

Influence of Travel Decision Parameters in a CGE Model Incorporating Tourism

A working paper by
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Table of Contents

1	Introduction	3
1.1	Purpose.....	3
1.2	Scope of the Project	3
1.3	Overview of paper.....	3
2	Why use CGE to model tourism?	4
3	QGEM-T Data and Theory	5
3.1	Tourism Expenditure Data.....	6
3.2	Tourism Behavioural Theory	9
3.2.1	Travel Expenditure by Business	9
4	Business Tourism Parameters	13
4.1	Export Demand Equation.....	13
4.2	Intermediate Input Demand Equations	15
5	Simulation	17
6	Closure and assumptions	17
7	Results	18
8	References	22
	Appendix 1	23

1 Introduction

The Office of Economic and Statistical Research is undertaking a research project, in partnership with Tourism Queensland, to develop a Queensland General Equilibrium Model of Tourism (QGEM-T). QGEM-T utilises a number of key parameters in order to determine the travel decisions of economic agents. The choice of these travel parameters will influence the results generated by the model. The focus of this paper is the impact different parameters have on the QGEM-T estimates of business travel demand and the broader economy.

1.1 Purpose

The purpose of this paper is to:

- 1) Provide information on the tourism-specific enhancements to the Queensland General Equilibrium Model (QGEM); and
- 2) Highlight the influence of key business travel parameters using a simulation involving a productivity shock to the Queensland economy.

1.2 Scope of the Project

Only expenditure by *Overnight* visitors travelling for the purposes of *Holidays*, *VFR* and *Business* is explicitly modelled in QGEM-T. Hence, QGEM-T does not separately specify any *Day-visitor* expenditure or any *Other Overnight* visitor expenditure. This is because it is assumed that these categories are not significantly impacted on by tourism specific policy changes. This expenditure still exists within the QGEM-T database, but it is not identified as a separate tourism category.

1.3 Overview of paper

Section 2 provides an overview of the benefits of using CGE to model tourism. Section 3 describes the key modification required to incorporate tourism data into OESR's standard QGEM model and an overview of the behavioural theory underpinning the business tourism categories in the model. Section 4 of the paper details the equations and key parameters determining demand for business travel in the model. Sections 5 and 6 outline the simulation used to highlight the influence of business travel parameters and the closure and assumptions used in this simulation. Section 7 presents the results of this simulation and a discussion of the implications of these results. Finally section finishes with a brief discussion of the implications of the findings in this paper.

2 Why use CGE to model tourism?

In analysing the impact of tourism on the economy we need to distinguish between ‘direct’ and ‘indirect’ effects. In the *Tourism Satellite Accounts*¹ the ABS notes:

“The estimates of tourism gross value added and tourism GDP in this publication relate to the **direct** impact of tourism activity. For an activity to be included as part of tourism, there needs to be a direct relationship (physical and economic) between the visitor and the producer of the good or service. **Indirect** tourism demand is a broader notion that includes downstream effects of tourism demand and is out of the scope of this study. A full analysis of indirect effects is best done using a general equilibrium model of the economy”.

A method commonly used to value the contribution of tourism to an economy is I-O modelling. However, as explained in (Dwyer, Forsyth & Spurr, 2002), I-O models are insufficient for this task:

“The fundamental problem with I-O analysis is that it is incomplete; it ignores key aspects of the economy. It focuses on the industry which is being directly affected, and on its direct relationships with other parts of the economy. It effectively assumes that there is a free, unrestricted flow of resources to these parts of the economy. The effects which come about because of resource limitations, the workings of the labour and other markets, the interactions between the economy and the rest of the world, are all ignored. As a result, it does not capture the feedback effects, which often work in opposite directions to the initial change. As a consequence, I-O estimates of impacts, on economic activity generally or on specific variables such as employment, are usually overestimates, very often by large margins. Indeed it can even get the direction of the change wrong”.

Whilst the I-O table and the related tourism satellite accounts can be used to determine the direct contribution of tourism, as was done in OESR’s earlier report (*The Contribution of Visitor Expenditure to the Queensland Economy 1998-99*), I-O analysis is inadequate for analysing the (direct and indirect) economy-wide impacts of any specific tourism issue. Therefore, a more rigorous evaluation technique is required that addresses the limitations of the I-O method.

One of the most well researched and documented sectoral analysis modelling frameworks is CGE. The CGE framework proceeds on the basis that events in one sector of the economy will have flow-on impacts on the other sectors of the economy. In turn, the impacts on these other sectors may have noticeable feedback effects on the original sector. In effect, general equilibrium analysis captures the impacts of a policy change or specific event on all parts of the economy, by incorporating feedback from all parts of the economy, while recognising economy-wide constraints.

¹ ABS 5249.0, Australian National Accounts: Tourism Satellite Account 1997-98.

A recent academic research paper (Dwyer et al, 2002b) acknowledged that the CGE approach is a rigorous and appropriate methodology for measuring the net benefits of tourism changes:

“The approach is one of adjusting the estimates of impacts on activity using a CGE model. This is appropriate, since CGE models are recognised as the most rigorous means of estimating quantitative impacts in economies. It is particularly appropriate in the tourism context, because the benefits which tourism produces are the total of small gains and losses spread throughout the economy, and an economy-wide approach to evaluation is needed”.

These features of the CGE approach are essential components for undertaking a thorough and rigorous evaluation of the net benefit of, tourism-related, policy changes or economic shocks. Consequently, the CGE framework is the approach adopted by OESR for analysis of the impact of tourism on the economy.

3 QGEM-T Data and Theory

This section describes the key tourism-related aspects of QGEM-T.

The basis of QGEM-T is OESR’s standard Queensland General Equilibrium Model, QGEM. QGEM is based on the MONASH-MRF multi-region model (Peter et al, 1996) developed by the Centre of Policy Studies at Monash University. Aside from the tourism-related enhancements described below, QGEM explicitly models 108 industries and commodities in two regions (Queensland and the ROA), and its database (Thomas et al, forthcoming) employs the 1996-97 Queensland Input-Output (I-O) Table produced by OESR.

The development of tourism enhancements to QGEM by OESR builds on earlier work by Cole et al (1996) and Madden and Thapa (1999).

In enhancing QGEM to achieve a higher degree of realism for tourism issues, two aspects of tourism were considered to be important from a modelling point of view:

- differences in *expenditure structure*, and
- differences in *behaviour* between the various categories of tourism.

