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AN INPUT-OUTPUT MODEL WITH VARYING JOB AND INCOME RATIOS FOR SERVICE INDUSTRIES: AN APPLICATION OF THE "DOUBLING TOURIST ARRIVALS PLAN" IN TAIWAN

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By

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ABSTRACT

AN INPUT-OUTPUT MODEL WITH VARYING JOB AND INCOME RATIOS FOR SERVICE INDUSTRIES: AN APPLICATION OF THE "DOUBLING TOURIST ARRIVALS PLAN" IN TAIWAN

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An Input-Output model that allows the value added components to vary with respect to capacity utilization is developed for service industries. The assumption of constant ratios of jobs and income in the standard I-O framework is tested by examining firm-level time-series data of tourist hotels in Taiwan from 1999 to 2003. A national input-output model with fixed and varying economic ratios and multipliers are established to evaluate the economic impacts of the Taiwan tourism policy, "Doubling Tourists Arrival's Plan" (DTAP), under three scenarios. Each scenario specifies distinct international visitor volume and hotel capacity, simulating alternative conditions of demand and supply of tourism activities in Taiwan.

Based on empirical data, jobs to sales ratios and personal income to sales ratios are not constant with respect to capacity utilization. Hotel businesses with higher occupancy rates or more rooms support fewer jobs per dollar of sales and allocate lower percentages of revenue to wages and salaries. A five percent increase in occupancy rates, for example, leads to a 7% decrease in jobs to sales ratios and 1.5% reduction in income

to sales ratios. Given a rise in occupancy rates, the proposed I-O model generates lower type I and type II job and income multipliers.

Inbound tourism contributed 0.76% of Gross Domestic Product (GDP) and 1.10% total employment in 2001 in direct effects. Projected changes in tourism demand and hotel capacity in the DTAP policy would increase foreign receipts to Taiwan from the current US$3.5 billion in 2001 to a range of US$5.2 billion to $6.5 billion by 2008. The increased tourism would support 142 ~ 190 thousand jobs and $1.89 ~ $2.51 billion personal income by 2008. The contribution of foreign receipts is expected to grow to 0.87% ~ 1.16% GDP by 2008, assuming a 3% national GDP growth rate in Taiwan.

Relaxing jobs and income ratios in the I-O model introduces a non-linearity between impact estimates and visitor spending. Economic impacts are determined simultaneously by final demand changes as well as the level of capacity utilization in the accommodation sector. Across three scenarios, total projected job estimates for the hotel sector differ from 12% to 30% between I-O models with fixed and varying jobs to sales ratios. Estimates for total personal income in the hotel sector, on the other hand, are more stable with differences ranging from 2% to 7%.

The assumption of linearity and constant coefficient in the production system generally leads to overestimation in the secondary effects, especially with respect to income and employment. The proposed I-O model with value added components varying with capacity utilization allows changing returns to scale, and provides more accurate assessments of jobs and personal income for service industries.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I INTRODUCTION

Tourism Policy in Taiwan

Taiwan has experienced a steady expansion in both international arrivals and foreign tourism receipts since 1960. International visitors to Taiwan increased from 24 thousand person visits in 1960 to 2.8 million visits in 2001 (Taiwan Tourism Bureau, 2004). Concurrently, total foreign receipts increased from US$ 1 million to US$ 4.3 billion.

In 2002, the government of Taiwan announced the "Doubling Tourist Arrivals Plan" (DTAP) as one major investment project for the national long term development plan (Council for Economic Planning and Development, 2002). Its goal is to increase international pleasure visitors from 1 million yearly visits in 2001 to 2 million by 2008, and overall international visitors including pleasure, business, study purposes, visiting friends and relatives from 2.8 million in 2001 to 5 million[1] person visits by 2008.

To cope with rising demands on accommodation services, a sub-policy, the "Tourist Hotel Development Plan", was announced, which encouraged private investments in lodging facilities by providing them with low interest financial assistance (Taiwan Tourism Bureau, 2003). This sub-policy intends to increase the lodging capacity of tourist hotels from 20,697 rooms in 2001 to 37,900 rooms by 2008. The overall public investment for the "Doubling Tourist Arrivals Plan" is US$ 2.5 billion.

[1] If excluding foreign laborers working in Taiwan, approximately 200,000 person visits per year, the policy aims to generate 4.8 million international visitors by 2008.

The economic objectives of the DTAP policy are to increase foreign receipts, create job opportunities, and diversify the economy (Council for Economic Planning and Development, 2002). It is therefore critical to measure, monitor, and forecast the economic impacts of international visitor spending in Taiwan over the policy span. Economic impact analysis can be used to evaluate and compare various policy alternatives, advise marketing strategies, generate constituencies' support, and most importantly, assess the relative contribution of tourism developments to the national economy.

Input-Output (I-O) analysis has been used extensively for evaluating the economic impacts of tourism since the 1970's (Archer, 1977, 1978, 1984; Fletcher, 1989). I-O analysis estimates the changes in economic activity within a region resulting from a given level of final demand changes, such as visitor spending or government investment. Impacts are computed first by converting the final demand changes into direct effects in jobs, personal income, tax revenue or value added using economic ratios pertaining to the regional economy. Secondary effects are then computed by multiplying the direct effects by the regional multipliers, which result from interindustry transactions. Total job impacts, for example, are determined by three factors: jobs to sales ratios, regional sales multipliers, and final demand changes. The first factor, the jobs to sales ratio, represents the average ratio of labor inputs to production, regional sales multipliers indicate the structure of the local economy, and final demand changes specify the total amount of money injected.

Within the standard I-O framework, total impact is solely determined by final demand changes (Armstrong & Taylor, 2000; Miller & Blair, 1985). Constant technical

coefficients and fixed economic ratios of labor cost, employment, and profitability are applied when calculating total impacts regardless of the scale of demand changes as well as the level of sector capacity. The dynamics of the supply function for a given sector and its interaction with the cost function are not accurately reflected in the I-O model. A service firm operating at a 40% capacity, for example, is assumed to have the same cost structure as one operating at an 80% capacity.

Problem Statement

The "Doubling Tourist Arrivals Plan" influences the tourism industry in Taiwan from both supply and demand perspectives. Tourism consumption is expected to increase by hosting more international visitors while the infrastructure and service supply is expected to expand with financial assistance/investments from government and private sectors. The future operational capacity of tourism-related industries, a function of both demand and supply, is currently undetermined.

For service-oriented sectors, Bryden (1973) notes that input-output coefficients and economic ratios are likely to be influenced by the utilization of operating capacity. A concern is therefore raised for evaluating the economic impacts of the DTAP policy, because the suitability of standard I-O assumptions- the fixed ratios of labor cost and employment with respect to different capacity utilization, is challenged. Without understanding changes in cost functions due to capacity utilization, the accuracy in evaluating and forecasting economic impacts of the tourism policy is in question.

Conceptual Framework

One primary limitation of the I-O analysis is that constant technical coefficients and fixed economic ratios of labor cost, employment, and profitability are applied when calculating total impacts. For manufacturing sectors, constant economic ratios and regional multipliers within a short term period may provide a satisfactory portrayal of the real-world production function and offer impact estimates with acceptable errors (West, 1995). Tourism, however, is not a single acknowledged sector (Fletcher, 1989; Smith, 1994). It covers a combination of industries, most providing time perishable services, such as lodging, entertainment, and transportation. These services have distinct production and consumption characteristics, compared to manufactured goods.

The major characteristics of services are intangibility, simultaneity and perishability. Intangibility indicates that services are not solid products, and they are perishable because they cannot be stored for repeated use. Simultaneity means that the production and the consumption of services occur at the same point in time and location. Unlike manufactured goods, unused perishable products (e.g., hotel rooms or airline tickets) cannot be resold somewhere else and the associated sales are lost forever. High fixed costs are generally incurred in the production process regardless of the demand level (Kimes, 1989; Lewis & Chambers, 1989). The marginal cost of an additional unit is relatively low unless at full capacity. The operational objective, therefore, is to maximize profits instead of minimizing costs (Berman, 1994).

One approach to generate maximum profits for perishable products is through price discrimination in which the price is determined based on the level of demand and unused capacity. Accommodations and air transportation generally employ this pricing

strategy (referred as yield management by the academicians). Due to high fixed capacity and product perishability, the profit level of many service firms is greatly tied to capacity utilization (Allen, 1988).

The other general characteristic of service industries is that they are labor and capital intensive (Mullins, 1993). Due to limited productivity gains through technological progress, accommodations and restaurants tend to make the best use of existing labor to accommodate additional demands (Hollenstein, 2001; Peneder, Kaniovski, & Dachs, 2003; Smeral, 2003).

Due to these fundamental characteristics - perishability, intangibility and simultaneity, cost structures of perishable services are determined by the number of units consumed (sold), instead of the number of units produced. This has led to a distinct measurement for time-perishable services: capacity utilization (CU), the ratio of actual used products to some measure of potential outputs (Nelson, 1989; Ng, Wirtz, & Lee, 1999). Based on Berndt and Morrison (1981), CU is an important factor in explaining changes in the rate of investment, labor productivity and inflation for services.

A conceptual model connecting capacity utilization and the I-O framework is presented in Figure 1. It hypothesizes that a shift in utilization for perishable services will lead to economies of scale in both labor and material inputs (Miller & Blair, 1985), price changes in final output (Arenberg, 1991), and possible substitution between input factors, especially between capital and labor (Krakover, 2000; West & Gamage, 2001). The pricing strategy will modify the price ratio of intermediate inputs to final output[2]; the

[2] Price change may result in technical substitution between different intermediate inputs. However, it has been argued that a major swing in relative price is required before substitution takes place (Rose & Miernyk, 1989).

economies of scale change the input ratio of labor and materials; and the substitution pattern between labor and capital adjusts the average salary per employee. These factors simultaneously affect the I-O technical coefficients, jobs to sales ratios, and personal income to sales ratio.

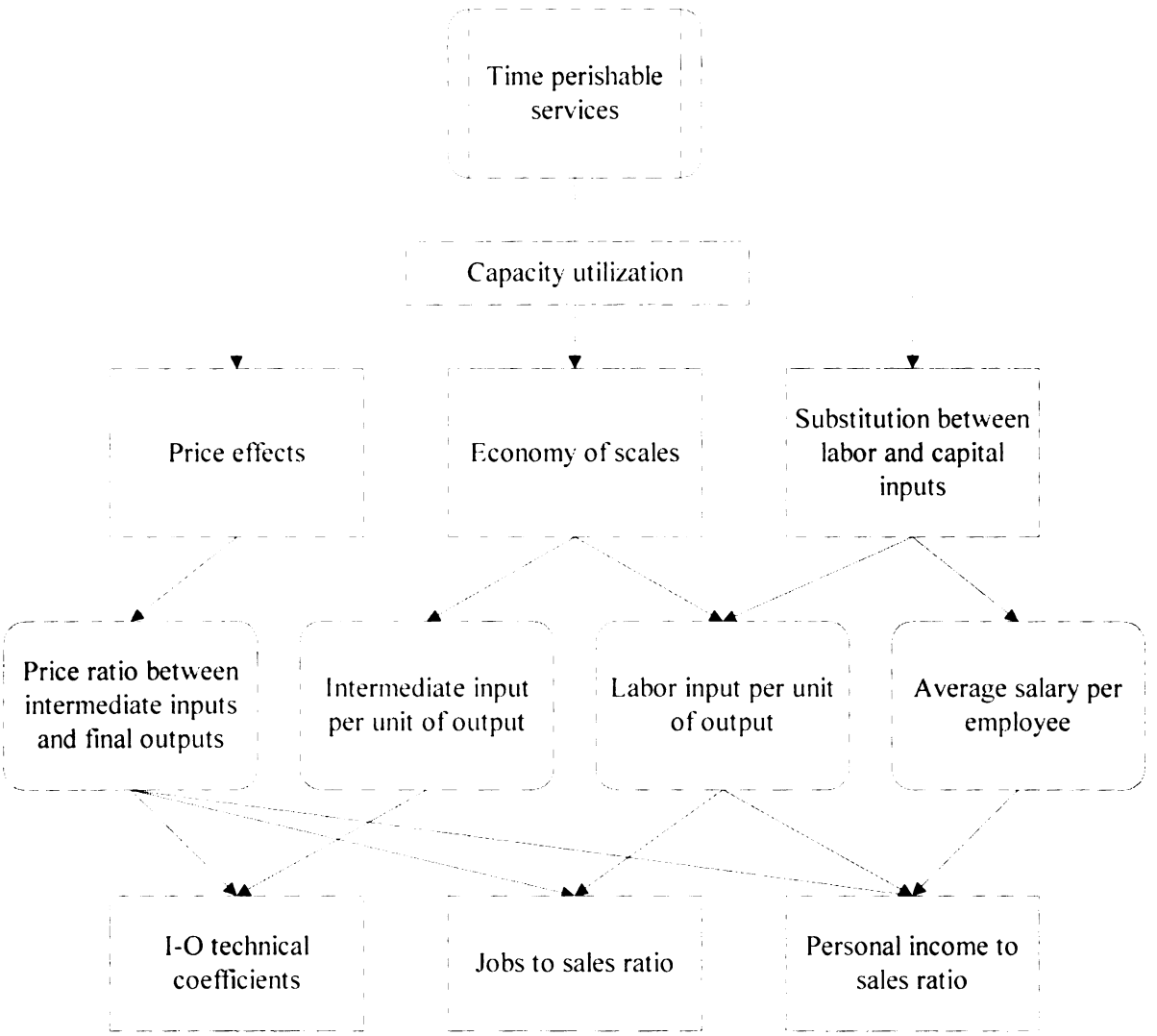

Figure 1. The Conceptual Framework of Capacity Utilization and I-O Analysis

As demonstrated in Equation 1, economies of scale in input materials and price changes of the final product would modify the I-O technical coefficients. Economies of

scale in labor inputs (labor efficiency) and changes in the price of the final product would adjust the jobs to sales ratios (Equation 2). Personal income to sales ratios on the other hand are influenced concurrently by labor inputs, output price and average salary per employee (Equation 3).

$$\alpha_{ij} = q_{ij} * \frac{P_i}{P_j} = f(\text{economy of scale in materials, price ratio of inputs to final product}) \quad \text{(Equation 1)}$$

Where α_{ij} = technical input coefficient = output of industry i that is bought by industry j to produce one unit of product j

q_{ij} = physical input coefficient = physical output of industry i required to produce a physical unit output of industry j

P_i = price of product i ;

P_j = price of product j

$$\text{Jobs to sales ratio} = \frac{\text{Total employees}}{\text{Total sales}}$$

$$= \frac{\text{Total employees}}{\text{Total units sold}} * \frac{1}{\text{Price of the final product}}$$

$$= f(\text{labor productivity, price of the final product}) \quad \text{(Equation 2)}$$

$$\text{Personal income to sales ratio} = \frac{\text{Total wages}}{\text{Total sales}}$$

$$= \frac{\text{Total employees}}{\text{Total units sold}} * \frac{1}{\text{Price of the final product}} * \text{Average salary per employee}$$

$$= f(\text{labor productivity, price of the final product, average salary per employee})$$

(Equation 3)

A hypothesized example is used in Table 1 to demonstrate changes in the cost structure by allowing output price and labor ratio to vary. Labor ratio, in this example, is defined as number of final products sold per employee, which can be regarded as a measure of labor efficiency. The base year cost function of the accommodation sector is presented first using the I-O coefficients from the 1999 Taiwan Input-Output table. Assuming a room price of $100, thirty-three percent of the cost will go to intermediate inputs, such as business services and manufacturing, 41% will be allocated to employee compensation, 2% to imported products, and 24% to profits and taxes. In this instance, the labor efficiency equates to the number of occupied rooms per worker. In the base year (the year I-O table is compiled), one worker is hypothesized to support five occupied rooms at an occupancy rate of 50%.

By allowing labor efficiency and output price to change along with occupancy rates, the cost function and profitability, in absolute value and relative percent, are different. For example, if labor efficiency is improved from serving 5 occupied rooms per employee to 8 occupied rooms per employee, the relative ratio of labor cost is reduced per room while the ratio of input materials remain unchanged. In this instance, type I sales multipliers will remain unchanged from the base-year level but the jobs to sales ratio will decrease, indicating that fewer jobs are supported with the same amount of hotel sales. A change in room price, however, will affect the relative cost ratio for both

intermediate inputs and labor inputs. In this case, the elasticity of changes in I-O multipliers will be determined simultaneously by three factors: labor efficiency, the price of input materials, and the price of final products. For example, if the average room price rises from $100 to $150, assuming the input materials still cost $33 per room and one employee supports 5 occupied rooms (unchanged from the base-year level), the absolute monetary costs of intermediate inputs and labor are unaffected but the relative ratio of costs is reduced. This will then lead to reduced type I sales multipliers and jobs multipliers.

Table 1. An Example of the Cost Structure for a Hotel Room by Absolute Value and Percent

	Absolute values per room ($)				Percent			
	Base Year	Change of labor efficiency	Change of room price	Change of labor efficiency and room price	Base year	Change of labor efficiency	Change of room price	Change of labor efficiency and room price
Hypothesized parameters								
Room price	$100	$100	$150	$150	$100	$100	$150	$150
Occupied rooms/ employee	5	8	5	8	5	8	5	8
Intermediate inputs								
Manufacturing	8	8	8	8	8%	8%	5%	5%
Electricity	6	6	6	6	6%	6%	4%	4%
Wholesale & retail	2	2	2	2	2%	2%	1%	1%
Business service	18	18	18	18	18%	18%	12%	12%
Subtotal	33	33	33	33	33%	33%	22%	22%
Primary inputs								
Personal income[a]	41	26	41	26	41%	26%	27%	17%
Profits and tax[b]	24	39	74	89	24%	39%	49%	60%
Imported product	2	2	2	2	2%	2%	1%	1%
Subtotal	67	67	117	117	67%	67%	78%	78%
Total	100	100	150	150	100%	100%	100%	100%

[a] Assuming the average salary per employee is fixed. When an employee can clean more room, for example, the average wage cost per room is reduced (marginal labor cost per room is decreasing).

[b] Profits and tax are computed by deducting the rooms sales with costs on intermediate inputs, imported products and labor.

Based on this example, an increased room price and more efficient labor usage result in a reduced input costs and subsequently, higher operating surplus. Allowing the average salary per employee to vary creates a more complicated example. Any change in the input factors will lead to modifications of the cost structure. The assumption of Constant Returns to Scale (CRTS), which indicates fixed input costs, labor expenses, and profitability in relation to sales volume, is not valid when output price, labor efficiency, and average wages are allowed to vary.

Based on the proposed model in Figure 1, shifts in capacity utilization will lead to modifications of technical input coefficients and economic ratios for the value added components. In this study, the primary focus is to relax the assumption of constant value added components (the dynamics of job, income and profits) in the I-O model while the technical input coefficients remain constant.

Objectives

The accommodation sector in Taiwan is selected as the study subject to examine the relationships between capacity utilization and two economic ratios (jobs to sales ratios and personal income to sales ratios) due to the following reasons. First, the Taiwan tourism policy directly influences both the supply (the expansion of tourist hotels) and the demand (doubling international visitors) of the accommodation sector. Hotel occupancy rates as well as cost structures of the accommodation sector are expected to vary, depending upon the realization of the proposed policy. Second, hotel rooms are a good example of time perishable services and the accommodation sector is sensitive to demand and supply changes, in terms of room price, labor use and the resulting

profitability. Third, the concept of capacity utilization is well defined and measurable in the accommodation sector. With data on total available and occupied rooms, capacity utilization of the accommodation sector can be precisely measured in terms of occupancy rates (Borooah, 1999).

Three study objectives are:

I. Estimate the economic impacts of inbound tourism on the Taiwan economy in 2001, before the implementation of the DTAP policy, in terms of sales, jobs and personal income.

II. Test the stability of jobs to sales ratios and income to sales ratios with respect to occupancy rates in the accommodation sector

III. Estimate economic impacts of inbound tourism on the Taiwan economy for three scenarios based on 1) standard I-O models with fixed job and income ratios, and 2) I-O models with varying jobs to sales ratios and income to sales ratios by occupancy rates. The former I-O model is referred as "fixed ratios model" and the latter as "varying ratios model" in the following.

Three scenarios to be evaluated are

1. Lodging capacity does not expand during the policy period, maintaining the same capacity of 2001 as 20,697 rooms. Estimate the maximum economic impacts in 2008 under a possible capacity constraint in the accommodation sector.

2. Lodging capacity expands from the current 20,697 rooms to 37,900 rooms by 2008, based on the "Tourist Hotel Development Plan" (Taiwan Tourism Bureau, 2003), and 75% of the intended visitation volume in the DTAP policy is achieved (3.6 million of international visitors).
3. Lodging capacity expands from the current 20,500 rooms to 37,900 rooms by 2008, and 100% of the intended visitation volume in the DTAP policy is achieved (4.8 million of international visitors).

Each scenario involves particular demand and supply conditions in the accommodation sector (Table 2). Supply levels are measured by the number of total available rooms in tourist hotels. Demand levels, on the other hand, are measured in terms of the total tourist hotel rooms demanded from inbound and domestic tourists. The domestic tourism volume is assumed constant (135 million person trips a year by 2008) across the three scenarios (Taiwan Tourism Bureau, 2003). Maintaining constancy in domestic tourism helps to simulate the changes in occupancy based on fluctuations of inbound tourism and hotel capacity.

