Tourism Satellite Accounts and their Applications in CGE Modelling

Chapter 22

TOURISM SATELLITE ACCOUNTS AND THEIR APPLICATIONS IN CGE MODELLING

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Abstract: Two important tools employed increasingly by tourism economists to enhance our knowledge of the economic significance of tourism are Tourism Satellite Accounts (TSAs) and Computable General Equilibrium (CGE) models. But the relationship between the two is often not fully understood by tourism stakeholders. The chapter first outlines the nature and importance of TSAs as a measure of the economic contribution of tourism to an economy. TSAs based estimates of the direct contribution of tourism in Australia are provided to illustrate the use of this tool. The chapter then discusses the importance of developing TSAs at the regional level and the approaches that can be employed (bottom up, top down, mixed), as well as the limitations of TSAs as a policy instrument. It then discusses CGE modelling as a tool of economic impact analysis providing CGE based estimates of the economic impacts of increased inbound tourism to Queensland to illustrate the use of this technique. The analysis is expected to enhance stakeholder's understanding of the separate roles that TSAs and CGE modelling can play in determining the economic significance of tourism to an economy.

Keywords: Australian tourism; computable general; economic contribution; equilibrium models; tourism satellite accounts.

22.1. Introduction

Tourism has grown substantially over recent decades as an economic and social phenomenon. Tourism differs from many other economic activities in that it makes use of a diverse range of facilities across a large number of industrial sectors. The problem with measuring the economic significance of tourism spending is that 'tourism' does not exist as a distinct sector in any system of economic statistics or of national accounts. While all the

products and services that are produced and consumed in meeting tourism demand are included in the core accounts, they are not readily apparent because 'tourism' is not identified as a conventional industry or product in international statistical standards (ABS, 2007). While the largest proportion of this expenditure is allocated to sectors typically associated with tourism such as accommodation, transportation, car hire, duty free purchases, restaurants, tours, and attractions, tourists also spend money in other sectors when they gamble, buy hats, clothes, gifts, newspapers, sunglasses, cinema tickets, and such like. Since it is not possible to identify tourism as a single 'industry' in the national accounts, its value to the economy is not readily revealed. Tourism activity is 'hidden' in other industry activities.

There is a recognised need for improved statistical bases for tourism analysis and policy (TSA: RMF, 2008; IRTS, 2008). Many nations, both developed and developing, typically have emphasised agriculture, mining and manufacturing as the key sectors driving economic growth, failing to appreciate the size and significance of tourism and service industries in general. Tourism data tend not to be well incorporated in the complex system of official statistics, and often do not receive the full attention they deserve. Within most existing statistical systems it has been extremely difficult to adequately document the full scale and scope of tourism-related economic activities. Therefore, any attempt to examine the economic contribution of tourism by indirectly using data on tourism-related sectors in the system of national accounts is very unlikely to give an accurate measure of the economic significance of the tourism sector.

Comprehensive and reliable statistics are essential for policy-makers to make effective decisions about resource allocation. Only with sufficient and adequate data that generate credible statistics is it possible to compare the performance of tourism with other industry activity. Besides measuring tourism's economic contribution to a country, tourism statistics are necessary for designing and evaluating marketing strategies, strengthening inter-institutional relations, and evaluating the efficiency and effectiveness of management decisions to support tourism development.

Furthermore, as tourism comprises a wide range of outputs of many industries in the economy, changes in demand for tourism will affect other industries significantly. Conversely, changes in demands for outputs of other industries, higher export for example, will also affect resources in the economy required by the tourism sector. This requires a modelling framework that can capture explicitly the relationship between tourism and the rest of the economy for the tourism impact analysis tasks.

Unfortunately, in many countries, the development of statistical concepts and frameworks for tourism has not kept pace with the changes in the nature and significance of tourism worldwide and its potential for future growth. In response to the need for improved tourism statistics and modelling techniques, in recent years we have seen the development of a Tourism Satellite Account (TSAs) as well as the incorporation of TSAs in economic modelling technique, in particular the Computable General Equilibrium (CGE) framework. This chapter has several aims:

1. To set out the nature and importance of TSAs as a measure of the economic contribution of tourism to an economy. TSAs based estimates of the direct contribution of tourism in Australia are provided to illustrate the use of this tool.
2. To discuss the importance of developing TSAs at the regional level and the approaches that can be employed (bottom up, top down, mixed).
3. To discuss the limitations of TSAs as a policy instrument.
4. To discuss CGE modelling as a tool of economic impact analysis. CGE based estimates of the economic impacts of increased inbound tourism to Queensland are provided to illustrate the use of this technique.
5. To understand the separate roles that TSAs and CGE modelling can play in our understanding of the economic significance of tourism to an economy.

22.2. Nature and Importance of TSAs

Satellite accounts allow an understanding of the size and role of activities which are not separately identified in the conventional national accounting framework. They allow an expansion of the national accounts for selected areas of interest while maintaining the concepts and structures of the core accounts. In TSAs all of the tourism associated economic activity is identified in a separate but related account, that is, an account which is a satellite of the core national accounts. TSAs are compiled using a combination of visitor expenditure data, industry data, and Supply and Use Tables (SUT) in the system of national accounts. The SUT for an economy provides the framework in which data for visitor expenditure (demand) and industry output (supply) are integrated and made consistent in the TSAs. The best known supply and use tables, input–output tables, capture the interdependence that exists between sectors of the economy. Through a matrix table, they describe how one sector's output becomes another sector's input, showing the input–output flows (the exchange of intermediate goods) between various sectors of the economy. As such, they are used to estimate the effects of changes in

one industry on output, income and employment in other industries. TSAs provide detailed production accounts of the tourism industries, including data on employment, and linkages with other productive economic activities. They enable the relationships between tourism and other economic activity to be explored within the national accounts framework, extracting all the tourism-related economic activity which is included in the national accounts but not identified as tourism.

Because TSAs are derived from the overall system of National Accounts structure, they enable tourism to be compared with other industries in the economy using consistent and internationally endorsed national accounting principles. Tourism accounts for a proportion of the outputs of a range of industries which are explicitly recorded in the national accounts. The basic procedure in satellite accounting is to claim a 'share' of sales of each commodity or industry to tourism. TSAs use these estimates of tourist expenditure and then allocate tourism expenditure to different industries. For example, if tourism accounts for 80% of 'Accommodation' consumption, 90% of 'Air Transport', 25% of 'Ground Transport' and say, 12% of 'Retail Trade', and so on for other industry sectors, then these proportions of these industry outputs attributable to 'Tourism' are calculated and aggregated to obtain an estimate of the output of 'Tourism'. The result is a set of accounts documenting output, value added, employment and so forth for the tourism industry, consisting of the sum of the various parts of other industries which are attributable to tourism. TSAs provide information as to where tourists spend, the extent to which different sectors benefit from tourist spending, and the extent to which individual sectors are dependent upon tourism (Dwyer *et al.*, 2010, Ch. 7).