Firstly, OESR’s research effort was focussed on capturing the magnitude and characteristic structure of expenditure for each type of visitor². Secondly, research was undertaken to determine the important behavioural differences between visitor types and to develop an appropriate theoretical and parametric structure within QGEM-T to reflect these differences³.

The sections below outline these aspects of QGEM-T.

² For example, VFR tourists spend proportionately less on accommodation than Holiday tourists do.

³ For example, Business travel is influenced not only by relative prices but also by the destinations of the industries’ output.

3.1 Tourism Expenditure Data

Altogether, QGEM-T's tourism database consists of eighteen distinct tourism expenditure categories⁴ in each of the two regions – Queensland and the ROA.

The eighteen tourism categories arise from:

- Three purposes of visit (Holiday, Visiting Friends and Relatives (VFR) and Business);
- Three destinations for domestic travellers (intra-state, inter-state, and overseas);
- For domestic travellers going interstate or overseas, expenditure *at the destination* versus *local* travel-related expenditure is separately categorised; and
- Visitors from overseas.

Figure 1 provides a schematic description of the structure of the Tourism expenditure data in QGEM-T, using Queensland as an example. Descriptions of each tourism category follow.

⁴ Note that QGEM-T addresses *expenditure aggregates*, not *numbers of visitors*. In order to infer changes to visitor numbers from QGEM-T simulation results, an additional assumption regarding the change (or lack of change) in per-visitor expenditure would need to be employed.

Queensland Example

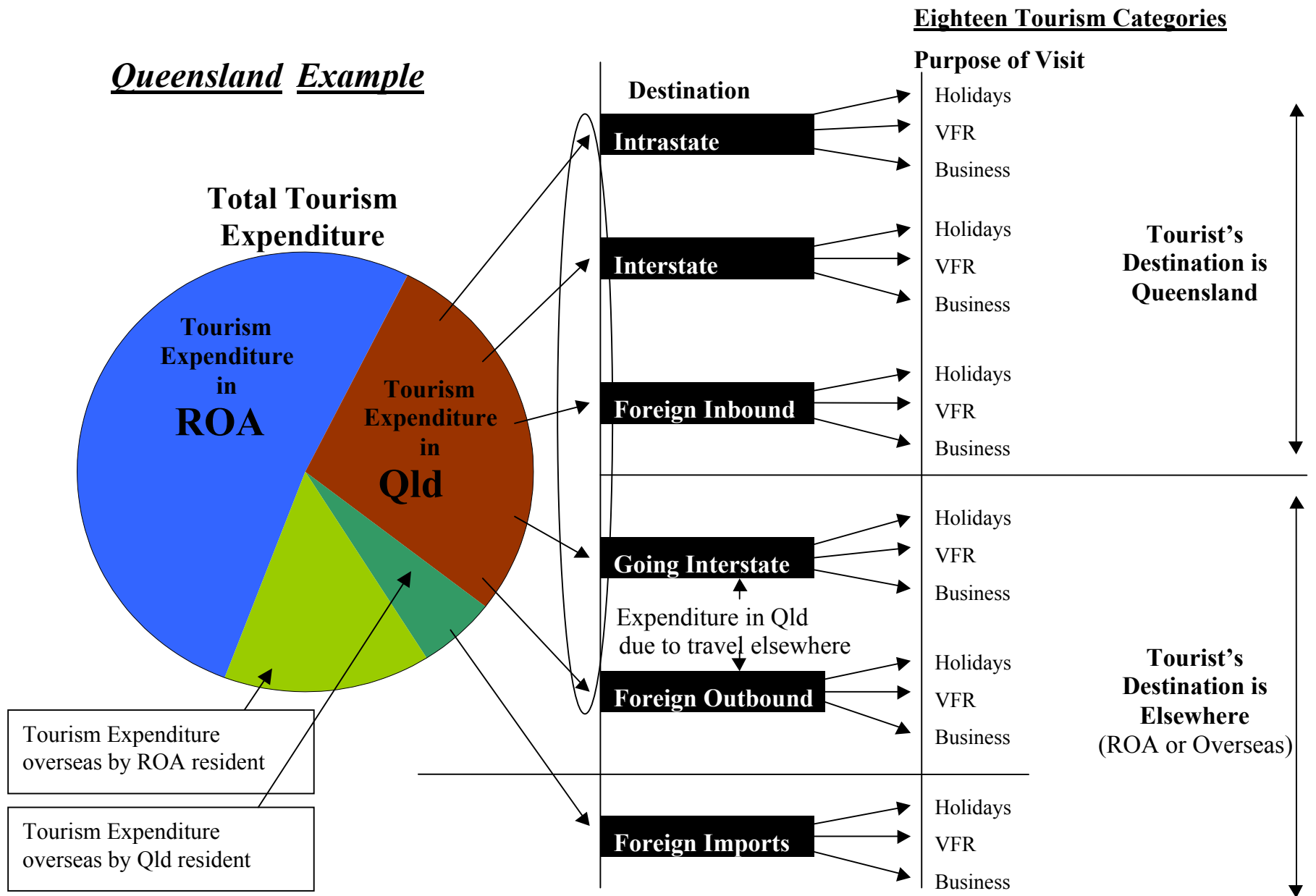


Figure 1: Graphical Explanation of the Eighteen Tourism Categories

Intrastate

For each of the three purposes of visit, the category '*Intrastate*' represents tourism expenditure captured within the home region when travelling intrastate. An example of this would be a Queensland resident travelling *within* and spending money in Queensland.

Interstate

The '*Interstate*' category represents expenditure in the destination region by travellers from interstate. An example of this would be the money spent at a Queensland hotel by a Victorian travelling within Queensland.

Going Interstate

The '*Going Interstate*' tourism categories for each purpose of visit captures expenditure by travellers in their *home* region in connection with their interstate visits. An example of such expenditure is when a Queensland resident spends money at a Queensland snow-ski store prior to travel to Victoria.

Foreign Inbound

The '*Foreign Inbound*' category represents expenditure in the destination region by an inbound visitor. Therefore, any money spent in Queensland by a German resident on a holiday would be captured in this category.

Foreign Outbound

Similar to '*Going Interstate*', '*Foreign Outbound*' categories capture expenditure within the home region of the traveller in connection with their overseas visits. This could include a Queensland resident using travel agency services prior to a business trip to Ireland. Importantly, the '*Going Interstate*' and '*Foreign Outbound*' tourism categories essentially capture expenditure within the home region of the traveller *induced* by their travel elsewhere.