Table 2. Demand and Supply Level under the Three Scenarios

Scenarios	Tourist Hotel Capacity	Domestic Tourism (person trips)	Inbound Tourism (person trips)[a]
Base Year (2001)	20,697 rooms	97 million	2.6 million
Scenario 1 (2008)	20,697 rooms	135 million	Maximum visitors (?)
Scenario 2 (2008)	37,900 rooms	135 million	3.6 million
Scenario 3 (2008)	37,900 rooms	135 million	4.8 million

[a] Foreign laborers to Taiwan are excluded, which are approximately 20 thousand persons per year.

Assumptions

For objective I, three primary assumptions of standard I-O analysis are employed. They are 1) the output of each sector is produced with a unique set of inputs, 2) the amount of inputs required is solely determined by the level of output, and 3) there are no capacity constraints in the production process (Miller & Blair, 1985; Otto & Johnson, 1993). In other words, constant cost structures during the policy evaluation period are assumed. Fixed technical coefficients and economic ratios are employed.

In objective II, the assumption of constant job and income ratios for the accommodation sector is tested using tourist hotel operational data in Taiwan. Due to limited data, it is assumed that small accommodation firms, such as Bed & Breakfast and general hotels, behave in a similar fashion as tourist hotels toward capacity utilization. In 1996, tourist hotels accounted for 4% of total accommodation entities, 70% of total employees, 60% of total sales, and 55% of total personal income in the accommodation sector (Directorate-General of Budget Accounting and Statistics, 2003). Tourist hotels are assumed to be representative for the accommodation sector as they account for a majority of hotel sales and workforce.

For objective III, the following assumptions are employed. First, technical input coefficients for the accommodation sector are assumed constant across the policy period from 2002 to 2008. This implies technologies, trade flows and price movements between intermediate inputs and room prices[3] are constant. This assumption is proposed because 1) the accommodation sector possesses a much slower rate of technological change than

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[3] $\frac{P_{ij}}{P_j}$ at time (t) = $\frac{P_{ij}}{P_j}$ at time (t+1), where as P_j equates to the price of product j and P_{ij} equates to the price of input i required to produce product j.

other service sectors (Hollenstein, 2001; Peneder et al., 2003), and 2) only 2% of the inputs in the Taiwan accommodation sector were imported based on the 1999 I-O table. The low level of imported products and limited technological change are expected to pose minimal influences on the I-O coefficients over time. Assuming constant technical input coefficients for the accommodation sector, in other words, implies constant type I sales multipliers across the three scenarios.

Second, for the rest of the economy (besides the accommodation sector), I-O technical coefficients and economic ratios are assumed to be constant during the policy period. Third, trip characteristics in visitors' length of stay, average spending, propensity of hotel stays, and regional distribution in trips are assumed constant. The shift of demands due to crowding or regional development will not be considered here. The only factor influencing final demand changes (inbound tourism visitor spending) is the total number of international arrivals. Last, domestic tourism volume is provided by the Taiwan Tourism Bureau (2003), estimated to be 135 million person trips in 2008. The possible fluctuation of domestic tourism volume due to competition or price inflation is not discussed.

Limitations

Limitations of this study primarily rest on the assumptions it employs. The first limitation is that the current model does not consider possible cost structure changes for other service sectors at different capacities. Joint effects across sectors with respect to capacity utilization are not modeled. Second, modifications of existing travel patterns, in terms of length of stay and accommodation types, are possible. Regional development,

the amalgamation of new attractions, quality of services, the newly constructed west-coast Highway 3 and the high-speed bullet train may influence current travel patterns in Taiwan. Also, gasoline price, exchange rates, or effects of terrorism, weather or disease outbreaks may also influence the volume of international arrivals to Taiwan. These factors are currently not modeled. The third limitation lies in the assumption that small establishments may behave in a similar fashion as tourist hotels with respect to capacity utilization. Due to distinct organizational and cost structures, sensitivity and direction of changes for small establishments may be different.

Definition of Terms

Capacity: Lovelock (1992) defined the capacity of service firms is "the highest quantity of output possible in a given time period with a predefined level of staffing, facilities and equipment"(p.26). In the context of the accommodation sector, the capacity is the maximum rooms that are available for rent in the short-term.

Capacity utilization (CU): The ratio of actual used products to some measure of potential output (Nelson, 1989; Ng et al., 1999). Potential output can be referred to 1) the maximum output that may be produced given a firm's short-run stock of capital, or 2) the output based on the economic measurements using the long-term and short-term total cost curves (Nelson, 1989). In the context of the accommodation sector, CU is referred as the occupancy rate (Borooah, 1999).

Returns of scale: The percentage increase in output by a one percent increase in all inputs (Caves & Christensen, 1988).

Labor efficiency: In this study, labor efficiency is defined as number of products consumed (sold) per employee. This indicator equates to the occupied rooms per employee and is independent from room price.

Jobs to sales ratio: Number of jobs supported per dollar sale.

Personal income to sales ratio: The ratio of wage, salary, proprietor's income and employee benefits per dollar sale.

Type I multipliers: The sum of direct and indirect effects divided by the direct sales effect. The multiplier can be measured in terms of sales, jobs, personal income or value added.

Type II multipliers: The sum of direct, indirect, and induced effects divided by the direct sales effect. Induced effect is resulted from the inclusion of household consumption in the I-O model. The multiplier can be measured in terms of sales, jobs, personal income or value added.

Value added: The sum of personal income plus rents, profits and indirect business taxes.

Tourist hotels: There are four hotel categories in Taiwan: the international tourist hotel, standard tourist hotel, general hotel and Bed and Breakfast (B&B), based on standards issued by Taiwan Tourism Bureau (2003). The first two categories are referred to as "tourist hotels", which are subject to governmental regulations on its facilities and service procedures, serving mainly international visitors.

Tourists, travelers or visitors: In the context of this study, these terms are used interchangeably. Tourists include travelers with business, leisure and other trip purposes.

N.T.: New Taiwan Dollar, the currency of Taiwan.

CHAPTER II LITERATURE REVIEW

The literature review chapter includes three sections. The first section reviews the current status of Taiwan domestic and inbound tourism, followed by the "Doubling Tourist Arrivals Plan" and Taiwan tourism economic impact studies. The second section compares the four primary tourism economic impact models with detailed specification of the Input-Output (I-O) analysis. The third section discusses estimation errors in tourism I-O models with respect to capacity utilization for service sectors.

Tourism Development in Taiwan

Domestic and Inbound Tourism

Inbound tourism. Following worldwide trends in tourism, Taiwan has experienced strong growth since 1960 in both international arrivals and foreign exchange. International visitors to Taiwan increased from 24 thousand person visits in 1960 to 2.25 million visits in 2003. Concurrently, total foreign receipts increased from US$ 1 million to US$ 2.98 billion (Table 3). Inbound tourism peaked in 2002, with approximately 3 million international arrivals and US$ 4.6 billion foreign exchange receipts. The average spending per visitor was US$ 1,539 for a 7.5 night stay in Taiwan. Due to the spread of Severe Acute Respiratory Syndrome (SARS) and Avian influenza in Taiwan in 2003, international arrivals decreased by 25% and foreign receipts were reduced by 35% compared to 2002 (Taiwan Tourism Bureau, 2004). The following discussion of domestic and inbound tourism is based on the 2002 statistics as the 2003 data may not represent the general behaviors of tourists in Taiwan.

Table 3. International Arrivals and Expenditures in Taiwan, 1960 - 2003

Year	International visitor arrivals (000's)	Total visitor expenditure ($US million dollars)	Average spending per person per trip ($US dollars)	Average spending per person per day ($US dollars)	Length of stay (nights)
1960	24	1	63	25	2.50
1965	134	18	137	38	3.64
1970	472	82	173	36	4.86
1975	853	359	421	67	6.30
1980	1,393	988	709	105	6.78
1985	1,452	963	664	102	6.51
1990	1,934	1,740	1,346	187	7.20
1995	2,332	3,286	1,409	191	7.38
2000	2,624	3,738	1,425	193	7.40
2001	2,831	4,335	1,531	208	7.37
2002	2,978	4,584	1,539	204	7.54
2003	2,248	2,976	1,324	166	7.97

Source: Taiwan Tourism Bureau (2004)

In 2002, eighty percent of international visitors came from Asia. The top three origin countries were Japan (34%), Hong Kong/Macao (15%) and United States (13%), representing more than 60% of total arrivals (Table 4). Thirty-seven percent of international visitors were leisure travelers, followed by business visitors (30%) and those visiting friends and relatives (10%)[4]. In terms of lodging types, eighty-one percent of international visitors stayed at hotels. Among those, 52% stayed at international tourist hotels, 8% at standard tourist hotels, and 40% at general hotels (Taiwan Tourism Bureau, 2003). Approximately one in every two international visitors stayed at tourist hotels in Taiwan [81% * (52% + 8%)].

[4] Fifteen percent of visitors did not identify their trip purposes to Taiwan (Taiwan Tourism Bureau, 2003).

Table 4. International Visitor Arrivals by Region and Country of Residence, 2000 - 2003

	Visitor Arrivals (000's)				Percent			
	2000	2001	2002	2003	2000	2001	2002	2003
Region								
Asia	1,985	2,224	2,331	1,768	76%	79%	78%	79%
America	410	402	437	315	16%	14%	15%	14%
Europe	161	149	149	119	6%	5%	5%	5%
Oceania	38	38	41	32	1%	1%	1%	1%
Africa	9	9	9	8	0%	0%	0%	0%
Unstated	22	9	10	7	1%	0%	0%	0%
Grand Total	2,624	2,831	2,978	2,248	100%	100%	100%	100%
Country								
Japan	916	977	998	657	35%	35%	34%	29%
Hong Kong & Macao	361	435	457	323	14%	15%	15%	14%
United States	360	349	377	273	14%	12%	13%	12%
Korea	84	86	84	93	3%	3%	3%	4%
Singapore	95	99	111	79	4%	3%	4%	4%

Source: Taiwan Tourism Bureau (1999-2003)

Domestic Tourism. The domestic tourism market had increased from 72 million person trips in 1997 to 106 million person trips in 2002, averaging 4.01 trips per person[5] in 1997 to 5.62 trips per person in 2002 (Taiwan Tourism Bureau, 1998-2004). A trend of increasing day trips and fewer overnight stays at hotels was observed (Table 5). This has lead to shorter stays and lower average spending per person per trip over the past few years. In 2002, sixty-three percent of domestic trips were day trips, 22% were two-day overnight trips, and 10% were three-day overnight trips. Sixty-one percent of domestic trips were pleasure trips and 23% were visiting friends and relatives (VFR). The average expenditure per person per trip was NT$ 2,228, with food and transportation each accounting for 25%. In 2002, total expenditures by domestic travelers were NT$ 236.8 billion or US$ 6.95 billion. In terms of total trip spending, the domestic tourism market in Taiwan is approximately 1.5 times the inbound tourism market (US$ 4.5 billion in 2002).

[5] Excluding children younger than 12

Table 5. Basic Statistics of Taiwan Domestic Tourism, 1997 - 2003

Domestic Travel	1997	1999	2001	2002	2003
Average trips per person per year	4.01	4.01	5.26	5.62	5.39
Total person trips (000's)	71,879	72,651	97,445	106,278	102,399
Distribution of trip lengths					
1 day	50%	59%	62%	63%	64%
2 days	26%	23%	22%	23%	22%
3 days	15%	12%	10%	10%	9%
4 days or more	8%	6%	5%	5%	5%
Average length of stay	2.0	1.8	1.7	1.7	1.7
Lodging types					
Day trips	50%	58%	62%		64%
Hotel	25%	20%	19%		18%
VFR	18%	18%	16%		13%
Spending					
Average spending per person per trip (NT$)	3,300	2,738	2,480	2,228	2,130
Total domestic travel spending (NT$ million's)	237,201	198,918	241,664	236,787	218,110
Spending percentage by sector					
Transportation	24%	22%	24%	24%	22%
Lodging types	17%	18%	16%	18%	17%
Food	26%	26%	25%	25%	24%
Entertainment	11%	10%	10%	7%	7%
Shopping	17%	20%	20%	21%	22%
Others	5%	4%	6%	4%	8%

Source: Taiwan Tourism Bureau (1998-2004)

The lodging industry. Hotels in Taiwan are divided into four levels: international tourist hotel, standard tourist hotel, general hotel and Bed and Breakfast (B&B), based on standards issued by Taiwan Tourism Bureau (2003). The first two categories are referred to as "tourist hotels". International tourist hotels are four or five star equivalent, providing an array of services besides lodging, and supporting more rooms and employees per establishment. Standard tourist hotels are two or three star equivalents with a smaller operating scale. The average international tourist hotel has 292 rooms with 329 employees. Standard tourist hotel, on the other hand, has 132 rooms with 88 employees on average.

In 2002, there were 62 international tourist hotels and 16 standard tourist hotels in Taiwan, providing 17,840 rooms and 2,713 rooms respectively (Taiwan Tourism Bureau,

1999-2003). The average occupancy rate was 61.3% and the average room price was NT$2,907 in 2002 (Table 6). Forty-four percent of hotel revenue came from food and beverage sales[6] and 40% from room sales. Forty-two percent of employees worked in the food and beverage division, 29% in the room division and 18% in the administration division. In 2002, total sales of tourist hotels were NT$ 33.7 billion and total employment was 20,879 jobs, indicating 0.62 jobs per million NT$ dollars in sales.

Table 6. Basic Statistics of Tourist Hotels in Taiwan, 2002

	International tourist hotels	Standard tourist hotels	Total (Tourist hotels)	Percent
Number of establishments	62	16	78	
Room numbers	17,840	2,713	20,553	
Occupancy Rate	62%	59%	61%	
Average room rate (NT$)	3,025	2,101	2,907	
Revenue (NT$ million's)				
Room sales	12,133	1,230	13,363	40%
Food and beverage	14,026	915	14,941	44%
Others	4,899	487	5,386	16%
Total	31,058	2,632	33,690	100%
Employee number				
Rooms	5,319	634	5,953	29%
Restaurants	8,477	564	9,041	43%
Administration	3,291	364	3,655	18%
Others	1,936	295	2,231	11%
Total	19,023	1,856	20,879	100%
Customer number (person nights 000's)				
Domestic customers	2,402	337	2,739	43%
International customers	3,088	554	3,642	57%
Total	5,490	891	6,381	100%
Jobs/ million NT dollars in sales	0.61	0.71	0.62	
Jobs/ million US dollars in sales[a]	21.18	24.38	21.43	

[a] One US dollar equated to $34 Taiwan dollar in 2002 (OANDA Corporation, 2004).
Source: Taiwan Tourism Bureau (1999-2003)

[6] Mainly wedding banquets and conferences.

In 2002, tourist hotels reported 6.38 million person nights. Forty-three percent of these were generated by domestic customers, followed by Japanese customers (25%) and other Asian customers (11%). Demand for tourist hotels was fairly consistent across four seasons (Figure 2) as high seasons for domestic and international travel were different. A higher percentage of domestic customers were reported during the summer season of July through September (31%) while higher volumes of international visitors were reported during the first and fourth quarter of the year (26~27%).

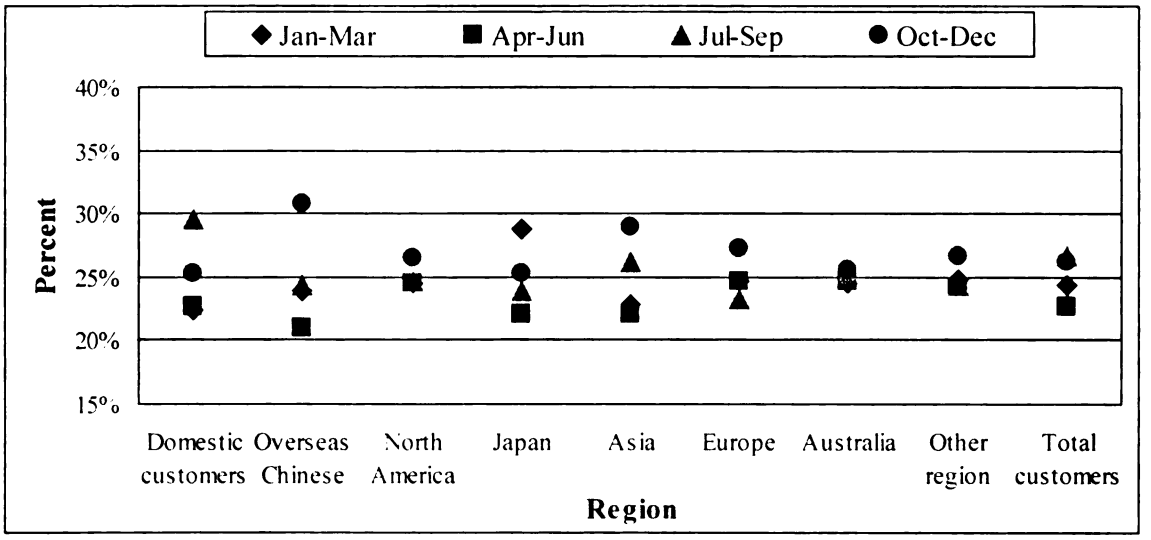

Figure 2. Seasonal Distribution of Domestic and International Customers at Tourist Hotels, 1999 - 2003

Source: Taiwan Tourism Bureau (1999-2003)

Twelve thousand tourist hotel rooms are located in northern Taiwan[7], accounting for 60% of the total tourist hotel capacity, followed by southern Taiwan (22%), eastern Taiwan (10%) and central Taiwan (9%) (Table 7). Tourist hotels in northern Taiwan

[7] Eighty-five percent of tourist hotels in Northern Taiwan are located in Taipei (the capital of Taiwan).

contribute 71% and 66% of the nation-wide tourist hotel sales and employees, respectively. The average room price in the Taipei area was NT$ 3,158 in 2002 and the average occupancy rate was 67%, representing 8.6% and 9.8% higher than the nation-wide averages. Around three and half million customers were reported in the Taipei area, which accounted for 57% of total customers in 2002. Tourist hotels in northern Taiwan primarily serve international visitors, only 20% of their customers are domestic travelers. In summary, hotels in northern Taiwan account for the majority of hotel capacity, have higher occupancy rate and room price, and mainly serve international visitors.

Table 7. Basic Statistics of Tourist Hotel by Region in Taiwan, 2002

Region	Northern Taiwan	Central Taiwan	Southern Taiwan	Eastern Taiwan	Total
Number of rooms	12,250	1,748	4,551	2,005	20,553
Occupancy Rate	67%	52%	55%	49%	61%
Average room price (NT$)	3,158	2,649	2,333	2,515	2,907
Total room sales (NT$ million's)	9,444	880	2,139	901	13,363
Total revenue (NT$ million's)	24,224	2,292	5,503	1,671	33,690
Total employees	13,752	1,599	4,103	1,425	20,879
Number of customers in 2002 (000's)					
Domestic	708	294	1,066	671	2,739
International	2,915	179	417	132	3,642
Total	3,623	472	1,484	802	6,381
Pct of international customers	80%	38%	28%	16%	57%

Source: Taiwan Tourism Bureau (1999-2003)

Doubling Tourist Arrivals Plan (DTAP)

The "Challenge 2008- National Development Plan" establishes the long-term development goals and investment plans for Taiwan from 2002 to 2007. It includes three governmental reforms on political, fiscal and financial aspects and ten industrial

development plans[8] (Council for Economic Planning and Development, 2002). The main objectives of this policy are to stimulate economic growth through public investments, create employment by diversifying economic structures, and increase the quality of life for people in Taiwan.

The "Doubling Tourist Arrivals Plan" (DTAP) is one of the ten industry development policies in. The goal of this tourism policy is to increase the international pleasure visitors from 1 million yearly visits in 2001 to 2 million by 2008, and overall international visitor from the current 2.6 million to 5 million yearly visits. The proposed international visitor numbers by individual country from 2002 to 2007 are listed in Table 8. International visitors from Japan, Hong Kong/Macao are the two current major markets for Taiwan, which are expected to increase the visitation number from a combination of 140 million person visits in 2002 to 260 million in 2008, representing more than 50% of total international visitors.

Table 8. Intended Goal of International Visitors to Taiwan, the DTAP Policy

Year	Japan	Hong Kong/ Macao	Korea	Singapore /Malaysia	North America	Europe	New Zealand/ Australia	Others	Total
Visitors (10,000)									
2002	100	45	9	16	35	15	3	47	270
2003	110	50	10	18	36	16	3.5	56.5	300
2004	120	55	14	20	38	18	4	81	350
2005	140	63	18	23	40	20	5	91	400
2006	160	70	22	26	42	24	6	100	450
2007	180	80	30	30	50	28	8	94	500
Annual growth rate	13%	12%	28%	13%	8%	13%	22%	16%	13%

Source: Council for Economic Planning and Development (2002)

[8] Ten key individual plans are e-Generation Manpower Cultivation Plan, Cultural and Creative Industry Development Plan, International Innovation and R& D Base Plan, Industrial Value Heightening Plan, e-Taiwan Construction Plan, Operations Headquarters Development Plan, Island-Wide Trunk Transportation Construction Plan, Doubling Tourist Arrivals Plan, Water and Green Construction Plan, and New Home Community Development Plan.

Five development strategies are proposed in the DTAP policy (Council for Economic Planning and Development, 2002).

1. Reorganize existing tour itineraries

   Five tour itineraries, which mainly serve international visitors, would be reformed through improving current transportation systems, landscape designs, events organizations, lodging services, and managements. These five destinations are located across Taiwan with two in central mountain regions, one in northern Taiwan (near the capital, Taipei), one in eastern Taiwan, one in the southeast region.

