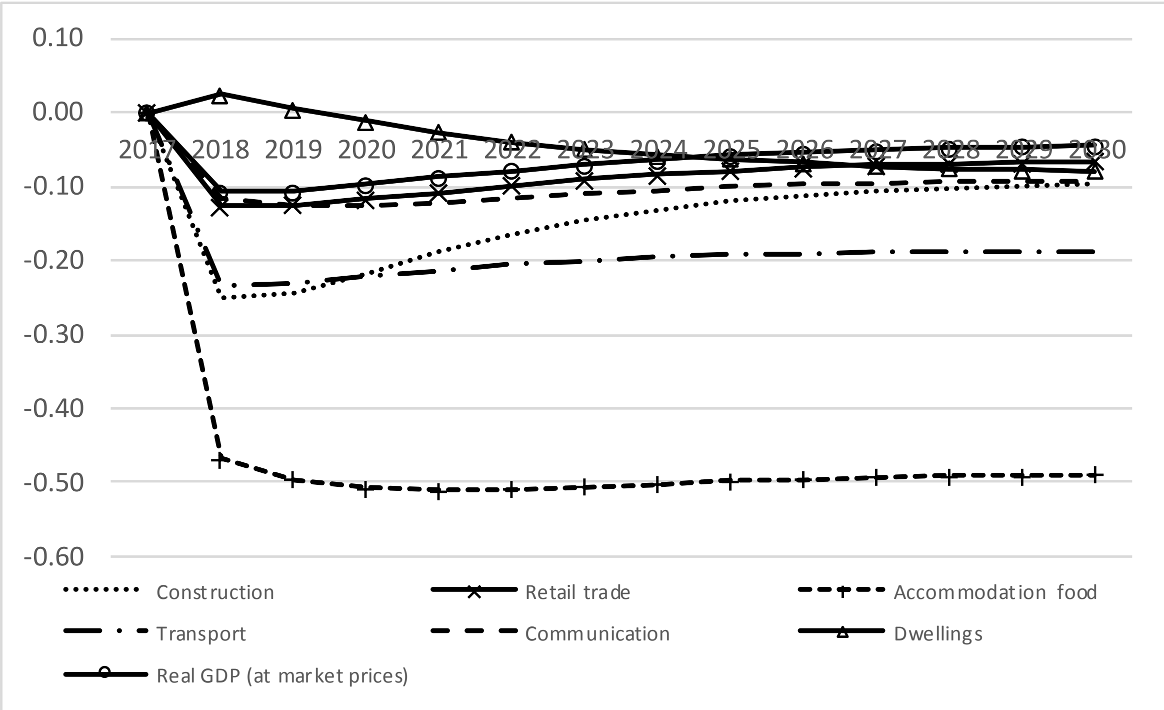

Figure 13: Regional and national real GDP deviations (% deviation from baseline)