TSAs can be viewed from two perspectives (TSA: RMF, 2008, para. 1.17). First, as a *statistical tool* that complements those concepts, definitions, aggregates, classifications, already presented in the International Recommended Tourism Statistics (IRTS, 2008) and articulates them into analytical tables. Second, TSAs can also be considered as the *framework* to guide countries in the further development of their system of tourism statistics, the main objective being the completion of the TSAs, which could be viewed as a synthesis of such a system. TSAs provide a framework of monetary flows which can be traced from the tourism consumer to the producing unit or supplier within the economy and have now become the unifying framework of most of the components of the System of Tourism Statistics (UNWTO, 2008). As a consequence of the limitations of existing accounting systems, increasing numbers of countries have developed or are developing TSAs consistent with the 'Tourism

Satellite Account: Recommended Methodological Framework' (TSA/RMF, or just RMF for short hereafter). This framework has been developed by the Commission of the European Communities, the Organization for Economic Cooperation and Development (OECD), the United Nations World Tourism Organisation (UNWTO) and the World Travel and Tourism Council (WTTC), and approved by the United Nations Statistical Commission (EUROSTAT, OECD, UN and WTO, 2000; RMF, 2008).The RMF presents 10 tables, recommending that only eight of them (Tables 1–7 and Table 10) should be prepared at the present time in order to achieve international comparability of results.

The advantages associated with TSAs can be summarised as follows:

22.2.1. *TSAs identify 'tourism' and 'tourist'*

TSAs concepts of 'tourism' and 'tourist' are based on the approved international recommendations for tourism statistics (IRTS, 2008). For purposes of the TSAs, 'tourism' is more limited than 'travel' since it refers to specific types of trips: Those that take a traveller outside his/her usual environment for less than a year and for a main purpose other than to be employed by a resident entity in the place visited. Individuals who take such trips are called visitors (IRTS, 2008, paras. 2.6. to 2.13). In the TSAs, 'tourism' is not restricted to what could be considered as *typical* tourism activities such as sightseeing, sunbathing, visiting attractions, etc. Travelling for the purpose of conducting businesses, for education and training, etc. can also be part of tourism if the conditions that have been set up to define tourism are met (IRTS, 2008, para. 3.17).

22.2.2. *TSAs identify a tourism 'industry'*

TSAs define and identify the various tourism 'industries' or groups of suppliers which produce or import the goods and services purchased by visitors. This is a critical first step to measuring the industry and its economic contribution, and is a tool for strengthening the identity of the tourism industry. TSAs identify tourism's component products and industries through the concepts of Tourism Characteristic and Tourism Connected products and industries (RMF, 2008; IRTS, 2008).

Tourism characteristic products are those that represent an important part of tourism consumption, or for which a significant proportion of the sales are to visitors (for example, accommodation and air transport). They are those products, that, in most countries, it is considered, would cease to exist in meaningful quantity or those for which the level of consumption would be significantly reduced in the absence of visitors.

Tourism connected products are those that are consumed by visitors in volumes which are significant for the visitor and/or the provider but are not included in the list of tourism characteristic products. The 'tourism industry' comprises all establishments for which the principal activity is a tourism-characteristic activity (IRTS, 2008). While allowing for some differences between countries adherence to these definitions improves the international comparability of tourism statistics.

22.2.3. *TSAs measure the key economic variables*

TSAs bring together basic data on the key economic variables that describe the size and the economic contribution of tourism, presenting them in a consistent and authoritative way using internationally endorsed concepts and definitions (Frechtling, 1999). By highlighting tourism within the national accounting framework, TSAs allow the tourism industry to be better included in the mainstream of economic analysis. Headline variables include *Tourism expenditure, Tourism Consumption, Tourism Output, Tourism Gross Value Added (TGVA)*, *Tourism Gross Domestic Product (TGDP), and Tourism Employment.*

22.2.4. *TSAs measure tourism's interrelationship with other industries*

By identifying the sources of gross value added generated across the economy in order to satisfy visitor demand, TSAs make it possible to examine the inter-relationships between tourism and other industries and to answer questions such as which industries in the economy rely most heavily on tourism and to what extent they do so.

22.2.5. *TSAs support inter-industry comparisons*

TSAs allow tourism activity to be compared for its importance with other major industries in terms of size, economic performance, employment, and contribution to the national economy. For example, tourism's share of GDP and employment, the relative importance of identified tourism components to overall tourism activity, and their contribution to other non-tourism industries can all be examined. The Canadian TSAs, for instance, has been linked to the future development of benchmarking tools and micro-economic tourism indicators allowing private sector operators to compare their performance with industry norms in terms of productivity, growth, and earnings (Libreros *et al.*, 2006).

22.2.6. *TSAs support international comparisons*

TSAs allow for valid comparisons between regions, countries or groups of countries. In making these estimates comparable with other internationally recognised macroeconomic aggregates and compilations, TSAs also facilitate comparisons of the scale, scope and performance of one country's tourist industry with those in other countries. Caution is needed in cross-country comparisons, however, because a number of variations exist in the implementation of TSAs standards, including the extent of coverage of all forms of visitor consumption and tourism supply as well as differences in the interpretation and treatment of certain key concepts such as business travel, value added, and gross domestic product. Presently, inconsistent definitions limit the comparability of TSAs results between countries.

22.2.7. *TSAs can provide a base to develop different measures of tourism performance*

Measures of performance for the tourism industry include tourism yield, tourism productivity and tourism's carbon footprint

Tourism yield: A focus on 'yield' is an important aspect of both business strategy and public policy to maintain and enhance the returns from tourism in destinations world-wide. Yield is a term which refers to the gain, in financial or economic benefits which a destination achieves from attracting particular tourist market segments e.g., by origin, by type (holiday, VFR, Business) or by niche market (e.g., convention visitor, honeymooner). A growing number of destinations now emphasise 'high yield' as a primary objective of tourism policy. Measures of tourism yield (e.g., contribution to tourism expenditure, tourism industry profitability, tourism GDP, tourism value added and tourism employment) can be estimated for each type of visitor (Salma and Heaney, 2004). However, these are only direct impacts on the tourism industry. TSAs based measures do not incorporate the economy wide effects of tourist expenditure after allowance is made for inter-industry effects of the injected expenditure resulting from changes in prices, exchange rates in the presence of factor constraints.