2. Develop new tour packages and new destinations

   Thirteen destinations and travel routes are proposed as the additional destinations for international visitors. New tourism destinations would be incorporated into regional development plans to establish and coordinate new infrastructures, transportation systems, and management agencies. Each region of Taiwan is assigned one major destination development plan with specific themes, such as cultural, flora, sports, and natural resources.

3. Establish a tourist service network

   This objective aims to improve the quality of travel experiences through improvement in transportation, lodging facilities, package discounts, and information network. Regional transportation system, such as "bus seeing system", and national rail tours around the island would be established to increase the convenience of traveling. Tourist information networks, such as itinerary booking systems, would be expanded through online information and regional information centers in multiple languages.

4. Launch international tourism promotion campaigns

   Marketing programs are implemented in target markets. The short-term and primary goal focuses on markets in Asia while the long-term goal will focus on visitors from Australia and Europe.

5. Develop the MICE (Meetings, Incentives, Conventions, and Exhibitions) market

   This objective aims to increase facilities for international conventions and exhibitions, offered financial incentives for hosting international meetings and provided training and education opportunities for cultivating Professional Convention Organizers (PCO).

In response to possible capacity constraints on lodging, the Taiwan government also proposed to expand hotel capacity through the following two approaches. First, general hotels would be financially supported to upgrade and renovate current facilities to a higher standard (three stars or higher). Second, existing regulation regarding land use and zoning would be modified to allow new establishments on agricultural lands (Taiwan Tourism Bureau, 2003). An estimated 15,100 upgraded and newly constructed rooms will be added. Eighty-five percent would be allocated to northern Taiwan, and 3%, 8%, 4% to central, southern, and eastern Taiwan respectively. By 2008, a total of 37,900 tourist hotel rooms will be available and 70% of these will be located in northern Taiwan (Table 9).

The DTAP policy is funded by the central government (NT 75.71 billion / US$ 2.16 billion), local governments (NT 0.15 billion), and special funds (NT $9.06 billion / US$ 0.26 billion).

Table 9. Allocation of Current and Future Tourist Hotel Rooms by Region in Taiwan, "Tourist Hotel Development Plan"

	Northern Taiwan	Central Taiwan	Southern Taiwan	Eastern Taiwan	Total
Number of tourist hotel rooms [a]					
Room available in 2002	13,100	2,200	4,800	2,700	22,800
Rooms that will be added	12,900	400	1,200	600	15,100
Total rooms available in 2008	26,000	2,600	6,000	3,300	37,900
Pct by regions					
Room available in 2002	57%	10%	21%	12%	100%
Rooms that will be added	85%	3%	8%	4%	100%
Total rooms available in 2008	69%	7%	16%	9%	100%

Source: Taiwan Tourism Bureau (2003)

[a] These are the proposed lodging capacities by Taiwan Tourism Bureau. There is slight differences between the proposed volume and the reported hotel rooms for 2002.

Taiwan Tourism Economic Impact Studies

The first nation-wide tourism economic impact study for Taiwan was carried out in 1991 using an Input-Output model (Wang & Wang, 1991). The study estimated the total economic impacts of domestic tourism, inbound tourism, and government investments in 1984, 1986, and 1988 using the 1984 and 1986 Taiwan National I-O tables[9]. Results of the study are summarized in Table 10.

From 1984 to 1988, total visitor spending of inbound and domestic tourism ranged from NT$ 72 billion to NT$ 125 billion. In 1988, tourism activities in Taiwan supported 4.0% of the national total sales and 5.8% of the total personal income. The aggregate type II sales multiplier ranged from 2.56 to 2.63 during 1984 to 1988. The attribution of tourism activities, including government investments, to the total national employment ranged from 4.75% to 6.81%.

[9] Tourism economic impacts in 1988 were estimated using the 1986 Taiwan I-O table.

Table 10. Tourism Economic Impacts in Taiwan in 1984, 1986 and 1988

Year	1984	1986	1988
Final demand (NT$ billion's)			
Domestic tourism	26.96	34.02	58.84
International inbound tourism	45.14	48.76	66.46
Government investment	0.36	0.39	0.45
Total	72.45	83.17	125.75
Total economic impacts (Direct, indirect and induced effects)			
Sales (NT$ billion's)	190.64	212.84	323.48
Employment (1000's)	371	367	552
Personal income (NT$ billion's)	74.40	89.10	134.45
Pct of tourism economic impacts to the national economy			
Sales	3.27%	3.14%	3.99%
Employment	5.08%	4.75%	6.81%
Personal income	3.14%	3.05%	5.76%
Type II sales multipliers	2.63	2.56	2.57

Source: Wang and Wang (1991)

The World Travel & Tourism Council (WTTC), an affiliated organization of World Travel Organization (WTO), has provided tourism economic impact estimates for all major countries in the world since 1990 using standard Tourism Satellite Accounts. WTTC (2002) estimated that travel and tourism demand in Taiwan, which includes domestic leisure travel, business travel, governmental expenditures, capital investment, inbound tourism and other exports, was NT $ 754.2 billion in 2002. Tourism sales generated a total of 172,902 jobs or 1.8% of total employment in terms of direct effect; 585,587 jobs including indirect effects. The travel and tourism economy contributed NT$ 106.2 billion in Gross Domestic Product (GDP) in direct effects, corresponding to 1.1% of national GDP.

In 2002, the Taiwan Tourism Bureau published the first government report of the Tourism Satellite Accounts for 1996 (Taiwan Tourism Bureau, 2002). The study estimates of tourism GDP and employment in Taiwan were substantial higher than the

WTTC report. The Taiwan Tourism Bureau figures should be more accurate because of its greater use of local data sources and detailed methods provided.

This study covered tourism expenditures associated with hotel, food service, ground transportation, aviation transportation, car rental, travel service, culture and entertainment and retailing from inbound tourism, outbound tourism[10], and domestic tourism. Government and private investments in tourism-related activities were not included in the report. Transactions that were associated with non-currency products or services, such as barter transaction, production for own use, and counterpart of income in kind (Taiwan Tourism Bureau, 2002, p.3-6) were also not included.

Using 1996 as the base year, total tourism expenditures in Taiwan were NT $321.63 billion, including domestic tourism of NT $166.05 billion, inbound tourism NT$ 108.62 billion, and outbound tourism NT $46.96 billion (Table 11). One third of total expenditures went to transportation, followed by food (20.0%), shopping ($18.4%), and accommodation (11.5%). The percent of tourism consumption to total supply are computed by two systems: by products and by industry. Percentages by product indicate the share of tourism consumption by individual product whereas percentages by industry present the share of tourism consumption in relation to the total production by individual industries, which may offer a bundle of tourism products. The percentages of tourism sales to total supply by products of accommodations, aviation transportation, car rental, travel service and food service were 0.94, 0.76, 0.85, 0.92, and 0.37, respectively. In terms of percentage contribution of tourism sales to the total supply by industries on accommodation, aviation transportation, car rental, travel service and food service were

[10] Only counting expenditures that were incurred in Taiwan before and after the trip abroad.

0.73, 0.5, 0.82, 0.9, and 0.35, respectively. Tourism value added was NT $197.74 billion, corresponding to 2.58% of the total GDP in Taiwan. Tourism activities supported 221,974 fulltime equivalent jobs, with the majority in the food service, ground transportation, hotel and retail industries.

Table 11. Comparison of Taiwan Tourism Satellite Accounts from Two Reports

	Taiwan Tourism Bureau	World Travel & Tourism Council[a]	World Travel & Tourism Council
Year	1996	2002	2012
GDP (NT billion's)	$197.7	$106.2	$220.6
Employment (000's)	222.0[b]	172.9	192.8
Pct of total GDP	2.6%	1.1%	1.1%
Pct of total employment	-	1.8%	1.7%

[a] Government and private investments in tourism-related activities are excluded so that the estimates are comparable across two studies.
[b] Full time equivalent.
Source: Taiwan Tourism Bureau (2002) and World Travel and Tourism Council (2002)

Tourism Economic Impact Estimation Model

There are four main evaluation tools for estimating tourism economic impacts: Tourism Satellite Accounts (TSA), tourism multipliers, Input-Output (I-O) analysis, and Computable General Equilibrium (CGE) models (Corcoran, Allcock, Frost, & Johnson, 1999; Song, 2002). Each analytical tool requires different data input and has distinct advantages and limitations.

Tourism Satellite Accounts

Tourism Satellite Accounts are recommended by the World Travel Organization (WTO) as a standard method for measuring the contribution of the tourism industry to national Gross Domestic Product (GDP), final consumption, and gross fixed capital

formation (private investment) (Frechtling, 1999). This method mainly computes the direct effects of total visitor spending, business investment, non-profit organizational operations, and governmental expenditure. The underlying concept is to address the balance between demand and supply of tourism commodities, the number of jobs depending on tourism as well as the indirect taxes generated by the sales of goods and services to tourists within the framework of a national accounting system (Lapierre & Hayes, 1994).

TSA is widely adopted at the national level and the results are comparable across nations, consistent through time, and compatible with the standard measures of a national economy. However, despite its wide-spread applications at the national level, drawbacks of this method primarily rest on debates over definitions and quantifications of tourism activities, goods, and services (Frechtling, 1999; Quevedo, 2002). Other criticisms include the inability of TSA to monitor tourism activity within more narrowly defined user segments, and also, most TSA models do not include indirect and induced effects.

Tourism Multipliers

Tourism multipliers, I-O analysis, and CGE share a common theoretical basis. Each model examines the relationship between an injection of spending into an economy and the resulting change in economic activities from an equilibrium perspective. The difference between these three methods is mainly determined by the model specifications in terms of endogenous variables and assumptions. The tourism multipliers method is the first developed analytical tool and has not been used in recent applications (Archer, 1977). The primary technique to estimate the value of multipliers is through the Keynesian approach, which takes into account investments in the local region and the

marginal propensity to consume locally produced goods (Archer, 1978; Armstrong & Taylor, 2000; Wagner, 1997).

Limitations of the model arise from applying an aggregate multiplier to a region without differentiating unique patterns of spending between visitor segments, such as cruise passengers vs. backcountry campers, and ignoring the variation and magnitude of leakages during each round of transactions (Archer & Fletcher, 1988). Although improvements have been made by disaggregating multipliers to the sector level based on individual export ratios, the most sophisticated economic base models only produce multipliers for ten or fewer sectors (Krikelas, 1992). In terms of practical applications, tourism multipliers are overly simplified in terms of the use of aggregated multipliers, and the model does not provide the complete information by individual user groups for policy making.

Computable General Equilibrium

Computable General Equilibrium (CGE) model is the most advanced tourism economic impact model in terms of the number of variables and the comprehensiveness of assumptions. CGE models employ tight theoretical structures. Households, producers, importers, exporters, and distributors are modeled separately as individual agents whose behaviors follow the rules of utility maximization and cost minimization (McDougall, 1995). In general, the multiplier effects estimated by CGE are more conservative than I-O models as the original I-O assumptions of infinite supply and constant price in transactions are relaxed (Dwyer, Forsyth, Madden, & Spurr, 2000; Dwyer, Forsyth, & Spurr, 2003; West, 1995). Additionally, CGE catches feedback effects, integrates possible supply constraints on labor or capital, and considers opportunity costs of

resources across all sectors. These factors typically create negative impacts elsewhere in the economy and are reflected in the CGE outputs (Dwyer, Forsyth, & Spurr, 2004). For example, CGE model can simulate the shifting of labor from the manufacturing sectors to the service sectors or changes of labor cost and price indexes between imported and exported products. A ten percent increase in world demand for Australian tourism, demonstrated through the CGE model, will lead to negative impacts on the output and employment of mining and machinery sectors (Dwyer et al., 2003). The reason for the negative impacts is that a higher tourism demand would drive up the consumer price index, exchange rates and labor cost, which in turn decrease the competitiveness of exports and generate negative impacts on the export-oriented industries.

Although the use of CGE models has been advocated in the tourism evaluation process (Dwyer et al., 2003, 2004), real world examples are uncommon. The major criticisms of CGE are the technical complexity, complicated interpretation of results, and the amount of time and data required in the model building (Hunn & Mangan, 1999; Rose, 1995; West, 1995). Results of CGE are sensitive to the assumptions and parameters used because the system is composed of extensive inter-relationships between each sector and intra-relationships within itself. Some parameters, lacking the support of historical data, are adopted from best-guest values, studies conducted in other countries or outside sources (Blake & Sinclair, 2002; Dixon, 1994; Rose, 1995; West, 1995). For example, the production function of Constant Returns To Scale (CRTS) is generally assumed in the CGE models, in which, the scale of economy is assumed to have no influence on its cost and output structures (Blake, 2000; Dwyer et al., 2004; Woollett, Townsend, & Watts, 2003). One approach to mitigate the concern over the accuracy of parameters in the CGE

models is to adopt sensitivity analysis on key parameters and to test the relative influences on outputs from different parameter specifications.

The high demands of data input and complexity of computations make CGE models somewhat impractical for tourism applications. Applications of tourism CGE models are primarily at the national level, mainly in Australia, United Kingdom, Canada, and United States (Dwyer et al., 2003). Published examples of tourism CGE models are Adams, Dixon, McDonald, Meagher and Parmenter (1994) for the Australian economy; Zhou, Yanagida, Chakravorty and Leung (1994) for Hawaii; Blake (2000, 2001) for Spain; Dwyer, Forsyth, Madden and Spurr (2000) for multi-regions in Australia; Cooper and Wilson (2002) for United Kingdom, Blake and Sinclair (2002) for the United States, and Sugiyarto, Blake and Sinclair (2003) for Indonesia.

Input-Output Analysis

Input-Output analysis has been used extensively since the 1970's to evaluate the economic impacts of tourism development (Archer, 1977, 1978, 1984; Fletcher, 1989). Advantages of I-O analysis are 1) its flexibility to evaluate economic impacts from the equilibrium perspective based on different temporal and spatial scales, 2) its ability to monitor the economic impacts of individual groups who have distinct spending patterns, 3) the ease of interpretation and convenience of data availability, and 4) its ability to assess the importance of tourism in terms of what proportion of GDP is attributable to it (Blake, 2000; Briassoulis, 1991; Fletcher, 1989). Applications of tourism I-O analysis range from the evaluation of national tourism economic impact (Archer & Fletcher, 1996) to regional tourism development (Eriksen & Ahmt, 1999); and from year-round

recreation activity (Stynes & Sun, 2003) to short-term events or festivals (Upneja, Shafer, Seo, & Yoon, 2001).

Like other economic models, I-O analysis involves assumptions to simplify calculations. These assumptions limit the I-O model to simulate the real world operation in terms of the dynamics of prices or the negative effects on the rest of the economy, such as labor shortages. Also, I-O analysis is insufficient to model the more extensive economic issues such as taxation, welfare distortions or exchange rate inflation (Copeland, 1991). Arguments in adopting I-O models over CGE models are first that an I-O model may produce similar results as the CGE when it is appropriately formulated (McGregor, Swales, & Yin, 1996). McGregor et al. (1996) demonstrated that a detailed calibrated I-O model, which incorporates the infinite elasticity of labor supply and exogenously fixed interest rates and import prices, will produce similar outcomes as CGE models in the long run. Furthermore, I-O models work well for small and open economies in which the relative price is set by the outside world and the supply of labor and resources are unlimited because of imported materials and immigration workers (Hunn & Mangan, 1999; Rose, 1995; West, 1995). Blake (2000) claims that CGE is a better tool for comparing "with/without" or "before/after" scenarios, while fixed-price input-output models are more appropriate for evaluate the relative contribution of tourism activities to the overall economy.

Operation of Input-Output Model

I-O analysis was originally proposed by Wassily Leontief (1936). The theoretical background is based on the concept of the Marxian and Walrasian general equilibrium, which states that all transactions in an economic system are balanced and can be

quantified. The transactions of "sell" and "buy" activities by industries in a defined region during a given period of time are presented in an I-O table in monetary or physical units. The interdependence of industries is calculated from an I-O table, and the resulting impacts on each sector can then be computed for a given final demand change.

Economic entities are divided into a number of sections in the I-O table, including industries (intermediate), final demand, and final payment. Businesses are aggregated into a number of industries (sectors) where input (ingredients) and output (sales) flows can be traced. Rules are imposed to compile the I-O table. First, the total output of each industry is equal to the intermediate demand from other industries plus the final demand. Similarly, the total input each industry relies on is equal to the intermediate inputs from other industries plus final payments. Lastly, for each industry, total inputs equates to total outputs. These relationships can be presented in a matrix format (Equation 4).

$$X = AX + Y \qquad \text{(Equation 4)}$$

Where X = Total output

A = Technical input coefficients

Y = Final demand

Equation 4 could be further modified as follows

$$X - AX = Y$$

$$(I-A)\,X = Y$$

$$X = (I-A)^{-1}Y = BY \qquad \text{(Equation 5)}$$

Where $(I-A)^{-1}$ or B matrix is the Leontief Inverse Matrix

The Leontief Inverse Matrix in Equation 5 represents the interrelationships of transaction flows between industries. When industry A produces one unit of output, it will require inputs from industry B and C, which in turn stimulates sales in industry B and C. This interdependence produces the secondary effects as money circulates in the region, which can be calculated as the indirect and induced effects (type I and type II multipliers)[11]. The economic impacts resulting from changes in final demand are then assessed by multiplying the Inverse Matrix by the changes in final demand (Equation 5). Impacts are generally expressed in terms of jobs, personal income and value added (Equation 6-8).

Jobs = $\hat{E}$ BY (Equation 6)

Income = $\hat{I}$ BY (Equation 7)

Value added = $\hat{V}$ BY (Equation 8)

Where $\hat{E}$, $\hat{I}$, $\hat{V}$ respectively, are the diagonal matrix of job to sales ratio, income to sales ratio, and value added to sales ratio.

Three principal assumptions employed in the I-O analysis are 1) the output of each sector is produced with a unique set of inputs, 2) the amount of inputs required is solely determined by the level of output, and 3) there are no capacity constraints in the production process (Miller & Blair, 1985; Otto & Johnson, 1993). Based on these assumptions, economic impacts are solely determined by final demand changes. Multipliers and economic ratios of jobs, personal income and value added are assumed to

[11] If the household consumption is included as an endogenous variable in the model, the multipliers represent the direct, indirect and induced effects (Type II multipliers).

be constant. Tourism however experiences frequent fluctuation in supply and demand. Standard I-O analysis, in this instance, may not be appropriate for evaluation, as it does not differentiate cost structures for service firms, for example, operating at 40% capacity versus those operating at the 80% capacity.

Capacity Utilization and Tourism Economic Impact Analysis

Factors that influence the production function at different level of operating capacities include 1) the price effects regarding material cost, labor wages, and final outputs, 2) economies of scale in factor inputs, 3) substitution between labor and capital, and 4) capacity constraints in the production process (Armstrong & Taylor, 2000; Bryden, 1973; Fletcher & Snee, 1989; Miller & Blair, 1985; Porter, 1999; West & Gamage, 1997). The following section describes how each of these factors influences the sensitivity of tourism economic impact estimates with respect to capacity utilization.

Price Effects

The stability of the production function and I-O coefficients are mainly determined by four factors: price changes, technological changes (TC), returns to scale, and trade patterns (Rose & Miernyk, 1989; West, 1995). The influence of price movements on the I-O structure can be directly evaluated through the price-flex model proposed by Moses (1974). Moses' model indicated that outputs in the I-O table are generally expressed in value terms, which can be further distinguished in terms of price and physical quantity. As demonstrated in Equation 9, each value coefficient in the I-O table is the underlying physical input coefficient multiplied by a relative price ratio of input material and final product. Assuming the input coefficient for material i to product j

is 0.3 for the base year, the coefficient will change to 0.25 ($=0.3*\frac{1.1}{1.3}$) if price of product j increases 30% and the price of material i increases 10% from the base year point.

$$X_j = Q_j * P_j$$

$$X_{ij} = q_{ij} * Q_j * P_i$$

$$\alpha_{ij} = \frac{X_{ij}}{X_j} = \frac{q_{ij} Q_j P_i}{Q_j P_j} = q_{ij} * \frac{P_i}{P_j} \qquad \text{(Equation 9)}$$

Where

X_j = Output (sales) of sector j

X_{ij} = Output (sales) of sector i required to produce one unit output of product j

Q_j = Quantity of product j

P_i = Price of product i ; P_j = Price of product j

α_{ij} = Technical input coefficient = Output of industry i that is bought by industry j to produce one unit of product j

q_{ij} = Physical input coefficient = Physical output of industry i required to produce a physical unit output of industry j

Traditional I-O analysis assumes that the physical input coefficients (q_{ij}) remain constant and price ratios between inputs and the final product are unchanged during the policy period (Miller & Blair, 1985). This assumption is more realistic for manufacturing sectors as the product price is generally determined by the outside world, and material and labor are imported if domestic resources are constrained (Hunn & Mangan, 1999;

Rose, 1995; West, 1995). However, time-perishable services, such as the lodging, amusement, and transportation sectors, generally employ a strategy of price discrimination to maximize profits. In this case, the output price is based on levels of demand and unused capacity (Arenberg, 1991; Kimes, 1989). With a price discrimination strategy, I-O technical coefficients will change primarily depending upon the sensitivity of the price ratio between input material and the final product (Hudson & Jorgenson, 1974; Moses, 1974). A similar reasoning can also be applied to argue that the stability of income to sales ratios and jobs to sales ratios in the I-O framework will be directly influenced by the relative price change of final output.

