Tourism Economics, 2008, 14 (4), 769–789

A comparison of three economic impact models for applied hospitality and tourism research

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This study examines the differences between three economic impact models: the capacity utilization model (CUM), Regional Economic Models, Inc (REMI) and the impact analysis for planning (IMPLAN) model with a view to providing insights into their applicability for hospitality and tourism educators and researchers. Four databases have been used to compare the results concerning total output, income and employment. The results were most dissimilar for the 'income' variable. The difference in income lies in the fact that the three models estimated income in three different ways. The CUM estimated 'payroll', REMI estimated 'disposable personal income' and IMPLAN estimated 'value added'. Due to the different income measurements, REMI's income estimates were the highest, while the CUM's were the lowest. This study does not strive to recommend one economic impact model over another; however, it does examine the behaviour of the respective models concerning various data sets and describes the underlying characteristics of the models.

Keywords: economic impact; tourism models; IMPLAN; REMI; capacity utilization model (CUM)

Tourism contributes significantly to the US economy as it impacts a wide range of business sectors and augments employment and payroll income. During 2003, total tourism-related direct and indirect employment was 5.4 million and 2.5 million, respectively (Kuhbach and Herauf, 2005). The tourism industry's

The authors would like to thank the Apalachee Regional Planning Council and the Tampa Regional Planning Council for providing the opportunity to use the region-specific REMI software for their respective counties.

value added grew 4.5% to US$285 billion, which represented 2.6% of the GDP for the period 2001–2003 (Kuhbach and Herauf, 2005). Moreover, tourism provides tremendous benefits for federal, state and local governments in the form of taxes (for example, excise, sales, income and property taxes). In 2004, the industry generated an estimated US$100 billion in taxes based on US$546.4 billion of direct sales from tourism (Travel Industry Association of America, 2005 – personal communication with Dr Tien Tian).

The economic impacts of tourism are frequently analysed using economic impact modelling software. The objective of this paper is to compare three economic impact models (the capacity utilization model (CUM), Regional Economic Models, Inc (REMI) and the impact analysis for planning (IMPLAN) model) using four visitor survey expenditure databases. The study also examines previous tourism economic impact studies (from 1990 to current) to determine methodologies pertaining to CUM, REMI and IMPLAN.

In doing so, the State of Florida was selected to provide data sets for analysis of the economic impact models. Florida was selected because tourism is the number one industry, due primarily to its natural resources, a favourable climate, an immense shoreline, theme parks, professional and major university sports, major airports and cruise industry ports, cultural events and retirement communities. The number of Florida tourists reached a record 76.8 million in 2004 and is projected to grow to 89 million by 2010 (Visit Florida, 2006). Currently, 1.3 million Florida jobs are related directly or indirectly to tourism and are projected to grow to between 1.5 and 1.8 million by 2010. The 2005 Florida Visitor Study reported that the state collected US$3.7 billion in tourism/recreation sales taxes in 2005; that is, US$62 billion was infused into the state's economy during the year through tourist expenditures. The study also noted that tourism expenditures supported 948,700 jobs in 2005 (Visit Florida, 2005). Tax revenues accounted for about 20% of the total tax revenues (in sales and use taxes) collected (Baker and Aydin, 2005).

Literature review of economic impact models

There have been various studies relating to the economic impact estimation of tourism spanning the past 20 years; however, few articles exist that compare the performance of those models. Following is a literature review of several of the studies that have examined economic impact modelling and performance with respect to the tourism industry. Stynes (1999) conducted numerous studies that focused on the economic impacts of tourism. He outlined several approaches that researchers might employ, including four typical approaches: (a) subjective estimates that rely on expert opinion; (b) secondary data, in aggregate form, using existing estimates tailored to the situation; (c) secondary data, in disaggregate form, allowing a finer resolution to fit the situation; and (d) primary data and/or formal models, usually involving visitor surveys and regional economic models. It is the latter issue of economic impact modelling that this paper will address. Archer (1984) described the sources available to acquire data and the necessary processes to adapt these data for use in input–output (I/O) modelling. He noted that a local or regional consumer expenditure survey was rarely available and was both expensive and time-consuming. However,

this study was able to utilize those 'expensive and time-consuming' data sets since the local verifiable survey data was collected based on a series of personal interviews using the randomized sampling design. Hence, this would serve to strengthen the ability of this paper to allow more accurate comparisons of CUM, REMI and IMPLAN.

Ryan (2003) discussed the economic impacts of tourism and economic impact models. He pointed out that while I/O analysis further refined the basic multiplier processes, the transference to service (in particular, tourism sectors) was hampered by the lack of definition with regards to the tourism industry. There are no SIC or NAICS codes assigned solely to the tourism sector. Currently, there are only two NAICS codes pertaining to two tourism-related sectors:[1] Convention and Visitor's Bureau and Administration of General Economic Programmes. As can be surmised, the tourism sector is still not fully defined by NAICS.

A seminal work, and highly quoted tourism economics text, *Economics of Outdoor Recreation* (Clawson and Knetsch, 1971), discussed the economic impact of outdoor recreation, including tourism, on local areas. Although the book did not cover economic impact modelling *per se*, it provided an economic impact foundation for the calculation of multipliers and procedures regarding expenditure surveys.

In *Travel, Tourism, and Hospitality Research: A Handbook for Managers and Researchers* (1994a,b,c), Frechtling provided an overview of Archer and Owens's *ad hoc* model (developed individually for each area studied). He recommended using the *ad hoc* model and the I/O approach, depending on the budget available and the expertise of the researchers. Frechtling suggested that IMPLAN was a cost-effective way to measure total tourism impacts on an area's economy. In conclusion, he advocated that the time had come to progress beyond measurement issues and begin to draw conclusions that could be applied broadly to public marketing, planning and development decision making.