Tourism productivity: TSAs can be used to develop valuable economic performance indicators. These include measures of productivity and profitability for the tourism industry as a whole (Dwyer *et al.*, 2007). They can also be used to explore performance in individual sectors, such as accommodation or motor vehicle hire. The measures can be used to explore the performance of individual tourism sectors or of tourism relative to that of other industries — for example, how productivity growth in tourism compares to

that elsewhere. Productivity can be measured for tourism characteristic and connected industries with benchmarking comparisons made between different regions, states and countries for each industry, including comparisons of productivity growth over time. Productivity growth rates can be very valuable in forecasting — prices or competitiveness in the future will depend on productivity growth and changes in input prices.

Calculating the Carbon Footprint of Tourism: There is increasing interest in the environmental impacts of tourism, and especially its impact on greenhouse gas (GHG) emissions. We have discussed how TSAs document the outputs and value added in the various industries which make up tourism — i.e., they summarise the productive activities. It is these activities which generate GHG emissions. If the relationship between industry production and GHG emissions is known, then it is possible to calculate the emissions which are due to tourism as measured by the TSAs (Dwyer *et al.*, 2010). The advantage of using the TSAs to estimate the carbon footprint is that it ensures that the measure is comprehensive, and incorporates all emissions from all industries which make up tourism. In addition, since the TSAs are extensively used as a measure of the economic contribution of size of the tourism industry, this carbon footprint is an environmental measure which is consistent, in terms of definition of the industry, with the economic measure.

22.2.8. *TSAs give 'credibility' to estimates of the economic contribution of tourism*

As a statistical tool that is compatible with international national accounting guidelines, TSAs can enhance credibility of tourism as a main economic sector. TSAs can help to raise awareness of tourism and its contribution to national economies. They help tourism stakeholders to better understand the economic importance of tourism activity; and by extension its role in all the industries producing the various goods and services demanded by tourists. TSAs thus help to legitimise or give credibility to the tourism industry as a main economic sector in the minds of politicians and the general public. In doing so, they can help to solicit and justify funding for tourism development and marketing (Cockerell and Spurr, 2002).

Not surprisingly, the extensive involvement of governments in tourism planning, infrastructure provision and marketing at a state, regional or local level, has led to a strong demand for better economic statistics to be made available at the state or regional level. Yet, only a small number of countries, in particular Canada, Spain, Norway, and Australia, have attempted to develop TSAs for regions (Jones and Munday, 2008; Pham *et al.*, 2009). The

use of the term 'satellite account' may be misleading at the regional level given that it cannot strictly conform to the national accounts. Some substantial challenges to their construction may be noted (RMF, 2008, Annex 7). Nevertheless, there are benefits to estimating tourism's contribution to sub-regions of the national economy within the TSAs context.

22.2.9. *TSAs provide a tool for tourism research and policy analysis*

TSAs provide policy makers with insights into tourism and its contribution to the economy providing an instrument for designing more efficient policies relating to tourism and its employment aspects (Jones *et al.*, 2003). TSAs can serve as a tool for enhanced strategic management and planning for the tourism industry. Indeed, a major purpose of the TSAs is to improve the effectiveness of tourism policies and actions and to improve existing measures for evaluation of these policies in the context of a broader policy agenda (OECD, 2000).

There is a worldwide trend towards the de-centralisation of political power and destination management, with the associated need to improved data for decision making at the local level. Tourism often produces substantial economic contributions in certain regions of a national economy but with a negligible impact in others. Since tourism activity tends to be unevenly concentrated within countries, national TSAs cannot help us to determine the importance of tourism to different sub-regions or provide any guidance as to its potential as a tool for regional development in particular cases (Jones *et al.*, 2003). Worldwide, regional governments are developing tourism plans to maximise the opportunities for income and employment growth resulting from an expanding tourism industry. The forms of planning implemented must depend on the estimated net benefits on local economies of different strategies. In such cases, national TSAs may be of much less relevance to regional destination management organisations and local businesses than regional TSAs.

In helping governments and businesses determine the value of tourism to the economy, TSAs can also aid in the formulation of strategies for ensuring competitive advantage in this sector. Given that they allow comparisons across sectors, TSAs give tourism organisations the information they need to lobby governments to ensure that tourism can compete on a level playing field.

TSAs also provide the basic information required for the development of models of the economic impact of tourism. For example, analysts may

use data from TSAs to estimate the direct effect of changes in tourism consumption on other industries or on employment. We shall further explore this use of TSAs below.

22.3. Direct Contribution of Tourism using TSAs: Australia

In this section, we provide some data contained in the Australian TSAs for 2008–2009. Table 22.1 provides some 'headline estimates'. Table 22.2 provides measures of Direct Output by industry sector. While highlighting only some of the measures from the Australian TSAs, the data in Tables 22.1 and 22.2 will be contrasted with the economic impact estimates of CGE modelling in Secs. 22.5 and 22.6 below.

In 2008–2009, total tourism consumption in Australia was $92.0bn. Table 22.1 shows that in terms of direct economic contribution, this tourism consumption generated $62.4bn of Australian industry output, $30.0bn of industry gross value added (GVA), $32.8bn of gross domestic product (GDP), and 486,100 jobs. These direct contributions of tourism represent 2.6% of Australia's GVA, 2.6% of GDP, and 4.5% of total employment.

When producing tourism goods and services, Australian businesses use goods and services produced and supplied by other businesses. Tourism industry output measures the value of goods and services produced by establishments to satisfy visitor consumption, excluding net taxes on tourism products (taxes less subsidies). The TSAs indicate the industry shares of Direct Tourism Output at basic prices for 2008–2009.

Table 22.2 shows the composition of tourism direct output for Australia as a whole and by State. For Australia, Air water and other transport have the greatest output ($13,325 mil.), followed by Accommodation ($10,547), Cafes, restaurants and takeaway food services ($9,617), and Other retail trade ($6,848). Taken together these sectors generate almost two-thirds of tourism direct output. For Queensland, an important state for tourism in Australia, Direct Tourism Output is $14,707 or 24% of the total for Australia. The profile of Direct Tourism Output for Queensland differs from that of Australia with greatest shares in Accommodation ($2,783), Air, water and other transport ($2,623) and Cafes, restaurants and takeaway food services ($2,366), and Other retail trade ($1,746).

22.4. Limitations of TSAs as a Policy Instrument

There are two main limitations associated with TSAs as a policy instrument.

Table 22.1. Estimates of direct contribution of tourism in Australia by State and Territory, 2008–2009.

