ผลกระทบทางเศรษฐกิจ สังคมและสิ่งแวดล้อมของการท่องเที่ยวในประเทศไทย

นางสาวมัลลิกา สมพลกรัง

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาเศรษฐศาสตรดุษฎีบัณฑิต
สาขาวิชาเศรษฐศาสตร์
คณะเศรษฐศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2557

THE ECONOMIC, SOCIAL AND ENVIRONMENTAL IMPACT OF TOURISM IN THAILAND

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A Dissertation Submitted in Partial Fulfillment of the Requirements

for the Degree of Doctor of Philosophy Program in Economics

Faculty of Economics

Chulalongkorn University

Academic Year 2014

Thesis Title	THE ECONOMIC, SOCIAL AND ENVIRONMENTAL IMPACT OF TOURISM IN THAILAND
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Field of Study	Economics
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มัลลิกา สมพลกรัง : ผลกระทบทางเศรษฐกิจ สังคมและสิ่งแวดล้อมของการท่องเที่ยวในประเทศไทย (THE ECONOMIC, SOCIAL AND ENVIRONMENTAL IMPACT OF TOURISM IN THAILAND) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: ศ. ดร.อิศรา ศานติศาสน์, 131 หน้า.

การท่องเที่ยวถือว่าเป็นภาคที่สำคัญในระบบเศรษฐกิจไทย นอกจากนี้ยังมีความสำคัญของประเด็นสิ่งแวดล้อมและสังคมน้อยที่สุดในการพัฒนาการท่องเที่ยวของไทย ในการศึกษาครั้งนี้มีวัตถุประสงค์หลัก 3 ข้อคือ ข้อแรกปัจจัยที่กำหนดอุปสงค์การท่องเที่ยวระหว่างประเทศ ข้อที่สองการบริโภคของนักท่องเที่ยวต่างชาติสัมพันธ์กับสิ่งแวดล้อม ข้อสุดท้ายคือการประเมินผลกระทบของการท่องเที่ยว

ผลการศึกษาพบว่าสินค้าที่ไม่ใช่อาหารและที่พักเป็นสินค้าฟุ่มเฟือย ตามค่าความยืดหยุ่นของค่าใช้จ่าย การรับประทานอาหารข้างนอกบ้าน สินค้าที่ไม่ใช่อาหาร เครื่องดื่มแอลกอฮอล์และยาสูบ การขนส่ง และสถานที่ให้บริการที่พักเป็นสินค้าประกอบกัน ตามค่าความยืดหยุ่นของราคาค่าใช้จ่ายทั้งหมดของการท่องเที่ยวขาเข้ามีอิทธิพลอย่างมีนัยสำคัญในการปล่อยก๊าซคาร์บอนไดออกไซด์จากการขนส่ง ค่าใช้จ่ายทั้งหมดของการท่องเที่ยวมีความสัมพันธ์เชิงบวกกับการปล่อยก๊าซคาร์บอนไดออกไซด์จากการขนส่ง ในขณะที่การปล่อยก๊าซคาร์บอนไดออกไซด์จากภาคการผลิตกระแสไฟฟ้าและค่าใช้จ่ายในการบริหารจัดการระบบบำบัดน้ำเสียสำหรับนักท่องเที่ยวไม่ได้รับผลกระทบจากการใช้จ่ายของนักท่องเที่ยว ผลจากการจำลองแสดงให้เห็นว่าการเพิ่มขึ้นของค่าใช้จ่ายของการท่องเที่ยวขาเข้ามีผลกระทบเชิงบวกต่อเศรษฐกิจของไทย เนื่องจากการเพิ่มขึ้นของผลผลิตมวลรวมประชาชาติ ระดับราคา การส่งออกทั้งหมดจากการท่องเที่ยว การนำเข้าทั้งหมด เงินออมจากต่างประเทศและรายได้ของรัฐบาล การบริโภค การผลิต ผลผลิตรวม ความต้องการแรงงาน และผลตอบแทนจากปัจจัยการผลิตขั้นต้น ในขณะที่มีการลดลงของรายได้รวมโดยไม่รวมการท่องเที่ยว สำหรับผลกระทบทางสังคมของการท่องเที่ยว ครัวเรือนในชนบทได้รับผลประโยชน์จากการเพิ่มขึ้นของค่าใช้จ่ายการท่องเที่ยวในด้านรายได้และการบริโภค สำหรับผลกระทบต่อสิ่งแวดล้อมของการท่องเที่ยว การปล่อย CO_2 จากการขนส่งมีความสำคัญจากการเพิ่มขึ้นของค่าใช้จ่ายในการท่องเที่ยว ผลแสดงให้เห็นว่าผลกระทบทางเศรษฐกิจและสังคมของมากกว่าผลกระทบต่อสิ่งแวดล้อม

สาขาวิชา เศรษฐศาสตร์ ลายมือชื่อนิสิต .....

ปีการศึกษา 2557 ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

5285909129 : MAJOR ECONOMICS
KEYWORDS: COMPUTABLE GENERAL EQUILIBRIUM / TOURISM

MALLIGA SOMPHOLKRANG: THE ECONOMIC, SOCIAL AND ENVIRONMENTAL IMPACT OF TOURISM IN THAILAND. ADVISOR: PROF. ISRA SARNTISART, Ph.D., 131 pp.

Tourism is considered to be an important sector in the Thai economy. Moreover, the importance of the environment and social issues is minimal in the tourism development of Thailand. There are the three main objectives of the study. Firstly, the important factors affecting the consumption behavior of tourists should be determined. Secondly, the foreign tourist consumption relates to the environment. Finally, this study is to evaluate the impact of tourism.

The results indicate that non-food and lodging are luxury goods according to their expenditure elasticities. Eating out, non-food, alcoholic beverages and tobacco, transport, and lodging places are complementary according to their price elasticities. Total inbound tourism expenditure significant influences on carbon dioxide emissions from transport. The tourism expenditure has a positive relationship with carbon dioxide emissions from transport while the carbon dioxide emissions from the power generation sectors and the cost of wastewater management for tourists are not affected by the tourism expenditure. The simulation results reveal that an increase in inbound tourism expenditure results in the positive impact on the economy of Thailand because of an increase in GDP, the price level, total exports from tourism, total imports, foreign savings and government revenue, consumption, production, total output, the demand for labor and the return on primary factors, while there is a decrease in total income without tourism. For social impacts of tourism, rural households are beneficiaries of the increase in tourism expenditure in terms of income and consumption. For environmental impact of tourism, CO_2 emissions from transport are significant from the increase in tourism expenditure. Results indicate that the economic and social effects of are greater than the environmental effect.

Field of Study: Economics Student's Signature .....

Academic Year: 2014 Advisor's Signature .....

ACKNOWLEDGEMENTS

I wish to express my sincere gratitude to my thesis advisor, Prof. Dr. Isra Sarntisart, not only for his many valuable suggestions on my study, but also for his teaching, support, and enthusiasm which always inspire me to develop myself to become a good teacher as well as a good academician. My study would not have been possible without his kind support. I owe him a great deal and I am very grateful to be his student.

I am also very grateful to the committee; Dr.Yong Yoon, Assoc. Prof. Dr. Paitoon Kraipornsak, Asst. Prof. Dr. Sittidaj Pongkijvorasin and Asst. Prof. Dr. Anan Wattanakuljarus for many useful suggestions, comments and supports on my thesis.

I would like to acknowledge the financial support from the Ph.D. scholarship from Khon Kean University and Nong Khai Campus scholarship for Human Resource Development, Khon Kean University.

I would like to thank my colleagues in the Faculty of Integrated Social Science, Nong Khai Campus, Khon Kean University and my friends in the Ph.D. Economics program, Chulalongkorn University for their help and encouragement. I also would like to thank to the administrative staffs in the Faculty of Economics, Chulalongkorn University for their help. I am also grateful to Steve Cannell for his proofreading assistance.

On a personal note, I wish to express my deepest appreciation to my family, Mr. Chalermphol, my father, Mrs. Somluck, my mother, Miss Nawarat, my sister and Mr. Apichart, my brother for their love and moral support. My study would not have been possible without his help. Lastly, I wish to express my deepest gratitude and affection to Jessada Sodtipinta for his love, care, and patience.