In 2001, The Connecticut Center for Economic Analysis (CCEA) performed an economic impact study of Connecticut's travel and tourism industry using REMI. They employed a mix of survey methods to calculate a reliable estimate of total tourism-related economic activities in Connecticut. They examined 8 counties and 11 tourism 'districts'. Their results revealed that, in relative terms, Connecticut's travel and tourism industry employed a larger fraction of workers than manufacturing or financial, insurance and real estate (FIRE).

Rickman and Schwer compared the REMI and IMPLAN economic models in 1993 and 1995a,b. To date, their studies are the only ones that exist, the exception being a paper by Perlich (2005), that describe the differences between REMI and I/O. Crihfield and Campbell (1992) and Deller (1992) ultimately found that, based on the structural differences in the REMI and IMPLAN models, differences did not affect the multiplier estimates significantly. In their 1995b study, Rickman and Schwer examined how multipliers compared among various versions of the models. They found that there was a tendency for IMPLAN to overestimate the regional purchase coefficients (RPCs) in the service sectors, such as in resource-based and tourist-based economies. It was discussed, however, that this would be easy to remedy based on the user's ability in IMPLAN to alter or adjust RPCs. However, this limitation could result in unintentional underestimation because it is arbitrary and non-scientific.

Description of models

The capacity utilization model (CUM)

The capacity utilization model (CUM) was developed originally in 1990 by Henry Fishkind for economic analysis of tourism in the State of Florida. Fishkind and Associates conducted numerous tourism studies in Florida and other states. One of those studies was summarized in the Central Florida Visitor Industry Report in 1989. With respect to tourism, the CUM quantifies the economic impact (labour and fiscal) that tourism has on the local economy. The basic assumption of CUM is that it uses the hotel/motel industry as a baseline. In order to measure the capacity of the tourism sector, the model uses the hotel/motel industry as a baseline and obtains total numbers of rooms available and occupancy rate information from a national industry reporting service, Smith Travel Research.[2] Additionally, surveys of local lodging properties for each of the four studies were conducted to determine occupancy rate, average daily rate and historical occupancy during the specific time of the event and estimates of total numbers of rooms sold to event attendees. This information was compared with the Smith Travel information to provide an increased accuracy. The models also used the following information based on survey instruments: estimates of average party size for those using hotel and motel accommodations, the average trip length in nights for those staying in hotels/motels and the proportion of visitors who stay in hotel/motels versus those staying with friends and relatives, in campgrounds, condominiums, as well as visitors coming just for the event and spending no evenings in the area. Visitor expenditures (hotels, transportation, entertainment and food, etc) were also obtained through the survey.

Using the CUM to estimate the total number of visitors is especially valuable when the event is open access and visitor numbers cannot be obtained by the total number of tickets sold. The CUM has been used by Bonn and Bell (1998 and 2003) to estimate economic impact, recreational (use) value and visitor numbers associated with natural springs and artificial and natural reefs. These studies involved 21 Florida counties over a six-year period. Economic impact is measured by the direct and indirect output and employment created by visitors, as well as total wages paid to visitor industry employees and the geographic distribution of the paid salaries. The CUM does not address induced impacts. Multipliers in this model for Tampa, Florida and Tallahassee, Florida, were obtained using the US Department of Commerce database on county multiplier statistics. A multiplier of 1.5 was provided and used to estimate the total output (that is, direct expenditures (Table 1) $\times$ 1.5 = total output).[3] Direct employment and wages were estimated using the latest statistics published by Economic Census, the US Census Bureau (Economic Census, 2002). For the two events and two quarterly databases studied in this article, the 1997 Economic Census was used and updated using the Consumer Price Index (that is, CPI) for inflation. Figure 1 outlines the theoretical framework for the calculation of economic impact estimates in the CUM.

The REMI model

REMI 2002 is a widely used dynamic integrated I/O and econometric model. REMI is based on neoclassical theory and was founded in 1980. The model's

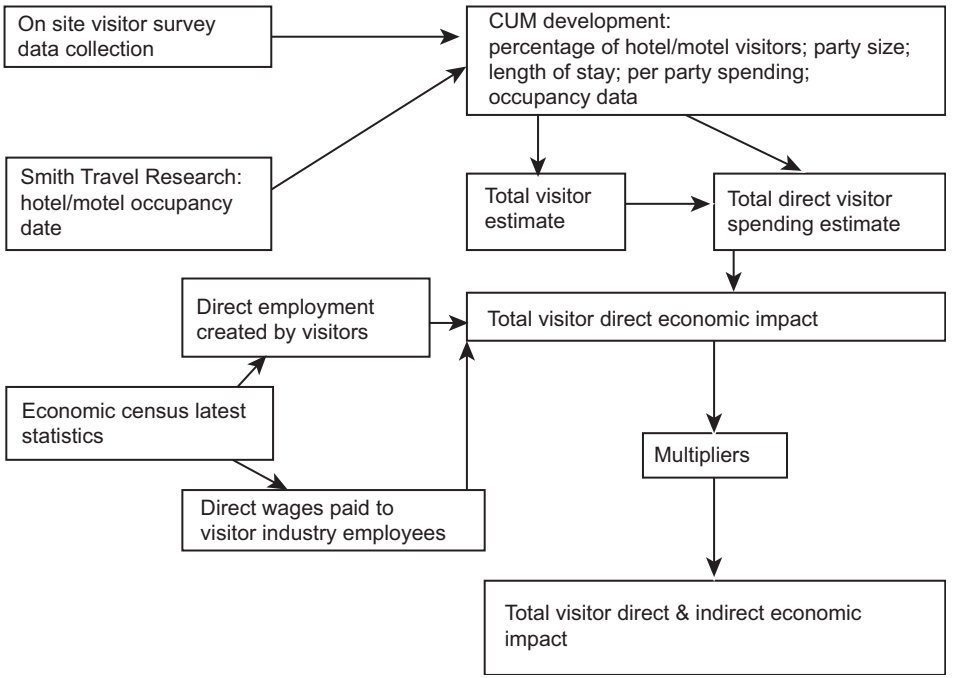


Figure 1. CUM economic impact analysis framework.

structure incorporates inter-industry transactions and endogenous final demand feedbacks. The basic assumption of REMI is that the model is based on theoretical structural restrictions rather than individual econometric estimates based on single time-series observations for each region. It has much in common with the computable general equilibrium (CGE) models. It does, however, differ from the CGE models in that the REMI model does not require markets to clear continuously (Treyz, 1993). REMI is used extensively to measure proposed legislative and other programme and policy economic impacts across the private and public sectors of the state by the Florida Joint Legislative Management Committee, Division of Economic and Demographic Research, the Florida Department of Labor and other state and local government agencies. In addition, it is the chosen tool to measure these impacts by a number of universities and private research groups that evaluate economic impacts across the state and nation. Figure 2 provides a baseline for the calculation of economic impact estimates in REMI.