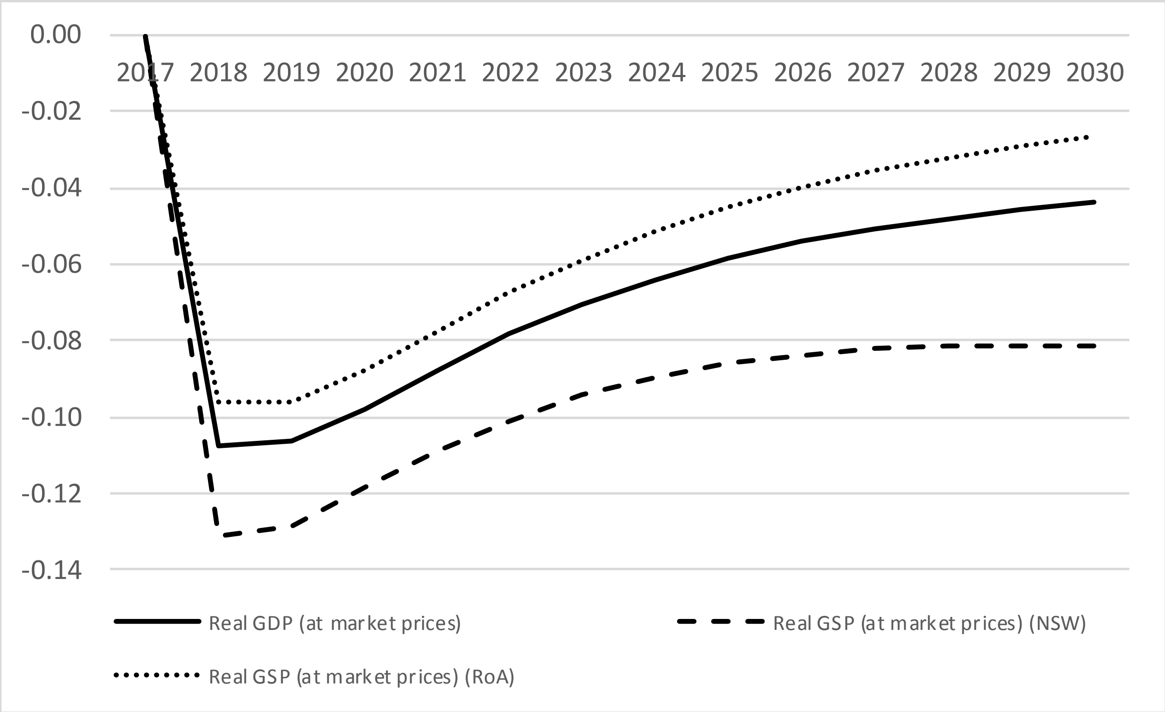

Figure 14: Ratio of NSW to Australian GDP, decomposition into contributing factors (% deviation from baseline).

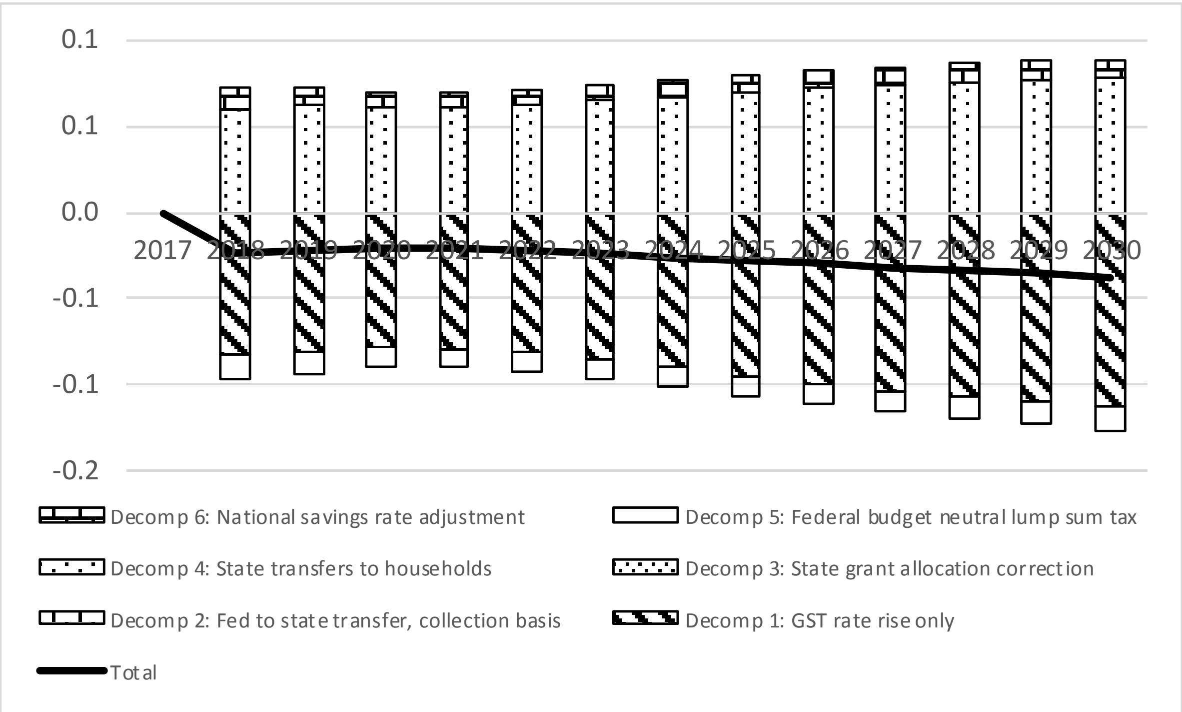

Figure 15: Ratio of household consumption deflator (inclusive of GST) and household consumption deflator (exclusive of GST). Australia, NSW and RoA. (% deviation from baseline).