Direct contribution	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	AUS
Tourism GVA ($m)	10,198	6,537	7,032	1,747	2,526	775	642	556	30,013
Tourism net taxes on products ($m)	854	631	739	178	228	78	68	40	2,816
Tourism GSP, GDP ($m)	11,052	7,168	7,770	1,925	2,754	853	710	596	32,829
Tourism employment ('000)	160.3	106.5	118.0	29.6	39.7	13.2	10.4	8.3	486.1
GVA ($m)	364,991	265,158	231,795	71,450	162,990	21,012	15,155	24,350	1156,900
Tourism share of GVA (%)	2.8	2.5	3.0	2.4	1.5	3.7	4.2	2.3	2.6
GSP, GDP ($m)	402,334	291,637	243,901	78,986	169,950	23,176	17,168	25,969	1253,121
Tourism share of GSP, GDP (%)	2.7	2.5	3.2	2.4	1.6	3.7	4.1	2.3	2.6
Employment ('000)	3,414.0	2,682.8	2,224.5	788.0	1,166.4	233.8	115.3	196.0	10,820.8
Tourism share of employment (%)	4.7	4.0	5.3	3.8	3.4	5.6	9.0	4.2	4.5
Direct Tourism Output	21,439	13,445	14,707	3,524	5,207	1,587	1,369	1,147	62,425

Source: Spurr *et al.* (2010), Table 1.

Table 22.2. Tourism output, Australia, by state and territory, 2008–2009, $m.

	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	AUS
Tourism characteristic industries									
Accommodation	3,454	2,135	2,783	541	888	309	266	172	10,547
Ownership of dwellings	1,056	711	734	205	305	82	53	81	3,226
Cafes, restaurants and takeaway food services	3,167	2,141	2,366	569	765	271	187	152	9,617
Clubs, pubs, taverns and bars	843	570	630	152	204	72	50	41	2,561
Rail transport	342	219	211	40	58	0	15	0	885
Taxi transport	244	136	162	36	60	37	19	12	704
Other road transport	479	307	295	56	81	40	21	17	1,296
Air, water and other transport	5,497	2,676	2,623	537	1,155	218	296	324	13,325
Motor vehicle hiring	273	239	296	69	122	46	76	17	1,137
Travel agency and tour operator services	793	412	570	245	194	78	55	40	2,387
Cultural services	284	214	336	56	73	30	39	13	1,045
Casinos and other gambling services	97	99	95	23	24	9	8	2	357
Other sports and recreation services	453	342	536	90	117	48	61	21	1,667
Total tourism characteristic industries	16,983	10,201	11,637	2,617	4,043	1,239	1,143	892	48,754
Tourism connected industries									
Automotive fuel retailing	197	130	137	43	54	16	14	10	601
Other retail trade	2073	1,565	1,746	497	552	182	120	113	6,848
Education and training	1,145	855	430	160	273	65	18	88	3,033
Total tourism connected industries	3,415	2,550	2,312	699	879	263	152	211	10,482
All other industries	1,042	695	757	208	284	85	73	45	3,189
DIRECT TOURISM OUTPUT, at basic prices	**21,439**	**13,445**	**14,707**	**3,524**	**5,207**	**1,587**	**1,369**	**1,147**	**62,425**

Source: Spurr *et al.* (2010), Table 4.

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(a) TSAs are mainly descriptive in nature and do not include any measurement of the indirect and induced effects of visitor consumption on the economic system as a whole.

Tourism's total economic significance is greater than just the direct contribution estimated in the TSAs. Additional output and value added is generated by the industries supporting the initial 'round' of tourism spending. Thus TSAs measures do not measure the full impact of tourism on the host economy because they are limited to those businesses that have a direct relationship with tourists. Measuring indirect tourism output or value added involves estimation of this indirect contribution and requires economic modelling, tracing the flow-on effects of businesses' intermediate purchases that are used directly in producing tourism products and measuring the cumulative output and value added that these purchases generate. These indirect effects redistribute to the tourism sector output, value added, GDP, employment that occurs outside the tourism sector. They reflect the value of production and employment that occur on an economy wide basis as a result of the demand of tourists for goods and services. A comparison of the direct and indirect estimates for Australia indicates that the indirect contribution of tourism was slightly higher than the direct contribution in terms of gross value added, thus more than doubling the overall contribution of tourism reported in the TSAs (Salma, 2004).

(b) TSAs represent an important information base for the estimation of the economic contribution of changes in tourism demand, but TSAs are not in themselves modelling tools for economic impact assessment. We must distinguish between 'economic contribution' and 'economic impact'. *Economic contribution* measures the size and overall significance of the industry within an economy. *Economic impact* refers to the compound effects of a change that permeates through the whole economy and results in changes in all other industries. To gain more comprehensive insight into the indirect and induced effects of tourism requires a further level of analysis — this is economic impact analysis, requiring the use of specific economic modelling techniques. Economic impact is much broader and more important to policy makers than the economy contribution (Dwyer *et al.*, 2007). Economic impact implies that the overall change in the economic contribution must take account of the extensive interactive effects which occur across the economy. In such an exercise, TSAs provide a starting point for other more comprehensive approaches to analysing the overall economic impact of tourism. The CGE section below will elaborate the impact in more detail.

22.5. CGE Modelling as a Tool of Economic Impact Analysis

The range of popular policies that CGE analysis has been adopted is voluminous, some illustrative topics include tax policy evaluation, international trade, economic growth, economic structure, income distribution (Johansen, 1960; Harberger, 1962; Shoven and Whalley, 1972; Keller, 1980; Dixon *et al.*, 1982; Dervişş *et al.*, 1982; Dixon and Rimmer, 2002), trade policies (Hertel, 1997) and climate change effects (Adams, 2008; Böhringer and Rutherford, 2010). The list is not exhaustive, particularly for the rapid development of the CGE technique over last several decades, and these are only a few to highlight the use of CGE in applied economic analysis.

The construction of a CGE model involves setting up a series of markets (for goods, services and factors of production), production sectors and demand groups (households). Each market, sector and household has its own set of economic rules that determine how it reacts to external changes. CGE models consist of a set of equations characterising the production, consumption, trade and government activities of the economy. There are four types of equations in the set which are solved simultaneously. These are:

- *Equilibrium conditions* for each market ensure that supply is equal to demand for each good, service, factor of production and for foreign exchange. Assuming flexible prices and wages, this enables factors of production, such as labour and capital, and foreign exchange markets to be modelled (although some sticky prices can be assumed such as might occur in the labour market).
- *Income-expenditure identities* ensure that the economic model is a closed system. All earnings must be accounted for through expenditure or savings. These conditions apply to all private households, the government, firms and any other economic agents that are modelled. These define various macroeconomic identities such as aggregate employment and the components of gross domestic product.
- *Behavioural relationships* state how economic agents (consumers, suppliers, investors and so on) acting in their own best interests can lead to changes in price and income levels. For example, businesses will seek to maximize profits. Consumers will look for lowest prices for equivalent products. The zero-pure-profits condition for production is assumed. Resource allocation is via market forces — where markets behave imperfectly unemployment may increase. Increasing government expenditures are met either by raising taxes or borrowing, with implications for the expenditure of other economic agents.