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CHAPTER 1
INTRODUCTION

This chapter begins with the background of the study with regard to the importance of tourism in Thailand. Following this is the significance of the problem and research questions. This also includes the objectives of the study, the scope of the study, the expected benefits of the study and a brief summary of the methodology.

1.1 Background

Tourism is considered to be an important sector in the Thai economy. It helps in raising revenue for the country (Bank of Thailand, 2014; Tourism Authority of Thailand, 2014; World Travel and Tourism Council, 2014). According to the Tourism Authority of Thailand (TAT), the revenue from tourism in Thailand in 2014 accounts for approximately 1,147,653 million baht or about 9 percent of Gross Domestic Product. Tourism is approximately 13 percent of total exports (Bank of Thailand, 2014).

Foreign tourists contribute more than Thai tourists to the Thai economy (Table 1.1). The Department of Tourism report the number of foreign tourists, the average length of stay, the average expenditure and tourism revenue as shown in Table 1.1.

Table 1.1 Tourism in Thailand during 2010 – 2013

	2010	**2011**	**2012**	**2013**
Tourists (persons)				
Thai	122,522,114	133,177,728	149,067,803	161,724,688
Foreigners	15,936,400	19,230,470	22,353,903	26,546,725
Average Length of Stay (Days)				
Thai	2.59	2.73	2.72	2.70
Foreigners	9.12	9.64	10.02	9.85

Table 1.1 Tourism in Thailand during 2010 – 2013

	2010	2011	2012	2013
Average Expenditure (Baht/Person/Day)				
Thai	1,740.38	1831.53	1,956.63	2,053.52
Foreigners	4,078.67	4,187.12	4,392.81	4,616.49
Revenue (Million Baht)				
Thai	402,574.39	483,224.53	578,447.00	660,714.67
Foreigners	592,794.09	776,217.20	983,928.36	1,207,145.82

Source: Department of Tourism, 2015

Foreign tourists increasingly travel to Thailand. It can be seen that there has been a gradual increase in the number of foreign tourists in the period under study. With regard to the length of stay, the average duration of a foreign tourist's stay is approximately nine days. The duration of a foreign tourist's stay is longer than that of a Thai tourist. The average expenditure of foreign tourists shows an increasing trend. The expenditure of foreign tourists is around twice that of Thai tourists. In this study, the increase in expenditure of foreign tourists is presented between the years 2011 and 2013. It shows an increase in revenue from foreign tourists.

1.2 Significance of the Problem

Tourism encourages many economic activities both directly and indirectly. First, the travel of foreign tourists leads to the purchase of goods and service in related businesses. Businesses directly related with tourism include ground transportation, hotels, restaurants, travel agencies and retail shops (Gee, 1989). Second, other economic activities related to tourist activities are agriculture, manufacturing, government taxation and other services. The Office of the National Economic and Social Development Board reported that transportation, hotels and restaurants, agriculture and manufacturing represented about 7, 4, 10 and 27 per cent, of Gross Domestic Product in Thailand in 2014, respectively.

Changes in the environment also result from tourism. According to Tribe (2005), the environment is affected by the growth of the tourism sector. The environment is related to tourism through several activities such as accommodation for visitors, food and beverage serving activities, transport, cultural activities, sports and recreational activities, the retail trade of country-specific tourism goods and other country-specific tourism activities (United Nations, 2010; United Nations Environment Programme, 2015). The relationship between the activities and energy use is direct as revealed in the study of Gössling (2002). The activities create CO2 emissions, contributing about five per cent of total world CO2 emissions (Scott, Daniel, et al., 2008). The use of energy and the emission of greenhouse gases by transport are highly significant (Gössling, 2002).

As mentioned above, the harmful effects on the environment represents an external cost. Carbon emissions by the travel of tourists are greenhouse gases which affect climate change because coal, natural gas and oil are burnt by the transportation and energy sector. It leads to an intangible cost for the environment. Tourist travel involves resource use at a destination such as water, fossil fuels and electricity use, which cause indirect costs to the environment. Uncontrolled high level use increases the pressure on the environment.

Moreover, the importance of the environment and social issues is minimal in the tourism development of Thailand. As the data of Ministry of Tourism and Sports and Tourism Authority of Thailand show, tourism development in Thailand in the first and second period (1960-1991) focused on the development of infrastructure and tourism marketing and promotion, but ignored the negative effects such as wastewater treatment and water management. The tourism development of Thailand in the third period (1992-2001) also took into account environment issues to move towards sustainable development. For the fourth period (2002-2006), the government made attempts at tourism administration reform, increased efficiency in the service sector and broadened the range in the types of tourism by employing marketing strategies. Tourism development in the fifth period (2007-2011) concentrated on the improvement of tourism quality.

The analysis of the economic impacts of tourism should completely cover every important aspect and it appears that the analysis of the tourism impacts seems to lack awareness of environmental and social issues, which led to a vague understanding of the issues. Tourism impact assessment with regard to the environment and society should be conducted. Therefore, this study seeks to clarify how inbound tourism is linked with economics, the environment and society at a destination.

There are a number of issues in this study. Firstly, the important factors affecting the consumption behavior of tourists should be determined, and whether or not each category of tourist expenditure is influenced by these factors. This study will then determine how the environment will be affected as a result of the consumption of foreign tourists. Finally, whether international tourist spending affects industries, households, government, output prices and the environment will be determined in both direct and indirect ways.

1.3 Objectives of the Study

The first objective of this study is to estimate the determinants of international tourist demand. This study will determine how some factors affect the consumption of international tourists, and how these factors affect the expenditure of international tourists. The second objective of this study is to investigate the relationship between foreign tourist consumption and the environment. It is also necessary to determine whether the expenditure of foreign tourists affects the environment, especially the cost of wastewater management, carbon dioxide emissions from transport and carbon dioxide emissions from accomodation. The final objective of this study is to evaluate the impact of tourism. Inbound tourism and the environment are included in the Computable General Equilibrium (CGE) model. It will reveal how international tourism affects both economic and environment variables.

1.4 Scope of the Study

This study analyses the effects of tourism in the Thai economy and involves the relationship between the expenditure of international tourism and the environment. Inbound tourism is also considered in the study.

1.5 Expected Benefits of the Study

The impact of tourism in Thailand has not been completely examined. Past studies have not examined tax refunds for tourists in a General Equilibrium framework. In addition to the analysis of tourism on the economy, early studies did not determine the economic impacts of tourism on the environment. This study will include these factors in the analysis.

The results of the study will give more complete information regarding the impacts of tourism. This study will enhance the understanding of the relationship between tourism and the environment, which can determine the direction of effective tourism policies. This may allow the negative impacts to be reduced to allow more sustainable development.

1.6 Brief Summary of Methodologies

The Linear Expenditure System (LES), the Ordinary Least Squares (OLS) regression method, and the Computable General Equilibrium model will be employed in this study.

The Linear Expenditure System will be employed to estimate the determinants of international tourist demand. When deciding to travel, an international tourist considers the limitation of budget. Furthermore, international demand for tourism will relate to many categories of goods. The equation system should be appropriate to solve this issue.

The Ordinary Least Squares regression method will be used to examine the relationship between the expenditure of international tourism and the environment. The Ordinary Least Squares method may determine these relationships without a

theoretical framework. This study focuses on environmental variables which are carbon dioxide emissions from transport, carbon dioxide emissions from accommodation, and the cost of wastewater management.

The Computable General Equilibrium model will be employed to investigate the impacts of inbound tourism expansion in Thailand. The main motivation for this study is to determine whether inbound tourism is of benefit to some parts. This study will include the consumption of inbound tourism, tax refunds for tourists and the environment.

CHAPTER 2

The Tourism Situation

An overview of international tourism and the structure of tourist expenditure is necessary to analyze the effects of tourism on the Thai economy. This chapter describes the economic situation of tourism in terms of Gross Domestic Product, the revenue from tourism, employment and wages. The environmental situation of tourism is also described.

2.1 Thailand's International Tourism

The total number of tourists in Thailand continuously increased in Thailand between 2010 and 2013. The total number of tourists to Thailand was approximately 122 million tourists in 2010 and approximately 161 million tourists in 2013.

The important components of tourism in Thailand are Thai and foreign tourists. The share of Thai and foreign tourists to Thailand between 2010 and 2013 is shown in Figure 2.1. The dark area shows the share of Thai tourists and the light area shows the share of foreign tourists.