Economies of Scale and Substitutions

Gosh (1958) points out that the matrix coefficients observed in the I-O table not only express a snapshot of the production/allocation function of an individual industry at the survey period, but also indicate how businesses perform at a given level of demand and supply. When demand is shifting in greater extent, the producers of a specific sector would then experience economics of scale (Miller & Blair, 1985). That is, as the price of input factors are fixed, the input per dollar of output falls as the scale of production increases (Lin & Lin, 2000). When economies of scales are experienced, I-O technical coefficients as well as job to sales ratio and personal income to sales ratios must be modified to reflect changes in the input-output relationship.

I-O technical coefficient. Bryden (1973) was the first study to indicate the quantitative differences among hotel revenue and cost structures at different utilization (occupancy) rates. He used financial data of a single hotel in Antigua to simulate the revenue and cost structures at a 45% occupancy rate versus a 65% occupancy rate. By

assuming a constant room price, the cost increased less than proportionately with revenue when occupancies were up. This in part can be explained by economies of scale, as marginal cost is lower than average cost for an additional unit sold.

Arranging the projected financial data of a hotel into a national accounting framework, Bryden (1973) further demonstrated the differences of Gross Domestic Product (value added) multipliers at 31%, 45%, 55%, and 65% occupancy rates for the accommodation sector. By assuming constant price indices and fixed I-O coefficients for the rest of the economy, the value added multipliers of the hotel sector decreased from 0.684 at a 31% occupancy rate to 0.644 at a 65% occupancy rate. The personal income multipliers decreased from 0.490 at a 31% occupancy rate to 0.443 at 65%, and the gross profit multipliers increased from 0.194 to 0.201. The decreasing value added multiplier effect is mainly due to increasing import contents and decreasing labor costs as demand rises. These results support Bryden's statement that "the assumptions regarding utilization of capacity are likely to be important in determining the input-output coefficients in the hotel industry" (p.126).

Jobs. Standard I-O models have generally been criticized for overestimation in employment effects because they assumed existing labor was fully utilized so that an increase in external demand would lead to a proportional increase in the level of employment (Fletcher & Snee, 1989; Porter, 1999; West & Gamage, 2001; West, 1995). However, in reality, labor is rarely at full utilization levels and employers will generally attempt to increase output without corresponding proportional increases in employment numbers. West (1995) claimed that "service-type industries are better able to support an increase in tourist activity largely within existing resources, whereas manufacturing-type

industries, which have more rigid production structures, respond in a manner closer to that of the Leontief production system" (p.223). It can be inferred from West's research that, in service sectors, production costs do not rise in direct proportion to sales when demand increases because certain levels of outputs can be accommodated by better use of the existing work force. This also implies that the level of employee expansion would depend upon the current level of utilization in existing workers.

Economies of scale are generally accompanied by substitution of primary factors in service-type industries, especially between employment and capital. For example, a greater labor productivity can be achieved through by subsidizing existing workers for the extra working hours/efforts (Krakover, 2000; West & Gamage, 2001). In the example of Grand Prix in Australia (Hatch, 1986), the study first used an I-O model to estimate total economic impacts from visitor spending at a car-racing event and then surveyed local businesses to validate the estimated results. The study revealed that no new permanent jobs were generated in the transportation sector as a result of the Grand Prix, and for some operations, the workload was rearranged so that even overtime pay was not required (Hatch, 1986). Hatch (1986) concluded that profits and value added components increased at higher utilization levels at the expense of employment.

Capacity Constraints

The third factor that explains the possible overestimation in the I-O model is the supply constraints of domestic traded goods. Supply constraints or bottleneck conditions generally result in increasing import requirements when businesses are operating at full or near capacity. The problem was first raised by Bryden (1973), who indicated that the domestic agriculture production in Antigua cannot satisfy the increasing demand from

tourism developments, and therefore substantial imported agriculture products were observed. To account for the leakage effects in the I-O model, Bryden (1973) totally removed the agriculture sector in the I-O technical coefficient matrix and included it in the imports vector. The result was a lower sales multiplier due to higher import contents.

O'Hagan and Mooney (1983) experimented with tourism multipliers based on different supply constraints for multiple traded sectors in Ireland. The tourism income multipliers decreased from the optimum 0.86 when all sectors were able to meet extra demand to 0.51 when both agriculture and food productions were constrained by domestic supply. By incorporating joint capacity constraints, the reduced income multipliers, due to leakage effects, behaved in a non-linear manner, depending on the nature of the linkages within the I-O table. A similar study was also found in Wanhill (1988), who examined the relationship between leakage effects and multipliers when multiple sectors were operating at different capacities. He simulated the income and employment multipliers for Mauritius when the agriculture and manufacturing sectors were assumed to operate at zero, 25%, 50%, 75%, and 100% of available capacity. The overall income multiplier was 0.69 when both industries operated at zero available capacity, increased to 0.78 at the 50% capacity, and to 0.96 when both operated at the 100% available capacities.

Summary

This chapter has reviewed four major tourism economic impact models and the detailed methodological specification of the Input-Output analysis. In the standard I-O model, fixed input costs, labor expenses, and profitability are applied in computing total

impacts regardless of the sales volume or operating capacities. This assumption has resulted in the exclusion of price effects, economies of scale, substitution between input factors and possible capacity constraints in the I-O framework. For all the cited references in this section, Bryden's (1973) is the most comprehensive tourism economic impact study that exploits the concept of capacity utilization within the I-O model. His study considered the economies of scale for the accommodation sector at different occupancy levels and supply constraints for agricultural products. Differences with respect to the standard I-O model were demonstrated in terms of sales multipliers and value added multipliers.

Although Bryden's study is pioneering, refinements are called for to address some of his model limitations. The first limitation is that the model employs constant price indexes for all input and output factors. Room prices, average personal wages, and intermediate product price are assumed constant and are not influenced by the level of capacity utilization. Second, his data are based on a single hotel and its validity to represent the overall accommodation sector is in question. Third, the study only briefly discusses the changes of sales multipliers and value added multipliers from the perspective of I-O technical coefficients. Stability of the jobs to sales ratio and personal income to sales ratio are not explicitly discussed. Economies of scale in labor and substitutions between labor and capital inputs are not included in the model.

CHAPTER III METHODS

The methods chapter presents the data sources, treatments, and the estimation process. Five secondary datasets are used in the analysis including, the "Inbound Traveler Consumption and Trends Survey (ITCTS)", the "Domestic Travel by Domestic Residents Survey (DTDRS)", Taiwan tourist hotel operation data, the 1999 Taiwan Input-Output table, and the "Manpower Survey Statistics in Taiwan Area". The first two datasets are used to estimate trip characteristics, spending averages, and the propensity of hotel stays for inbound and domestic tourists. These parameters are required to compute total inbound tourism visitor spending, and hotel rooms demanded from domestic and international tourists.

Tourist hotel data is adopted to establish the econometric models for jobs to sales ratio and income to sales ratio with respect to occupancy rates. These equations specify the relationship between capacity utilization and cost structures in jobs and income. Last, the I-O table and manpower survey are used to compile a national Input-Output model for Taiwan. Multipliers with fixed economic ratios based on standard I-O assumptions are first generated. Distinct sets of multipliers with varying job and income ratios are computed separately by incorporating the predicted job and income ratios from econometric equations. Comparison of impact estimates of the DTAP policy is calculated using I-O models with fixed and varying ratios under three scenarios. Detailed methods in estimating each objective are listed below.

Objective I

The purpose of objective I is to estimate the economic impact of inbound tourism to Taiwan in 2001. The estimation process follows a standard Input-Output Analysis. Final demand is calculated first by multiplying the average visitor spending with total number of international arrivals. Economic impacts are then computed by applying total visitor spending to a national Input-Output model of Taiwan.

Average Visitor Spending

Data sources. The "Inbound Traveler Consumption and Trends Survey (ITCTS)" was used to estimate average visitor spending. ITCTS is periodically conducted by the Taiwan Tourism Bureau to estimate spending profiles and trip characteristics for international visitors to Taiwan. The survey is conducted monthly at international airports in Taipei and Kaohsiung, collecting approximately 5,000 cases each year. The sample is stratified in proportion to the overall visitors admitted to Taiwan each year by country of residence. The database used in this analysis contains interviews conducted in 2000 and 2001, a total of 10,006 cases.

ITCTS measures visitor spending on a person trip basis, differentiating prepaid expenses[12] and expenses incurred in Taiwan. Visitors are asked to report an aggregate prepaid total and individual expenses in Taiwan within six categories: hotel[13], food, transportation, entertainment, shopping[14], and other expenses.

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[12] Exclude airfares.

[13] Expenses related to lodging, food, laundry and personal services inside the hotel.

[14] For the 2001 survey, visitors were asked to report their shopping expenses in 9 categories, including clothes, jewel, souvenir, cosmetics, local products, tobacco/alcohol, Chinese herbs, and others.

Data treatment. Variables selected from the database to perform the spending analysis were pre-paid expenses, expenses in Taiwan within six categories, length of stay in Taiwan, party size, lodging types, country of residence, and trip purpose. Cases were examined first to detect outliers and invalid cases. Cases were excluded from the spending analysis if 1) all spending questions were skipped, 2) the length of stay was longer than 60 days[15], 3) party size was larger than 10 persons, or 4) no spending was reported.

Expenses were initially reported in the currency of the visitors' origin and then converted to U.S. dollars. Spending per party per night was estimated by multiplying the per person per trip expense by the average party size and dividing by the average length of stay. Separate spending profiles were estimated by country of residence.

Total Spending of International Visitors

Total visitor spending was computed by multiplying 1) the average spending per person per day, 2) the official length of stay published by Taiwan Tourism Bureau in 2000-01, and 3) total international arrivals in 2001 by country of residence. Total visitor spending was allocated to six service sectors and ten manufacturing sectors based on the percentages in Appendix A. This procedure bridges the visitor spending to sectors in the Taiwan I-O table.

[15] This was the standard cut-off point in the official report by Taiwan Tourism Bureau (Taiwan Tourism Bureau, 2002).

Taiwan Input-Output Model

The 1999 Taiwan I-O table (Directorate-General of Budget Accounting and Statistics, 2003) was used to compile type I and type II sales multipliers, personal income to sales ratios, and value added to sales ratios. The 1999 Taiwan I-O table has 160 sectors that were further aggregated into 39 sectors[16], including 18 service sectors and 14 manufacturing sectors. Type I and type II sales multipliers were calculated as specified in Equation 10. Type II sales multipliers were calculated with the household sector endogenously included in the table.

$$B = (I-A)^{-1} \qquad \text{(Equation 10)}$$

Where B = Leontief inverse matrix

A = Technical input coefficient of 39 industries

I = Identity matrix

Regional purchase coefficients (RPC)[17] were computed as one minus the percentage of imported goods[18] for each manufacturing sector. Trade margins and transportation margins for goods were estimated using the 1996 producer price I-O table, which separates trade and transportation costs from production costs. Ratios were computed by dividing the trade and transportation costs by the total domestic sales for each manufacturing sector.

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[16] See Appendix B for sector definition and category.

[17] The proportion of the regional demand for a good or service that is fulfilled by regional production.

[18] Sum of territorial import and non-territorial import.

The "Manpower Survey Statistics in Taiwan Area" was used to establish jobs to sales ratios. The report includes sole proprietors and jobs in the government and private sectors (Directorate-General of Budget Accounting and Statistics, 2003). Jobs estimated from the Manpower Survey Statistic were grouped into the 39 I-O sectors[19]. The jobs to sales ratio for each I-O sector was computed by dividing the jobs by NT$ sales (in million's). The type I and type II multipliers of jobs, personal income, and value added were calculated as Equation 11-13.

Jobs = $\hat{E}$ BY (Equation 11)

Income = $\hat{I}$ BY (Equation 12)

Value added = $\hat{V}$ BY (Equation 13)

Where $\hat{E}, \hat{I}, \hat{V}$ respectively, are the diagonal matrix of job to sales ratio, income to sales ratio, and value added to sales ratio.

Total Economic Impacts

Total economic impacts were computed by applying total visitor spending to the Taiwan I-O model. The calculation process was carried out in three steps. First, sales for retail trade and domestic transportation were computed by multiplying total visitor

[19] The I-O table includes hotel restaurant sales within the "food and beverage" sector while the Manpower Survey counts employees working in hotel restaurants within the "hotel services" sector (Directorate-General of Budget Accounting and Statistics, 2003, 2003). For consistency with the I-O accounts, hotel employees working in the restaurant division were moved from the hotel sector to the food and beverage sector in the Manpower Survey Statistics. The estimates of restaurant employees in hotels were taken from data reported by tourist hotels in Taiwan. It is assumed that regular hotels (small-scale establishments) do not provide food and beverage services, and therefore no employees are reported in the restaurant division.

expenses in manufactured goods by the trade and domestic transportation margins, respectively. These expenses were later individually applied to multipliers for the retail trade and transportation sectors. Direct sales were computed by excluding imported manufactured goods (Equation 14). Finally, total direct sales were multiplied by the type I and type II multipliers to compute total sales, jobs, personal income and value added. Economic impacts were calculated for 39 I-O sectors. Results were summed and presented in 14 major categories to facilitate interpretation and presentation (Appendix B).

Direct sales = $\sum$ Expenses of non-traded goods + $\sum$ (Expenses of manufactured goods * regional purchase coefficients) (Equation 14)

Objective II

The purpose of objective II is to test the stability of jobs to sales ratios and income to sales ratios with respect to occupancy rates. Econometric relationships between these two ratios and occupancy rates were established using time series data of tourist hotels in Taiwan. Predicted job and income ratios were then applied to the Taiwan I-O model to re-compute multipliers by different occupancy rates. These distinct sets of multipliers were then multiplied with the 2001 inbound tourism visitor spending to re-compute total impacts in Taiwan.

Econometric Relationships

Two panel data sets, provided by the Taiwan Tourism Bureau (1999-2003), were employed in the estimation of jobs to sales ratios and income to sales ratios. Econometric

models were constructed to determine the relationship between occupancy rates and (1) jobs per NT$ million hotel sales, and (2) personal income per NT$ million hotel sales. Geographic location, consumer price index, and hotel scales were included as control variables in the regression equation to account for differences between hotels (Liu & Var, 1982; Pan). Locations were introduced as dummy variables representing northern Taiwan, central Taiwan, southern Taiwan and eastern Taiwan (Figure 3). The consumer price index (Directorate-General of Budget Accounting and Statistics, 2004) was incorporated to capture changes in jobs to sales ratios and income to sales ratios due to general price inflation. Hotel scale was measured as the number of rooms in each establishment.

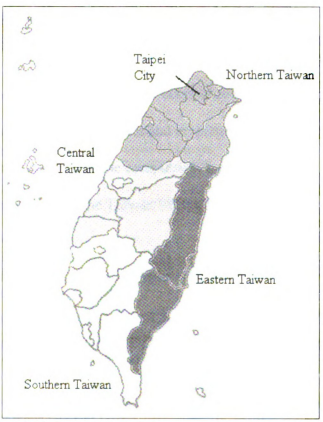

Figure 3. Four Geographic Regions, Taiwan

Jobs to sales ratios. The econometric relationship between hotel occupancy rates and jobs to sales ratios was estimated using the yearly firm level operational data for tourist hotels in Taiwan from 1999 to 2003 (Taiwan Tourism Bureau, 1999-2003). Variables included in the data set were the average room price, occupancy rate, total available rooms, total employees[20], and total revenue[21] per month. The dataset included 4,751 cases of monthly data from 75 international tourist hotels and 20 tourist hotels over the 5-year period[22].

The data set was examined first for data consistency and accuracy. Cases with incomplete information on key variables, such as sales and occupancy rate, were deleted. Monthly hotel operational data were aggregated to compute yearly totals for each individual establishment. Aggregating to a yearly basis controls for seasonal fluctuations in employment and sales.

After aggregation, 361 observations representing 83 hotels over a 5 year period were available covering average room price, occupancy rate, total employees and revenues. As noted above, restaurant sales and employees within hotels were excluded from the hotel sector to ensure that the computed jobs to sales ratios[23] correspond to the definitions of the hotel sector in the Taiwan I-O table.

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20 Total jobs were differentiated by employees working at the room division, food and beverage division, administration division, and others.

21 Total revenue included the sales in rooms, affiliated restaurants, and others.

22 International tourist hotels reported 3,638 cases and tourist hotels reported 1,113 cases during 1999 to 2003. Due to closures and renovations, not all hotels had complete monthly data for the five year period.

23 Jobs to sales ratio = [(Employees from the room division and managers) / rooms sales (NT$ million's)]. Number of managers was computed by multiplying the number of employees working in the administration division with a proportion, representing the room sales to total hotel sales.

Three dummy variables were included in the equation to represent the central, southern, and eastern Taiwan (Equation 15). The dummy variable representing northern Taiwan was excluded to avoid perfect multicollinearity. Regression analysis was performed within the Statistical Package for Social Science (SPSS) and Stata using the stepwise approach. The functional form was determined by comparing adjusted R-square values across 11 functional forms (curve-estimation process in the SPSS program). Multicollinearity and autocorrelation were examined during the analysis. Corrections were performed when needed.

Jobs to sales ratio = α_0 + f (occupancy rate, rooms per hotel, consumer price index, central Taiwan, southern Taiwan, eastern Taiwan) + ε_0 (Equation 15)

where α_0 is the intercept and ε_0 is the error term with normal distribution

Income to sales ratio. The econometric relationship between hotel occupancy rates and personal income to sales ratios was estimated using the yearly firm level international tourist hotel financial data from 1999 to 2002 (Taiwan Tourism Bureau, 1999-2003). Income statements, balance sheets, and other related operating data are reported yearly by all international tourist hotels in Taiwan. Cost information is itemized by labor, material (food or laundry expenditure), energy (water, electricity and fuel) and others (marketing, rent or business services). A total of 221 cases (annual averages) from 59 hotels were reported over the 4-year span.

The same procedure of the regression analysis, as described above, was used to analyze the relationship between personal income to sales ratios and occupancy rates (Equation 16).

Income to sales ratio = α_I + f (occupancy rate, rooms per hotel, consumer price index, central Taiwan, southern Taiwan, eastern Taiwan) + ε_I (Equation 16)

where α_I is the intercept and ε_I is the error term with normal distribution

Predicted Economic Ratios and Multipliers

Economic ratios. The predicted jobs to sales ratios and income to sales ratios for tourist hotels were estimated using econometric equations under different occupancy rates. Proportional changes in these two economic ratios from the base point (year 1999) were computed, and then applied to adjust the hotel job and income ratios in the 1999 Taiwan I-O table.

I-O multipliers. To calculate multipliers with varying ratios, the first step was to regenerate type II sales multipliers by adopting the predicted income to sales ratio in the accommodation sector. Multipliers of 39 I-O sectors were then recalculated by replacing the fixed job and income coefficients with the predicted job and income figures under different occupancy rates. These distinct sets of multipliers were applied to the 2001 inbound tourism visitor spending to recompute total impacts in Taiwan by occupancy rates.

Objective III

The purpose of objective III is to compare economic impact estimates of the DTAP policy under the three scenarios based on 1) standard I-O models with fixed multipliers, and 2) I-O models with varying jobs to sales ratios and personal income to sales ratios with occupancy rates. Each scenario is defined by international visitor volume and hotel lodging capacity to simulate alternative conditions of demand and supply of tourism activities.

The estimation process involves two primary models as illustrated in Figure 4. The ratio prediction model generates specific job and income ratios based on the predicted occupancy rate, which is determined by volumes of inbound travel, domestic travel and hotel capacity. Given the predefined demand and supply levels in each scenario, average occupancy rates are calculated and then applied to the econometric equations (objective II) to obtain jobs to sales ratios and income to sales ratios.

The input-output model computes total economic impacts. Final demand changes are calculated by multiplying average spending by the number of international visitors. Total visitor spending is then applied to fixed and varying multipliers. Fixed multipliers are computed using the Taiwan I-O model with average job and income coefficients. The varying multipliers for each scenario are individually computed using the predicted job and income ratios from the econometric equations.

Four major inputs are used in the estimation: the spending averages of international visitors, the volume of inbound tourism, the volume of domestic tourism, and tourist hotel capacity. In this analysis, average spending and the level of domestic tourism are assumed constant across scenarios. The changing variables for each scenario

are the number of international arrivals and hotel capacity. A lodging capacity of 20,697 rooms in 2008 is assumed in scenario 1. The maximum volume of international tourists is estimated based on hotel capacity. Scenarios 2 and 3 assume an increase in lodging capacity to 37,900 rooms, and that international arrivals grow to 75% and 100%, respectively, of the DTAP 4.8 million vitiation volume.

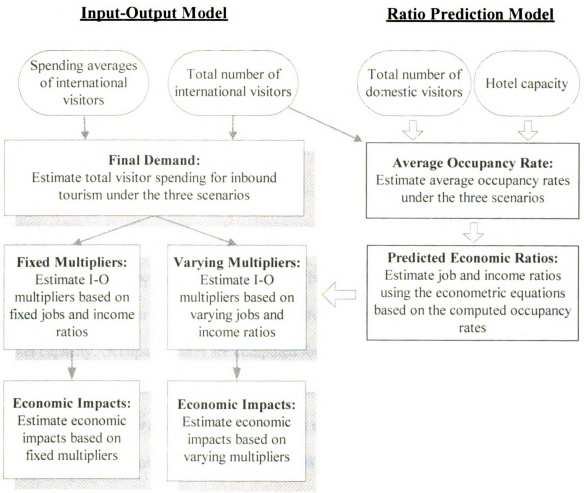

Figure 4. Estimation Process for Objective III

For I-O models with varying job and income ratios, the volume of inbound tourism serves two purposes. It determines the size of total visitor spending and also influences the job and income ratios, which are adjusted based on occupancy rates. In other words, economic impacts are determined by final demand changes as well as the level of capacity utilization in the accommodation sector.