REMI shares two underlying assumptions with mainstream economic theory: households maximize their utility and producers maximize their profits. It includes hundreds of equations that describe cause-and-effect relationships in the economy, extending beyond an I/O model.

The REMI used for this analysis (version 8.0) was developed specifically by county for the state of Florida and included 23 sectors. For the Tallahassee area, the county model comprised Leon, Jefferson, Gadsden and Wakulla counties. For the Tampa area, Hillsborough, Pinellas, Pasco and Manatee counties were examined. REMI's principal advantage is that it is a dynamic I/O econometric

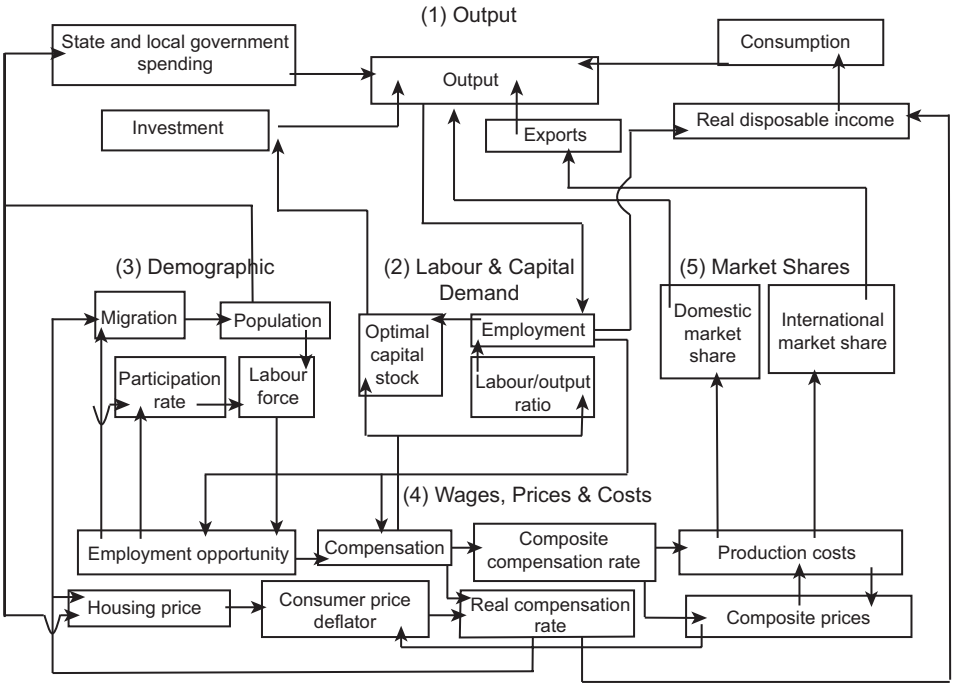


Figure 2. REMI economic impact analysis framework.

model and can be used to forecast both direct and indirect economic effects over multiple-year time frames. However, the model is not county specific, which could lead to unnecessarily inflated results. Other I/O models are used primarily for static or single-year analysis. REMI uses three sources of employment, wage and salary data: the Bureau of Economic Analysis (BEA) employment, wage and personal income series, ES 202 establishment employment and wage and salary data, and county business patterns (CBPs) data published by the Bureau of the Census. The industries are based on the North American Industrial Classification System (NAICS).

IMPLAN model

The impact analysis for planning, or IMPLAN, model, in contrast to REMI, is solely an I/O model. The theoretical framework is input–output, developed by Wassily Leontief, for which he received the Nobel Prize in 1973. The basic assumption of the IMPLAN model is that the fundamental information in I/O analysis involves the flow of products from each industrial sector (producer) to each of the industrial sectors considered as consumers. This information is contained in an inter-industry transactions table. The rows of the table represent the distribution of the producer's output throughout the economy. The columns represent the composition of inputs required by an industry to produce its output. There are additional columns that depict 'final demand', or sales, by

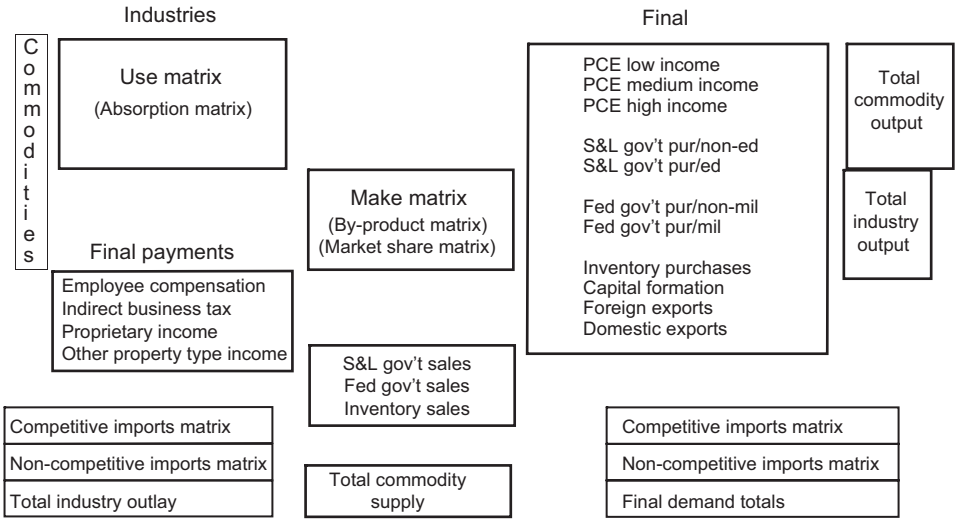


Figure 3. IMPLAN economic impact analysis framework.
Source: IMPLAN Central NRCS Economists Workshop (MIG, Inc, 1997).