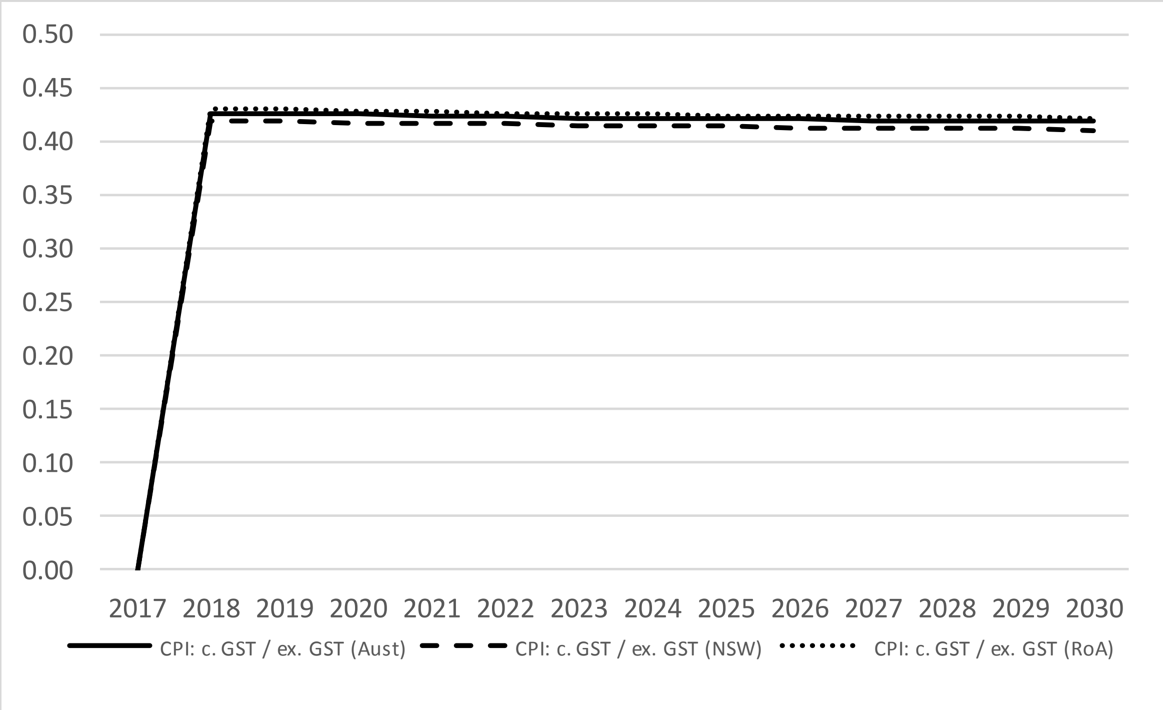

Figure 16: Ratio of investment price deflator (inclusive of GST) and investment price deflator (exclusive of GST). Australia, NSW and RoA. (% deviation from baseline).