Ratio Prediction Model

The ratio prediction model involves two steps. In the first step, average occupancy rates are estimated for each scenario. The second step then applies the computed occupancy rates to the econometric equations (established in objective II) to obtain the jobs to sales ratios and income to sales ratios.

Occupancy rates under the three scenarios

The average occupancy rates for tourist hotels were determined from 1) the demand level- number of domestic and international tourists, and 2) the supply level- the hotel capacity. Occupancy rates are computed for four geographic regions in Taiwan to take into account possible regional capacity constraint.

Domestic Tourism. Domestic tourism is assumed to grow from 97 million person trips in 2001 to 135 million person trips by 2008 for adults and children older than 12 years (Taiwan Tourism Bureau, 2003). The same level of domestic tourism volume (135 million person trips) and trip allocations to the four regions is assumed in all 3 scenarios. Trip characteristics of domestic travel were obtained from the "Domestic Travel by

Domestic Residents Survey" (DTDRS)[24] (Taiwan Tourism Bureau, 1998-2004). These variables included average propensity to stay at tourist hotels, regional trips distribution, party size, and average length of stay. Using these parameters, 135 million person trips were first allocated to the four regions and then converted to total room nights at tourist hotels[25].

Inbound tourism. Rooms demanded by international visitors were computed by multiplying the average hotel stay per visitor by the total number of international arrivals. The average propensity to stay at tourist hotels, regional trip distribution, party size and length of stay are assumed constant for all 3 scenarios. These parameters were computed from the "Inbound Traveler Consumption and Trends Survey" by country of residence.

Hotel capacity. Scenario 1 assumes a capacity of 20,697 tourist hotel rooms in 2008 with 58% of the capacity in northern Taiwan. The anticipated growth in the volume of international visitors is subject to room capacity constraints. It is assumed that when a region reaches the maximum capacity (100% occupancy), inbound tourism reaches the upper limit and additional international visitors are not allowed. Under current use patterns, northern Taiwan will be the first region to reach full capacity in tourist hotels. Additional trips will not be feasible if northern Taiwan remains the major destination and point of entry and exit for international visitors. The shifting of excess demand for tourist

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[24] DTDRS is conducted bi-annually to Taiwan residents for their trips within Taiwan, and is used to estimate trip characteristics for domestic tourism in this study. The dataset was obtained from the Taiwan Tourism Bureau, which collected 12,504 cases for the year of 2001.

[25] Domestic demand for tourist hotels (room nights)

$$= \text{total person trips} * \sum_{\text{region}=1}^{4} (\text{percent of trip distribution by regions} * \text{percent of tourist hotel stays} * \text{length of stay/ party size})$$

hotels from northern Taiwan to other regions is not permitted in the model. Scenarios 2 and 3 assume an expanded tourist hotel capacity of 37,900 rooms in 2008 with 69% of capacity in northern Taiwan.

Average occupancy rates. Average occupancy rates for the 3 scenarios are computed by dividing the total tourist hotel rooms demanded from domestic travel and inbound travel by capacity of tourist hotels.

Predicted economic ratios

The estimated occupancy rates from the previous section were applied to the econometric equations (established in objective II) to predict jobs to sales ratios and income to sales ratios for tourist hotels under each scenario. Proportional changes in these two economic ratios from the baseline in 1999 were computed, and then applied to adjust the hotel job and income ratios in the 1999 Taiwan I-O table.

Input-Output Model

Economic impacts of inbound tourism were calculated using the input-output analysis. Visitor spending is applied to the national I-O model with fixed and varying ratios. Total visitor spending by country of residence was computed by multiplying 1) the average spending per person per day, 2) the official length of stay published by Taiwan Tourism Bureau in 2000-01, and 3) total visitation volume specified in objective III. Total visitor spending was then allocated to six service sectors and ten manufacturing sectors based on the percentages in Appendix A.

Multipliers with fixed job and income ratios were reported under objective I. To calculate multipliers with varying coefficients, the predicted job and income ratios from

the ratio estimation model were applied to the Taiwan I-O model. Type II sales multipliers were first recalculated by substituting the predicted income to sales ratio for the accommodation sector. Multipliers for the 39 I-O sectors were then computed by replacing the fixed job and income coefficients with the predicted figures. The last step applied final demand changes to the I-O models with fixed and varying multipliers.

CHAPTER IV RESULTS

This chapter presents the results for each of the three study objectives. The economic impacts of international visitor spending in Taiwan in 2001 (objective I) are presented first to establish the baseline for the DTAP policy. Econometric equations in estimating jobs to sales ratios and income to sales ratios (objective II) are discussed. These equations specify the relationship between capacity utilization (occupancy rate) and economic ratios in jobs and income for tourist hotels in Taiwan. Predicted economic ratios and multipliers at different occupancy rates are then provided. The final section introduces the economic impact estimates of the DTAP policy under the three scenarios to simulate different conditions of demand and supply of tourism activities (Objective III). For each scenario, economic impacts are estimated using 1) the fixed economic ratios, and 2) the varying job and income ratios with respect to occupancy rates in the I-O model. The magnitude and direction of differences in impact estimates between the fixed and varying I-O ratios are summarized at the end of the chapter.

Objective I

Estimate the economic impacts of inbound tourism on the Taiwan economy in 2001, before the implementation of the "Doubling Tourist Arrivals Plan.

Economic impacts of inbound tourism are calculated using the Taiwan Input-Output model. Total international visitor spending is presented first, followed by the Taiwan I-O multipliers and economic impacts of inbound tourism in 2001.

Visitor Spending of Inbound Tourism

Average Spending. Visitors from Japan, Hong Kong/Macao and the "other" region have the highest spending per person per day in Taiwan, representing US$ 233, $188, and $173 respectively[26] (Table 12). On a party trip basis, visitors from the "other" region, North America and Japan are the top three spenders. Visitors from North America spend more than 45% of their trip expenses on accommodations, whereas visitors from Hong Kong incur half of their expense on food and shopping. In general, visitors from North America and Europe stay longer and incur more spending per visitor in Taiwan than Asian visitors.

Total visitor spending. Based on 2.6 million international visitors[27] with an average spending of US$ 1,361 per person per trip in Taiwan, inbound tourists spent US$ 3.5 billion in Taiwan in 2001 (Table 13). Thirty-one percent of this spending is contributed by Japanese visitors, followed by "other" regions (27%), and North American visitors (17%). Excluding airfares, lodging expenses account for 41% of total trip expenditures, expenses for food are 18%, and shopping represents 14%.

[26] Spending averages reported in this study are different from the spending averages published by the Taiwan Tourism Bureau due to exclusion of outliers and calculation formula. Taiwan Tourism Bureau directly computes the daily spending average per person without weighting the case with respect to length of stay, which leads to overestimation of short-term visitors' spending. In addition, the spending analysis conducted by Taiwan Tourism Bureau included all cases, covering outliers in expense or length of stay. The spending averages published by the Taiwan Tourism Bureau are approximately 15% higher than the averages computed by the author.

[27] Foreign labors (approximate 200,000) are excluded.

Table 12. Inbound Tourist Spending Profiles by Country of Residence, 2000-01

	Japan	Hong Kong/ Macao	Korea	Singapore /Malaysia	North America	Europe	New Zealand/ Australia	Others
Spending per person day (US$)								
Hotel	79.5	53.1	46.7	55.2	70.2	63.1	53.1	62.7
Food	50.4	48.5	24.9	31.9	35.8	34.8	30.4	39.6
Transportation	18.6	10.7	11.6	11.1	9.7	10.5	9.2	12.4
Entertainment	22.6	16.5	11.2	11.8	15.2	10.6	10.7	16.8
Shopping	44.9	46.3	19.7	14.2	14.0	15.6	13.6	22.9
Others	17.5	13.2	12.1	11.5	10.2	15.1	10.9	18.7
Total	233.6	188.2	126.2	135.6	155.1	149.7	127.8	173.1
Spending per person trip (US$)								
Hotel	382.8	271.0	255.7	452.3	700.6	492.5	422.1	960.0
Food	242.6	247.7	136.2	261.3	358.0	271.7	242.1	605.7
Transportation	89.7	54.5	63.3	91.2	96.6	81.6	72.9	189.8
Entertainment	108.5	84.1	61.4	96.8	151.8	82.5	85.0	257.7
Shopping	216.3	236.3	107.5	116.2	139.5	121.6	108.0	350.1
Others	84.4	67.6	66.3	94.3	102.1	117.6	86.3	285.3
Total	1,124.4	961.2	690.4	1,112.1	1,548.5	1,167.4	1,016.5	2,648.6
Length of stay	4.81	5.11	5.47	8.20	9.99	7.80	7.95	15.30
Party size	1.26	1.15	1.19	1.12	1.12	1.10	1.17	1.14
Cases	3,280	1,014	361	301	990	1,156	162	666
95% confidence interval of daily spending per person (US$)								
Upper bound	244.4	203.9	144.0	152.2	169.2	174.5	183.8	194.3
Lower bound	222.8	172.5	108.4	119.0	141.0	124.9	71.8	151.9

Table 13. Visits and Total Spending By Country of Residence, 2001

Country of residence	Japan	Hong Kong/ Macao	Korea	Singapore/ Malaysia	North America	Europe	New Zealand/ Australia	Others	Total/ Average
Person trips (000's)	977	435	86	156	392	149	38	364	2,597
Pct of person trips	38%	17%	3%	6%	15%	6%	1%	14%	100%
Average spending per person trip	$1,124	$961	$690	$1,112	$1,549	$1,167	$1,016	$2,649	$1,361
Total spending (US million's)	$1,098	$418	$59	$174	$607	$173	$39	$965	$3,534
Pct of spending	31%	12%	2%	5%	17%	5%	1%	27%	100%

Taiwan Input-Output Model

Economic ratios and multipliers for tourism related sectors are displayed in Tables 14 and Table 15. Across all service sectors, food and beverage services have the

highest jobs to sales ratio (1.84 jobs per NT$ million sales), followed by retail trade (1.38), and theatrical & arts (1.09). "Food and beverage services" and "wholesale trade and retail trade" have the highest personal income to sales ratio. Approximately half of the sales in these sectors go to employee compensation. With the exception of apparel and wood products, manufacturing sectors employ fewer people per million in sales and spend a lower percentage of their revenue on wages and other value added components.

Table 14. Economic Ratios for Primary Tourism Sectors, 1999

	Income to sales ratio	Value added to sales ratio	Jobs/ million NT$ sales	Jobs/ million US$ sales[a]
Services				
Hotel services	0.411	0.649	0.497	16.891
Food & beverage services	0.527	0.707	1.841	62.567
Transportation	0.362	0.560	0.523	17.774
Theatrical and other arts	0.330	0.567	1.091	37.078
Recreational & cultural services	0.376	0.693	0.729	24.775
Other personal services	0.407	0.579	0.876	29.771
Wholesale trade	0.496	0.687	0.480	16.313
Retail trade	0.485	0.738	1.383	47.002
International trade	0.339	0.599	0.433	14.716
Manufacturing				
Process foods & beverages	0.108	0.245	0.264	8.972
Tobacco	0.116	0.731	0.038	1.291
Textile mill products	0.149	0.241	0.269	9.142
Wearing apparel and accessories	0.243	0.300	0.886	30.111
Leather & leather products	0.155	0.215	0.653	22.192
Wood products	0.271	0.391	1.153	39.185
Paper & paper products	0.239	0.360	0.427	14.512
Chemical manufactures products	0.125	0.275	0.212	7.205
Non-metallic mineral products	0.202	0.369	0.318	10.807
Iron and steel products	0.143	0.246	0.384	13.050
Machinery & electronic products	0.136	0.256	0.264	8.972
Transport equipment	0.141	0.308	0.258	8.768
Other manufacturing products	0.218	0.315	0.318	10.807

Note. Economic ratios and multipliers for 39 sectors can be found in Appendix C and D.

[a] One US dollar equated to 33.99 New Taiwan dollars in 2001 (OANDA Corporation, 2004).

Type I sales multipliers for service sectors generally fall between 1.4 and 1.5, while type II sales multipliers average about 3.5 (Table 15). With the exception of

tobacco, type I sales multipliers for manufacturing sectors are greater than 1.5 with some above 2.0. Type II sales multipliers for manufacturing sectors are slightly below service sectors. The general pattern is for larger induced effects for service sectors and greater indirect effects for manufacturing. The international trade, wholesale trade and retail trade margins range from 9% to 23% for manufacturing sectors (Appendix E). Transportation margins account for 1% to 4% of total sales. Regional purchase coefficients vary substantially across manufacturing; from a high of 91% in the textile sector to a low of 49% in "other manufactured products".

Table 15. Multipliers for Primary Tourism Sectors, 1999

Sector	Type I sales multipliers	Type II sales multipliers	Type I jobs to $NT million sales ratio	Type I income to sales ratio	Type I value added to sales ratio
Services					
Hotel services	1.507	3.558	0.749	0.619	0.979
Food & beverage services	1.423	3.768	2.620	0.750	1.006
Transportation	1.449	3.271	0.758	0.525	0.811
Theatrical and other arts	1.564	3.449	1.706	0.516	0.887
Recreational & cultural services	1.427	3.261	1.040	0.537	0.989
Other personal services	1.573	3.680	1.378	0.640	0.911
Wholesale trade	1.421	3.761	0.682	0.705	0.977
Retail trade	1.363	3.531	1.885	0.661	1.006
International trade	1.519	3.394	0.658	0.515	0.910
Manufacturing					
Process foods & beverages	2.135	3.706	0.564	0.231	0.523
Tobacco	1.286	2.005	0.049	0.149	0.940
Textile mill products	2.156	3.567	0.580	0.321	0.519
Wearing apparel and accessories	2.135	3.962	1.891	0.519	0.641
Leather & leather products	1.560	2.635	1.019	0.242	0.336
Wood & wood products	1.535	3.118	1.770	0.416	0.600
Paper & paper products	1.744	3.412	0.745	0.417	0.628
Chemical manufactures products	1.674	2.679	0.355	0.209	0.460
Non-metallic mineral products	1.779	3.329	0.566	0.359	0.656
Iron and steel products	2.028	3.454	0.779	0.290	0.498
Machinery & electronic products	1.633	2.700	0.431	0.222	0.417
Transport equipment	1.908	3.215	0.492	0.269	0.588
Other manufacturing products	1.831	3.356	0.582	0.399	0.577

Multipliers do not vary substantially between visitor groups by country of residence, except for the jobs to sales ratios (Table 16). The total jobs per million US$ sales by country of residence range from 27 to 30. These variations depend on the relative amounts spent on different items/services during the trip. Visitors from Hong Kong/ Macao support the most jobs per million dollar of spending, due to a high proportion of spending on food/restaurants, a sector with the most jobs per million sales. On the other hand, Korean visitors support the fewest jobs per million dollars in spending due to a high proportion spending on accommodation. The accommodation sector supports 16.9 jobs per million sales, less than a third of the food & beverage job ratio. Personal income to sales ratios vary by plus or minus 1% from the average of 40% for different visitors by country of residency, and value added to sales ratios vary by plus or minus 2% from the average of 62%.

Table 16. Economic Ratios and Multipliers by Country of Residence

	Japan	Hong Kong/ Macao	Korea	Singapore Malaysia	North America	Europe	New Zealand/ Australia	Others
Direct effects ratio[a]								
Capture rate	0.95	0.93	0.96	0.98	0.98	0.97	0.97	0.97
Jobs/ US$ million sales	27.44	29.83	26.58	28.33	27.42	27.84	27.85	28.30
Personal Income	0.39	0.39	0.39	0.41	0.41	0.41	0.41	0.40
Value Added	0.61	0.60	0.61	0.63	0.64	0.63	0.63	0.62
Type I multiplier								
Sales	1.53	1.54	1.52	1.50	1.50	1.51	1.51	1.51
Jobs/ US$ million sales	36.15	38.95	35.06	36.15	35.07	35.79	35.80	36.45
Personal Income	0.53	0.53	0.53	0.54	0.54	0.54	0.54	0.54
Value Added	0.88	0.88	0.89	0.90	0.90	0.90	0.90	0.89
Type II multiplier								
Sales	3.49	3.50	3.49	3.52	3.53	3.53	3.52	3.51
Jobs/ US$ million sales	74.89	77.71	73.91	76.04	75.15	75.63	75.60	75.91
Personal Income	1.11	1.11	1.12	1.14	1.15	1.14	1.14	1.13
Value Added	2.02	2.02	2.03	2.07	2.08	2.07	2.07	2.05

Note. [a] Ratio is expressed in terms of effects (jobs, income and value added) divided by direct sales.

Economic Impacts of Inbound Tourism, 2001

Direct sales to inbound tourists in 2001 were US$ 3.4 billion (Table 17). Approximately 4% of visitor spending leaked out the Taiwan economy for purchases of imported products. Total direct visitor spending supported 95 thousand jobs, US$ 1.4 billion in personal income, and US$ 2.1 billion in value added. Thirty percent of jobs were supported by Japanese visitors, followed by visitors from other regions (28%), and North American visitors (17%).

Table 17. Direct Effects of Inbound Tourism by Country of Residence, 2001

Country of residence	Total spending (US million's)	Direct sales (US million's)	Jobs (000's)	Income (US million's)	Value added (US million's)
Japan	$1,098	$1,042	28.5	$407	$634
Hong Kong/Macao	$418	$391	11.6	$152	$235
Korea	$59	$57	1.5	$22	$35
Singapore/Malaysia	$174	$170	4.8	$70	$108
North America	$607	$596	16.3	$245	$379
Europe	$173	$169	4.7	$69	$106
New Zealand/Australia	$39	$38	1.1	$15	$24
Others	$965	$935	26.4	$375	$582
Total/ Average	$3,534	$3,398	94.8	$1,356	$2,103

In 2001, forty-three percent of total tourism foreign receipts accrued to the hotel sector, followed by food & beverage services (19%), and recreation and culture services (10%) (Table 18). The majority of jobs were in food & beverage services (42%). Twenty-six percent of jobs were in the hotel sector and 9% in recreation and culture services.

Through secondary effects, inbound tourism supported an additional US$ 2.0 billion in sales, 37 thousand jobs and US$ 535 million in personal income (Table 19). The aggregate type I sales multiplier for tourist spending is 1.58, and the type II sales multiplier is 3.59. The approximate ratios of direct effects, indirect effects and induced effects are 2 : 1 : 3, indicating substantial induced effects across the economy. In terms of

direct and indirect effects, international visitors to Taiwan generated $5.3 billion sales and 132,000 jobs in 2001. When induced effects are included, the impacts increase to $12.2 billion sales and 267,000 jobs.

Table 18. Direct Effects of Inbound Tourism by Sector, 2001

	Sales (million's)	Jobs (000's)	Personal Income (million's)	Value Added (million's)	Percentage			
					Sales	Jobs	Income	Value added
Hotel services	$1,456	24.6	$598	$946	43%	26%	44%	45%
Food & beverage	$642	40.2	$338	$454	19%	42%	25%	22%
Transportation	$264	4.7	$95	$147	8%	5%	7%	7%
Recreational service	$336	8.3	$126	$233	10%	9%	9%	11%
Theatrical & arts	$166	6.2	$55	$94	5%	6%	4%	4%
Other personal service	$166	5.0	$68	$96	5%	5%	5%	5%
Manufacturing	$286	3.8	$42	$83	8%	4%	3%	4%
Retail trade	$37	1.7	$18	$27	1%	2%	1%	1%
Wholesale	$23	0.4	$11	$16	1%	0%	1%	1%
International trade	$22	0.3	$7	$13	1%	0%	1%	1%
Total	$3,398	95.2	$1,360	$2,110	100%	100%	100%	100%

Table 19. Economic Impacts of Inbound Tourism by Sector, 2001

	Direct & Indirect Effects				Direct, Indirect & Induced Effects			
	Sales (million)	Jobs (000's)	Income (million)	Value Added (million)	Sales (million)	Jobs (000's)	Income (million)	Value Added (million)
Hotel services	1,458	24.6	599	947	1,462	24.7	600	950
Food & beverage	646	40.4	340	457	828	51.8	437	586
Transportation	313	5.6	113	175	568	10.1	205	318
Recreation service	576	17.0	206	370	691	20.4	248	446
Theatrical & arts	226	8.4	75	128	264	9.8	87	150
Personal services	232	6.9	95	135	548	16.3	223	317
Manufacturing	849	10.3	134	245	2,602	28.4	384	740
Retail trade	87	4.1	42	64	609	28.6	295	449
Wholesale	60	1.0	30	42	316	5.2	157	217
International trade	52	0.8	18	31	174	2.6	59	105
Financial & business	596	7.1	183	430	3,135	38.0	984	2,383
Agri., forest, fishery	76	3.9	24	37	472	25.5	144	227
Utilities	176	0.7	26	80	362	1.3	52	169
Construction	36	1.0	9	12	150	4.1	39	51
Total	5,384	131.8	1,895	3,154	12,182	266.8	3,916	7,107
Type I multipliers[a]	1.58	38.80	0.56	0.93				
Type II multipliers[a]					3.59	78.51	1.15	2.09

[a] Impacts (jobs, income and value added) divided by direct sales.