- *Production functions* determine how much of output is produced for any given level of factor employment. With assumptions regarding market structure, these determine what levels of labour employment, capital usage and intermediate input usage are required to satisfy a given level of output for a given set of prices. The production assumptions allow substitution between intermediate inputs and factors of production as prices and wages change.

CGE modelling has become increasingly widely used across many countries for the last several decades. The emerging importance of the technique has been due to its ability to provide decision makers with insight into policy outcomes at both economy-wide as well as at the industry levels. It is the inter-industry linkages of all producers, the interaction between producers and consumers, the simultaneous responses of primary inputs to output growth of industries in an economy that makes the CGE technique an indispensible economic modelling tool for policy analysis that the so-called partial equilibrium analysis could not offer.

22.5.1. *Model database*

A typical IO database of a CGE model is presented in the simplest form in Fig. 22.1. The format of an IO database published by any national statistical office is often more complicated than the representation in Fig. 22.1. This simplest form makes it easier to explain the general mechanism of a CGE model without losing the essence of the technique. Each column in the Input–Output table represents a user in an economy. Users include all industries, household consumption (HH), investment by industries (INV), government consumption (GOV) and overseas export (EXP). Users purchase commodities from the rows for their consumption, for example the amounts $C_{11}, C_{21} \ldots C_{n1}$ represent the amounts of all n commodities that industry 1 purchases as intermediate inputs in the production process; the household sector purchases the amounts $HH_1, HH_2 \ldots HH_n$ of those n commodities for their final consumption; and the amounts of $E_1, E_2 \ldots E_n$ are exports to overseas market. Total sale of a locally produced commodity is the sum across all sales across a row, such as TS_2 for commodity 2. In addition to the usage of intermediate inputs, industries will also pay wages to employees (P1), capital rental (P2), net commodity taxes on intermediate inputs (P3), net production taxes (P4), and imported goods (P6). The Total Cost (TC) of production for an industry is the column total. The total cost has to equal total sales for every industry, for example $TC_2 = TS_2$.

	Industry							Final Demands				Total
	J1	J2	J3	...			Jn	HH	INV	GOV	EXP	Supply
C1	C_{11}							HH_1			E_1	**TS_1**
C2	C_{21}	C_{22}	.....				C_{2n}	HH_2			E_2	**TS_2**
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Cn	C_{n1}							HH_n			E_n	**TS_n**
	T1: Total Intermediate use											
	Value Added											
	P1: Compensation of employees (COE)							(not applicable)				**COE**
	P2: Gross operating surplus & mixed income							(not applicable)				**GOS**
	P3: Net taxes on products											**PTAX**
	P4: Net taxes on production							(not applicable)				**CTAX**
	P6: Imports											**M**
	T2: Australian Production											
Total	**TC1**	**..**	**TC3**	**.....**			**TCn**	**C**	**I**	**G**	**E**	

Fig. 22.1. Input–output database.

At the aggregate level, Gross Domestic Product from the expenditure and income sides is calculated as follows.

Gross Domestic Product

(Expenditure side) = +Total Household consumption (C)
+ Total Investment (I)
+ Total government consumption (G)
+ Total Export (E)
− Total Imports (M)

Gross Regional Product

(Income side) = +Total wages (COE)
+ Total Gross operating Surplus (GOS)
+ Total net commodity taxes (CTAX)
+ Total net production taxes (PTAX)

22.5.2. *Model closures*

Simulation results from CGE models depend largely on the adopted assumptions that are often referred to as a *closure*. For a comparative static CGE model, the solution path over time is NOT known. Rather, it is assumed that the economy operates within a certain timeframe either a long run or a short run, depending on the purpose of a simulation.

The two main assumptions that characterise a *short run* closure are: (a) The economy operates in a timeframe where real wage rates are rigid. Changes to labour demand will be reflected by changes in employment, as often this is not long enough for sale contracts to be re-negotiated for higher commodity prices in order to take into account any necessary changes to wage rates that producers have to pay to their employees; (b) There is not enough time for capital stock to be adjusted; return to capital (or the rate of return in other words) will adjust to reflect changes in demand for capital.

The *long run* closure adopts the opposite assumptions. For the labour market, real wage rates are now fully flexible while employment is fixed. The whole economy cannot have more than the total aggregate employment level that the labour market can offer. Any demand higher than this will be reflected by a rise in the real wage rates. In an adverse situation, the fixed employment implies that whoever wants a job will get employment as long as they are prepared to take whatever wage rate that is affordable by the producers. Implicitly, this assumes full employment in the economy. Thus, in a long run closure, the total employment at the national will not change under the impact of any shocks introduced to the model. However, for a state CGE model, this does not simultaneously assume that total employment at the state level remains unchanged. Total employment at the state level can change, and often an increase in employment in one state will be at the expense of other states via regional migration. Regional employment supply is a function of the ratio of regional to national real wage rates: A region with a real wage rate higher than the national real wage rate can attain higher employment growth than regions with lower wage rate ratios. For the capital market, the economy-wide capital stock is now allowed to change in response to the demand of capital in the economy, while the national rate of return is fixed. At the state level, industry rates of return are set to be positively correlated to the capital growth. Industries require large increases in their rates of turn in order to attain high capital growth.

22.6. Structure of a Tourism CGE Model with TSAs Data

The conventional IO table in Fig. 22.1 does not present tourism expenditure data explicitly. The domestic tourism expenditure is embedded in household final consumption and the overseas tourism expenditure is included in the export vector. That is, final demand data in the CGE database include both tourism and non-tourism data for the same final demand category. As a result, tourism impact analysis using the conventional CGE database will not be able to capture the impact of tourism shocks on non-tourism industries for the same commodity.