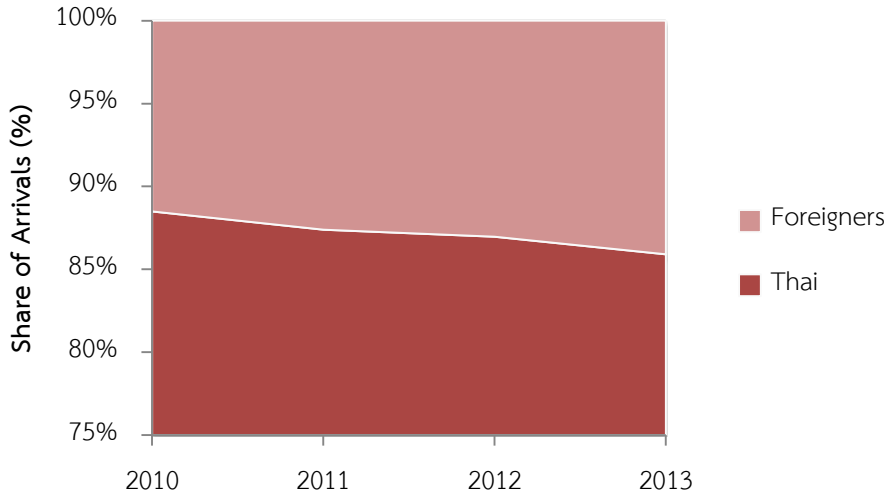

Figure 2.1 The Share of Thai and Foreign Tourists to Thailand

Source: Tourism Authority of Thailand, 2015

The number of Thai tourists was greater than foreign tourists during the period from 2010 to 2013 (Figure 2.1). The share of Thai tourists in Thailand during the time is more than eighty five percent while the share of foreign tourists to Thailand is approximately ten percent. In 2010, there is a big share of Thai tourists but the proportion of Thai tourists continuously decreased to 2013. The number of foreign tourists increased rapidly in 2013 and the share of foreign tourists also increased.

Tourism in Thailand by region in 2014 is presented in Table 2.1. The table shows the number of Thai and foreigner tourists.

Table 2.1 Internal Tourism by Thai and Foreign Tourists, 2011

(Unit: Person)

Region	Thai	Share (%)	Foreigners	Share (%)	Total	Share (%)
Northern	10,999,559	13	925,258	2	11,924,817	9
Bangkok	16,847,839	20	13,801,933	33	30,649,772	24
Central (Excluding Bangkok)	4,678,005	6	534,950	1	5,212,955	4
Western	6,412,752	8	918,106	2	7,330,858	6
Eastern	13,719,721	16	12,862,679	31	26,582,400	21
North eastern	17,687,941	21	422,876	1	18,110,817	14
Southern	13,705,331	16	12,053,045	29	25,758,376	21
Total		100		100		100

Source: Tourism Authority of Thailand, 2014

Thai tourists and foreign tourists in Thailand have different preferences in travelling in different regions of Thailand (Table 2.1). The most travelled region of Thai tourists is the North East. The second one is the Central region, following by Eastern, Southern, Northern, and Western, respectively. In contrast, the Central area is the most travelled region by foreign tourists. Foreign tourists also travel to Eastern, Southern, Northern, Western and North Eastern regions, respectively.

International Tourist Arrivals to Thailand from 2002 to 2014 includes seven groups (Figure 2.2). International tourist groups are classified by geography, ethnicity, and culture (Tourism Authority of Thailand, 2003). The light blue area shows East Asian tourists, the dark blue one shows arrivals of European tourists, the purple one shows the number of American tourists, the pink one shows South Asian tourists, the green one shows the Oceania tourist arrivals, the yellow one shows the tourists arrivals from the Middle East, and the black one shows the arrivals of African tourists.

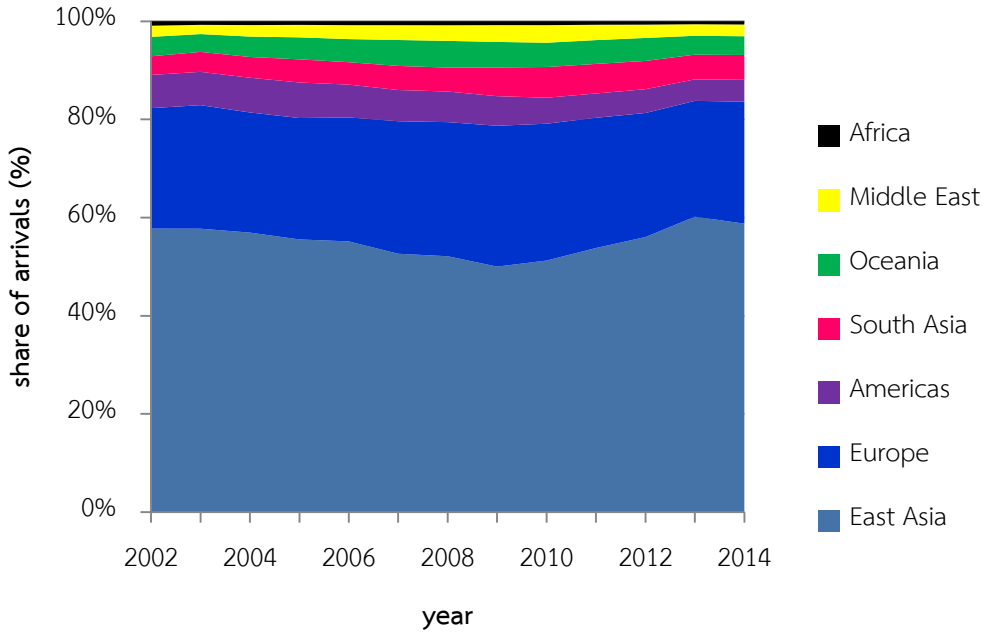

Figure 2.2 International Tourist Arrivals in Thailand from 2002 to 2014

Source: Tourism Authority of Thailand, 2014

The arrivals patterns of international tourists to Thailand from each region are different (Figure 2.2). Tourists from East Asia are the main tourist group of total international tourists in Thailand. Europeans are the second largest tourist group among international tourist groups to Thailand. America, South Asia, Oceania, the Middle East, and Africa are ranked third, fourth, fifth, sixth and seventh, respectively.

The change in East Asian tourist arrivals to Thailand is rather slight (Figure 2.2). The share of the tourists varied between fifty percent and sixty percent. From 2002

to 2009, tourist arrivals from East Asia to Thailand decreased. After that, the trend continuously rises.

Tourist arrivals from Europe to Thailand are more constant (Figure 2.2). In 2004, the share of the tourists was around twenty four percent. In the following years, there was a slight rise in the share of tourists until 2009. After that, there was a slight slowdown in tourists from 2010 to 2013. After that period, there was a rise in the share of tourists to twenty four percent again.

Tourist arrivals from the Americas to Thailand are downward (Figure 2.2). In 2005, the share of tourists was about seven percent. In the following years, there was a gradual percentage decline of tourists to about five percent.

South Asian arrivals to Thailand are growing (Figure 2.2). The share of tourists increased from approximately four percent to five percent. The largest share of South Asian tourists was in 2010, at approximately six percent.

There have been very small changes in the share of tourists from Oceania to Thailand (Figure 2.2). During this period, the share of the tourists was between three and five percent. The number of tourist to Thailand rose from 2003 to 2008. In 2008, Oceanic tourists to Thailand had a large share. After the year 2008, the share of tourists decreased.

Tourists from the Middle East have a fairly constant share (Figure 2.2). The tourist market share was between two and three percent. The share of tourists rose for the first eight years. There was a 3 % share of Middle Eastern tourists in 2010. The market share slightly fell in the subsequent four years.

The share of tourists from Africa moved in a lower direction (Figure 2.2). The share of the tourist market is around zero point six to zero point nine. In 2002, there was a big share of the tourist market, but the tourist market had a lower share in the following years.

The duration of international tourist stays in Thailand is shown in Table 2.2. The length of stay is classified by each region.