"Recreation & culture services", "financial & business services" and "manufacturing" received the largest indirect effects from international visitor spending (Table 20). When induced effects are taken into account, "financial & business services", "retail trade", and "agriculture, forest & fisheries" benefited the most in terms of job creation. Due to limited interindustry linkages with other sectors, hotel services received relatively small secondary effects. In 2001, inbound tourism indirectly supported 38,000 jobs in "financial & business services" (indirect + induced effects) followed by 26,900 jobs in "retail trade" and 25,500 jobs in "agriculture, forestry and fisheries".

Table 20. Indirect and Induced Effects of Jobs and Personal Income, 2001

	Jobs (000's)		Income ($ million)		Ranking of jobs		Ranking of income	
	Indirect effects	Indirect + induced effects	Indirect effects	Indirect + induced effects	Indirect effects	Indirect + induced effects	Indirect effects	Indirect + induced effects
Recreation services	8.7	12.1	80	122	1	5	3	7
Financial & business	7.1	38.0	183	984	2	1	1	1
Manufacturing	6.5	24.6	92	342	3	4	2	2
Agri., forest, fishery	3.9	25.5	24	144	4	3	6	6
Retail trade	2.3	26.9	24	277	5	2	6	3
Theatrical & arts	2.2	3.6	20	32	6	11	8	13
Personal services	2.0	11.4	27	155	7	7	4	4
Construction	1.0	4.1	9	39	8	10	12	12
Transportation	0.9	5.4	18	110	9	8	10	8
Utilities	0.7	1.3	26	52	10	13	5	10
Wholesale	0.6	4.8	19	146	11	9	9	5
International trade	0.4	2.2	11	52	12	12	11	10
Food & beverage	0.3	11.7	2	99	13	6	13	9
Hotel services	0.0	0.1	1	2	14	14	14	14

In 2001, Taiwan reported NT$ 9.448 billion in Gross Domestic Product (GDP) and 9.38 million total jobs (Ministry of Economic Affairs, 2005). Visitor spending of inbound tourism in 2001 contributed 0.76% of national GDP and 1.01% of total jobs in terms of direct effects; 2.56% of GDP and 2.84% of total jobs in terms of total effects.

Objective II

Test the stability of job to sales ratios and personal income to sales ratios relative to occupancy rates in the accommodation sector

Job to Sales Ratio

A log linear functional form best captures the relationship between hotel jobs to sales ratios and occupancy rates. This functional form has higher adjusted R-square value than others (Appendix F, Equation 17). No multicollinearity is detected among the independent variables, and no heteroskedasticity is detected among the error terms.

ln (jobs to sales ratio) = $\alpha + \beta_1$* occupancy rate + β_2* hotel scale + β_3* consumer price index + β_4* central Taiwan + β_5* southern Taiwan + β_6* eastern Taiwan + error term (0, δ^2) (Equation 17)

Occupancy rates and hotel scales (number of rooms) are significant in determining jobs to sales ratios at the 95% confidence level. The consumer price index and three region dummy variables are not significant (Table 21). Jobs to sales ratios are negatively correlated with occupancy rates. A rise in occupancy rate leads to fewer jobs per million sales (Equation 18). Due to the non-linear functional form, the percentage changes in jobs to sales ratio are not constant at different occupancy levels. A 5% increase from 80% to 85% in occupancy, for example, will lead to a smaller reduction in jobs to sales ratios than a 5% increase from 40% to 45%.

Table 21. Regression Statistics for the Log Jobs to Sales Ratio

Variables in the equation	B	Std. Error	BETA	T	SIG T	Tolerance
Constant	3.1342	0.0663		47.2566	0.0000	
Occupancy Rate	-1.4776	0.1144	-0.5503	-12.9182	0.0000	0.895
Rooms	-0.0006	0.0001	-0.2058	-4.8305	0.0000	0.895
Excluded variables						
Consumer price index						
Central Taiwan						
Southern Taiwan						
Eastern Taiwan						

Stepwise analysis is employed with 0.05 to enter and 0.10 to remove. Adjusted R-Squared = .415 ; F-Value = 128.820 (p value = 0.0000); Number of cases = 361

ln (jobs to sales ratio) = 3.1342 –1.4776*occupancy rate - 0.0006* rooms

(Equation 18)

Personal Income to Sales Ratio

Personal income to sales ratios are modeled as a linear function of occupancy rates, the number of rooms per establishment, consumer price index, and regional dummy variables. The linear functional form is applied because of its high adjusted R-square values than other forms (Appendix G, Equation 19).

Personal income to sales ratio = $\alpha + \beta_1$* occupancy rate + β_2* hotel scale + β_3* consumer price index + β_4* central Taiwan + β_5* southern Taiwan + β_6* eastern Taiwan + error term $(0, \delta^2)$ (Equation 19)

No multicollinearity is observed in the independent variables but some level of heteroskedasticity is discovered among the error terms. Variances of the coefficients are re-calculated using the Huber-White sandwich estimation, which corrects the bias of

heteroscedasticity. The correction provides larger variances (robust standard error) for the constant and occupancy rates in the equation, but the recomputed standard error does not change the significance of the independent variables.

Occupancy rates and hotel scales (number of rooms) are significant in determining personal income to sales ratios at the 95% confidence level (Table 22). Income to sales ratios and occupancy rates are negatively correlated, indicating that a rise in the occupancy rate leads to a smaller percentage of sales going to employee compensation. A one percent increase in occupancy rate would yield a decrease of 0.11 in the income to sales ratio, ceteris paribus (Equation 20).

Table 22. Regression Statistics for the Income to Sales Ratio

Variables in the equation	B	Std. Error	Robust Std. Error	BETA	T	SIG T	Tolerance
Constant	0.4672	0.0246	0.0334		13.9760	0.0000	
Occupancy Rate	-0.1060	0.0410	0.0528	-0.1740	-2.0080	0.0445	0.895
Rooms	-0.0002	0.0000	0.0000	-0.2868	-3.8810	0.0000	0.895
Variables excluded							
Consumer price index							
Central Taiwan							
Southern Taiwan							
Eastern Taiwan							

Stepwise analysis is employed with 0.05 to enter and 0.10 to remove. Adjusted R-Squared = .1368; F-Value = 18.0350 (p value = 0.0000); Number of cases = 216

Income to sales ratio = 0.4672 - 0.1060*occupancy rate - 0.0002 *rooms

(Equation 20)

The predicted job and income to sales ratios are estimated using Equation 18 and 20. With the average occupancy rate of 62% in 1999 and an average 253 rooms per hotel, a five percent increase in occupancy rates would lead to a 7% decrease in job ratios, and a

1.5% reduction in income ratios (Table 23). A five percent decrease in occupancy rates, on the other hand, would raise the job ratio by 8% and increase the income ratio by 1.5%.

Table 23. Predicted Jobs and Income Ratios for Tourist Hotels

Occupancy rate	Predicted jobs to sales ratio	Pct change	Predicted personal income to sales ratio	Pct change
40%	0.9102	38.4%	0.372	6.7%
45%	0.8453	28.6%	0.366	5.2%
50%	0.7851	19.4%	0.361	3.7%
57%	0.7080	7.7%	0.354	1.5%
62% (base year)	0.6576	0.0%	0.348	0.0%
67%	0.6107	-7.1%	0.343	-1.5%
70%	0.5843	-11.1%	0.340	-2.5%
75%	0.5427	-17.5%	0.334	-4.0%
80%	0.5040	-23.4%	0.329	-5.5%
85%	0.4681	-28.8%	0.324	-7.0%

Predicted I-O Multipliers

These predicted changes are applied to the hotel job and income ratios in the 1999 Taiwan I-O table. The results are displayed in Table 24. In 1999, when the average occupancy rate was 62%, the jobs to sales ratio was 0.4972 per NT$ million sales. The jobs to sales ratio would rise to 0.6681 if occupancy rates decrease to 42%. The ratio would fall to 0.3436 if occupancy rates increase to 87%. The personal income to sales ratio, on the other hand, is less responsive to changes in occupancy rates, ranging between 0.38 and 0.44 over the same range of changes in occupancy (Figure 5).

Table 24. Predicted Jobs and Income Ratios for the Accommodation Sector

Occupancy rate	Predicted jobs to NT$ million sales ratio	Predicted personal income to sales ratio
42%	0.6681	0.4358
47%	0.6206	0.4295
52%	0.5764	0.4232
57%	0.5353	0.4169
62% (base year)	0.4972	0.4106
67%	0.4618	0.4043
72%	0.4289	0.3981
77%	0.3984	0.3918
82%	0.3700	0.3855
87%	0.3436	0.3792

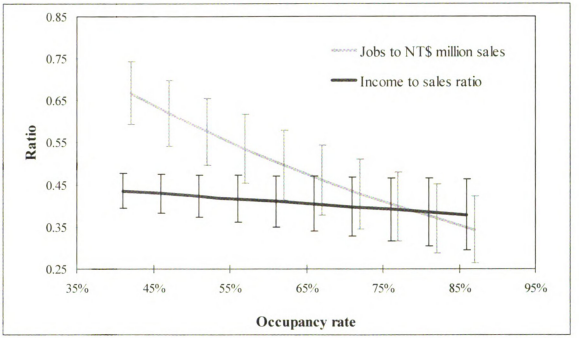


Figure 5. Predicted Jobs and Income Ratios with 95% Confidence Intervals for the Accommodation Sector

The predicted job and income ratios with respect to occupancy rates in Table 24 are applied to re-compute multipliers for the hotel sector in the Taiwan I-O model (Table 25). Type I sales multipliers remain constant with respect to occupancy rates, while type II sales multipliers vary by plus or minus 3% from the base year value when occupancy rates fluctuate between 42% and 82%. Type I job multipliers for the hotel sector differ

substantially, ranging from 1.01 jobs per NT$ million hotel sales at 42% occupancy to 0.56 jobs per NT$ million hotel sales at 82% occupancy. The job ratio is 34% higher than the base year job ratio when businesses operate at 42% occupancy. Using fixed ratios in the standard I-O model will therefore underestimate hotel jobs by as much as 34% if occupancy rate drops to 42% or will overestimate hotel jobs by 26% if occupancy increases to 82%. The type I income multiplier is more stable with a maximum 6% difference from the base year figure for occupancy rate between 42% and 82%.

Table 25. Multipliers of the Hotel Sector Based on Different Occupancy Rates

Occupancy rate	Type I sales	Type II sales	Type I jobs /NT$ million sales	Type I income
Multipliers				
42%	1.51	3.65	1.01	0.66
52%	1.51	3.61	0.87	0.64
62% (base year)	1.51	3.56	0.75	0.62
72%	1.51	3.51	0.65	0.60
82%	1.51	3.46	0.56	0.58
Pct change				
42%	0%	3%	34%	6%
52%	0%	1%	16%	3%
62% (base year)	0%	0%	0%	0%
72%	0%	-1%	-14%	-3%
82%	0%	-3%	-26%	-6%

To demonstrate the direction and magnitude of biases with fixed and varying I-O ratios, the multipliers in Table 25 are applied to inbound tourism visitor spending in 2001 under 42%, 62% and 82% occupancy rates. Standard I-O models with fixed ratios yield the same impact estimates regardless of capacity utilization. I-O models with varying job and income ratios, in contrast, estimate more jobs and higher wages and salaries when hotels operate at lower occupancies (Table 26). At an occupancy rate of 42%, the I-O model with fixed ratios underestimates hotel jobs by 34% and personal income of hotel

employees by 6%. At an occupancy rate of 82%, the fixed ratios overestimate jobs by 26% and income by 4% for the hotel sector. Differences in the overall economy are 4% in jobs and 2% in income. As changes in the job ratios are nonlinear, the estimation error is reduced when occupancy approaches higher capacity.

Table 26. Economic Impacts of Inbound Tourism in 2001 with Fixed and Varying Ratios

	Direct & indirect jobs		Direct, indirect & induced jobs		Direct & indirect income (million's)		Direct, indirect & induced income (millions)	
Occupancy rate	Hotel	All sector	Hotel	All sector	Hotel	All sector	Hotel	All sector
I-O models with fixed ratios								
42%	24,644	131,819	24,705	266,770	$599	$1,895	$600	$3,916
62%	24,644	131,819	24,705	266,770	$599	$1,895	$600	$3,916
82%	24,644	131,819	24,705	266,770	$599	$1,895	$600	$3,916
I-O models with varying job and income ratios								
42%	33,118	140,293	33,201	278,380	**$636**	$1,932	**$637**	**$4,000**
62%	24,644	131,819	24,705	266,770	$599	$1,895	$600	$3,916
82%	18,339	125,514	18,383	257,334	$562	$1,858	$564	$3,833
Pct error between fixed and varying ratios[a]								
42%	34%	6%	34%	4%	**6%**	2%	**6%**	**2%**
62%	0%	0%	0%	0%	**0%**	0%	**0%**	**0%**
82%	-26%	-5%	-26%	-4%	**-6%**	-2%	**-6%**	-2%

[a] (Impacts with varying ratios – impacts with fixed ratios) / impacts with fixed ratios

Objective III

Estimate economic impacts of inbound tourism on the Taiwan economy for three scenarios based on 1) standard I-O models with fixed multipliers, and 2) I-O models with varying jobs to sales ratios and personal income to sales ratios by occupancy rates

Three scenarios are defined with alternative levels of demand and supply as summarized in Table 27. Impacts for scenario 1 are estimated at the current hotel capacity of 20,697 rooms and the maximum international visitor volume that this capacity can accommodate. Scenarios 2 and 3 assume an increase in lodging capacity to 37,900 rooms, and that international arrivals grow to 75% and 100%, respectively, of the DTAP visitation target.

Economic impacts of the 3 scenarios are estimated using Input-Output models with fixed and varying job and income ratios. Multipliers for 39 I-O sectors with fixed ratios were reported in the previous section (Table 15). Multipliers with changing job and income ratios with respect to occupancy rates are computed using equations 18 and 20.

Table 27. Demand and Supply Levels under the Three Scenarios

Scenarios	Tourist Hotel Capacity	Domestic Tourism (person trips)	Inbound Tourism (person trips)[a]
Base Year (2001)	20,697 rooms	97 million	2.6 million
Scenario 1 (2008)	20,697 rooms	135 million	Maximum visitors (?)
Scenario 2 (2008)	37,900 rooms	135 million	3.6 million
Scenario 3 (2008)	37,900 rooms	135 million	4.8 million

[a] Foreign labors to Taiwan are excluded, which are approximate 20 thousand persons per year.

As hotels operate with distinct cost structures with respect to capacity utilization (indicated in objective II), the first step to compute varying I-O multipliers is to calculate hotel occupancy rates under each scenario.

Occupancy Rates by Scenario

Three pieces of information are needed to compute the average occupancy rates of tourist hotels in 2008: (1) rooms demanded from domestic tourists, (2) rooms demanded

from international visitors, and (3) the proposed lodging capacity under each scenario in 2008. For domestic travel, the same level of demand and regional distribution are assumed across the three scenarios. Hotel occupancy rates are therefore primarily determined by the international visitor volume and lodging capacity of tourist hotels.

Domestic tourism. Based on a projected volume of 135 million domestic person trips (Taiwan Tourism Bureau, 2003), domestic tourism is estimated to support 2.02 million room nights at tourist hotels in 2008 (Table 28). The regional distribution of domestic travel is assumed to be constant between year 2001 and 2008, estimated from the "Domestic Travel by Domestic Residents Survey". Forty percent of these room nights are in southern Taiwan, 28% in northern Taiwan, and 21% in eastern Taiwan.

Table 28. Trips and Room Nights for Domestic Tourism, 2008

	Northern Taiwan	Central Taiwan	Southern Taiwan	Eastern Taiwan	Total
Person trips of domestic travel (million's)	48.02	34.24	44.08	8.66	135.00
Pct of person trips	36%	25%	33%	6%	100%
Room nights at tourist hotels (million's)	0.57	0.23	0.81	0.42	2.02
Pct of room nights	28%	11%	40%	21%	100%

Note. [a] Party size covers adults and children 12 or older.

Inbound Tourism. For every one thousand international visitors, 1,141 room nights (party nights) are generated at tourist hotels. On average, 85% of these 1,141 room nights are located in northern Taiwan, 9% in southern Taiwan, 4% in central Taiwan, and 2% in eastern Taiwan. Total room nights generated by international visitors are computed by multiplying the average hotel room nights per visitor by the total volume of inbound travel.

For scenario 1, the maximum number of room nights that tourist hotels in northern Taiwan can supply is 4.34 million (Table 29). Subtracting 566 thousand room

nights for use by domestic tourists leaves 3.78 million room nights available for international visitors. Assuming tourist hotels in northern Taiwan operate at 100% occupancy that no shifting of excess demand to other regions is permitted, the maximum volume of international visitors that can be accommodated is 3.89 million. This corresponds to 81% of the DTAP visitation goal of 4.8 million international visitors.

Table 29. Supply, Demand, and Average Occupancy Rates of Tourist Hotels

Scenario	Northern Taiwan	Central Taiwan	Southern Taiwan	Eastern Taiwan	Total/ Average
Base year, 2001					
Supply - Tourist hotel rooms	11,906	1,726	4,618	2,447	20,697
Demand (000's room nights/year)					
Domestic tourism	409	164	584	303	1,458
Inbound tourism	2,579	110	275	73	3,037
Total	2,988	274	859	376	4,496
Occupancy rate	70%	44%	51%	42%	62%
Scenario 1, 2008					
Supply - Tourist hotel rooms	11,906	1,726	4,618	2,447	20,697
Demand (000's room nights/year)					
Domestic tourism	566	227	809	419	2,021
Inbound tourism	3,777	162	402	107	4,448
Total	4,343	389	1,211	526	6,469
Occupancy rate	100%	62%	72%	59%	86%
Scenario 2, 2008					
Supply - Tourist hotel rooms	26,000	2,600	6,000	3,300	37,900
Demand (000's room nights/year)					
Domestic tourism	566	227	809	419	2,021
Inbound tourism	3,497	150	372	99	4,118
Total	4,063	377	1,181	518	6,139
Occupancy rate	43%	40%	54%	43%	44%
Scenario 3, 2008					
Supply - Tourist hotel rooms	26,000	2,600	6,000	3,300	37,900
Demand (000's room nights/year)					
Domestic tourism	566	227	809	419	2,021
Inbound tourism	4,663	200	496	132	5,491
Total	5,229	426	1,306	551	7,512
Occupancy rate	55%	45%	60%	46%	54%

Given the expanded hotel capacity of 37,900 rooms, scenarios 2 and 3 do not experience a capacity constraint in accommodations. International visitors of 3.6 million in scenario 2 purchase 4.12 million room nights at tourist hotels. International visitors of 4.8 million in scenario 3 purchase 5.50 million room nights.

Average occupancy rates. For scenario 1, the estimated average occupancy rate is 86% nationwide. Tourist hotels in northern Taiwan reach 100% occupancy while the three other regions still have rooms available (Table 27). For scenario 2, the estimated occupancy rate is 44% based on 3.6 million international visitors. Occupancy rates range from 40% to 54% across the four geographic regions. Under scenario 3, international visitor numbers are assumed to increase to 4.8 million, which raises the average occupancy rate to 54%.

The "Tourist Hotel Development Plan" calls for significant expansion of lodging capacity in northern Taiwan, from 11,900 rooms in 2001 to 26,000 rooms by 2008. The increased capacity in northern Taiwan (scenario 2 and 3) relieves the lodging constraint on tourism consumption, and room utilization is more balanced across the four geographic regions. However, the overall occupancy rates in scenarios 2 & 3 are below the base year occupancy (62%). The proposed increase in lodging capacity in the "Tourist Hotel Development Plan" is greater than the projected increase in hotel demand from international visitors in the DTAP.

Predicted Economic Ratios and Multipliers By Scenario

Armed with the average occupancy rates for each scenario, the next step is to calculate economic ratios and multipliers at the predicted level of capacity utilization.

Distinct economic ratios and multipliers for the accommodation sector are computed by inserting the occupancy rates from Table 29 into the two econometric equations. Scenario 1 has the highest occupancy rates, and thus the lowest predicted job and income to sales ratios (Table 30). Scenarios 2 and 3, on the other hand, have job ratios between 0.65 and 0.55 and income to sales ratio around 0.42 to 0.43. Type I sales multipliers remain constant across the three scenarios (1.507). Type II sales multipliers vary slightly with changing occupancy rates due to small changes in personal income to sales ratios. The type II sales multiplier for scenario 1 is 3% lower than the base year multiplier, while the type II sales multipliers for scenarios 2 and 3 are higher by 2% and 1%, respectively.

The job multipliers are more sensitive to the changes in occupancy rates across the three scenarios than the income multipliers. For type I job multipliers, the percentage change ranges from 12% in scenario 3 to 30 % in scenario 2. Income multipliers, on the other hand, are more stable, with a maximum change of 7% across the three scenarios.

Table 30. Predicted Hotel Economic Ratios and Multipliers under the Three Scenarios

	Occupancy rate	Jobs to sales ratio	Income to sales ratio	Type I sales multiplier	Type II sales multiplier	Type I job multiplier	Type I income multiplier
Base year	62%	0.497	0.411	1.507	3.558	0.749	0.619
Scenario 1	86%	0.351	0.381	1.507	3.446	0.529	0.574
Scenario 2	44%	0.645	0.433	1.507	3.641	0.972	0.653
Scenario 3	54%	0.557	0.420	1.507	3.594	0.839	0.633
Pct change to the base year							
Scenario 1	39%	-29%	-7%	0%	-3%	-29%	-7%
Scenario 2	-29%	30%	5%	0%	2%	30%	5%
Scenario 3	-13%	12%	2%	0%	1%	12%	2%

Inbound Tourism Visitor Spending

Economic impacts of the three scenarios are calculated by applying inbound visitor spending to the Taiwan I-O multipliers. Total visitor spending under the three scenarios is estimated to be US$ 5.25 billion, US$ 4.86 billion and US$ 6.48 billion, respectively (Table 31). Excluding airfares, lodging expenses account for 41% of total trip expenditures, expenses for food are 18%, and shopping represents 15%.