Given the importance of tourism in an economy, the ability that CGE model can offer for impact analysis, and the availability of TSAs data, the tourism sector has been incorporated into the CGE framework more explicitly in recent years (Madden and Thapa, 2000; Dwyer *et al.*, 2003; Pham *et al.*, 2010). Figure 22.2 is an extension of Fig. 22.1, in which the process to modify the original CGE IO database is carried out in order to incorporate the tourism sector into a CGE model (Pham *et al.*, 2010). In a tourism CGE database, most of the original elements remain unchanged, except that two new industries *Dtour* and *Etour* have been created, for domestic tourism and overseas tourism respectively. The final household consumption by commodities is decomposed into tourism and non-tourism parts, and the tourism part is moved to the intermediate quadrant to represent the domestic tourism

	Industry						Final Demands				Total
	J1	J2	J3	…	Jn	Dtour	Etour	HH	INV	GOV	EXP	Supply
C1	C_{11}					HH_{1T}	E_{1T}	HH_{1NT}			E_{1NT}	**TS_1**
C2	C_{21}	C_{22}	.....		C_{2n}	HH_{2T}	E_{2T}	HH_{2NT}			E_{2NT}	**TS_2**
Cn	$Cn1$					HH_{nT}	E_{nT}	HH_{nNT}			E_{nNT}	**TS_n**
Dtour						0	0	Tot_Dtour			0	**Tot_Dtour**
ETour						0	0	0			Tot_ETour	**Tot_ETour**
	T1: Total Intermediate use											
	Value Added											
	P1: Compensation of employees (COE)					0	0		(Not available)			**COE**
	P2: Gross operating surplus & mixed income					0	0		(Not available)			**GOS**
	P3: Net taxes on products											**PTAX**
	P4: Net taxes on production					0	0		(Not available)			**CTAX**
	P6: Imports											**M**
	T2:Australian Production											
Total	**TC1**	..	**TC3**	.....	**TCn**	**Tot_Dtour**	**Tot_ETour**	**C**	**I**	**G**	**E**	

Fig. 22.2. Tourism CGE IO database.

supplier. Similarly, elements of *Etour* are extracted from the export vector. The tourism sectors *Dtour* and *Etour* do not require primary inputs. They each act as a 'middle man' to select all goods and services for tourism activity, and then sell all tourism services to the corresponding tourists. This follows closely the approach adopted in the construction of the TSA (Pham *et al.*, 2009), where the tourism sector is not a commodity or industry *per se*, as tourists consume a wide range of commodities and services for their tourism activity. *Dtour* is not purchased by any users in the economy other than the household sector, and similarly *Etour* by the export. These purchases of tourism services are defined as domestic and inbound tourists' consumption respectively. To some extent, the treatment here reflects exactly how loosely defined the tourism sector is in relation to goods and services in reality.

The task to split the tourism and non-tourism parts relies mainly on the TSAs data, particularly from the consumption side. The approach in Fig. 22.2 focuses only on integrating the demand side of TSAs into a CGE model while the supply side of the tourism sector remains implicitly with the existing industries in the IO database. While this structure suffices to allow model users to carry out impact analysis on changes to tourism demands, the current structure is not able to analyse the supply side of the tourism sector, for example labour productivity, employment in tourism. However, it is not a suitable solution to split the original industries in the IO database into non-tourism and tourism because this will create an unrealistic modelling environment, generating two different prices for the same good which is purchased for two different purposes. Moreover, both components in the same industry will have to compete for resources to produce the same good where, in reality, no such competition and different prices for the same good will arise. The supply side presents challenges for future research, in which an additional module can be added to extract the supply factors from the conventional industries to make up the supply side of the tourism sector explicitly.

22.7. Application of a Tourism CGE Model: The Case of Queensland, Australia

In this section, we augment the MONASH Multi-Regional Forecasting Model, in short MMRF, (Adams, 2008) with a tourism extension. This model contains all six States of Australia: New South Wales (NSW), Victoria (Vic), Queensland (Qld) South Australia (SA), Western Australia (WA), Tasmania (Tas), as well as the Northern Territory (NT), and the Australian Capital

Territory (ACT). MMRF is a dynamic model, but in this application, the model was run in a comparative static mode and in a short run closure to illustrate immediate impacts of an increase by 10 per cent of inbound tourism expenditure in the Qld region. Results are based on the 2004–2005 IO database. The model simulation was run on GEMPACK software (Horridge *et al.*, 2008).

In this section, we highlight some typical results for macro- and micro-economic variables that CGE modelling can provide to policy makers. Specifically, we illustrate how changes to inbound tourism in Queensland could affect other states in Australia via crowding out effect of exports and differences of the impacts on different industries. The results are displayed in Table 22.3.

The increase in inbound tourism in Queensland induces a large increase in demand for both capital and labour in the State. As capital is fixed in the short run, higher demand for capital is reflected by an increase rental to capital in Queensland (row 14). In contrast, the assumption of rigid real wage rates in all states implies that labour cost units across all states (row 15) are set equal to the national CPI (row 17). Higher demand for labour in Queensland reduces unemployment in the State, making the labour cost relatively cheaper than the cost of capital (row 14 compared to row 15 for QLD). Thus producers in Queensland increase usage of labour (row 11) relative to capital. In other states, crowding out effects occur in the export sector, implying that industries have to cut back their output, resulting in lower demand for labour (row 11), and higher unemployment rates (not reported here). In essence, the main driver in the economy is the movement of labour with QLD increasing while decreases occur in other states.

Factor incomes of both labour and capital generated in QLD are much higher than all other states (rows 21 and 22), adding to Queensland's household income initially. However, since unemployment is reduced largely in Queensland, government payment to unemployment benefits is also reduced, which offsets to some extent the increase in factor income in the state. The initial increase in inbound tourism imposed on Queensland is approximately 1.14% of the total export of the State, or equivalent to 0.28% of total national exports. However, the total export in QLD only increases by 0.825%, and at the national level it only increases by 0.07% (row 5); both are far below the initial stimulus. This is because the increase in inbound tourism has pushed up the domestic costs (row 19) across all States; export prices rise in all States (row 18), as indicated by an appreciation of the terms of trade (row 13), causing all States to lose their competiveness in the international market for all other commodities. All States other than QLD experience

Table 22.3. Effects of a 10% increase in inbound tourism in QLD — Macro Results.