Foreign Imports

Finally, the '*Foreign Imports*' category represents expenditure by a domestic traveller at their overseas destination. An example would be money spent in Ireland by a Queensland resident on a business trip. As indicated in Figure 1, this expenditure is considered a leakage from the Australian economy.

In its standard form QGEM cannot adequately model the expenditure patterns of travellers because the core database does not separately classify tourism expenditure. Instead, tourism is captured within the standard database as general expenditure on a wide range of commodities. Therefore, the standard database does not distinguish between tourism expenditure and general expenditure. For example, a tourist's expenditure on air transport is recorded as general air transport expenditure rather than expenditure on tourism.

In order to create a model incorporating an explicit recognition of tourism, the tourism expenditure within the standard QGEM database was extracted into new tourism categories which are then treated as dummy industries⁵ in QGEM-T. Figure 2 provides a simple example of how tourism data was extracted into new tourism dummy industries.

⁵ Tourism is not an industry in the sense that tourism has no value added component.

Figure 2: extraction of data to (domestic) holidays.

	Farms	Manuf	Serv	Exports	
Farms	5	1	1	1	
Manuf	6	20	6	23	→
Services	12	12	30	45	
Total	23	42	37	78	

	Farms	Manuf	Serv	For_inb	Exports
Farms	5	1	1	0	1
Manuf	6	20	6	2	21
Services	12	12	30	8	37
For_Inb					10
Total	23	42	37	10	78

	For_Inb
	0
	2
	8
	10

In our standard database, tourism expenditure by foreigners is recorded as exports of a number of commodities that, together, make up a bundle of tourism related purchases. In order to explicitly model tourism expenditure by foreigners in Australia, we create a new dummy industry called *Foreign Inbound*. Tourism expenditure is extracted from exports expenditure and this forms the inputs to the new *Foreign Inbound* industry. In the new treatment, foreigners now purchase tourism exports through purchases of the new *Foreign Inbound* tourism category.

The visitor expenditure in each category is mapped to the 108 standard QGEM commodities. Each tourism-related commodity flow is decomposed by source of production, and split into its basic value, margin, and tax components.

3.2 Tourism Behavioural Theory

In addition to the database development described above, QGEM-T's *theoretical* structure was also enhanced to cater for the eighteen tourism categories. The enhancements involved both additions and modifications to the *behavioural equations* in the model, as well as the model *parameters* used in those equations.

These additions and modifications fall into two broad categories:

- tourism expenditure by *households*; and
- tourism expenditure by *business*.

As this paper's focus is on business travel parameters, only tourism expenditure by businesses is discussed here. Further information regarding tourism expenditure by households can be found in OESR (2002).

3.2.1 Travel Expenditure by Business

In QGEM-T, industries purchase only the business tourism categories, not the holiday or VFR categories. The main features of Business tourism behaviour in QGEM-T are as follows:

For each industry, aggregate real business travel expenditure is assumed to vary in fixed proportions to industry output. For example, if an industry's real output increases by 5 per cent, then total real business travel expenditure undertaken by the industry is assumed to increase by 5 per cent also.

Within total business travel expenditure for each industry, the shares of Intrastate, Interstate, and Overseas business travel is assumed to change in accordance with the destination shares of the industry's sales. For example, if an industry increases the proportion of its sales going to overseas markets, then the share of Overseas business travel will increase, at the expense of the shares of Intrastate and Interstate business travel.

Foreign Inbound business travel to Queensland and ROA is dependent on two factors. Firstly, overseas imports of the relevant commodity, and secondly, the foreign currency price of *Foreign Inbound* business travel in Australia. A limitation of the demand equation determining *Foreign Inbound* business travel arises because, in QGEM-T's database, *Foreign Inbound* business travel only encompasses expenditure in Australia by foreigners. In addition to the cost of *Foreign Inbound* business travel in Australia, the travel decisions of foreign business travellers are likely to be influenced by the cost of business travel in their home region in connection with travel to Australia. For example a business traveller in Japan is faced with both the cost of travel expenditure in Australia (accommodation, meals etc), but also with the cost of any travel expenditure made in the home region prior to travelling (air transport if travelling on Japan Airlines, travel agent fees etc).

QGEM-T has no explicit acknowledgment of the cost of business travel in the foreign country's region associated with travel to Australia. It is assumed, however, that as the share of this component in the total cost of business travel to Australia increases, foreigners are likely to become less sensitive to changes in the price of the Australian component of business travel (*Foreign Inbound* business travel). While QGEM-T has no explicit recognition of the role of external cost factors, an implicit recognition is made by way of the value assigned to the elasticity of demand for *Foreign Inbound* travel.

Interstate and *Going Interstate* business travel are modelled as complements. Together they effectively comprise interstate travel, and are assumed to move in fixed proportions. The same treatment is employed for the *Foreign Outbound* and *Foreign Imports* categories.

QGEM-T also models the private consumption component of business travel, however this category is not discussed in this paper. For more information regarding the personal consumption component of business travel see OESR (2002).

Once an agent has made the choice to devote a share of their expenditure to a tourism category, QGEM-T does not allow substitution between foreign and domestically sourced tourism or substitution between Queensland and ROA tourism. The reason this behaviour was introduced has to do with the spatial implications of the tourism categories. For example, *Interstate* travel implies that the consumption of tourism occurs in the non-home region. QGEM-T does not allow consumption of Queensland interstate travel by Queensland nor ROA interstate travel by ROA. However, while it may appear that the model does not explicitly allow agents to engage in cost minimisation behaviour through substitution, cost minimisation is achieved through the dummy tourism industries. For example, the *Intrastate* dummy industry is subject to the standard QGEM behavioural equations regarding cost minimisation and is able to substitute domestic between foreign sourced inputs. Therefore, an

industry purchasing, for example, *Intrastate* travel will benefit from the cost-minimising behaviour of the *Intrastate* dummy industry.

The main features of business tourism behaviour are shown in Figure 3.