each sector to final markets for their production. The additional rows are termed 'value added', which comprise the other non-industrial inputs to production, such as labour. IMPLAN was founded in 1993 as an extension of two researchers' work at the University of Minnesota and involving collaborative work with the US Forest Service Land Use Planning Unit in Colorado. It is non-survey based and its structure illustrates that of I/O models found in the regional science literature. Figure 3 provides a baseline for the calculation of the economic impact estimates in IMPLAN.

Key I/O assumptions used in IMPLAN

(1) Constant returns to scale production function (that is, linear).
(2) Homogeneous sector output.
(3) No input substitution.
(4) No supply constraints.
(5) Other IMPLAN considerations:
    (a) Technology and trade relations are assumed.
    (b) Need to account for price changes.
    (c) Need to account for structural changes.
    (d) Employment increase or decrease causes immediate in or out migration (that is, full employment).

Similar to REMI, IMPLAN assumes a uniform national production technology and uses the RPC approach to regionalize the technical coefficients. IMPLAN 2002 Florida county-level was used for the economic analysis for this research. This newer version now has 509 sectors instead of 528 and includes the conversion from SIC to NAICS codes. The primary sources of employment and earnings data are CBPs data and BEA data.

Table 1 provides a summary of the three economic impact models.

Table 1. Comparison of the three models.[a]

Characteristics		REMI	IMPLAN	CUM
I.	Type	Conjoined input–output and behaviour model	Regional input–output	Derived from labour force economics, linear equation Individual tourism arrivals
II.	General model characteristics			
	Base year	1980	1993	1975, updated in 1990s
	Reference model	National A matrix	National A matrix	
	Open/closed	Open	Both	
III.	Sector scheme			
	Disaggregated	493	509	Unlimited and dependent on survey variable numbers
	Aggregated	23 (county) or 70 sector (state) or 169 (state)	User choice	User choice
IV.	Regionalization technique			
	Product mix	Keep at a disaggregated level	Keep at a disaggregated level	Keep at a disaggregated level
	Consumption	BLS Regional Consumer Expenditure Surveys	Adjusted using RPCs	Adjusted using multipliers
	Trade patterns	Regional purchase coefficients	Regional purchase coefficients	Multipliers can be input into the model (from other source)
V.	Impacts measured			
	Output	Yes	Yes	Yes
	Employment	Yes	Yes	Yes
	Income	Yes	Yes	Yes
VI.	Special features	Economic Geography Transight 20/20 Policy Insight, BizDev	County Data, Zip Code, Level Data	Tourism and hospitality industry specific
VII.	Computer requirements	IBM PC or mainframe	IBM PC or mainframe	IBM PC
VIII.	Costs			
	Purchase model	Variable; many options and pricing schemes available (for example, US$46,000) for primary licence (70 sector state of Florida and US$69,000 169 sector) and US$6,900 for secondary licence for state of Florida model	US$540 software State totals packages US$500–US$2,650 state (including counties) Individual state US$350 Zip Code Level File US$425	Free

Table 1 continued.

Characteristics		REMI	IMPLAN	CUM
	Customized simulation	Available	Available	Available on request
	Other options	Leasing models are available		Customized models
IX.	Data	Secondary	Secondary	Primary
X.	Time period	Dynamic, 50 years or more	Static, one year	Static
XI.	Website	http://www.remi.com/	http://www.implan.com/	http://www.fishkind.com/

Note: [a]Excerpted from 'Analyzing the economic impact of transportation projects using RIMS II, IMPLAN and REMI', Dr Tim Lynch, Director, Center for Economic Forecasting and Analysis (2000). Prepared for Office of Research and Special Programs, US Department of Transportation, Washington, DC. Supported by a grant from the US Department of Transportation, University Research Institute Programme.

Overview of Florida tourism expenditures databases

During 2003–2004, researchers based in Florida collected survey data during two special events: the Southwest Airlines Gasparilla Pirate Fest (Gasparilla) and the University of Miami versus Florida State University Football Game Weekend (Miami vs FSU). Also, data were collected for two quarterly research projects involving visitors to Florida destinations within specific counties: Tampa (Hillsborough County) and Tallahassee (Leon County), Florida. Data were collected based on a series of personal interviews for each of the two events encompassing three days. Additionally, data were collected over the course of three months for each of the two quarterly databases. The following discussion is a detailed explanation on methodologies for each of the two events and the two quarterly databases that were used in the economic impact analysis comparisons.

Gasparilla 2004

The Southwest Airlines Gasparilla Pirate Fest is an open access mega-event that is held in Tampa, Florida. The annual event consists of a day parade that traverses an eight-mile route along what may be the longest contiguous sidewalk in the USA. On-site surveys were conducted based on a randomized sampling design. Surveyors were stationed at specific points on both sides of the parade route. Every third adult was approached for qualification as a non-resident. If the third adult was a local resident, then the next adult was approached for non-resident qualification purposes. This process continued until non-resident parade attendees were identified. In this study, Gasparilla visitors were defined as those who were non-Hillsborough County residents. Ultimately, 300 Gasparilla visitors provided data suitable for this analysis.