	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	AUSTRALIA
					per cent				
1 GSP/GDP	−0.0022	−0.0042	0.0902	−0.0051	−0.0031	−0.0015	−0.0091	0.0016	0.0144
2 Household Consumption	0.0150	0.0169	0.0152	0.0169	0.0153	0.0150	0.0103	0.0153	0.0156
3 Government consumption	0	0	0	0	0	0	0	0	0
4 Investment	0	0	0	0	0	0	0	0	0
5 Overseas Export	−0.2063	−0.2113	0.8255	−0.1748	−0.0635	−0.1459	−0.0788	−0.2735	0.0734
6 Inter-state Export	0.0805	0.0576	−0.2103	0.0392	0.0320	0.0365	0.0079	0.0185	
7 Overseas Import	0.0243	0.0221	0.1386	0.0206	0.0211	0.0271	0.0199	0.0300	0.0436
8 Inter-State Import	−0.0532	−0.0450	0.2168	−0.0359	−0.0321	−0.0175	−0.0205	−0.0091	
9 Trade balance (overseas, in $ millions)	−97.2	−71.3	362.7	−21.0	−25.8	−6.1	−3.0	−3.6	134.5
10 Capital	0	0	0	0	0	0	0	0	0
11 Labour	−0.0048	−0.0088	0.1698	−0.0107	−0.0079	−0.0040	−0.0177	0.0017	0.0248
12 Land	0	0	0	0	0	0	0	0	0
13 Economy-wide terms of trade									0.0414
14 Unit cost of capital	0.0788	0.0694	0.2171	0.0565	0.0282	0.0678	0.0137	0.0967	0.0938
15 Unit cost of labour	0.0752	0.0752	0.0752	0.0752	0.0752	0.0752	0.0752	0.0752	0.0752
16 Investment price index	0.0538	0.0500	0.0839	0.0511	0.0528	0.0545	0.0501	0.0547	0.0585
17 Consumer price index	0.0657	0.0622	0.1224	0.0626	0.0633	0.0660	0.0632	0.0667	0.0752
18 Export price	0.0421	0.0434	0.0688	0.0354	0.0130	0.0297	0.0161	0.0565	0.0414
19 GSP/GDP price index	0.0738	0.0691	0.1342	0.0630	0.0496	0.0685	0.0446	0.0800	0.0799
20 HH Disposable Income	0.0807	0.0791	0.1375	0.0795	0.0786	0.0810	0.0735	0.0821	0.0906
21 Labour income	0.0705	0.0664	0.2452	0.0645	0.0672	0.0712	0.0574	0.0769	0.1002
22 Capital income	0.0928	0.0929	0.1098	0.0930	0.0923	0.0922	0.0885	0.0921	0.0960

Source: Authors' simulation results.

a reduction in their total exports (row 5). The increase in total export of Queensland is mainly due to the tourism shock but discounted by the reduction in the export of other commodities. A higher domestic price level makes imported goods relative cheaper than goods produced domestically, thus overseas imports increase in all States (row 7). As a result, Queensland is the only region that has attained an improvement on its trade balance by $362.7 million while all other States experience decreases in their balance of trade (row 9).

As the stimulus originated from Queensland, the demands for primary inputs are highest in the State, making it the most expensive producing region among all States. This causes Queensland to lose its competitiveness in the domestic market. Exports from Queensland to other regions decline by 0.21%, making room for other States to expand their exports (row 6).

In contrast, as Queensland now requires extra inputs for its production to satisfy extra export demand of inbound tourism, it is the only region that increases its inter-state imports. This increase in inter-state import of Queensland goes hand in hand with the increase in demand for overseas import. Other States have cut down their demand for inter-state import mainly because they substitute domestically produced goods for the imported goods.

22.7.1. *Sectoral results*

At the industry level, exports have declined for all outputs, except the inbound tourism sector in Queensland. This is expected. However, the impact of export reduction on outputs is not the same across all industries in all states. Table 22.4 presents changes of industry outputs in million dollars, based on 2004/05 prices. As predicted, outputs of the tourism connected industries increase while outputs of non-tourism connected industries contract mainly because of lost overseas export demands. Industries that contract include Agriculture, Black Coal, Other Mining and Metals. These are major exports industries in Australia. The tourism connected industries in Queensland grow due to the direct impact of the stimulus while in other states, these connected outputs are adversely affected, for example Food, Drink, Other Manufacturing, TCF, Fuel (Petroleum product), Wholesale, Retail Trade, Accommodation, Road Transport, and Education. This is because the inbound tourism sector in the other states are adversely affected, leading to a lower demand for all tourism related goods.

For industries that mainly supply goods domestically, output growths of these industries are stronger in other States than in Queensland due to the

Table 22.4. Effects of a 10% increase in inbound tourism on industry output.

	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	AUSTRALIA
					$ million				
Agriculture	−1.2	−1.6	−1.3	−0.7	−1.0	−0.1	−0.1	0.0	−6.0
Forestry	0.0	−0.1	0.0	−0.1	−0.2	−0.1	0.0	0.0	−0.5
Fishing	0.0	−0.1	0.2	−0.3	−0.2	−0.1	−0.1	0.0	−0.5
Black Coal	−0.6	0.0	−2.5	0.0	0.0	0.0	0.0	0.0	−3.1
Brown Coal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oil	0.0	0.0	−0.1	0.0	−0.1	0.0	0.0	0.0	−0.2
Gas	0.0	−0.1	0.1	−0.1	−0.2	0.0	0.0	0.0	−0.2
Other Mining	−0.8	−0.5	−3.1	−0.3	−4.1	−0.1	−1.3	0.0	−10.2
Food	−4.0	−6.5	42.7	−0.8	−1.1	−0.3	−0.2	−0.1	29.7
Drink	0.1	−0.6	2.0	−0.7	−0.1	0.0	0.0	0.0	0.6
Other Manufacturing	−9.2	−5.8	22.8	−1.7	−1.6	−0.2	−0.1	−0.1	4.0
TCF	−2.7	−3.5	6.2	−0.4	−0.3	−0.1	0.0	0.0	−0.9
Wood Paper Print	−0.5	−1.4	4.2	−0.2	−0.2	−0.4	0.0	0.0	1.5
Petroleum Coal Products	0.7	1.1	8.6	−0.2	−0.1	−0.1	−0.1	−0.1	9.9
Chemicals	−4.2	−3.2	5.9	−0.4	−1.2	−0.1	0.0	−0.1	−3.3
Rubber, Plastic, Glass Products	−0.9	−1.4	0.4	−0.3	−0.1	0.0	0.0	0.0	−2.4
Ceramic Cement Concrete	−0.3	−0.3	−0.2	−0.1	−0.1	0.0	0.0	0.0	−1.0
Metals	−13.6	−8.8	−13.3	−3.5	−4.4	−1.0	−0.3	−0.1	−45.1
Motor Vehicle Transport Parts	−0.9	−4.9	0.0	−2.4	−0.3	0.0	0.0	0.0	−8.6
Ship Rail Air Equipment/ Parts	−0.9	−0.9	0.9	−0.1	−0.2	0.0	0.0	0.0	−1.2
Electricity Black Coal	0.2	0.0	0.0	0.0	−0.1	0.0	0.0	0.0	0.1
Electricity Brown Coal	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Electricity Gas	0.0	0.0	−0.1	0.0	−0.1	0.0	0.0	0.0	−0.1
Electricity Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