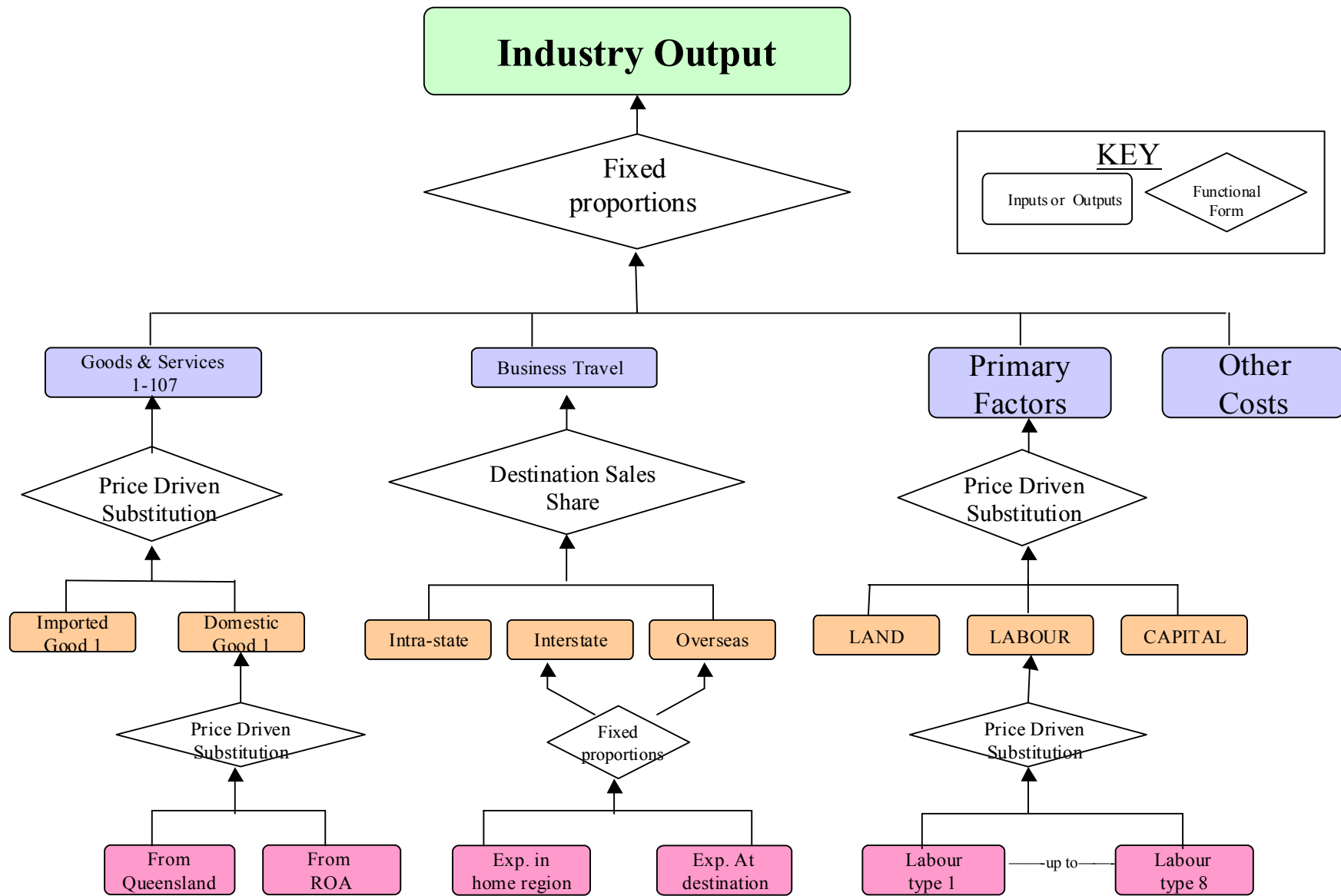


Figure 3: Tourism Expenditure by Industries

4 Business Tourism Parameters

4.1 Export Demand Equation

As discussed in 3.2.1, the demand for exports⁶ of business tourism in a region⁷ is a function of the foreign currency price of business travel and the sales of foreign sourced goods in the region. The demand equation for exports of business tourism categories is shown below.

$$x4r_s = \sum_{nbt} \left(\frac{DEST_SALES_{nbt, "foreign", s}}{\sum_{nbt} DEST_SALES_{nbt, "foreign", s}} \times destsales_{nbt, s} \right) + EXP_ELAST \times p4r$$

$nbt \in non - business\ tourism\ commodities$

$s \in REGSOURCE$

where:

$x4r$ is the demand for *Foreign Inbound* business travel,

$destsales$ is the percentage change in (non-tourism) sales to each destination,

$p4r$ is the purchaser's price of *Foreign Inbound* business travel, and

EXP_ELAST is the price elasticity of demand for *Foreign Inbound* business travel.

The business travel export demand equation differs from the standard export equation in QGEM in that it has two endogenous explanatory variables. Similar to the standard equation, the business travel demand equation has price⁸ as an explanatory variable. An increase (decrease) in the price of business travel in a region will decrease (increase) demand for business travel by foreigners (essentially a movement along the foreign demand curve).

The business travel demand equation also enables foreigners to adjust demand in response to changes in sales they are making in the region. An increase (decrease) in aggregate sales in a region by foreigners (i.e. an increase in imports by the region) causes an increase (decrease) in business travel demand by foreigners. This element of the business demand equation allows for shifts in the foreign demand curve, since it allows for changes in demand for a given price. Figure 4, illustrates this point and shows how a rise (fall) in import volumes could offset (compound) an increase in the price of business travel to a region.

⁶ Exports of business travel are incorporated in *Foreign Inbound* business travel to Queensland and ROA.

⁷ Normal convention is to discuss exports 'from' a region and activity 'in' a region. However, in the case of tourism exports, the supply and consumption of the good or service occurs in the same region.

⁸ See the discussion about Foreign Inbound business travel in section 3.2.1.