University of Miami versus Florida State University Football Weekend

During the weekend of 11 October 2003, the University of Miami versus Florida State University Football Game attracted approximately 82,000 individuals to the Doak Campbell Stadium through ticket sales. A significant number of tickets were purchased by local residents, including students, and were therefore omitted from the analysis. On-site surveys were conducted based on a randomized sampling design. Surveyors were stationed at specific data collection points around the stadium. Additionally, surveys were conducted at randomly selected lodging properties within the county. Every third adult was approached for qualification as a non-resident. If the third adult was a local resident, then the next adult was approached for non-resident qualification purposes. This process continued until non-resident attendees were identified. In this study, visitors were defined as those who were non-Leon County residents. A total of 284 usable data were collected during the event weekend.

Tallahassee, Florida: Q1 2004

Visitors to Tallahassee (Leon County, Florida) were interviewed personally as part of a comprehensive destination marketing research project. During random days, sites and times, visitors were screened randomly using random numbers to qualify them as non-residents. Once qualified as non-residents of Leon County, visitors were asked to respond to a survey related to their on-site (most recent) travel experience. Information pertaining to economic expenditures, party size, length of stay, demographics, activities pursued during this trip, primary destination for this visit and many other dimensions were represented on the survey instrument. More than 500 (N = 515) usable surveys were collected for the analysis.

Tampa, Florida: Q1 2004

Visitors to Tampa (Hillsborough County, Florida) were interviewed personally as part of a comprehensive destination marketing research project. The survey methodology was identical to the Tallahassee Q1 study. A total of 1,538 surveys were identified as suitable for the analysis.

Economic impact methodology

This paper describes the impact of tourism on the economy of Florida counties using three economic impact models (CUM, REMI and IMPLAN). Comparisons were conducted using the results from these three economic impact models and examined the increase in employment and economic output generated by tourism activities specific to the counties' economies. The net economic stimulus from tourism was estimated by summing tourism expenditures based on survey data for four economic activities and events:

Gasparilla, Miami vs FSU Football Game, the Tallahassee quarterly and the Tampa quarterly visitor survey. Direct expenditures were divided into the following for each of the four databases: lodging, event admission fees, restaurants, evening entertainment, shopping, ground transportation, groceries and all other. These expenditures were then used as inputs for the three Florida regional I/O models, which included cross-linkages among every sector of the Florida economy. As tourists/visitors expend dollars, further demand for goods and services across other sectors of the Florida economy are generated. Direct tourism spending creates a secondary 'multiplier' cycle of spending that further increases income, jobs and total state economic activities, referred to as state output. This analysis measures those direct and indirect economic increases flowing from tourism dollars based on the four expenditure databases. It does not quantify the intangible benefits generated by the presence of tourism to the local economy for issues such as improved transportation, health care, historical environment or cultural amenities, among others.

Measured economic impacts include increases in: (a) total output; (b) income; and (c) employment. Short-term economic impacts are the net changes in regional output, earnings and employment that are due to new dollars entering a region from a given enterprise or economic event. In this study, the enterprise is tourism and the region is specific Florida counties. The effects of expenditures external to Florida (termed leakages) were not included in the impact estimates.

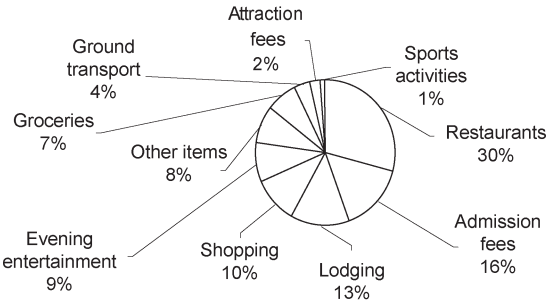
As part of our modelling strategy, actual tourism expenditures were used to calculate the economic impact (Table 2). The various tourism direct expenditures (for example, lodging, event admission fees, restaurants, shopping, ground transportation, groceries and all other) were disaggregated by specific economic sectors to calculate the economic impacts (Figure 4).

Table 2. Amount of tourism expenditure by economic database/event for Gasparilla, Miami versus FSU Football Weekend, Tallahassee, Q1 and Tampa, Q1.

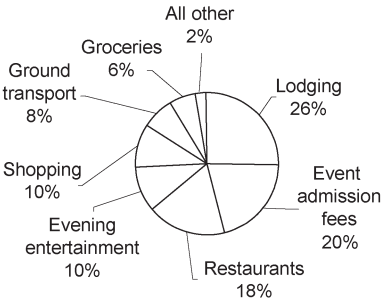
Spending category by value (US$ million)	Gasparilla	Miami vs FSU	Tallahassee, Q1	Tampa, Q1
Attraction fees	0.49	0.00	1.79	0[a]
Evening entertainment	1.99	1.03	17.53	26.58
Event admission fees	3.36	2.01	2.92	196.38
Groceries	1.58	0.62	10.07	31.54
Ground transportation	0.88	0.76	9.49	54.30
Lodging	2.91	2.61	52.47	145.00
Other items	1.81	0.23	7.82	20.18
Restaurants	6.37	1.79	58.97	162.47
Shopping	2.23	1.01	58.16	95.80
Sports activities	0.21	0.00	5.23	22.00
Total expenditure	*21.83*	*10.07*	*224.45*	*754.25*

Note: [a]Events (US$22.8 was included with admission fees).

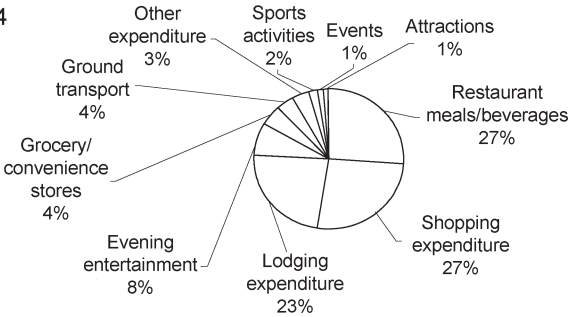
Gasparilla



Miami versus FSU Home Football Game



Tallahassee, Q1, 2004



Tampa, Q1, 2004

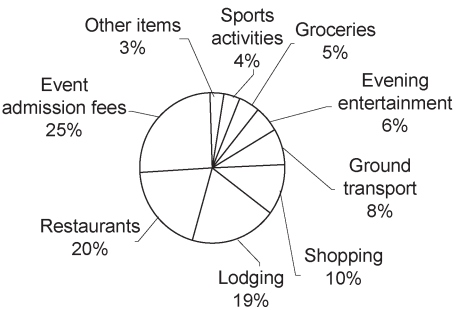


Figure 4. Percentage of tourism expenditures by economic database/event for Gasparilla, the Miami versus FSU Home Football Game Weekend, Tallahassee, Q1 and Tampa, Q1.