(*Continued*)

Table 22.4. (*Continued*)

	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	AUSTRALIA
Electricity Hydro	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Electricity Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Electricity Supply	−1.0	−0.7	2.2	−0.2	−0.3	−0.1	0.0	0.0	0.0
Gas Supply	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water Supply	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.9
Construction	1.3	0.6	−1.1	0.4	1.0	0.1	0.0	0.0	2.3
Wholesale	−5.7	−5.6	25.3	−2.0	1.0	0.0	0.5	0.1	13.6
Retail Trade	−2.1	−1.3	21.4	−0.7	0.1	0.0	−0.2	0.1	17.4
Accommodation	−3.0	−2.4	52.5	−0.8	−0.5	−0.1	−0.1	−0.1	45.5
Road Transport	−5.0	−3.3	84.3	−0.8	−1.5	−0.2	−0.3	−0.2	73.0
Rail Transport	−0.1	0.0	3.7	0.0	−0.1	0.0	0.0	0.0	3.6
Trans Other	1.9	0.6	14.3	0.2	0.4	0.2	0.0	0.1	17.6
Water Transport	0.2	0.0	8.5	0.1	0.2	0.1	0.0	0.0	9.1
Air Transport	−2.3	−1.0	34.4	0.1	−0.2	0.0	−0.2	−0.2	30.6
Communication	4.6	4.2	2.0	0.8	1.4	0.2	0.1	0.3	13.7
Financial Services	5.2	2.4	3.9	0.5	0.8	0.3	0.1	0.2	13.4
Dwellings	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.5
Business Services	11.4	5.4	11.7	0.9	2.4	0.3	0.2	0.7	33.0
Gov Admin Defence	−0.2	−0.1	2.6	0.0	0.0	0.0	0.0	−0.1	2.1
Education	−2.2	−1.7	31.3	−0.3	−0.4	0.0	−0.1	−0.2	26.3
Health	0.6	0.6	4.0	0.2	0.2	0.1	0.0	0.0	5.8
Community Services	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.2
Gambling Recreation	2.2	1.6	7.6	0.4	0.5	0.1	0.1	0.2	12.7
Personal Services	0.5	0.5	12.1	0.2	0.2	0.0	0.0	0.1	13.6
Inbound Tourism	−21.2	−12.2	483.5	−2.3	−5.1	−0.9	−1.3	−0.8	439.7

Source: Authors' simulation results.

substitution effect among domestic sources; Construction, Communication and Financial Services are examples.

22.8. Conclusions

By nature, TSAs are a statistical tool. They are used to report how much the tourism sector has contributed to an economy and how important the tourism sector is compared to other sectors in the economy. TSAs allow us to compare the contribution of the tourism sector across regions, countries and over time in a consistent manner. Apart from enabling direct comparison of the tourism sector with other industries in an economy, the existence of TSAs has a much more significant role in practice. This role has been recognised across so many countries around the world, and finally was consolidated by the United Nations World Tourism Organisation in an international guideline that we have today, the *Recommended Methodological Framework*. The policy relevance of TSAs was summarised above.

The contribution of tourism to the Australian and State economies was set out in Tables 22.1 and 22.2. For illustrative purposes we focussed on various 'headline estimates' as shown in Table 22.1 and Direct Tourism Output by industry as shown in Table 22.2. The variables that appear in the TSAs measure the size and overall significance of the industry within an economy. As we discussed, TSAs are mainly descriptive in nature and are limited to those businesses that have a direct relationship with tourists.

Economic impact refers to the *changes* in the economic contribution resulting from specific events or activities that comprise 'shocks' to the tourism system. This is distinct from the contribution itself. TSAs provide a continuous flow back and forth between the supply and demand aspects of the tourism sector, the direct effect is well captured within the TSAs and this can be useful for measuring the initial direct impacts of tourism on other industries in the economy. However, analysts should exercise caution when elaborating these relationships into the kind of indirect multipliers in order to capture the economy-wide impact of tourism because the standard multiplier technique does not take into account resource constraints in an economy. If there is a shock to tourism demand (e.g., increased visitor numbers) the contribution of the tourism industry to the economy is likely to increase but the approach that must be used to estimate this is economic impact analysis. Economic impact analysis acknowledges the extensive interactive effects which occur across the economy. Analysts account for these by employing a CGE model. Our example, shown in Tables 22.3 and 22.4, illustrated this. Thus, increased inbound tourism to Queensland generates

additional tourism expenditure, output, value added and employment as the local tourism industry expands to accommodate this expenditure increase. While the TSAs can be employed to estimate the direct effects of additional tourism demand on the contribution of the tourism industry to the economy (for example, tourism output, tourism GDP or tourism employment), they cannot be used to estimate the *economy wide* impacts of the increased tourism since they do not contain any behavioural equations specifying how each sector responds to external shocks, including shocks normally affecting the sector directly and shocks transmitted through inter-sectoral linkages, via changes prices, wages, exchange rates and other variables. Since TSAs represent a snapshot or description of the significance of direct tourism demand within an economy at a particular time, TSAs do not provide a measure of net impacts on the economy of change in tourism expenditures. TSAs take no account, for example, of the possible factor constraints that may present barriers to tourism growth in response to an increase in tourism demand, or the impacts that changing prices and wages might have on other (non tourism) industries.

The advantages of CGE are many. Since it comprises a comprehensive input–output database, CGE can provide results from the industry level to the economy-wide level. Given the availability of TSAs data, tourism CGE models can provide tourism industry and tourism government departments with estimates of the impacts of tourism on the rest of the industries in the economy as well as the impact of other industries on the tourism sector. A CGE tourism model takes into account the resource constraints in the economy, such as the crowding out effects on exports of other commodities when tourism sustains higher output growth to satisfy higher demand. With this framework, a CGE tourism model can provide more realistic analytical recommendations to policy makers. More specifically, the model can be used to measure economy-wide yield for a particular tourist market so that appropriate assistance from government, or appropriate decision on new investment of infrastructure for tourism destinations. A CGE tourism model with an additional CO_2 account can be used to measure, for example, the impact of carbon tax on tourism output. Given the comprehensiveness of data on the supply and demand for all commodity markets in the IO database, a CGE tourism model can be used to measure the spill-over effect of productivity in other industries on tourism, and the mechanism would also allow productivity of the tourism sector to be measured in a more rigorous manner of the inter-industry linkage framework.

The examples highlight the different roles of TSAs and CGE modelling. Although TSAs and CGE models play different roles in providing policy

makers with insights into the economics of tourism, both are important and complement each other in the policy making.

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