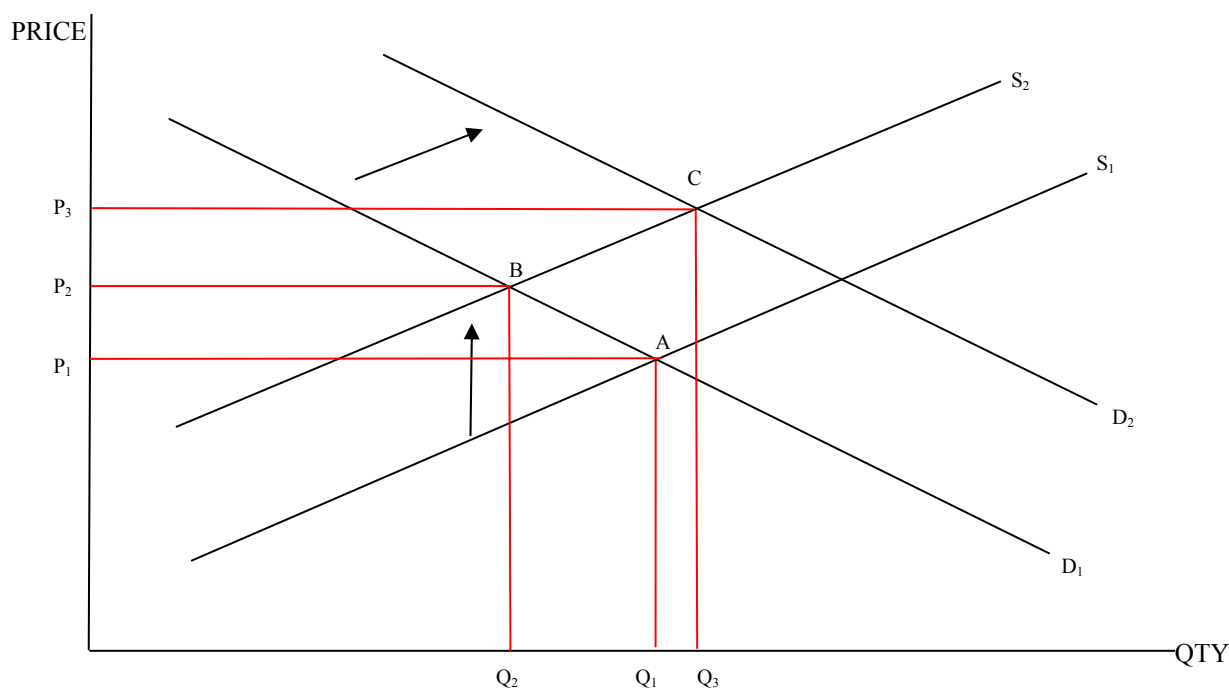


Figure 4: Point A shows an initial equilibrium point, with price = P_1 and Qty = Q_1 . If the cost of production for business travel increases, the supply curve shifts to the left, and a new equilibrium point, B, is reached with a new higher price, P_2 . At this new price there is a movement along the demand curve, D_1 , such that a lower quantity, Q_2 , is demanded. However, an increase in foreign sales (imports) in a region causes a shift of the demand curve to D_2 and a new equilibrium point, C, is arrived at. The shift in the demand curve has offset the change in demand caused by the initial price rise.

The business travel export demand equation has two parameters. The first, explicit, parameter is the export demand elasticity which is similar to that used in the standard (non-tourism) export demand equation. The export demand elasticity assigned to *Foreign Inbound* business travel is low compared with standard export commodities (-1.5 c.f. -20 for most other commodities). There are two reasons for this. Firstly, as discussed in section 3.2.1, the demand equation makes no allowance for travel costs incurred outside of Australia (such as booking fees or air travel with foreign airlines). Secondly, it is assumed that expenditure on business travel is less discretionary⁹ than for standard export commodities.

The second parameter is the implied parameter that determines the sensitivity of exports of business tourism to destination sales. The implied value of this parameter is 1. That is, a 1% change in (the share-weighted sum of) sales of goods by foreigners increases the amount of business tourism demanded by 1%. Increasing (decreasing) the magnitude of this parameter, makes the business travel export demand equation behave less (more) like our standard export demand equation. That is, increasing this parameter makes foreign business travel demand less sensitive to the price of business travel and more responsive to their sales activity.

⁹ That is, the demand for business travel is often a derived demand in that it is part of the firm's production function rather than a final demand good.

4.2 Intermediate Input Demand Equations

The previous section examined the foreign industry demand for business travel. This section examines domestic industry demand for business travel.

The demand for business travel by each domestic industry is a function of the activity level of the industry and the sales shares to each region. In order to understand the intermediate input demand equations, it is important to realise that, unlike standard (non-tourism) commodities, the tourism categories in QGEM-T have a spatial characteristic in that they indicate the destination of travel. For example, the *Interstate* and *Going Interstate* categories of business travel imply that source and destination are mutually exclusive. That is, only Queensland residents can consume interstate travel in ROA and vice versa.

The demand equation for *Interstate* and *Going Interstate* business travel is shown below. The intermediate demand equations for *Foreign Imports* and *Foreign Outbound*, and *Intrastate* are similar.

$$xlo_{b,j,"Qld"} = (z_{j,"Qld"} + a1_{j,"Qld"}) + 100 \times del_DSSHR_{j,"Qld","ROA"}$$

$b \in \text{Interstate, Going Interstate business travel}$

$j \in IND$

$q \in REGDEST$

where:

xlo is the demand for business travel

del_DSSHR is the change in an industry's sales share to each region,

z is activity, and

$a1$ is a technical change term.

The standard (non-tourism) intermediate input demand equations in QGEM-T have demand for each input moving with the activity of the purchasing industry. This facilitates the assumption of constant returns to scale since it implies that if a firm is to increase output by 1% it has to increase its use of aggregate intermediate inputs by 1%. The demand equations for business travel by industries introduce an additional explanatory variable that moves demand with changes to regional sales shares.

In introducing an extra explanatory variable we need to ensure that the constant returns to scale condition is not violated. This problem is avoided in QGEM-T by ensuring that:

- the changes to sales shares sum to zero over all destinations, and
- the parameter values are the same for each equation¹⁰.

Providing that these two conditions are maintained, the demand equations allow firms to adjust their demand for different business tourism categories (i.e. switch the destination of business travel), whilst ensuring that aggregate demand for business travel moves with activity.

¹⁰ This requirement stems from the previous requirement and the simple way we have written the behavioural equation. That is, if the parameter values were not all equal then the sales shares would not sum to zero.

The intermediate input demand equations for business travel ensure that the demand for the complementary¹¹ tourism categories, *Interstate* and *Going Interstate*, and *Foreign Imports* and *Foreign Outbound* move in fixed proportions. Since the sales of these categories are only made to other industries as intermediate inputs, a reasonable expectation might be that activity of these tourism categories would also move in fixed proportions. However, because the sales shares to industries for the complementary tourism categories differ, this industry-specific assumption does not hold true in aggregate. For example, in our QGEM-T database, the share¹² of *Interstate* business travel purchased by the Queensland *Wholesale* industry is 18% while the share of *Going Interstate* business travel purchased by the Queensland *Wholesale* industry is 28%. The implication of having sales shares that vary between the complementary tourism categories is that (providing that activity levels of each industry do not change uniformly in a region) activity¹³ of the complementary tourism categories does not move in fixed proportions despite demand by each industry for these categories moving in fixed proportions.¹⁴

The parameter in the industry demand for business travel equations determines the extent to which an industry changes demand for a business travel category as it changes the proportion of sales to regions. Currently this parameter is set at 100, implying that for each 1% increase in the sales share to a region an industry will increase its demand for business travel to that region¹⁵ by 1%. Decreasing (increasing) the magnitude of the parameter makes the business travel intermediate demand equations behave more (less) like the standard QGEM intermediate demand equations. That is, decreasing this parameter makes foreign business travel demand more sensitive to the price of business travel and less responsive to their sales activity.