Model assumptions

This paper provides estimates of the direct, indirect and induced effects of tourism expenditures on the economies of two Florida counties. The model assumptions are:

(1) The base model assumes a constant rate of growth for the economy.
(2) The expenditure approach model uses actual tourism expenditures (by category: lodging, shopping, etc) multiplied by total estimated number of visitors.
(3) The total number of visitors estimated by the CUM is valid and is used in the REMI and IMPLAN models.
(4) The total tourism expenditures by database are: Gasparilla – US$21.83 million; FSU–Miami Game – US$10.07 million; Tallahassee Q1 – US$224.45 million; and Tampa Q1 – US$754.25 million. Results are expressed in terms of impact on total output, income and employment.

Model limitations

(1) A limitation of the base model assuming a constant rate of growth for the economy is that there are multipliers associated with each sector; for example, if one sector grows by X amount, then the whole economy grows by X times the sector multiplier. Hence, theoretically, growth in any sector can result in an arbitrary high level of growth in the corresponding whole economy, which may not be the case. REMI has three options for simulating the growth rate of an economy; historical observed (the default choice), anticipatory fed and Keynesian approaches.
(2) The expenditure approach model uses actual tourism expenditures (by category: lodging, shopping, etc) multiplied by total estimated number of visitors. Spending estimates are based on a representative sample of the tourist population, which encompass a wide array of tourist type, location and seasonal variations.
(3) The total number of visitors estimated by the CUM is valid and is used in REMI and IMPLAN models.
(4) The total tourism expenditures by database are: Gasparilla – US$21.83 million; Miami–FSU Game – US$10.07 million; Tallahassee Q1 – US$224.45 million; and Tampa Q1 – US$754.25 million. Results are expressed in terms of impact on total output, income and employment. Economic impact estimates are based on solid numbers and types of visitors, which is not, the authors contend, a limitation of this study. However, the economic impact results are generalized to these specific events/databases.

Strengths and weaknesses of the three models

One major strength of the CUM is that it is industry specific and does not require an expensive software program. It provides detailed estimates of county-

level sectors based on primary data. The model can be distributed freely. The major strengths of REMI and IMPLAN are that they can provide detailed estimates of sectors at the county level. REMI is capable of providing a finer resolution than at the county level (for example, city); however, both REMI (by county) and REMI customized (for example, a metropolitan area) are far costlier options than county-level IMPLAN. REMI uses several economic impact methodologies (I/O, econometric equations, economic-base and some aspects of CGE) over multiple years (to 2050) and IMPLAN employs solely an I/O modelling methodology with a one-year (static) forecast horizon. Hence, depending on the modeller's needs, REMI would be advantageous for short- and long-term analysis. The REMI model is able to simulate how long-run impacts may differ from short-run impacts due to changes in competition, in/out migration rates, labour/capital substitution and inflation, among others. In addition, the REMI model estimates the future economic profile of a region based on national forecasts of industry growth, changing technology and its own estimates of the shifting competitive position of each industry in a given region compared to that industry elsewhere in the country (Weisbrod, 1990). IMPLAN does not have this capability.

IMPLAN allows internal customization; that is, by developing multiplier tables, changing components of the systems such as production functions and altering trade flows, generating Type I, II, or any true social account matrix (SAM) multiplier internalizing household, government and/or investment activities, and creating custom impact analysis by entering final demand changes, among others (IMPLAN, 1999). REMI provides a dynamic perspective (forecasting capabilities up to year 2050) and year-to-year effects for over 6,000 variables. The REMI model does not allow users to change the I/O or develop new multipliers. It can be run as a simple I/O model by turning off economic migration, endogenous consumption and certain price responses. The user cannot alter RPCs directly in the regional model (REMI, 2005). It is beneficial to be able to alter RPCs if the modellers are aware of information specific to a good or service that is not captured by the current model.

Although the CUM can produce estimates, similar to the other two models, on total output and number of jobs created, the model has its limitations. First, it can estimate only the direct and indirect impacts (that is, not induced impacts). It does not present results as separate categories (direct and indirect) but, rather, as total impacts. The model does not provide detailed information like total value added, employee compensation, proprietor's income, etc. Second, the CUM's only resource is Economic Census reports from the US Census Bureau. Since the Economic Census is updated every five years, the key statistics used in the model remain the same for five years and are adjusted for inflation only. Some general weaknesses of IMPLAN are that it is inappropriate to use with large impacts (Kraybill, 1993). According to Miller and Blair (1985), the I/O model (including IMPLAN) assumes a linear production function, which translates to constant returns to scale and constant production function for each firm in an industry. It also assumes there are no constraints to the supply of any commodity and that full employment is the norm. IMPLAN assumes national average production coefficients and margins and uses a set of econometric equations to predict interregional trade flows. If one does not accept these assumptions, users, as mentioned earlier, have the ability

to input their own data to improve the accuracy of the impact estimates (that is, internal customization or hybrid approach).

There is another method, called tourism satellite account (TSA), which can be used to estimate the economic impact of tourism activities like the one discussed in this paper. 'Satellite account' is a concept developed by the UN to measure the size of economic sectors that are not defined as industries in the *system of national accounts* (SNA). TSA is the outcome of the collaborative work of multiple national governments, as well as international institutions like the World Tourism Organization (WTO), the Organization for Economic Cooperation and Development (OECD) and the United Nations (UN), to create a *comprehensive* and *consistent* measure of the economic impact of tourism. As early as 1983, the WTO called for the creation of 'a uniform and comprehensive means of measurement [of tourism] and comparison with other sectors of the economy' (Smith and Wilton, 1997). In 1994, the WTO started designing a TSA with the objective of presenting a comprehensive and integrated framework for estimating production, consumption, capital investment, employment and other variables related to tourism activity. There are currently 70 countries or territories around the world implementing a TSA (Libreros *et al*, 2006).