Table 2.2 Average Length of Stay by International Tourists during 2000-2012

(Unit: Days)

Region	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
East Asia	5.2200	5.8300	5.3200	5.9800	6.8400	6.5300	5.9000	5.6800	5.9000	6.3700	6.7600
Europe	14.7000	14.7300	14.9000	14.9900	14.5700	16.3200	15.7900	14.2400	14.5400	15.6300	16.4700
The Americas	10.4900	10.3700	10.2200	10.3000	10.1500	11.1700	13.5300	13.5200	13.4500	14.2900	15.0800
South Asia	7.0300	7.3300	7.6300	7.2100	7.1800	6.3800	6.7800	6.1400	6.2400	6.9300	7.2300
Oceania	10.7400	10.7100	10.5800	10.5300	10.3700	12.2800	12.2900	11.2400	11.7900	12.7500	13.4000
Middle East	11.4600	11.5600	11.5700	11.3600	10.7400	10.9500	10.1700	9.9400	9.9800	10.9800	11.6900
Africa	10.4200	10.6300	11.2700	10.5100	10.1700	14.6800	10.3100	8.6400	9.2700	10.2400	11.4000
Total	8.9200	9.3700	8.8400	9.7300	9.7200	10.7100	9.5100	8.9900	9.1200	9.6400	10.0200

Source: Tourism Authority of Thailand, 2012

There are differences in the length of stay in Thailand for international tourists from different regions (Table 2.2). Tourists from the Americas and Oceania stayed longer in Thailand during the period. The average stay changed only slightly for Europe, East Asia, South Asia, the Middle East. There is uncertainty about the length of stay for Africa tourists.

The expenditure of international tourists by each region to Thailand between 2003 and 2013 is presented in Table 2.3.

Table 2.3 Expenditure of International Tourists to Thailand by Each Region

(Unit: baht/day)

Region	East Asia	Europe	The Americas	South Asia	Oceania	The Middle East	Africa
1998	4,038	3,193	4,283	3,865	3,796	4,290	5,198
1999	4,270	2,861	4,396	4,692	3,179	4,727	6,603

Table 2.3 Expenditure of International Tourists to Thailand by Each Region

(Unit: baht/day)

Region	East Asia	Europe	The Americas	South Asia	Oceania	The Middle East	Africa
2000	4,162	3,174	4,452	4,956	3,919	4,687	6,023
2001	4,215	3,109	4,088	4,695	3,478	4,227	4,399
2002	4,244	3,220	3,958	4,186	3,466	3,759	3,943
2003	3,849	4,463	3,115	3,122	2,882	3,286	3,658
2004	4,368	3,739	3,982	4,006	3,994	3,742	4,088
2005	4,044	3,795	3,867	3,659	3,585	3,917	3,389
2006	4,285	3,705	4,293	4,436	4,246	4,093	4,009
2007	4,269	3,789	4,599	4,492	4,484	4,276	4,413
2008	4,327	3,800	4,544	4,484	4,556	4,478	4,562
2009	4,161	3,700	4,344	4,403	4,446	4,395	4,478
2010	4,244	3,736	4,298	4,597	4,590	4,533	4,585
2011	4,313	3,849	4,356	4,777	4,770	4,657	4,732
2012	4,579	3,976	4,497	5,103	4,998	4,925	4,964
2013	4,859	4,141	4,632	5,322	5,284	5,228	5,139

Source: Tourism Authority of Thailand, 2013

The per capita daily expenditure of all tourists in every region is similar (see Table 2.3). The expenditure is between around 3,000 baht per day and around 5,000 baht per day. In 2013, tourists from East Asia spent around 5,300 baht per day. The expenditure of tourists from Oceania, the Middle East, and Africa are similar to the expenditure of tourists from East Asia. Tourists from East Asia and the Americas are also in a similar range to those from East Asia, Oceania, the Middle East, and Africa, but the expenditure of tourists from Europe is low.

The expenditure structure of international tourists to Thailand is classified into seven groups according to the Tourism Authority of Thailand (2003) (Figure 2.3).

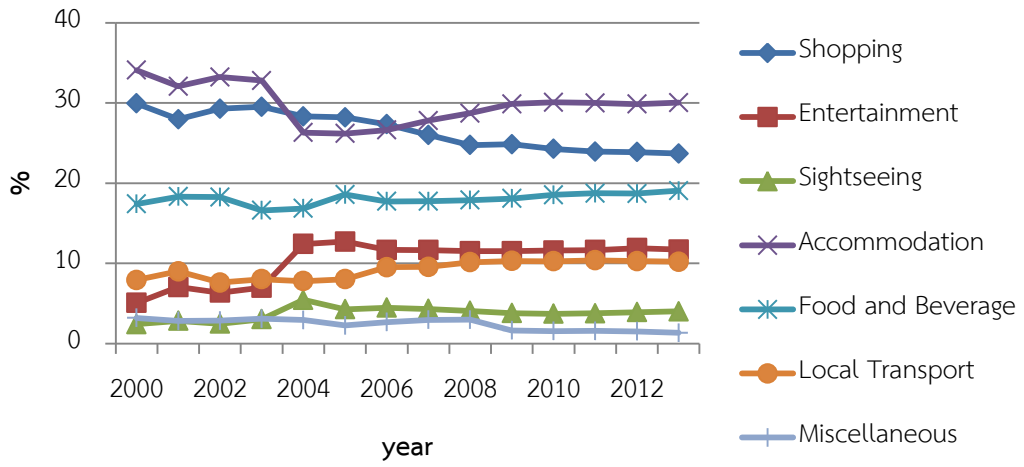

Figure 2.3 Expenditure Structure of International Tourists to Thailand

Source: Tourism Authority of Thailand, 2013

International tourists spend money differently with regard to the seven categories (Figure 2.3). Accommodation expenditure of tourists is the main expense. The next largest proportion is shopping, food and beverage, entertainment, transport, sightseeing and miscellaneous, respectively. The accommodation item fluctuated by approximately 30 percent during the period. Shopping expenditure had a decreasing trend during this period, but food and beverage, entertainment, transport and sightseeing expenditure had slight growth.

2.2 Economic Situation of Tourism

2.2.1 Gross Domestic Product

The tourism activities have an important role in the growth of the Thai economy as shown in the data in Figure 2.4. Tourism activities are related to hotels and restaurants, transport, storage and communication, real estate, renting, business activities and other community, social and personal service activities as presented by the International Standard Industrial Classification (ISIC) of United Nations Statistics Division.