¹¹ A trip to a destination other than the home region has two expenditure elements. The first is expenditure in the destination region and the second is expenditure in the home region in connection with the trip. In the model these elements are modelled as complements.

¹² The share is calculated as the purchases of the tourism category by the *Wholesale* industry divided by the total sales of that tourism category.

¹³ Because sales are limited to intermediate purchases by industries, activity of business tourism is the weighted sum, across industries, of intermediate demand for business travel.

¹⁴ Mathematically this can be expressed as:

if $a_j = b_j ; j \in IND$, where a is the percentage change in A

and a_j is not constant

and $\frac{A_j}{\sum_j A_j} \neq \frac{B_j}{\sum_j B_j}$

then $\frac{\sum_j (A_j \times a_j)}{\sum_j A_j} \neq \frac{\sum_j (B_j \times b_j)}{\sum_j B_j}$

¹⁵ Where the region is not the home region, increased demand for business travel will include both increased demand for business tourism in the non-home region (business tourism interstate and foreign imports) and increased demand for business tourism associated with travel to the non-home region (business tourism going interstate and foreign outbound).

5 Simulation

OESR had two goals in conducting the simulations discussed below:

- To investigate the impact of including changes in sales shares in the determination of business travel demand by Australian industries; and
- To investigate the impact of including changes in foreign import volumes in the determination of business travel demand by foreigners.

To assist this investigation a 10% labour productivity improvement¹⁶ in Queensland was modelled with two different treatments of business tourism demand:

1. **Alternative** business travel demand treatment.

- Demand for business travel by Australian industries moves in fixed proportion to industry output. This implies that a domestic industry's travel to *all* destinations changes by the same percentage; and
- Demand for business travel by foreigners moves with changes in the foreign currency price of business travel.

2. **Standard** business travel demand treatment

- Demand for business travel by Australian industries is determined by a combination of changes to industry output *and* changes to the destination sales share for the industry.
- Demand for business travel by foreigners is determined by a combination of changes in the foreign currency price of business travel *and* changes to foreign imports volumes.

6 Closure and assumptions

A long-run comparative static closure was adopted for each of the simulations. The key assumptions for this long-run closure were:

- No simulation-induced net interstate migration.
- Real wages in each region adjust in order to preserve the pre-simulation level of state employment.
- Differential growth in industry capital stocks occurs in order to preserve a pre-simulation economy-wide rate of return. Industry investment expenditure varies in line with industry capital stock.
- Real State Government public consumption moves in line with real State private consumption and real Federal Government consumption moves in line with real National private consumption. Tax rates are unchanged, and each government's budget position adjusts accordingly.
- The foreign currency price of imports is unchanged.

¹⁶ Labour productivity was shocked by 10% because OESR wanted to impose a shock that was large enough to cause observable changes in the destination sales shares of industries in Queensland.

7 Results

Given that the focus of this paper is on business travel, a detailed discussion of the macroeconomic results was not considered necessary. Therefore the macroeconomic results of the simulations have been explained in terms of their role in driving the results for the business travel aggregates.

The assumed labour productivity improvement in Queensland was projected to lead to a 7.15% increase in Queensland's GSP (see Table 1).

Table 1: Long Run Macroeconomic Results for Queensland and Rest of Australia

	Queensland (% change)	Rest of Australia (% change)
Real GSP	7.15	0.34
Employment	0.00	0.00
Capital stock	3.14	0.84
Real aggregate value of indirect taxes	3.03	0.99
Real consumption	4.19	0.57
Real State government consumption	4.19	0.57
Real Federal government consumption	1.18	1.18
Real investment	3.25	0.86
Foreign exports	18.55	-0.81
Foreign imports	6.66	0.37
GSP deflator	-3.89	0.66
Rental price of capital	1.48	-0.15
Nominal wage	1.92	1.24
Consumer price index	-1.89	0.38
Real wage	3.80	0.86
Investment price index	-3.17	0.76
Export price index	-1.35	0.68
Import price index	0.64	0.64
Queensland interstate exports	5.19	
Queensland interstate imports	2.57	

On the income-side of GSP, the direct effect of the assumed labour productivity improvement, given the assumed fixed regional labour supply, was to increase the effective supply of labour in Queensland by 10%. This caused a projected reduction in the cost structure of Queensland firms, which led to lower production prices and a projected increase in activity. The quantity of capital was projected to increase by 3.14% in Queensland driven by the projected increase in the activity of Queensland firms. This increase in the demand for capital was offset to some extent by some substitution of labour for capital. That is, in terms of effective units, the labour-to-capital ratio increased by 6.86% (10% – 3.14%).

On the expenditure-side of GSP, Queensland real household consumption was projected to increase by 4.19%, with real investment to increase by 3.25%. The projected lower domestic prices led to an improvement in the international competitiveness of Queensland industries, and consequently Queensland exports were projected to increase by 18.55%. Foreign imports

into Queensland were projected to increase by 6.66% reflecting the projected increase in Queensland GSP and Queensland real household consumption. The consumption-induced increase in imports was offset to some extent by the substitution effect of the projected reduction in domestic prices, which led to a decrease in the competitiveness of foreign imports.

The assumed labour productivity improvement was not applied to the Rest of Australia (ROA), and with no simulation induced interstate migration, the impact on ROA occurs mainly through the crowding out of their international exports and changes to interstate trade. Queensland's interstate exports to ROA were projected to increase by 5.19%, reflecting the projected decline in production prices in Queensland relative to ROA. Interstate imports from ROA were projected increase by 2.5%, driven by the activity and income effect in Queensland.

Simulation results with the alternative business-travel demand treatment

Under the alternative demand treatment, demand for business travel commodities by Australian industries was assumed to move in fixed proportions to industry activity. While demand for business travel by foreigners was assumed to move with changes in foreign currency price of business travel.

The demand for Queensland business travel categories was projected to increase as a result of the assumed increased in labour productivity in Queensland (see Table 2).