Table 31. Total Visitor Spending under the Three Scenarios (US$ million's)

Spending category	Scenario 1	Scenario 2	Scenario 3	Pct
Lodging	2,135	1,977	2,636	41%
Food	951	881	1,174	18%
Transportation	386	357	477	7%
Entertainment	499	462	616	10%
Shopping	774	717	956	15%
Others	500	463	618	10%
Total	5,246	4,857	6,476	100%

Economic Impacts - Scenario 1

Lodging capacity maintains 20,697 rooms. The maximum number of international visitors, under the hotel capacity constraints, is estimated to be 3.89 million.

Fixed I-O ratios. The maximum number of international visitors, under the lodging constraint in northern Taiwan, is 3.89 million. These visits are estimated to spend US$ 5.24 billion in Taiwan, which supports US$ 5.04 billion of direct sales, 141 thousand direct jobs, and US$ 2.01 billion of direct personal income in Taiwan (Table 32). Indirect effects create an additional 55 thousand jobs and $796 million in personal income. Induced effects generate an additional 200 thousand jobs and $2,995 million personal income.

Table 32. Economic Impacts of Scenario 1 using Fixed Ratios

	Direct Effects			Direct & Indirect Effects		Direct, Indirect & Induced Effects	
	Sales ($ million)	Jobs	Income ($ million)	Jobs	Income ($ million)	Jobs	Income ($ million)
Hotel services	2,135	36,078	877	36,143	878	36,233	881
Food & beverage	951	59,522	501	59,898	504	76,833	647
Transportation	396	7,035	143	8,350	170	15,050	307
Recreational service	499	12,362	188	25,452	308	30,396	370
Theatrical & arts	250	9,277	83	12,597	112	14,688	131
Personal services	250	7,445	102	10,350	142	24,263	332
Manufacturing	434	5,807	64	15,486	201	42,236	571
Retail trade	56	2,645	27	6,121	63	42,463	438
Wholesale	34	563	17	1,480	45	7,667	233
International trade	33	487	11	1,144	26	3,818	88
Financial & business	0	0	0	10,467	271	56,355	1,458
Agri., forest fishery	0	0	0	5,970	37	37,839	214
Utilities	0	0	0	974	39	1,880	77
Construction	0	0	0	1,476	14	6,134	58
Total	5,039	141,221	2,014	195,909	2,810	395,856	5,805

Modified I-O economic ratios. The recalculated direct effects on the accommodation sector are 25 thousand jobs and $813 million of employee wages and salaries using the predicted job and income ratios (Table 33). Hotel jobs estimated using the predicted job ratio is 29% less than the value estimated using constant ratios in the standard I-O models. This is because the hotel jobs to sales ratio is lower at the 86% occupancy rate, reflecting fewer jobs per millions in sales. Personal income is reduced by 7%, from $877 million to $813 million. Adjusting the economic ratios for the hotel sector reduces the direct effects across the entire economy by 8% in jobs and 3% in employee compensation. Total effects, including direct, indirect and induced effects, are reduced by 4% in jobs and 2% in personal income.

Table 33. Comparison of Economic Impacts between Fixed and Varying Ratios for Scenario 1

	Direct Effects		Direct & Indirect Effects		Direct, Indirect & Induced Effects	
	Jobs	Personal Income ($ million's)	Jobs	Personal Income ($ million's)	Jobs	Personal Income ($ million's)
Fixed I-O ratios						
Hotel sector	36,078	877	36,143	878	36,233	881
Total sectors	141,221	2,014	195,909	2,810	395,856	5,805
Varying I-O ratios						
Hotel sector	25,445	813	25,491	815	25,553	817
Total sectors	130,588	1,950	185,256	2,746	379,779	5,660
Percent change[a]						
Hotel sector	-29%	-7%	-29%	-7%	-29%	-7%
Total sectors	-8%	-3%	-5%	-2%	-4%	-2%

Note. [a] (effects with predicted economic ratios - effects with fixed ratios) / effects with fixed ratios

Economic Impacts - Scenario 2

Lodging capacity expands to 37,900 rooms by 2008, and international visitors increase to 3.6 million.

Fixed I-O ratios. Scenario 2 assumes a higher lodging capacity with fewer international visitors. In scenario 2, 3.6 million international visitors spend US$4.87 billion in Taiwan, which support US$ 4.67 billion of direct sales, 131 thousand direct jobs, and US$ 1.87 billion of direct personal income in Taiwan (Table 34). Indirect effects create an additional 51 thousand jobs, and induced effects generate an additional 185 thousand jobs.

Varying I-O ratios. The recalculated jobs in the accommodation sector are 43 thousand, 30% higher than the number calculated using fixed ratios (Table 35). Personal income increases by eight percent for the accommodation sector, from $812 million to $856 million. These differences arise because hotels operating at 44% occupancy support higher jobs to sales ratio and higher income to sales ratio than the base year point.

Relaxing the economic ratios for the hotel sector increases the tourism impact estimates across the entire economy by 8% in total jobs and 2% in personal income in terms of direct effects; 4% in total jobs and 2% in personal income, in terms of total effects.

Table 34. Economic Impacts of Scenario 2 using Fixed Ratios

	Direct Effects			Direct & Indirect Effects		Direct, Indirect & Induced Effects	
	Sales ($ million)	Jobs	Income ($ million)	Jobs	Income ($ million)	Jobs	Income ($ million)
Hotel services	1,977	33,405	812	33,466	813	33,549	815
Food & beverage	881	55,113	464	55,461	467	71,142	599
Transportation	367	6,513	133	7,732	158	13,935	284
Recreational service	462	11,447	174	23,567	285	28,144	342
Theatrical & arts	232	8,590	77	11,664	104	13,600	121
Personal services	232	6,893	94	9,583	131	22,466	307
Manufacturing	402	5,377	60	14,339	186	39,108	529
Retail trade	52	2,449	25	5,668	58	39,317	406
Wholesale	32	521	16	1,370	42	7,099	216
International trade	31	451	10	1,059	24	3,535	81
Financial & business	0	0	0	9,691	251	52,181	1,350
Agri., forest, fishery	0	0	0	5,527	34	35,036	199
Utilities	0	0	0	902	36	1,741	72
Construction	0	0	0	1,367	13	5,680	54
Total	4,666	130,761	1,865	181,397	2,602	366,534	5,375

Table 35. Comparison of Economic Impacts between Fixed and Varying Ratios for Scenario 2

	Direct Effects		Direct & Indirect Effects		Direct, Indirect & Induced Effects	
	Jobs	Personal Income ($ Million's)	Jobs	Personal Income ($ Million's)	Jobs	Personal Income ($ Million's)
Fixed I-O ratios						
Hotel sector	33,405	812	33,466	813	33,549	815
Total sectors	130,761	1,865	181,397	2,602	366,534	5,375
Varying I-O ratios						
Hotel sector	43,339	856	43,417	857	43,528	859
Total sectors	140,694	1,908	191,348	2,645	380,238	5,475
Percent change[a]						
Hotel sector	30%	5%	30%	5%	30%	5%
Total sectors	8%	2%	5%	2%	4%	2%

Note. [a] (effects with predicted economic ratios - effects with fixed ratios) / effects with fixed ratios

Economic Impacts - Scenario 3

Lodging capacity expands to 37,900 rooms and international visitors increase to 4.8 million.

Fixed I-O ratios. In scenario 3, inbound tourism with 4.8 million visitors is estimated to spend US$ 6.48 billion in Taiwan, which supports US$ 6.22 billion of direct sales, 174 thousand direct jobs, and US$ 2.49 billion of direct personal income in Taiwan under scenario 3 (Table 36). Indirect effects create an additional 68 thousand jobs, and induced effects generate an additional 247 thousand jobs.

Table 36. Economic Impacts of Scenario 3 using Fixed Ratios

	Direct Effects			Direct & Indirect Effects		Direct, Indirect & Induced Effects	
	Sales ($ million)	Jobs	Income ($ million)	Jobs	Income ($ million)	Jobs	Income ($ million)
Hotel services	2,636	44,540	1,082	44,621	1,084	44,732	1,087
Food & beverage	1,174	73,484	619	73,948	623	94,856	799
Transportation	489	8,685	177	10,309	210	18,580	378
Recreational service	616	15,262	232	31,422	380	37,526	456
Theatrical & arts	309	11,453	102	15,551	139	18,134	162
Personal services	309	9,191	126	12,777	175	29,955	410
Manufacturing	536	7,169	80	19,119	248	52,144	705
Retail trade	69	3,266	34	7,557	78	52,423	541
Wholesale	43	695	21	1,827	56	9,466	288
International trade	41	602	14	1,412	33	4,714	109
inancial & business	0	0	0	12,922	335	69,574	1,800
Agri., forest, fishery	0	0	0	7,370	45	46,715	265
Utilities	0	0	0	1,203	48	2,321	95
Construction	0	0	0	1,823	17	7,573	71
Total	6,222	174,347	2,486	241,863	3,469	488,711	7,166

Varying I-O ratios. The recalculated jobs in the accommodation sector are 50 thousand, 12% higher than the value calculated using fixed ratios (Table 37). Personal income increases by 2 percent for the accommodation sector, from $1,082 million to $1,108 million. These differences arise because job to sales ratios are adjusted upward by

12% and income to sales ratios are upward by 2% to reflect that business operates at lower occupancy rates supporting more jobs and personal income per unit sales. Relaxing the economic ratios for the accommodation sector increases the tourism impact estimates across the entire economy by 3% in total jobs and 1% in employee compensation in terms of direct effects; 2% in total jobs and 1% in personal income in terms of total effects.

Table 37. Comparison of Economic Impacts between Fixed and Varying Ratios for Scenario 3

	Direct Effects		Direct & Indirect Effects		Direct, Indirect & Induced Effects	
	Jobs	Personal Income ($ Million's)	Jobs	Personal Income ($ Million's)	Jobs	Personal Income ($ Million's)
Fixed I-O ratios						
Hotel sector	44,540	1,082	44,621	1,084	44,732	1,087
Total sectors	174,347	2,486	241,863	3,469	488,711	7,166
Varying I-O ratios						
Hotel sector	49,905	1,108	49,995	1,110	50,121	1,113
Total sectors	179,712	2,512	247,236	3,494	496,269	7,225
Percent change[a]						
Hotel sector	12%	2%	12%	2%	12%	2%
Total sectors	3%	1%	2%	1%	2%	1%

Note. [a] (effects with predicted economic ratios - effects with fixed ratios) / effects with fixed ratios

Summary. Jobs and income estimated based on the varying ratios are reported in Table 38 and Table 39. Job ratios are more sensitive to changes in occupancy rates, leading to greater variation in job estimates. In terms of total jobs, the hotel sector ranks 7th among the 14 sectors in scenario 1, 3rd in scenario 2, and 5th in scenario 3. Total personal income is not as sensitive to changes in occupancy. The hotel sector ranks 2nd among the 14 sectors across all 3 scenarios.

Table 38. Total Jobs and Ranking Using Varying Job Ratios

	Jobs in total effects			Ranking		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Hotel services	25,553	43,528	50,121	7	3	5
Food & Beverage	76,376	71,457	95,039	1	1	1
Financial & Business	55,116	53,036	70,072	2	2	2
Manufacturing	41,514	39,606	52,434	3	5	4
Retail Trade	41,481	39,995	52,817	4	4	3
Agri., forest, fishery	36,979	35,630	47,061	5	6	6
Recreational services	30,262	28,237	37,580	6	7	7
Personal services	23,888	22,726	30,106	8	8	8
Transportation	14,869	14,060	18,652	9	9	9
Theatrical & arts	14,632	13,639	18,157	10	10	10
Wholesale	7,500	7,215	9,533	11	11	11
Construction	6,008	5,766	7,623	12	12	12
International Trade	3,746	3,585	4,743	13	13	13
Utilities	1,855	1,758	2,331	14	14	14

Table 39. Total Personal Income and Ranking Using Varying Income Ratios

	Income in total effects (US$ million's)			Ranking		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Hotel services	817	859	1,113	2	2	2
Financial & business	1,426	1,372	1,813	1	1	1
Food & beverage	643	602	800	3	3	3
Manufacturing	561	536	709	4	4	4
Retail trade	428	413	545	5	5	5
Recreational services	368	343	457	6	6	6
Personal services	327	311	412	7	7	7
Transportation	303	286	380	8	8	8
Wholesale	228	219	290	9	9	9
Agri., forest, fishery	210	202	267	10	10	10
Theatrical & arts	130	122	162	11	11	11
International trade	86	83	109	12	12	12
Utilities	76	72	96	13	13	13
Construction	57	54	72	14	14	14

CHAPTER V CONCLUSION

The purposes of this study were (1) to establish baseline economic impacts for inbound tourism to Taiwan in 2001, (2) to examine the stability of jobs to sales ratios and income to sales ratios for the accommodation sector based on different capacity utilization, and (3) to estimate economic impacts of the "Doubling Tourist Arrival's Plan" using a national input-output model with fixed and varying value added components.

The assumption of constant job and income ratios in the standard I-O framework under varying capacity utilization was tested by examining hotel operational data. Firm-level time-series data of tourist hotels in Taiwan from 1999 to 2003 were used to establish econometric relationships between job and income ratios and occupancy rates. The predicted ratios were incorporated into the Taiwan I-O model to generate distinct sets of multipliers based on given occupancy rates. Economic impacts of the DTAP policy were estimated under three scenarios, defined by the international visitor volume and hotel lodging capacity. These scenarios simulate alternative conditions of tourism demand and supply.

Importance of Inbound Tourism to Taiwan's Economy

Inbound tourism impacts the Taiwan economy by generating foreign receipts, creating job opportunities, and contributing to the balance of payments. In 2001, 2.6 million international visitors spent US$ 3.5 billion in Taiwan, which supported 95 thousand direct jobs, and US$ 2.1 billion in value added. The sectors receiving the largest

direct effects in value added were hotel services, food & beverage, and recreational services. Sectors receiving the largest secondary effects were financial & business, manufacturing, and retail trade. Visitor spending of inbound tourism in 2001 contributed 0.76% of Gross Domestic Product (GDP) and 1.01% of total jobs in terms of direct effects; 2.56% of GDP and 2.84% of total jobs in terms of total effects.

Tourism has significant indirect and induced effects across the economy. Input-Output models are useful tools to estimate theses effects and demonstrate the complex interrelationships among sectors. In 2001, every direct tourism job in Taiwan supported 1.80 secondary jobs, and each dollar of income in tourism businesses yielded an additional $1.88 in secondary effects. Secondary effects, although a major part of tourism's economic impacts in Taiwan, are harder to monitor in a timely manner and are easily overlooked. For example, during the collapse of tourism activities in Taiwan due to the spread of Severe Acute Respiratory Syndrome (SARS) and Avian influenza in 2003, government subsidies (financing and tax breaks) were primarily directed to the accommodation and air transportation sectors (Taiwan Tourism Bureau, 2003). Economic losses in indirectly affected sectors were not recognized. Government tourism and economic planning therefore requires a comprehensive approach that considers the interrelationships among industries.

Changing Job and Income Ratios by Occupancy Rates and Hotel Scale

Jobs to sales ratios and personal income to sales ratios for the hotel sector are not constant. They change with capacity utilization and hotel scale. Changes in jobs to sales ratios are mainly explained by occupancy rates (Beta =-.5503) whereas changes in

income to sales ratios are more influenced by hotel scales (Beta = -.2868). Based on empirical data, tourist hotels in Taiwan operate with increasing returns to scale[28], indicating decreasing marginal costs for selling additional rooms.

Job and income ratios are related to the average salary per employee. Given the predicted job ratios and income ratios from econometric equations, the computed average salary is positively correlated with occupancy rates[29] (Table 40 & Figure 6). The average wage and salary received per employee at tourist hotels rise from NT$ 0.42 million at a 42% occupancy rate to NT$0.71 million at a 87% occupancy. As capacity utilization rises, fewer jobs are supported per unit sales but at higher wages per employee. This pattern indicates that hotels are more likely to pay existing workers for extra hours/efforts instead of hiring additional employees. The incremental adjustment of wages and salaries by positions (e.g., entry level versus managerial level) however is not clear.

Table 40. Economic Ratios for Tourist Hotels in Taiwan

Occupancy rate	Predicted jobs per NT$ million sales ratio (A)	Predicted income to sales ratio (B)	Computed average salary per employee (NT$ millions per year) (A/B)
42%	0.88	0.37	0.42
52%	0.76	0.36	0.47
62%	0.66	0.35	0.53
72%	0.57	0.34	0.60
82%	0.49	0.33	0.67

[28] "Returns to scale" is defined as the percentage increase in output by a one percent increase in all inputs, representing different cost structures with respect to the volume of sales. This is different from the hotel scale, which is related to the size of individual establishment, measured by number of rooms each hotels has.

[29] $\frac{\text{Total income}}{\text{Total sales}} = \frac{\text{Average income per job} * \text{total jobs}}{\text{Total sales}} = \text{Average income} * \text{the jobs to sales ratio}$

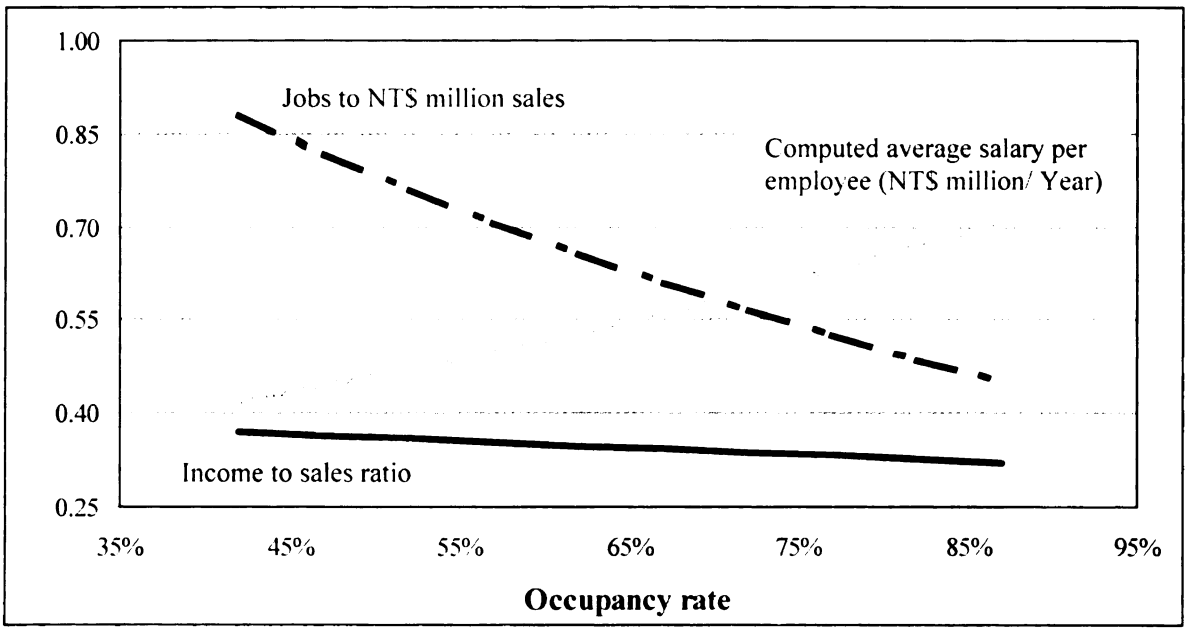


Figure 6. Job Ratio, Income Ratio and Average Salary per Employee by Occupancy Rates for Tourist Hotels in Taiwan

The direction and magnitude of biases associated with fixed I-O ratios can be approached from the perspective of returns to scale and cost structures. The coefficients in the standard I-O table represent the average production function, indicating the general performance of businesses at a specific level of supply and demand in a year. For services with constant returns to scale, the standard I-O model provides unbiased impact estimates regardless of the level of capacity utilization (Table 41). For services with increasing returns to scale (IRTS), the standard I-O model overestimates jobs and total income, and underestimates profits when applying average coefficients to scenarios with capacity utilization higher than the base-year point. The biases result from greater labor efficiency, economies of scale, and substitutions between capital and labor inputs under higher demand. For services following decreasing returns to scale, the biases will be in the opposite direction.

Table 41. Sensitivity of Impact Estimation using Fixed I-O Ratios by Returns to Scale

Standard I-O model with fixed ratios	Increasing returns to scale (IRTS)	Constant returns to scale (CRTS)	Decreasing returns to scale (DRTS)
Scenarios with capacity utilization higher than the base year level			
Jobs	Overestimation	Unbiased	Underestimation
Income	Overestimation	Unbiased	Underestimation
Profits	Underestimation	Unbiased	Overestimation
Scenarios with capacity utilization lower than the base year level			
Jobs	Underestimation	Unbiased	Overestimation
Income	Underestimation	Unbiased	Overestimation
Profits	Overestimation	Unbiased	Underestimation

Evaluation of the DTAP Policy

Economic Impacts

Achieving the goals of the "Doubling Tourists Arrivals' Plan" would increase Taiwan's total foreign receipts. The current lodging capacity constrains the growth of international arrivals to 81% of the DTAP policy target of 4.8 million international visitors by 2008 (scenario 1). Total visitor spending under this scenario is US$ 5.2 billion. With an expanded lodging capacity to 38,900 rooms and achieving 75% of the DTAP target (scenario 2), visitor spending is projected to be US$4.9 billion. Achieving 100% of the visitation target in scenario 3 yields US$6.5 billion in visitor spending by 2008. The GDP contribution of inbound tourism is expected to grow from 0.76% in 2001 to 0.94% in scenario 1, 0.87% in scenario 2, or 1.16% in scenario 3 (direct effects[30]). The percentage of GDP contribution will depend upon the Taiwan GDP annual growth and future exchange rates.