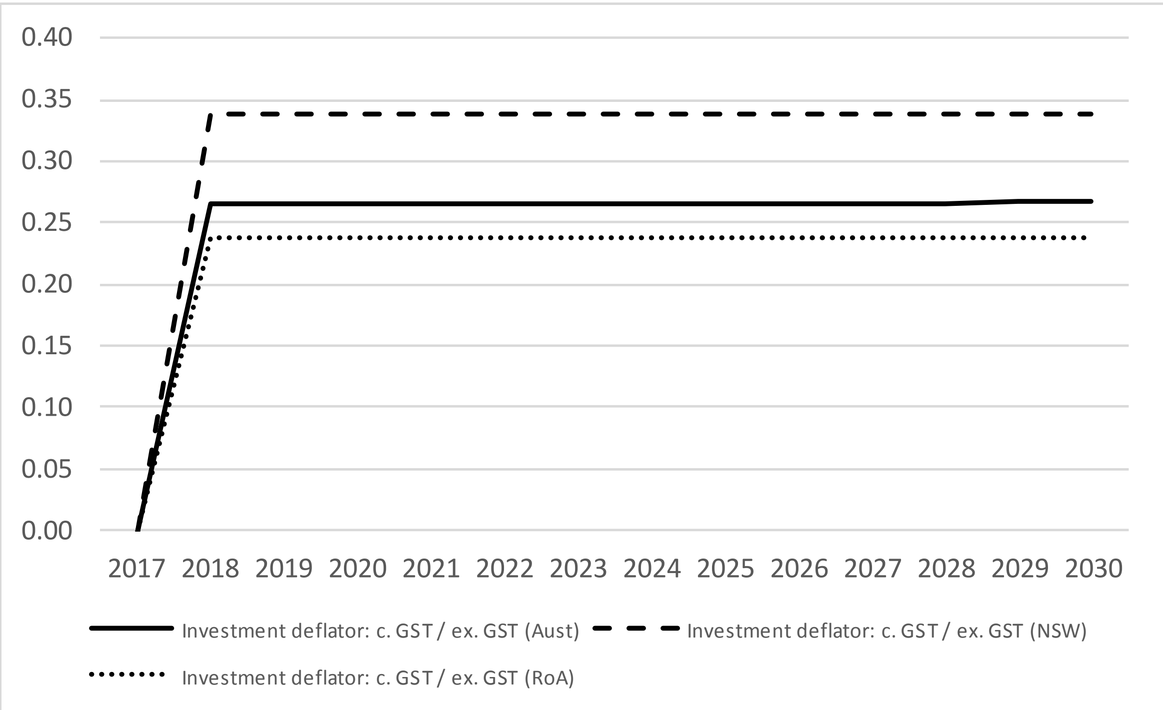

Figure 17: Ratio of export price deflator (inclusive of GST) and export price deflator (exclusive of GST). Australia, NSW and RoA. (% deviation from baseline).

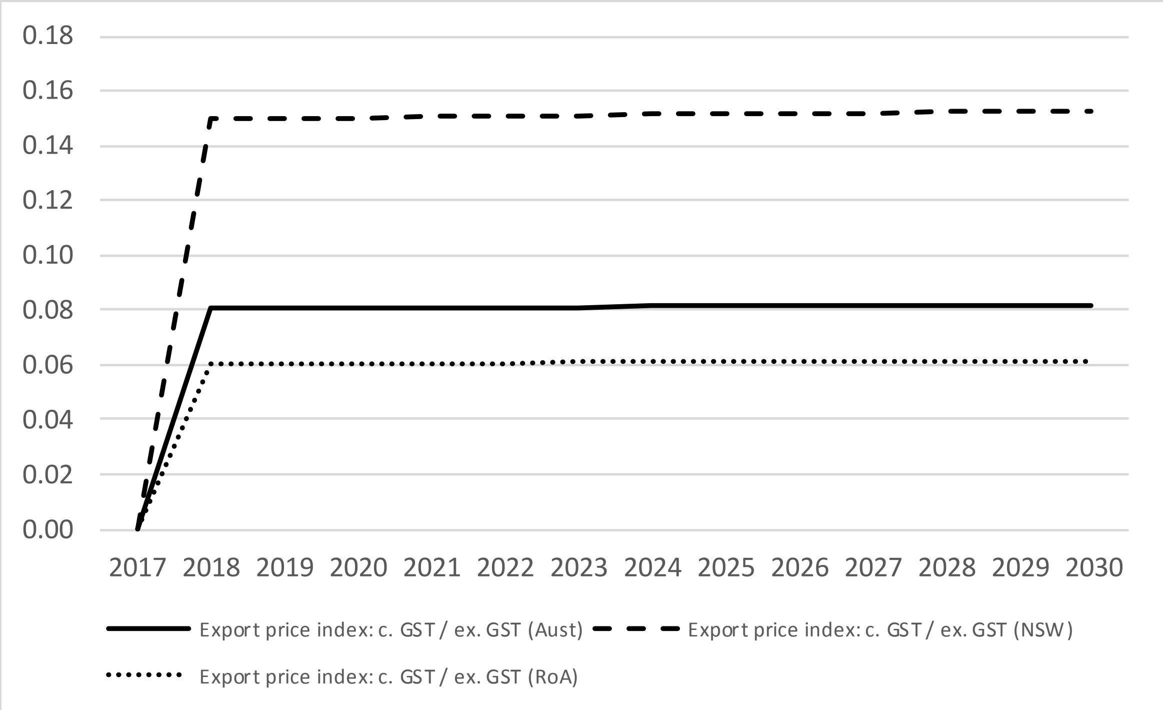

Figure 18: Ratio of intermediate input price index (inclusive of GST) and intermediate input price index (exclusive of GST). Australia, NSW and RoA. (% deviation from baseline).