Table 2. Changes in Business Demand for Queensland Travel Categories
Alternative Demand Treatment

Travel Category	Queensland	Queensland
	<i>Quantity change (%)</i>	<i>Price change (%)</i>
<i>Interstate (Bus_inter)</i>	7.29	0.80
<i>Going Interstate (Bus_ginter)</i>	7.29	0.43
<i>Intrastate (Bus_intra)</i>	7.30	-1.81
<i>Foreign Outbound (Bus_for_o)</i>	7.29	-2.23
<i>Foreign Imports (Bus_for_imp)</i>	7.51	-0.51
<i>Foreign Inbound (Bus_for_i)¹</i>	4.34	-0.64

¹ The price of *Bus_for_i* is a foreign currency price

Under the alternative demand treatment, demand for business travel categories by Australian industries was assumed to move in fixed proportions to industry activity. More specifically, changes in demand for *bus_inter*, *bus_ginter*, *bus_intra*, *bus_for_o* and *bus_for_imp* by industries in a region were assumed to be driven by changes in industry activity in the region. Consequently, demand for Queensland business travel categories by Queensland industries was projected to increase strongly as a result of the projected increase in the activity of Queensland industries.

Demand for business travel by Queensland industries was projected to increase by more than real GSP in Queensland because industries that were projected to increase by more than the economy-wide average had a higher use of business travel than the industry average. For example, the activity of *Services to Mining* was projected to increase by 8.16%, 1.1 times the economy-wide average (Queensland GSP). Business travel expenditure accounted for a

greater proportion of *Services to Mining's* total intermediate costs than the economy wide average¹⁷.

In section 4.2 it was acknowledged that even though it was assumed that each specific industry's demand for *bus_inter* and *bus_ginter*, and *bus_for_o* and *bus_for_imp* move in fixed proportions, the aggregate activity of the categories do not necessarily move in fixed proportions.

Demand for international travel by Queensland industries (*bus_for_imp*) was projected to increase by more than demand for the other business travel categories. This reflects the fact that in the QGEM-T database, a greater proportion of the purchases of the *bus_for_imp* category are made by export-orientated industries. For example, the activity of the Queensland *Meat Products* industry was projected to increase by 8.46%, 1.2 times the economy-wide average (Queensland GSP), and *Meat Products* purchased a greater proportion of *bus_for_imp* than the other business travel categories¹⁸.

Under the alternative demand treatment, foreigners' demand for business travel (*bus_for_i*) moves with changes in foreign currency price of business travel. The demand for *bus_for_i* was projected to increase as a result of the projected decline in the foreign currency price of *bus_for_i*, reflecting the projected decline in domestic prices.

Simulation results with the standard business-travel demand treatment

The macroeconomic results did not change significantly (e.g. real GSP results were the same value to three significant figures) under the standard demand treatment.

Under the standard demand treatment, foreign industry demand for business travel moves with a combination of changes in the foreign currency price of business travel *and* changes to the quantity of foreign imports. Demand for the Queensland *bus_for_i* category was projected to increase (see Table 3) by an additional 6.7% under the standard commodity demand treatment, reflecting the projected increase in aggregate import volumes. That is, whilst the volume of imports was the same under both treatments, this additional volume effect¹⁹ induces additional business travel demand over and above the price induced effect.

**Table 3: Changes in Foreign Business Demand for Queensland Business Travel
Differences between the Two Treatments**

<i>Foreign Inbound (Bus_for_i)</i>	Queensland	Queensland
	<i>Quantity change (%)</i>	<i>Price change (%)</i> ¹
Alternative treatment	4.34	-0.64
Standard treatment	11.02	-0.63
Difference	6.679	-0.007

¹ The price of *Bus_for_i* is a foreign currency price

Under the standard demand treatment, demand for business travel categories by Australian industries was assumed to be determined by a combination of changes to industry output and changes to the destination sales share of an industry. For example, a Queensland industry's

¹⁷ In the QGEM-T database, business travel expenditure accounted for 5% of *Services to Mining's* total intermediate costs, but only 2% of the Queensland industry average for total intermediate costs.

¹⁸ In the QGEM-T database, *Meat Products* accounted for 0.71% of total *bus_for_imp* purchases, compared to 0.3% of total business travel purchases.

¹⁹ The volume effect is the effect of the destination sales share variable in the business travel demand equation.

demand for *Interstate* business travel would increase, relative to the alternative demand treatment, if a greater proportion of the industry's activity was sold in the ROA.

**Table 4: Changes in Business Demand for Queensland Travel Categories
Standard Demand Treatment**

Tourism Category	Queensland <i>Quantity change (%)</i>	Queensland <i>Price change (%)</i>
<i>Interstate (Bus_inter)</i>	7.30	0.79
<i>Going Interstate (Bus_ginter)</i>	7.29	0.43
<i>Intrastate (Bus_intra)</i>	7.30	-1.80
<i>Foreign Outbound (Bus_for_o)</i>	7.30	-2.22
<i>Foreign Imports (Bus_for_imp)</i>	7.52	-0.51

Note: The price of *Bus_for_i* is a foreign currency price

Demand for Queensland business travel categories by Queensland industries was projected to increase by a greater amount under the standard demand treatment. For example, *bus_inter* was projected to increase by 7.30% (see Table 4). This was 0.005% more than under the alternative demand treatment (see Table 5).

**Table 5: Changes in Business Demand for Queensland Travel Categories
Differences between the Two Demand Treatments²⁰**

Tourism Category	Queensland <i>Quantity differences</i>	Queensland <i>Price differences</i>
<i>Interstate (Bus_inter)</i>	0.005	0.002
<i>Going Interstate (Bus_ginter)</i>	0.001	0.001
<i>Intrastate (Bus_intra)</i>	0.009	-0.006
<i>Foreign Outbound (Bus_for_o)</i>	0.012	-0.002
<i>Foreign Imports (Bus_for_imp)</i>	0.011	-0.003

Based on the earlier discussion about the offsetting nature of changes in sales shares at an industry level, a reasonable *a priori* expectation would be that an increase in the demand for one travel category would be at the expense of the other categories. However, the *aggregate* (i.e. summed across industries) demand for each business travel category was projected to increase (see Table 5).

Our behavioural equation stipulates that, at an industry level, an increase in the share of sales to one region must be offset by a reduction in the share of sales to another region. Therefore, when the changes to the sales shares are summed across regional destinations they sum to zero. The projected changes in sales shares for each Queensland industry are provided in Appendix 1.