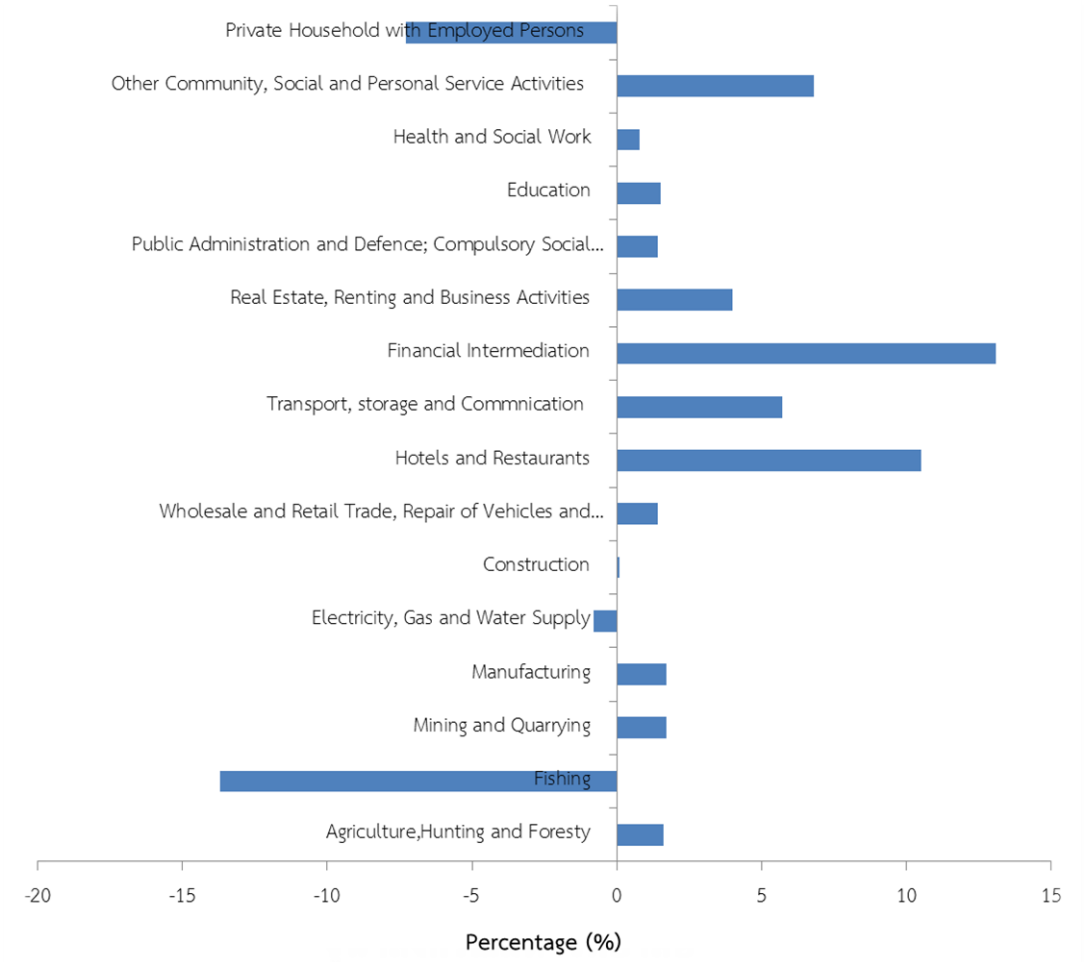

Figure 2.4 The Growth Rate of Gross Domestic Product, by Industry 2013

Source: Office of the National Economic and Social Development Board

In 2013, the growth rate of Gross Domestic Product of Thailand (2.8%) was less than the growth rate of tourism activities in Thailand. Hotels and restaurants are the main tourism sector with a growth rate of around 10.5%. The growth rate of transport, storage and communication in the tourism support sector account for 5.7%. The percentage of growth rate in real estate, renting, and business activities and other community, social and personal service activities in tourism-related sectors is 4% and 6.8%, respectively.

2.2.2 Revenues

The tourism industry generates revenue for Thailand and is related to changes in Gross Domestic Product and total exports (Table 2.4).

Table 2.4 Gross Domestic Product, Export, Tourism Revenues, Tourism-GDP Ratio, and Tourism-Export Ratio in Thailand 2001-2013

Year	Gross Domestic Product (Million Baht)	Export (Million Baht)	Tourism Revenues (Million Baht)	Tourism-GDP ratio (%)	Tourism-Export ratio (%)
1998	4,626,400	2,248,321	242,177	5.2300	10.7700
1999	4,637,000	2,215,179	253,018	5.4600	11.4200
2000	4,922,700	2,773,827	285,272	5.7900	10.2800
2001	5,133,502	2,884,703	299,047	5.8300	10.3700
2002	5,450,643	2,923,941	323,484	5.9300	11.0600
2003	5,917,369	3,325,630	309,269	5.2300	9.3000
2004	6,489,476	3,873,689	384,360	5.9200	9.9300
2005	7,092,893	4,438,691	367,380	5.1800	8.2800
2006	7,850,193	4,937,372	482,319	6.1400	9.7700
2007	8,529,836	5,302,119	547,782	6.4200	10.3300
2008	9,706,932	6,936,508	574,520	5.2800	8.2300
2009	9,654,016	6,193,271	510,255	5.2800	8.2300
2010	10,802,402	7,153,229	592,794	5.4800	8.2800
2011	11,300,485	7,943,226	776,217	6.8600	9.7700
2012	12,354,656	8,560,648	983,928	7.9600	11.4900
2013	12,910038	8,734,050	1,207,145	9.3500	13.8200

Source: Office of National Economic and Social Development Board, Thai Customs Department, Tourism Authority of Thailand

Tourism revenues in the year 2013 increased by five times compared with the tourism revenues in the year 1998. Tourism revenues fluctuated in this period because of SARS, the Iraq War, the Tsunami, and demonstrations to protest for and against Prime Minister Thaksin Shinawatra (McDowall & Wang, 2009). Tourism revenues varied by about 5-9 percent of GDP, while the ratio of tourism revenue to total exports fluctuated between approximately 8 per cent and approximately 13 per cent of all exports.

When comparing the revenue from tourism and those of major exports, tourism revenue is considered as a main source of income for the Thai economy (Table 2.5).

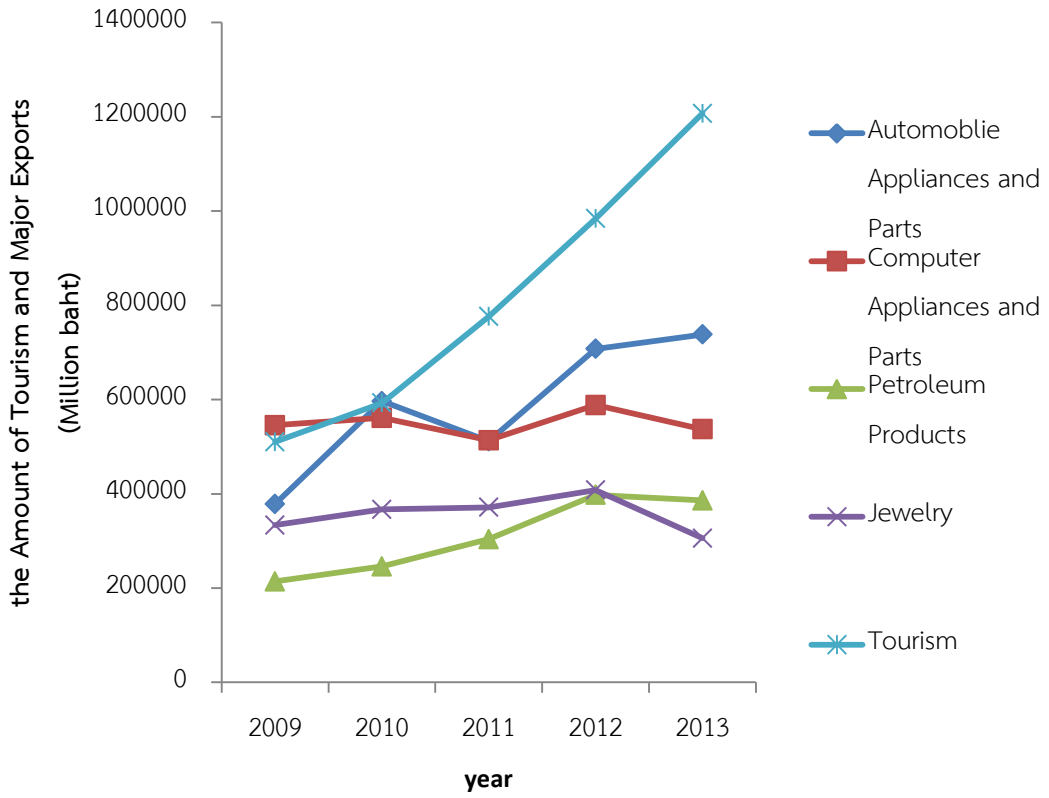

Figure 2.5 Comparisons of Tourism Revenue and the Major Exports of Thailand

Source: Thai Customs Department, Tourism Authority of Thailand

Figure 2.5 shows an increasing trend of revenue from tourism. Revenue from tourism ranked at 1st or 2nd among the major exports of Thailand from 2009 to 2013. In contrast, there is a fluctuation in the earnings from other major exports. In 2013, tourism revenues were higher than the export earnings from automobile appliances and parts and approximately equal to the export earnings from computer appliances and parts.

2.2.3 Employment and Wages

Employment in hotels and restaurants, transport, storage and communication, real estate, renting, and business activities and other community, social and personal service activities is considerable in the Thai economy (Figure 2.6).