The term 'satellite' refers to the fact that a TSA is based on the I/O framework of a state/regional economy. It is a subset of general I/O accounting. Since tourism is a conglomeration of industries, it is not possible to identify a set of industries, add up their output/employment and use the result to gauge the impact of tourism in a country or region. TSAs offer a solution to this problem by weighing the output/employment of all tourism-related industries by the ratio of tourism expenditures to total expenditures for each industry (Smeral, 2006).

TSAs start with a solid definition of tourism and delineation of 'core' tourism industry. As accepted by the UN and WTO, TSAs define tourism as 'activities of persons travelling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business, and other purposes' (United Nations, 1994). TSAs' core tourism industries consist of five broad industries: lodging, restaurants, entertainment, transportation and retail. TSAs first measure tourism's impact on these industries. They also extend beyond core tourism industries and measure tourism's indirect effect on other industries, such as printing/publishing, concrete, utilities, financial services, furnishing and equipment suppliers, food, security, administration and so forth. Thus, TSAs capture the impact of tourism on industries that benefit directly or indirectly from travel and tourism expenditures.

The TSA model was not used in this study for three reasons. First, unlike REMI and IMPLAN, a TSA model measures only direct and indirect impacts of tourism expenditures, not induced impacts. Second, since a TSA model is derived from an I/O model such as REMI and IMPLAN, direct and indirect impacts from a TSA model likely will not be different. Third, and most important, currently we do not have a TSA model developed for the state of Florida. While the US BEA and several other states currently use a TSA model to estimate the economic impact of tourism expenditures, Florida uses only a tourism/recreational sales category as a proxy to estimate direct visitor expenditures. A recent study strongly recommended that the state develop a

TSA model in order to capture the economic impact of visitor expenditures fully (Aydin, 2007).

Economic analysis results of the three models

The following results present the economic impact of tourism expenditures for the four specific databases regarding their respective counties. Table 3 summarizes the total economic impact of tourism on the economy of the Florida counties. The table depicts the economic impacts of tourism on employment, total output and income from the tourism expenditures based on the four specific databases. Output is the amount of production, including all intermediate goods purchased, as well as value added. Increases in personal (or disposable) income translate into more economic activities and local and state tax revenues. In addition to total output and income, tourism generates a significant amount of employment across the state. REMI assumes that changes in employment affect wages. These changes in wages affect in-migration (that is, population) and labour supply, which in turn affects employment levels. The employment results are expressed in terms of jobs. Total output and real disposable income results are expressed in terms of 2005 US$.

This tourism-generated rise in state output created considerable direct and indirect increases in employment across the state. Table 3 indicates that additional jobs are created from these spending increases. In turn, this employment increase also generates higher wage and salary earnings for Floridians. Table 3 illustrates the direct and indirect personal (or disposable) income increases. Structural differences were revealed through examination of the documentation for both the IMPLAN and REMI models. The authors were unable to obtain any documentation associated with the CUM developed by Hank Fishkind (personal communication with Fishkind and Associates, September 2005).

In REMI and IMPLAN, total output measures the sum of the direct, indirect and induced effects of changes in the economies of Tallahassee and Tampa, Florida. It refers to the amount of production/service, including all intermediate goods purchased, as well as value added (compensation and profit). Regarding output measures in the CUM, only direct and indirect impacts are provided. With respect to employment, the CUM uses county Economic Census reports to estimate the number of paid employees created. The county REMI gives BEA employment estimates as a count of the number of jobs. It incorporates the CBPs provided in an annual series that includes employment during this study period (not including proprietors and partners of unincorporated businesses). The series excludes data on self-employed individuals, employees of private households, railroad employees, agricultural production employees and most government employees. However, REMI is able to estimate self-employment by incorporating data from the BLS Current Employment Survey (for wage and salary jobs and average weekly hours), the Current Population Survey (for self-employed and unpaid family worker jobs, agricultural employment, employment and private household employment, except logging) and ES-202 employment and wages data collected from the unemployment insurance programme (for industries unpublished in the CES).[4] Similar to REMI, IMPLAN

Table 3. Comparison of IMPLAN, REMI and CUM models in 2005 US$.

Miami vs FSU Football Game: Leon, Gadsden, Jefferson and Wakulla Counties			
	Output (US$)	**Employment**	**Income (US$)**
IMPLAN results	14,242,929	312	9,497,102
REMI results	16,377,711	271	13,071,023
CUM results	16,131,938	315	3,122,453
Tallahassee Q1: Leon, Gadsden, Jefferson and Wakulla Counties			
	Output (US$)	**Employment**	**Income (US$)**
IMPLAN results	276,806,327	5,349	173,949,219
REMI results	352,953,481	5,748	263,391,248
CUM results	360,492,568	6,560	80,310,000
Gasparilla: Hillsborough, Pinellas, Manatee and Pasco Counties			
	Output (US$)	**Employment**	**Income (US$)**
IMPLAN results	32,977,669	510	19,259,177
REMI results	43,248,404	335	21,880,334
CUM results	32,760,000	493	8,412,504
Tampa Q1: Hillsborough, Pinellas, Manatee and Pasco Counties			
	Output (US$)	**Employment**	**Income (US$)**
IMPLAN results	1,317,689,044	18,794	731,359,298
REMI results	1,165,735,547	9,287	550,013,441
CUM results	1,131,378,421	17,395	286,570,000

bases its employment estimates on unemployment insurance (ES-202) data, or 'covered employment', and since the early 1990s has been providing estimates of self-employed, railroad, or any other firms that do not pay unemployment insurance using a combination of ES-202 and BEA Regional Economic Information System (REIS) data.[5] Self-employment data are important since they include those employees that typically are not surveyed but are still integral to tourism industries, such as taxis, micro-accommodations, etc. Wages, or income, for the CUM are based on the county Economic Census reports from the US Census Bureau. Both REMI and IMPLAN are based on CBPs, the US Department of Labor's Unemployment Insurance CEW – Covered Employment and Wages Program – and BEA REIS databases. It should be emphasized that the use of primarily national industry structures to represent local production, especially in more rural areas, can be problematic.