From Appendix 1 it can be observed that our theory holds and that when the sales shares are summed across regions for each industry they sum to zero. For example, the Queensland *Coal, Oil and Gas* industry was projected to increase the proportion of sales to export markets (0.005), and decrease the proportion of sales to Queensland (-0.005). Consequently, *Coal, Oil and Gas* demand for international business travel was projected to increase and its demand for intrastate travel was projected to decline. Likewise, the Queensland *Wholesale Trade* industry was projected to increase the proportion of sales to Queensland (0.016) and

²⁰ The differences between the results for the two simulations have been reported to 3 decimal places to that the reader is able to observe the differences that occurred.

export markets (0.003), and decrease the proportion of sales to ROA (-0.019). Consequently, *Wholesale Trade* demand for intrastate travel and international travel was projected to increase, and its demand for interstate travel was projected to decline.

Having identified that our behavioural equation enforces the rule that, at an industry level, the demand relative to the alternative treatment cannot increase for all types of business travel, we are left to explain why this does not occur in aggregate. That is, aggregate demand for each tourism category was projected to increase in the standard treatment over and above that projected for the alternative treatment. The reason why our modification leads to this overall increase in total business travel by Queensland industries is currently being investigated.

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Appendix 1

Projected Changes in the Destination Sales Shares of Queensland Industries

	1 QLD	2 ROA	3 foreign	Total
1 sheep	0.026	-0.01	-0.016	0
2 grains	0.007	-0.001	-0.005	0
3 beefcattle	-0.019	-0.006	0.025	0
4 dairycattle	0	0	0	0
5 pigs	0	0	0	0
6 poultry	-0.001	0	0	0
7 agric_nec	-0.021	0.007	0.014	0
8 sugar_cane	0	0	0	0
9 servs_agric	-0.059	-0.011	0.07	0
10 forestry_log	-0.025	0	0.025	0
11 fishing	-0.012	0	0.012	0
12 coal_oil_gas	-0.005	0	0.005	0
13 ferrous	0	0	0	0
14 non_ferr	0.011	-0.005	-0.006	0
15 minerals	-0.009	0	0.009	0
16 servs_mine	-0.003	0	0.003	0
17 meat	-0.015	-0.001	0.016	0
18 milk	-0.027	0.003	0.024	0
19 fruit_vege	-0.019	-0.011	0.03	0
20 margarine	-0.05	-0.026	0.076	0
21 flour	-0.013	-0.001	0.014	0
22 bread	-0.005	0	0.005	0
23 confectionry	-0.021	0	0.021	0
24 food_prods	-0.011	-0.004	0.015	0
25 soft_drinks	-0.007	0.001	0.006	0
26 beer	0	-0.006	0.006	0
27 alcohol	0.002	-0.021	0.019	0
28 tobacco	-0.003	0.003	0	0
29 textile_fib	0.007	-0.013	0.005	0
30 textile_prod	-0.011	0	0.011	0
31 knitting	-0.035	0	0.035	0
32 clothing	-0.006	0.001	0.006	0
33 footwear	0.007	-0.009	0.002	0
34 leather	-0.059	-0.066	0.125	0
35 sawmill	-0.029	0.006	0.023	0
36 oth_wood	-0.023	0.018	0.005	0
37 pulp	0.005	-0.049	0.043	0
38 bags	-0.003	-0.001	0.003	0
39 printing	-0.015	0.009	0.006	0
40 publishing	-0.009	0.009	0	0
41 petroleum	0.002	-0.021	0.018	0
42 basic_chems	-0.017	-0.017	0.034	0
43 paints	-0.009	0.001	0.008	0
44 pharm	-0.002	-0.009	0.012	0
45 soap	-0.008	0.001	0.008	0
46 cosmetics	-0.008	-0.006	0.013	0
47 chem_prods	-0.019	-0.005	0.024	0
48 rubber	-0.006	-0.012	0.018	0
49 plastic	-0.011	0.002	0.009	0
50 glass	-0.009	-0.001	0.01	0
51 ceramic	-0.021	0.005	0.015	0
52 cement	-0.003	0	0.003	0
53 plaster	-0.006	0.003	0.003	0
54 nm_mineral	-0.043	0	0.043	0

	1 QLD	2 ROA	3 foreign	Total
55 basic_iron	-0.003	-0.018	0.021	0
56 nf_metals	0.007	-0.005	-0.002	0
57 struct_metal	-0.014	0.007	0.006	0
58 sheet_metal	-0.016	0.004	0.012	0
59 metal_prods	-0.017	0.004	0.012	0
60 motor	0.006	-0.008	0.003	0
61 ships	-0.048	-0.001	0.049	0
62 railway	-0.019	0	0.019	0
63 aircraft	-0.031	-0.001	0.032	0
64 scien equip	0.009	-0.002	-0.007	0
65 elect equip	-0.004	-0.02	0.025	0
66 household	0.002	-0.021	0.019	0
67 elct equ nec	-0.034	-0.017	0.052	0
68 agric_mach	-0.029	-0.004	0.033	0
69 machinery	-0.043	-0.018	0.061	0
70 prefab_bldg	-0.03	0.01	0.019	0
71 furniture	-0.015	0.011	0.005	0
72 manuf_nec	-0.023	0	0.023	0
73 electricity	-0.002	0	0.002	0
74 gas	0	0	0	0
75 water	-0.001	0	0.001	0
76 res_building	0	0	0	0
77 const_nec	0	0	0	0
78 whole_trade	0.016	-0.019	0.003	0
79 ret_trade	-0.001	0.001	0	0
80 mech_repairs	-0.002	-0.001	0.003	0
81 repairs_nec	0	0	0	0
82 restaurant	-0.001	-0.004	0.005	0
83 road_trans	0.005	-0.008	0.003	0
84 rail_trans	0.006	-0.006	0	0
85 water_trans	-0.015	-0.029	0.043	0
86 air_trans	-0.001	-0.014	0.015	0
87 servs_trans	-0.02	0.003	0.016	0
88 communicat	-0.011	-0.001	0.012	0
89 banking	-0.003	0	0.003	0
90 non_bank	-0.002	0	0.002	0
91 insurance	-0.021	0	0.021	0
92 serv_fin	-0.001	0	0.001	0
93 ownership	0	0	0	0
94 property	0	0	0	0
95 tech_serv	0	0	0	0
96 bus_serv	-0.003	0	0.003	0
97 oth_bus_serv	-0.003	0	0.003	0
98 public_admin	0	0	0	0
99 defence	0	0	0	0
100 education	-0.006	0	0.006	0
101 health	-0.006	0	0.007	0
102 welfare	0	0	0	0
103 radio_tele	0	-0.001	0	0
104 museums	-0.001	0	0.002	0
105 rec_serv	-0.002	0	0.002	0
106 pers_serv	0.001	-0.001	0.001	0
107 oth_serv	0	0	0	0
108 nc_imports	0	0	0	0