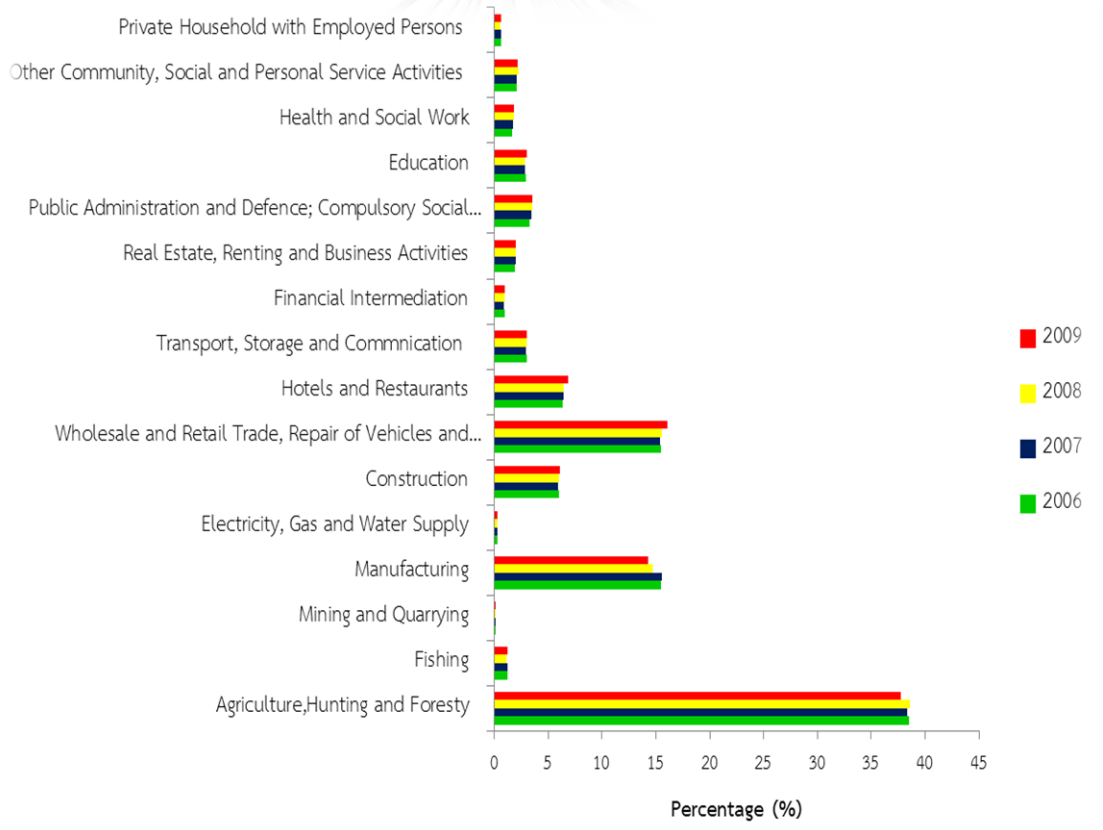

Figure 2.6 Employment in Thailand, by Industry, 2006–2009

Source: Bank of Thailand

Employment in hotels and restaurants ranked fourth among the employment of other industries at about 2 million people. Transport, storage and communication, real estate, renting, and business activities and other community, social and personal service activities industries employ between approximately 0.5 and 1 million people. As shown in Figure 3, the hotel and restaurant share of total employment was approximately 6 per cent from 2006 to 2009. At the same time, employment in transport, storage and communication accounted for about 3 per cent. Employment in real Estate, renting and business activities and other community, social and personal service activities had a small share of approximately 2 per cent

The average wages of the main industries are shown in Figure 2.7. The ability to pay wages by the tourism industry group is moderate.

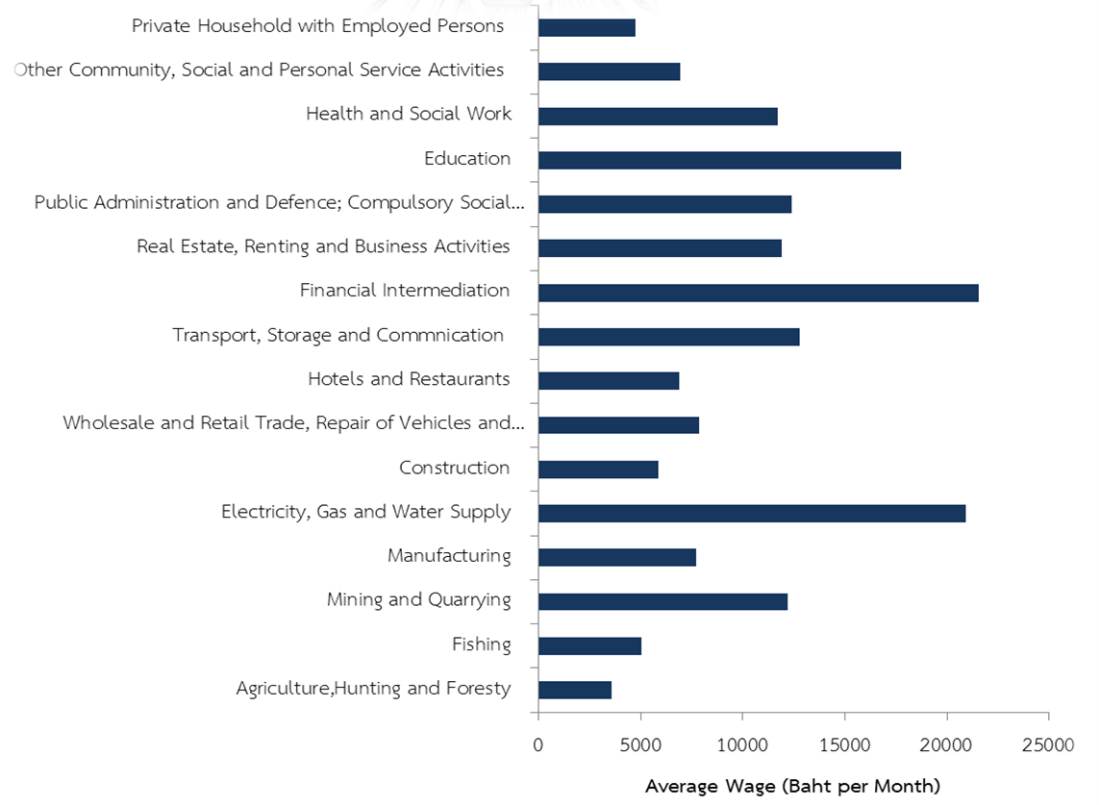

Figure 2.7 Average Wages in Thailand, by Industry, 2009

Source: Bank of Thailand

The average wages of transport, storage and communication, real estate, renting, and business activities were about 12,000 baht per month in 2009, while the average wages of hotels and restaurants and other community, social and personal service activities were below 10,000 baht.

2.3 The Environment Situation of Tourism

In addition to the impact of tourism on economics, tourism brings about some environmental effects through travel activities such as transport and accommodation. Becken and Patterson (2006), indicated that the consumption of fossil fuels is directly related to accommodation and catering services, road, rail and water passenger transport, air transport, other transport, while transport services, equipment hire, cultural and recreational services and the retail trade and electricity from petroleum, coal or gas are indirectly related to these tourism activities. Carbon dioxide emissions are the most important greenhouse gases emission which results from the consumption of these activities (Becken & Patterson, 2006). However, carbon dioxide emissions from tourism are not taken into account by these systems. Carbon dioxide emissions represent the environmental effect of tourism (Becken & Patterson, 2006).

The Energy Policy and Planning Office only reports carbon dioxide emissions from oil, coal or lignite and natural gas by industry (Figure 2.8).

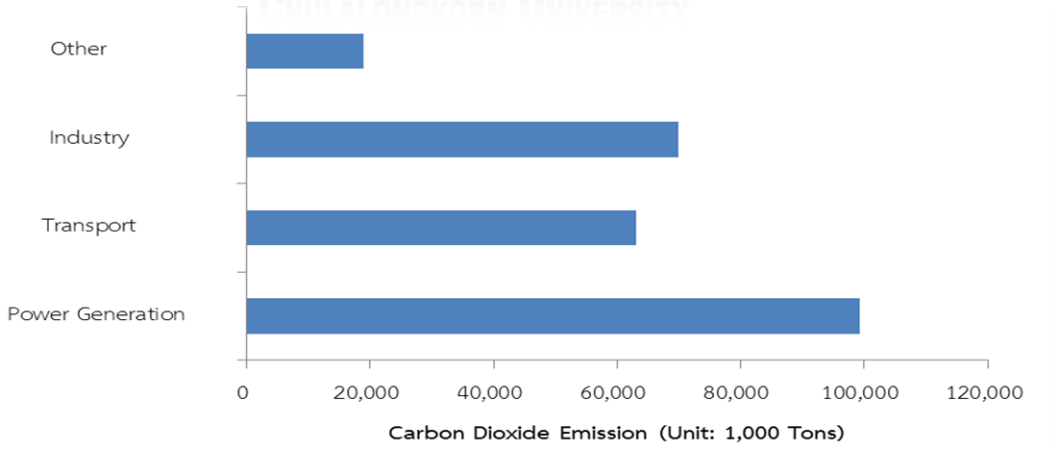

Figure 2.8 Carbon Dioxide Emissions by Industry, 2013

Source: Bank of Thailand

Transport has a considerable influence on the emissions of carbon dioxide. Carbon dioxide emissions by the transport industry are ranked third. Carbon dioxide emitted by transport represents about 60 million tons, although carbon dioxide emissions from power generation and industry are higher. However, transport is used for travelling by tourists, so energy consumption is significant related to transportation.