Discussion of results

The economic impact results pertain specifically to the four economic activity and event databases. An assumption is made (and limitation) in this study that the economic impact estimates are applicable for the entire year. The results

were variable between the models, particularly the 'income' result comparisons. The difference in income lies in the fact that both IMPLAN and REMI include multiple counties (three for each study area) within their model. The CUM includes only county-specific information. This is one of the main reasons that the CUM appears to offer very conservative outputs pertaining to income.

The CUM estimated the 'payroll' (but uses only county-specific information), REMI estimated the 'disposable personal income' and IMPLAN estimated the 'value added'. The major differences between the income definitions are:

- GVA, or gross value added – composed of the value of final demand created by consumer spending, investment, net exports and government spending excluding intermediate inputs.
- Personal income – consists of total increases in payroll costs paid by local industries, plus income from self-employment, other property income and transfer payments.
- Disposable income – a measure of after-tax buying power of the community (income less taxes). It reflects increased government spending and consumer activity.

Both REMI and IMPLAN incorporate three additional counties in each study area, which could lead to over-inflation of income. In REMI, the disposable income variable (personal income minus taxes) was used to represent the income impact. The REMI income determinants included: total labour and proprietor's income, personal contributions to social insurance, the net residence adjustment, dividends, interest and rent and transfer payments. In IMPLAN, however, the value-added impact was determined to resemble most closely REMI's definition of personal income. Value added consists of employee compensation, proprietor income, other property income and indirect business taxes. Due to the different income measurements, REMI's income estimates are the highest while the CUM's are the most conservative, again due to the fact that the CUM is county specific and the other two models use multiple counties (that is, regions) to generate output. In comparing both REMI and IMPLAN, the IMPLAN output results were consistently lower in three databases. The Tampa quarterly database, however, demonstrated higher output estimates with IMPLAN. This could possibly be due to the IMPLAN model, which incorporates four counties (representing the Tampa region) and corresponding level of disaggregation (509 sectors). The interregional effect among counties is not taken into account with IMPLAN;[6] however, it is accounted for in REMI.[7]

The CUM ranged from the highest output results (Tallahassee Q1) to the lowest output results (Tampa Q1). This could be a result of the fact that the CUM model is constructed specifically for the tourism, lodging and hospitality industries. Interestingly, in comparing the two models (REMI and IMPLAN) regarding employment, REMI was lower in all four databases. This could be due to the ratio between output and employment impacts being affected by REMI's inclusion of price/wage effects. County level IMPLAN uses a national average for output per worker (and adjusts to the regional level using the BEA REIS data) and REMI uses regional productivity values. Hence, given a uniform shock in each of the models, it is possible that REMI has a higher labour productivity rate, and demand for labour to produce the same level of output

is lower; hence, employment is lower. Thus, although REMI's output results are greater in terms of output in two databases, the employment results are consistently lower. Income level results are significantly greater with REMI, in three of the four databases. The CUM model consistently tracks significantly more conservatively in terms of personal income. Again, this may be due to the fact that the CUM model is specific to the tourism, lodging and hospitality industry. It uses only data from visitor spending, whereas the other two models do not. Furthermore, it uses only county-specific information. The other two models use four counties for each of the two study samples.

A possible explanation for the total output, employment and income differences (since the data sources are comparable) between REMI and IMPLAN could be that the REMI county-specific model is working from a highly aggregated regional I/O table (23 sectors) and the corresponding RPC values yield different results than the IMPLAN model, which is working from a highly specified county I/O table (509 sectors). A fundamental difference, as outlined by Perlich (2005), between IMPLAN and REMI is that IMPLAN accounts for economic variables only (production, spending, employment), whereas REMI accounts for economic labour force, population (migration, births, deaths) and fiscal impacts. In addition, market dynamics and relative regional competitiveness across time are also included.

Prior to selecting one economic impact model over another, decision makers should consider the following primary factors, as outlined previously in Table 3: (a) cost of the economic impact software; (b) time period of the analysis: multi-year or static; and (c) level of detail with respect to multipliers and indirect and induced effects. REMI is highly complex built on an I/O econometric framework; however, it is also the costliest software. IMPLAN is widely accepted by many organizations (public and private) in terms of analysis and economic impact results over a one-year time horizon, and is not cost prohibitive (less than US$3,000 for an individual state with associated counties). The CUM is suitable for specific hospitality and tourism-related analyses and is free of charge. The authors examine the overall structure of these economic impact models but do not strive to recommend one economic impact model over another, given their multifaceted use by economic modellers. However, this paper does examine the behaviour of the economic impact models regarding various data sets and describes the underlying characteristics of the models.

Endnotes

1. http://www.census.gov/epcd/www/naics.html.
2. http://www.smithtravelresearch.com/smithtravelresearch/.
3. RIMS II multiplier of 1.5 used for the CUM in this study based on previous research for these regions (personal communication with Frederick Bell, 2006).
4. REMI Policy Insight Documentation on County Business Patterns and Current Population Survey Data on self-employment.
5. IMPLAN, personal communication with Scott Lindall, 2007.
6. In order to construct a working multi-regional I/O model, however, a set of interregional trade flows (or coefficients) has to be estimated using the Commodity Flow Survey (Census Bureau and Transportation Statistics) http://www.implan.com/library/documents/2006pdfs/33_interregional_trade_flow_robinson.pdf.
7. REMI, personal communication with Adam Cooper, 2007.

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