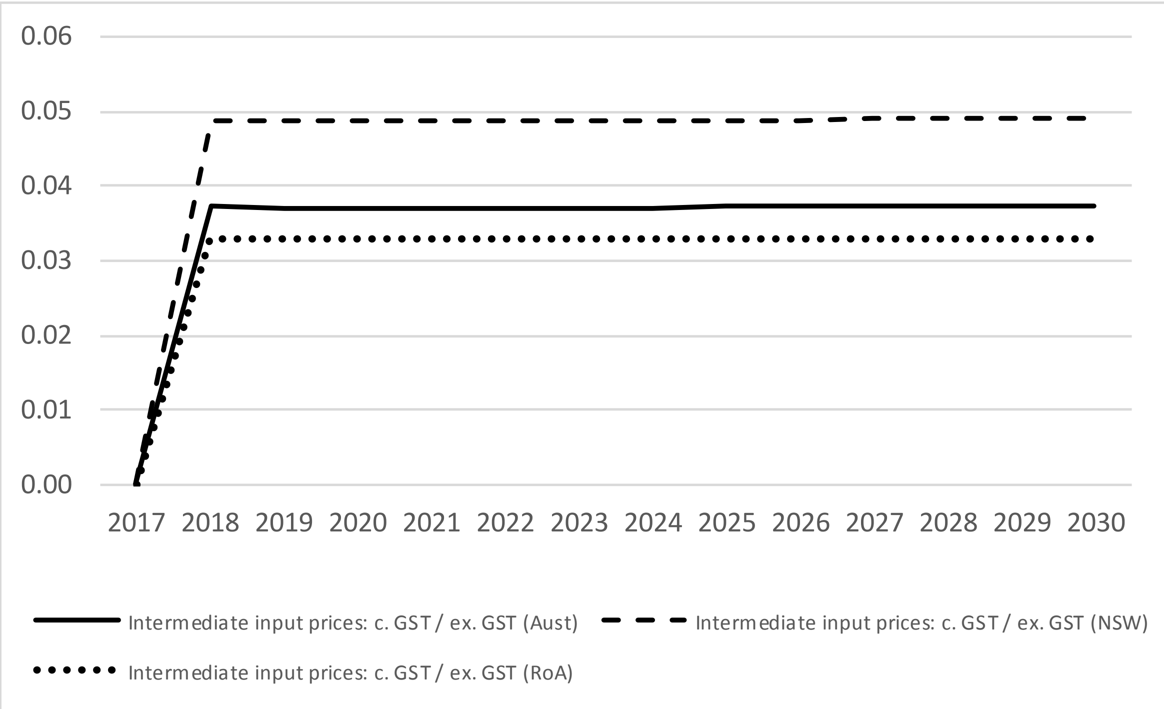

Figure 19: Public Sector Net Lending / Borrowing Requirement - NSW. ($m. deviation from baseline).