[30] Gross Domestic Products of Taiwan was NT$ 9.45 trillion in 2001. Assuming GDP increases with a 3% annual growth rate from 2001, the forecasted GDP in 2008 would be NT$ 11.28 trillion.

Doubling international visitors from 2.6 million in 2001 to 4.8 million in 2008 does not guarantee the doubling of employment and personal income. Total economic impacts for service sectors are determined simultaneously by final demand changes as well as capacity utilization rates. The supply level influences employment, wages, and business profits. The difference in impact estimates among the three scenarios between fixed and varying ratios models is as much as 30% for hotel jobs and 7% for hotel wages and salaries; 4% for total jobs and 2% for total income through out the entire economy. As transportation, amusements and food services may experience similar changing returns to scale, the reported differences in impact estimates using fixed and varying ratios are conservative.

Implications

Government agencies should coordinate expansion of tourism supply with increased demand so that a balance in capacity utilization can be maintained. Greatly expanding the demand level will result in high capacity utilization rate. Most of the increased sales will be absorbed as business profits, and the creation of jobs and personal income will not be in direct proportion to increased sales. Greatly expanding the supply level on the other hand will result in lower capacity utilization. Under the proposed "Tourist Hotel Development Plan", hotel capacity expands more than the anticipated increase in international visitors in the DTAP policy. The excess supply, while supporting more jobs per million sales, will result in lower average income and business profits, and may discourage future investment.

One approach to facilitate the balance of demand and supply growth is through tax instruments. Tax breaks and financial incentives can be implemented in the early

stage of the policy to encourage private investment when an expansion of the supply level is needed. Raising business tax when the market is matured, on the other hand, can help to control a blooming tourism demand by diverting a proportion of business profits to governments. The increased tax can be used to improve public welfares for the local regions, and avoids the increased impacts solely benefit a handful of stakeholders.

Coordinating tourism development and economic growth across regions can also facilitate the balance of demand and supply in tourism activities. Currently, most of the economic impacts of international visitor spending accrue to northern Taiwan. This region provides 85% of hotel room nights. In addition, Taipei, the capital area, provides the majority of financial & business services, retailing and personal services for the country. In other words, northern Taiwan captures most of the direct and indirect effects.

Balancing regional tourism development can reduce the risk of "putting all eggs in one basket" and minimize the regional demand and supply fluctuations. Demand stability can be enhanced by promoting diversified tourism attractions across the nation so that the overall visitation volume (demand level) are more resistant to changes in outside factors, such as economic crisis, earthquake or disease outbreaks in a single region. Second, diverting demand to other regions simultaneously reduces the supply pressure on northern Taiwan, and improves the utilization of tourism resources across the nation. Infrastructure, transportation systems, and a diversity of tourism attractions are therefore recommended to encourage visits to other regions. Especially nature-based attractions, such as national parks, and culture tourism can be promoted to establish distinct niches from the urban-based tourism in Taipei.

Last, a data collection instrument is recommended. Currently, the Taiwan government has an extensive system to keep track of inbound tourism in terms of monthly visits, length of stay and average spending per visitor. This information provides an accurate assessment of international visitor volume and spending in Taiwan. Information regarding supply levels, however, is relatively incomplete. Small-scale service firms are large in numbers and their cost structures and manpower usage may fluctuate. Systematically inventorying supply levels, in terms of the number and scale of establishments, and collecting operational data for major service sectors is recommended.

Application of the Varying Ratios I-O Model

The varying ratios model applies whenever the policy being evaluated causes changes in capacity utilization from the base year point (the year I-O table is compiled). The problem of using a fixed ratios model is particularly evident when evaluating special events and festivals. These are generally held for short periods, creating peaks in demand and high capacity utilization. In these instances, the fixed ratios model will overestimate jobs and income effects and underestimate business profits, such as the example of the British Open (Gelan, 2003). This is because increased sales in the short run are accommodated by greater labor efficiency. Jobs and wage payments therefore are not increased in direct proportion to additional sales. As documented by Hatch (1986) in the study of the Grand Prix car racing event in Australia, profits and value added components increased at higher utilization levels. Using the varying ratios model illustrates the nature of biases and provides quantitative estimates of the errors associated with fixed ratios models.

The varying ratios model is also appropriate when evaluating significant drops in tourism due to weather, disease outbreaks, or terrorist activities. Using fixed ratios in these cases will overestimate job and income losses because firms cannot immediately reduce labor inputs in proportion to reduced sales. The loss in business profits will be greater than predicted using a fixed ratios model as costs per unit sale will be above the baseline.

In evaluating long range policies, the rate of growth in supply must be considered along with anticipated demand increases. If supply and demand expand at similar rates from the base year, capacity utilization will remain relatively constant and standard I-O models will yield unbiased impact estimates. If demand grows faster than supply, utilization rates will increase and fixed ratio models will overestimate job and income effects. If supply grows faster than demand, the bias with fixed ratio models will be in the opposite direction.

Recommendations for Future Studies

The major finding of this study, the changing jobs and income by capacity utilization, rests on the specified regression models. The current equations include four independent variables: occupancy rates, hotel scales, consumer price index and regions. The relatively low adjusted R-square values, especially for the income to sales ratio (Table 22), indicate the potential to refine current regression models and to incorporate other independent variables. Business operation structures, such as ownerships, human resource management, and government tax policies, are some potential variables to be

considered. Refining current regression models helps to raise the credibility on its findings and avoid possible specification errors.

Future research is also recommended to understand managerial responses to fluctuation in demand for services. Impacts of demand changes ultimately depend on how firms adapt to these changes in the short- and long-term. Increased sales can be accommodated by using existing workers versus hiring new employees. Also, the addition of new jobs can be differentiated by management/ entry-level positions, seasonal/ permanent jobs, or full-time/ part-time status. Labor practices influence the jobs to sales ratios and subsequently determine the proportion of labor costs in business operation. Relationships between labor efficiency and wage compensation are also not well documented. A rise in wages to compensate employees for increased workload can be achieved through over-time pay, additional employee benefits or profit sharing.

The examination of varying ratios should be extended to other services, especially food & beverage services, transportation and amusement sectors. These three sectors have characteristics similar to accommodations in terms of product perishability and pricing strategies. A clear definition and measure of capacity utilization for each industry is required to quantify the relationships between capacity utilization and value added components. Modifying the value added components for multiple sectors simultaneously is also encouraged so that the joint effects on the rest of the economy can be modeled.

Value added is only part of the production function. To obtain comprehensive insights between business operation and capacity utilization, examination of changes in the Leontief technical coefficients that are caused by utilization rates is also recommended. Technical input coefficients depend on output prices (such as changes in

room rate in response to a rising demand), as changes in output prices affect the relative price ratio between intermediate inputs and final output. Technical coefficients also can vary due to economies of scale in input factors. For example, cost for utilities or business services per occupied hotel room is generally lower when hotels operate at higher occupancy rates. Empirical data are therefore needed to establish relationships between 1) price changes and capacity utilization, and 2) intermediate inputs and capacity utilization. Given a rise in occupancy rates, the likely pattern is an increase in output price and proportionally lower per unit cost for intermediate inputs. These patterns would lead to a reduced type I sales multiplier and larger value added components. The joint influence on the type II sales multipliers however is undetermined as it depends on the nature of each industry.

Conclusion

The assumption of linearity is a frequent criticism of standard I-O analysis (Crompton, 1995; West & Gamage, 1997; West, 1995). It has been demonstrated that this assumption leads to overestimation of the secondary effects, especially with respect to income and employment. The proposed I-O model with jobs to sales ratios and income to sales ratios varying as a function of capacity utilization admits changing returns to scale, and provides better estimates of the value added components.

This study identifies the potential biases associated with the applications of standard I-O models to service industries as tourism generally experiences fluctuation in demand and supply level. The most foreseeable challenge in expanding the current model lies in data availability, as extensive observations for individual establishments under

different level of capacity utilization are required. Comprehensive data collection plans and business cooperation are therefore needed. Such efforts will greatly improve existing policy models.

APPENDICES

Appendix A. Allocation of Visitor Spending to I-O Sectors

Spending category	I-O Sector
Spending inside the hotel	Lodging (90%) Restaurant (10%)
Food	Restaurant (100%)
Transportation	Transportation (100%)
Entertainment	Entertainment (100%)
Others	Theatrical, dance, music and other arts activities (50%) Personal service (50%)
Shopping	Production sectors[a] Food & beverage manufacturing (40%) Tobacco manufacturing (5%) Apparel & clothing accessories manufacturing (10%) Leather, fur & allied product manufacturing (5%) Wood products (5%) Paper and printing (5%) Chemicals Petroleum & coal products manufacturing (10%) Non-metallic mineral products manufacturing (3%) Basic metal industries & products (3%) Machinery & Electronic Products (5%)

[a] The percentages for allocating shopping expenses to ten production sectors was estimated using the 2001 ITCTS.

Appendix B. Definitions of Taiwan I-O Sectors

New I-O Code	New 39 I-O Sectors	Original 160 I-O Code	Employment Data Category	Spending categories in the results table
1	Agricultural products & livestock	1-10	Agriculture, animal husbandry	Agriculture, forest, fisheries
2	Forest products	11	Forestry & logging	
3	Fisheries	12	Fishing	
4	Minerals	13-17	Mining & quarrying	Manufacturing
5	Process foods & beverages	18-32	Food & beverage manufacturing	
6	Tobacco	33	Tobacco manufacturing	
7	Textile mill products	34-39	Textiles mills	
8	Wearing apparel and accessories	40-42	Apparel, clothing accessories & other textile products manufacturing	
9	Leather & leather products	43-45	Leather & fur & allied product manufacturing	
10	Wood & wood products	46-49	Wood & bamboo products manufacturing	
11	Paper & paper products & printed matter	50-53	Pulp, paper & paper products manufacturing	
12	Chemical manufactures & petroleum refining products	54-70	Chemical matter manufacturing Chemical products manufacturing Rubber products manufacturing Plastic products manufacturing& Petroleum & coal products manufacturing	
13	Non-metallic Mineral Products Manufacturing	71-75	Non-metallic mineral products manufacturing	
14	Iron and Steel Products & Miscellaneous Metals & Metallic Products	76-85	Basic metal industries & Fabricated metal products manufacturing	
15	Machinery & electronic products	86-105	Electrical & Electronic Machinery Precision, optical, medical instrument manufacturing, watches & clocks Other industrial products manufacturing	
16	Transport equipment	106-109	Transport equipment manufacturing	
17	Other products	110-113	Other industrial products manufacturing	
18	Electricity	114	Electric power supply	Utilities
19	Gas	115	Gas supply	
20	City water	116	Thermal energy supply	
21	Construction	117-120	Construction	Construction
22	Wholesale trade	121	Wholesale trade	Wholesale trade
23	Retail trade	122	Retail trade	Retail trade
24	International trade	123	Foreign trade	International trade

Appendix B. (cont'd).

New I-O Code	New 39 I-O Sectors	Original 160 I-O Code	Employment Data Category	Spending categories in the results table
25	Food & beverage services	124	Eating & drinking places	Food & beverage services
26	Transportation	125-130	Transportation	Transportation
27	Warehousing	131	Warehousing & storage	Business services
28	Postal services & telegram & telephone	132-133	Communication	
29	Financing & auxiliary financing	134	Finance & insurance	
30	Securities & futures	135	Finance & insurance	
31	Insurance carriers	136	Finance & insurance	
32	Real estate & rental & leasing	137, 139	Finance & insurance	
33	Hotel services	138	Accommodation service	Hotel services
34	Business services	140-145	Business Services	Business services
35	Public administration	146	Public administration	
36	Sanitary, pollution controlling, education services	147-153	Sanitary, pollution controlling services	
37	Theatrical, dance, music and other arts activities	154	Motion picture industries	Theatrical, dance, music and other arts activities
38	Recreational & cultural services	155	Entertainments	Recreational & cultural services
39	Other personal services	156-160	Personal services	Other personal services

Note. The original 160 sector I-O table is regrouped into 39 sectors to facilitate computation and interpretation.

Appendix C. Economic Ratios for Taiwan I-O Sectors, 1999

	Income to sales ratio	Profits to sales ratio	Value added to sales ratio	Jobs/million NT$ sales
Agriculture & Other Nature Products				
1. Agricultural Products & Livestock	0.303	0.100	0.456	1.809
2. Forest Products	0.675	0.053	0.814	1.684
3. Fisheries	0.283	0.241	0.593	0.713
4. Minerals	0.400	0.113	0.609	0.138
Manufacturing				
5. Process Foods & Beverages	0.108	0.038	0.245	0.264
6. Tobacco	0.116	-0.010	0.731	0.038
7. Textile Mill Products	0.149	0.039	0.241	0.269
8. Wearing Apparel and Accessories	0.243	0.028	0.300	0.886
9. Leather & Leather Products	0.155	0.031	0.215	0.653
10. Wood & Wood Products	0.271	0.063	0.391	1.153
11. Paper & Paper Products & Printed Matter	0.239	0.052	0.360	0.427
12. Chemical Manufactures & Petroleum Refining	0.125	0.052	0.275	0.212
13. Non-metallic Mineral Products	0.202	0.074	0.369	0.318
14. Iron, Steel Products & Miscellaneous Metals	0.143	0.058	0.246	0.384
15. Machinery & Electronic Products	0.136	0.066	0.256	0.264
16. Transport Equipment	0.141	0.050	0.308	0.258
17. Other manufacturing products	0.218	0.060	0.315	0.318
Utilities				
18. Electricity	0.121	0.156	0.508	0.072
19. Gas	0.100	0.022	0.145	0.155
20. City Water	0.339	0.086	0.594	0.233
Construction				
21. Construction	0.261	0.058	0.342	0.813
Services				
22. Wholesale Trade	0.496	0.131	0.687	0.480
23. Retail Trade	0.485	0.192	0.738	1.383
24. International Trade	0.339	0.179	0.599	0.433
25. Food & Beverage Services	0.527	0.123	0.707	1.841
26. Transportation	0.362	0.067	0.560	0.523
27. Warehousing	0.326	0.202	0.675	0.198
28. Postal Services & Telegram & Telephone	0.340	0.255	0.757	0.252
29. Financing & auxiliary financing	0.334	0.288	0.752	0.324
30. Securities & futures	0.377	0.169	0.654	0.324
31. Insurance carriers	0.411	0.248	0.726	0.324
32. Real estate & rental & leasing	0.028	0.692	0.819	0.041
33. Hotel Services	0.411	0.116	0.649	0.497
34. Business Services	0.371	0.143	0.562	0.522
35. Public administration	0.615	0.000	0.714	0.327
36. Sanitary, pollution controlling, education	0.707	0.067	0.818	0.911
37. Theatrical, dance, music and other arts	0.330	0.168	0.567	1.091
38. Recreational & Cultural Services	0.376	0.193	0.693	0.729
39. Other Personal Services	0.407	0.144	0.579	0.876

Appendix D. Multipliers for Taiwan I-O Sectors, 1999

	Type I sales multipliers	Type II sales multipliers
Agriculture & Other Nature Products		
1. Agricultural Products & Livestock	1.969	4.024
2. Forest Products	1.246	4.235
3. Fisheries	1.412	2.909
4. Minerals	1.393	3.227
Manufacturing		
5. Process Foods & Beverages	2.135	3.706
6. Tobacco	1.286	2.005
7. Textile Mill Products	2.156	3.567
8. Wearing Apparel and Accessories	2.135	3.962
9. Leather & Leather Products	1.560	2.635
10. Wood & Wood Products	1.535	3.118
11. Paper & Paper Products & Printed Matter	1.744	3.412
12. Chemical Manufactures & Petroleum Refining	1.674	2.679
13. Non-metallic Mineral Products	1.779	3.329
14. Iron, Steel Products & Miscellaneous Metals	2.028	3.454
15. Machinery & Electronic Products	1.633	2.700
16. Transport Equipment	1.908	3.215
17. Other manufacturing products	1.831	3.356
Utilities		
18. Electricity	1.491	2.305
19. Gas	1.875	3.235
20. City Water	1.616	3.541
Construction		
21. Construction	1.959	3.846
Services		
22. Wholesale Trade	1.421	3.761
23. Retail Trade	1.363	3.531
24. International Trade	1.519	3.394
25. Food & Beverage Services	1.423	3.768
26. Transportation	1.449	3.271
27. Warehousing	1.456	3.160
28. Postal Services & Telegram & Telephone	1.304	2.913
29. Financing & auxiliary financing	1.319	2.968
30. Securities & futures	1.472	3.447
31. Insurance carriers	1.301	3.259
32. Real estate & rental & leasing	1.302	1.724
33. Hotel Services	1.507	3.558
34. Business Services	1.600	3.641
35. Public administration	1.316	3.975
36. Sanitary, pollution controlling, education	1.234	4.132
37. Theatrical, dance, music and other arts	1.564	3.449
38. Recreational & Cultural Services	1.427	3.261
39. Other Personal Services	1.573	3.680

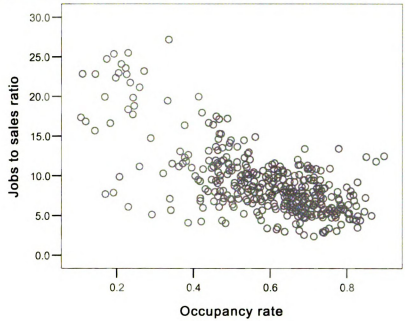
Appendix E. Trade Margin, Transportation Margin and Regional Purchase Coefficients for Manufacturing Sectors

	Trade margin	Transportation margin	Regional purchase coefficient (RPC)
Process foods & beverages	20%	1%	82%
Tobacco	23%	0%	58%
Textile mill products	9%	1%	91%
Wearing apparel and accessories	23%	1%	80%
Leather & leather products	17%	2%	70%
Wood & wood products	15%	4%	67%
Paper products	19%	1%	81%
Chemical manufactures products	10%	1%	73%
Non-metallic mineral products	9%	4%	85%
Iron and steel products	10%	2%	78%
Machinery & electronic products	8%	1%	67%
Transport equipment	14%	1%	83%
Other manufacturing products	14%	1%	49%

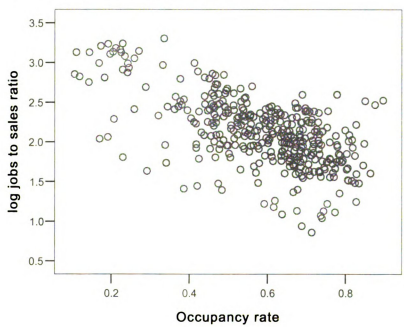
Note.
Trade margin: Margins of international trade, wholesale trade and retail trade.
Regional purchase coefficients: The proportion of the regional demand for a good or service that is fulfilled by production in Taiwan.

Appendix F. Scatterplot of Linear and Natural Log for Jobs to Sales Ratios versus Occupancy Rates

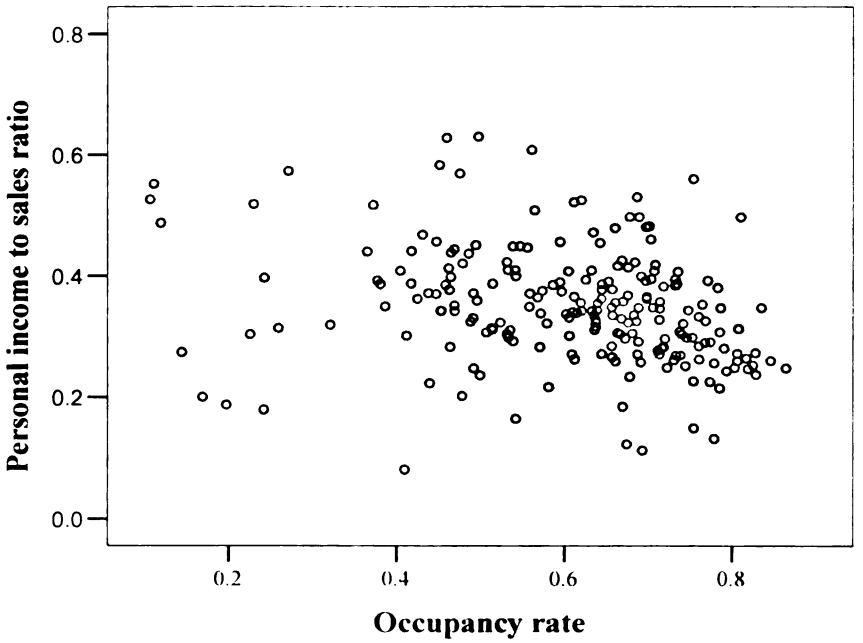
Linear (adjusted R-square value = 0.447)



Loglinear (adjusted R-square value = 0.479)



Appendix G. Scatterplot of Personal Income to Sales Ratios versus Occupancy Rates



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