Water is used by tourists in many activities such as washing or using the toilet and sports tourism (Gössling et al., 2012). Water use leads to the emission of wastewater. The Pollution Control Department reported the amount of wastewater by the type of building as shown in Table 2.5.

Table 2.5 The Amount of Wastewater by the Type of Building

Type of Building	Unit	Liter/Day-Unit
Condo - Residence	unit	500
Hotel	room	1,000
Dormitory	room	80
Services	room	400
Housing Estate	person	180
Hospital	bed	800
Restaurant	square meter	25
Market	square meter	70
Shopping Mall	square meter	5
Office	square meter	3

Source: Pollution Control Department, Ministry of Natural Resource and Management

The hotel sector is particularly significant in the emission of waste water. The amount of wastewater by hotels is the highest at 1,000 liters per day per unit. Restaurants, which are also related to tourism, emit a smaller amount of wastewater at 25 liter per day, per unit. The wastewater emissions of shopping malls are the smallest at 5 liter per day per unit.

CHAPTER 3
Literature Review

This aim of this chapter is to review the current studies that focus on the impacts of tourism in several sectors and employ various methods of study. This review of the literature can provide an in-depth understanding of how tourism may cause change in various ways. These studies employ different methods, which have both advantages and disadvantages. A summary of this chapter is also presented.

3.1 Impacts of Tourism

Tourism has many effects on income generation, the distribution of the income, employment, production, consumption, international trade, the relationships with local people, development, and the environment.

Tourism generates income for households, firms, and the government. First, villagers earn some of their income from tourism (Kantamaturapoj, 2007; Matarrita-Cascante, 2010; Oul, 2006; Zhang, 2006). Revenue from handicraft sales and tour guide services are examples of tourism revenue (Rabibhanada & Jatuworapruk, 2007; Taylor, Dyer, Stewart, Yunez-Naude, & Ardila, 2003). Second, businesses can make more profit (Martí Selva, Calafat Marzal, & Puertas Medina, 2012). According to Taylor et al. (2003), the agricultural and non-agricultural sectors received more revenue from the growth of tourism. Third, government received benefits by imposing tax on tourism (Kweka, Morrissey, & Blake, 2001; Martí Selva et al., 2012; Sinclair, Blake, & Gooroochurn, 2005). Tax income increased because of low-cost airline expenditure by tourists (Martí Selva et al., 2012). Tax to control and treat the environment was levied on firms and households (Alavalapati & Adamowicz, 2000; Lindberg & Johnson, 1997). In firms, natural resources, which are continuously depleted, are an input in the production sector. Households also contribute to pollution. Traffic congestion was found to be one of the increasingly negative impacts (Lindberg & Johnson, 1997). However, government taxation of tourism might also have had a negative effect. The increase in Value-Added Tax (VAT) on tourism-related sectors led to a slowdown in

expenditure on tourism and on Gross Domestic Product (GDP) (Sinclair et al., 2005).

Tourism may result in a different distribution of income for households. A variety of studies found that the distribution of income for tourism was unequal (Oul, 2006; Taylor et al., 2003; Untong, Phuangsaichai, Taweelertkunthon, & Tejawaree, 2006; Wattanakuljarus & Coxhead, 2008). Blake, Arbache, Sinclair, and Teles (2008), indicated that low income households are the main beneficiaries of the earnings of tourism expansion while the lowest income households gain less benefit compared to higher income households. According to Lee and Kang (1998), low income groups gain higher revenue than higher income groups from tourism. Blake et al. (2008), indicated that some higher income households are the main beneficiaries of the earnings from the tourism industry. According to Lee and Kang (1998), the living standards of low income groups has improved because of tourism. In contrast, Blake (2008), found that the income from tourism-related industries for poorer households was less than other export activities. However, equalizing effect on the distribution of income from tourism was greater than the equalizing effect in secondary and tertiary industries (Lee & Kang, 1998). In addition, there were some other factors contributing to the unequal income distribution from tourism such as seasonal variations, the type of household and location in commercial or tourist areas (Juan & Piboonrungroj, 2007; Taylor et al., 2003).

Employment was found to be related to tourism at tourist destinations, and an expansion of employment occurred in many sectors (Martí Selva et al., 2012). The employment level in agriculture was initially affected by international expenditure as shown in the study of Akkemik (2012). Most tourist workers were unskilled and semiskilled (Walpole & Goodwin, 2000); therefore low income households were employed (Sinclair et al., 2005). The wages of workers in the tourist industry were found to be low (Kantamaturapoj, 2007; Lee & Kang, 1998), and the real wages of unskilled and skilled labor changed little as tourism expanded (Blake et al., 2008). The linkage of employment in tourism with the economy was low compared to

other sectors (Kweka et al., 2001). In addition, the increase of tourism caused equal migration (Taylor et al., 2003)

Apart from the effects on income and employment, a change in consumption and the production of goods and services may result from tourism as follows. First, households consumed increasing amounts of some goods and services (Kweka et al., 2001). According to Martí Selva et al. (2012), there is a relationship between the expenditure of airline travelers and the increase in the demand for goods and services, for example in Spain. Second, production increased in several sectors due to tourism (Kweka et al., 2001; Martí Selva et al., 2012). Martí Selva et al. (2012), revealed that air transportation, restaurants and similar establishments and hotels gain benefits from the expenditure of tourists. This is contrary to the study of Akkemik (2012) who found that the percentage shares in manufacturing and agriculture sectors are the largest due to total international expenditure. The production sector is linked with GDP in tourist destinations and there has been a rise in GDP (Akkemik, 2012; Martí Selva et al., 2012; Ruíz, 1985; Sugiyarto, Blake, & Sinclair, 2003). However, Akkemik (2012) indicated that international tourism was insignificant in generating GDP in Turkey.

Due to a change in consumption and production, trade varies with tourism. The demand for goods and services from domestic and foreign sources increases with higher levels of tourism. In the case of domestic sources, the production of goods and services expanded in domestic-oriented industries more than in other industries (Wattanakuljarus & Coxhead, 2008) and the exports of traditional sectors decreased (Adams & Parmenter, 1995; Narayan, 2004). It was found that industries related to the tourism sector increased in imports as a result of foreign spending (Adams & Parmenter, 1995; Narayan, 2004; Walpole & Goodwin, 2000; Wattanakuljarus & Coxhead, 2008). This had a negative effect on the trade balance. In addition, the appreciation of the baht caused increased imports and decreased the competitiveness of exports (Adams & Parmenter, 1995; Narayan, 2004; Wattanakuljarus & Coxhead, 2008; Zhou, Yanagida, Chakravorty, & Leung, 1997).

One further effect of tourism was in social dimensions. There was both a positive and negative change in the relationship of local people. An impact of tourism was found to be enhanced cooperation in communities (Juan & Piboonrungroj, 2007; Walpole & Goodwin, 2000). Another impact was that relationships within families were more negatively affected than others because some villagers served tourists (Stronza & Gordillo, 2008; Zhang, 2006).