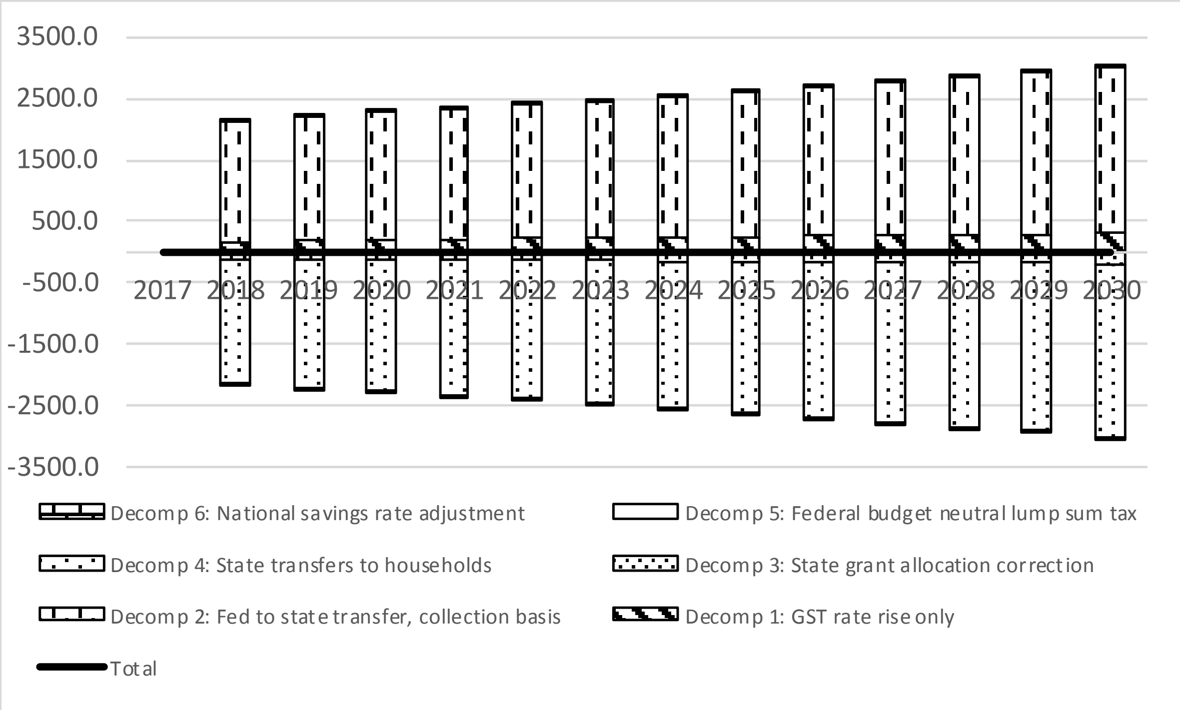

Figure 20: Public Sector Net Lending / Borrowing Requirement - RoA. ($m. deviation from baseline).

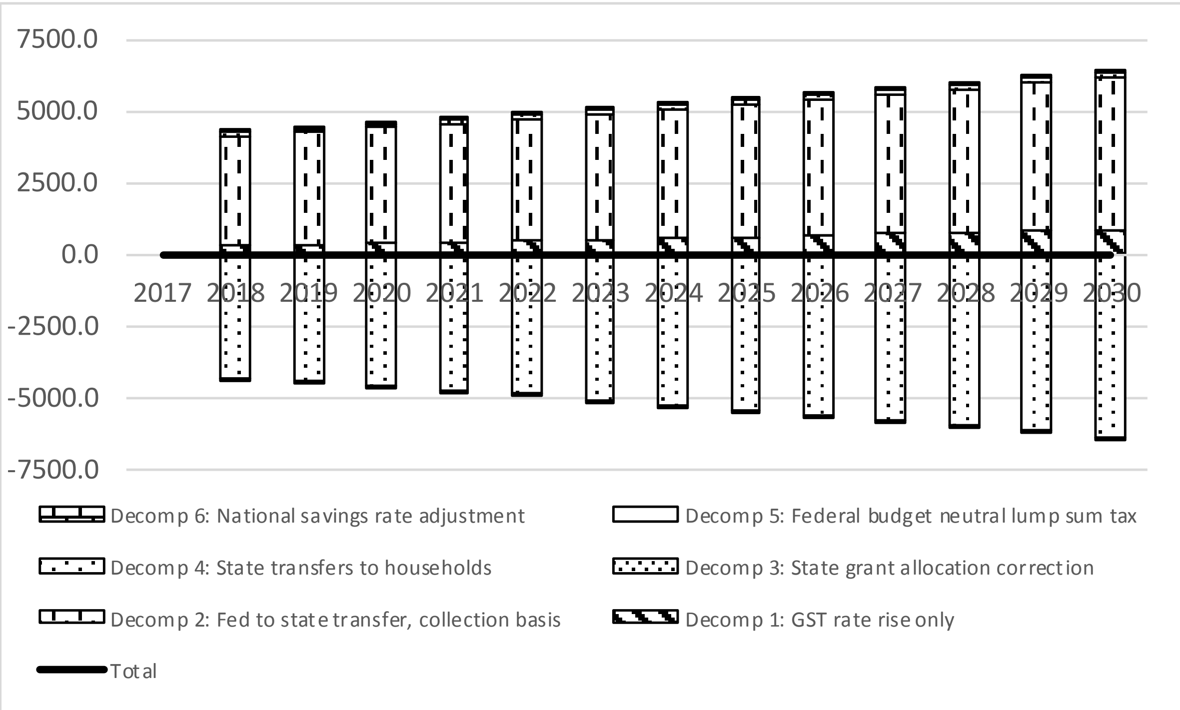

Figure 21: Real GSP at market prices. Comparison of total GSP impacts with CGC per capita correction GSP impacts only. (% deviation from baseline).