In addition to the above-mentioned effects, tourism has led to both positive and negative changes to the environment. First, tourism stimulated tourist destination to develop in various ways. For example, roads, healthcare, education, trash collection systems, commercial centers, coastal resorts, marinas, jetties and water treatment plants have been developed at tourist destinations (Davenport & Davenport, 2006; Juan & Piboonrungroj, 2007; Matarrita-Cascante, 2010; Stronza & Gordillo, 2008). The benefits to local people around tourist attractions were higher than the benefits for local people in other areas because the location of tourist attractions is reachable and convenient (Walpole & Goodwin, 2000). The demand for these were the highest in terms of the amount of visitor spending and population growth (Kim & Konan, 2004). In contrast, tourism development can also lead to harmful effects for local people. Davenport and Davenport (2006), indicated that there is increased destruction of natural habitats.

Second, tourism does not only affect the development of destinations, but also causes environmental problems such as excessive water demand, wastewater discharge, increased energy consumption and carbon dioxide emissions, air pollution, noise pollution, river bank erosion, congestion of people and cars, the reduction of biodiversity, and damage to the intertidal zone and the world's coral ecosystems (Davenport & Davenport, 2006; Juan & Piboonrungroj, 2007; Matarrita-Cascante, 2010; Saenz-de-Miera & Rosselló, 2014). The more the number of tourists increases, the more these impacts increase (Ceballos-Lascurain, 1996). The extension of tourism seems to bring about an increase in water demand and wastewater discharge through agricultural production as shown by the study of Wattanakuljarus and Coxhead (2008). There is also an increase in energy consumption and carbon dioxide emissions resulting from the development of tourism in Turkey, particularly in the

long term (Katircioglu, 2014). Saenz-de-Miera and Rosselló (2014), stated that an increase in the number of tourists brings about an increase in the particular matter (PM_{10}) concentrations, especially in the high season. These problems influence the travel patterns of some tourists, who may alter their travel patterns to high-quality and cleaner environments (Inskeep, 1987).

3.2 Estimation Method

This section reviews the method for this study. There are two parts of the review: models on consumer demand issues and the method employed to measure the impact of tourism issues.

3.2.1 Models on Consumer Demand Issues

Two main approaches were conducted for consumer demand studies based on the literature review, the single equation and a system of equations. The latter includes the Linear Expenditure System (LES), the Extended Linear Expenditure System (ELES), and the Almost Ideal Demand System (AIDS) (Divisekera, 2003; Pyo, Uysal, & McLellan, 1991; Sakai, 1988; Stabler, Papatheodorou, & Sinclair, 2009).

There are several strengths and weaknesses of the single equation approach for the analysis of consumption demand. The good point of this approach is easy implementation (Norsiah, 2008; Stabler et al., 2009). Log-linear form is mostly employed (Choong-Ki, Var, & Blaine, 1996; Nonthapot, 2013; Schiff & Becken, 2011; Stabler et al., 2009; Witt & Martin, 1987). The weakness of this approach is that it has limited validity in the measurement of consumer's behavior (Eadington, 1991). In addition, the allocation of budget at different consumption levels is not considered (Li, Song, & Witt, 2004). Furthermore, the interdependence of goods and services in basic consumer demand theory is not taken into account (Eadington, 1991).

The limitations of the single equation approach are reduced in the system of equations approach. Eadington (1991), stated that consumer theory and allocated expenditure are included in this approach. The effects of the relationship between a commodity and another commodity can be estimated from cross price elasticities by employing this approach.

Each type of equation system is different. Comparisons between the Linear Expenditure System (LES) model and the Extended Linear Expenditure System (ELES) model are relevant to utility maximization under the available money (Narayana & Vani, 2000; Stone, 1954). The estimates of parameters by the Extended Linear Expenditure System seem complex compared with the Linear Expenditure System model. The Extended Linear Expenditure System can examine different level of incomes and can consider savings in the price and expenditure of commodities (Narayana & Vani, 2000). Comparing the Linear Expenditure System with the Almost Ideal Demand System (AIDS), the allocation of expenditure on individual consumers or goods in the Linear Expenditure System is similar to the Almost Ideal Demand System (Fujii, Khaled, & Mak, 1985; Lim, 1997). However, the flexibility of functional form in the Almost Ideal Demand System is better than that in the Linear Expenditure System. However, Fujii et al. (1985) revealed that there are a few restrictions in the Almost Ideal Demand System. In contrast, Fujii et al. (1985) revealed that there are a few restrictions in the Almost Ideal Demand System. The sign of the compensated cross price elasticities is positive or all commodities that are substitutes and the sign of the income elasticities is positive or all commodities that are normal goods.

The Linear Expenditure System (LES) model is considered an appropriate approach for the analysis of tourist demand. Tourist behavior is considered as the primarily necessary consumption (committed consumption level), so a tourist will then consider other tourism goods and services (supernumerary consumption). This approach is employed to estimate the income and price elasticities of tourist demand.

3.2.2 Method on Tourism Impact Issues

Previous studies attempted to find the impacts of tourism in many different ways. The impacts are examined by employing several study methods such as the multiplier effect, input-output (IO) models, the social accounting matrix (SAM) model,

computable general equilibrium (CGE) models, and the Tourism Satellite Account (TSA).

The analysis of tourism impact has been conducted in two ways, namely partial equilibrium analysis and general equilibrium analysis. General equilibrium analysis is employed to analyze all sectors of the economy simultaneously and to examine relationships between sectors. Partial equilibrium analysis is also used to analyze a particular sector in an economic system.

1) Partial equilibrium analysis

Some earlier tourism studies were conducted by employing econometric models which revealed a lack of consideration of other aspects. These studies only focus on tourism demand and economic growth. For example, Chancharat and Chancharat (2010) revealed that tourism demand in Thailand was particularly related to Gross Domestic Product. According to Fayissa, Nsiah, and Tadasse (2008) and Oh (2005), tourism led to economic growth in South Korea and Africa. In addition, there was an attempt to include other factors in the study. For example, physical capital, the government expenditure ratio, the black market, premium life expectancy, education, the international country risk guide, the openness of an economy, and inflation were considered in the study of Seetanah (2011), and Sequeira and Nunes (2008).

The previous literature on the issues of economic growth and some environmental dimensions can also be considered by partial equilibrium analysis. Asafu-Adjaye (2000), Fatai, Oxley, and Scrimgeour (2004), Halicioglu (2009), and Wang, Zhou, Zhou, and Wang (2011) examined the relationship between economic growth and energy consumption by conducting Granger causality and cointegration tests. Fatai et al. (2004) and Wang et al. (2011) also investigated the CO2 emission issue. The case of water use in the tourism sector was investigated in the review of literature (Akkemik, 2012; Gössling et al., 2012).

2) General equilibrium analysis

Input-Output models are more suitable than econometric models to conduct tourism impact analysis. An important reason is that this model examines interrelationships in industry (Akkemik, 2012; Briassoulis, 1991; Fletcher, 1989; Khan, Seng, & Cheong, 1990; Oosterhaven & Fan, 2006). However, a limitation of the Input-Output model is the inconsistency of assumptions (Dwyer, Forsyth, & Spurr, 2004; Hara, 2008; Martí Selva et al., 2012; Oosterhaven & Fan, 2006). The assumptions in the input-output model are free resources in the economy, and the lack of a relationship between the economy and the rest of the world (Dwyer et al., 2004). Therefore, it may lead to overvalued results as in the studies of Dwyer et al. (2004) and Zhou et al. (1997).

The Social Accounting Matrix model has the advantage of analyzing tourism issues in contrast to the Input-Output model. It includes households, firms, government, and the rest of the world (Akkemik, 2012; Zhou et al., 1997). It displays the expenditure and income flow of an economy on production, households, enterprises, government, and the rest of the world (Akkemik, 2012; Zhou et al., 1997).

The Computable General Equilibrium model has the flexibility of the assumptions of the Social Accounting Matrix model in terms of supply, demand, price models, quantity models, income models, and equilibrium conditions (Akkemik, 2012; Oosterhaven & Fan, 2006). It can analyze the indirect effect of backward and forward linkage (Dwyer et al., 2004). Zhou et al. (1997), stated that this model examines the impact of tourism by considering resource allocation as well. The magnitude of the results of the computable general equilibrium is less than the magnitude of the results of the input-output model. This method has been conducted with regard to different tourism issues. For example, Adams and Parmenter (1995) included the regional equation in the main equation group on the effect of tourism on sector and region in the case of Australia. In the study of ecotourism in the Galapagos Islands, the database was a tourist and household survey to analyze the demographic and economic impact of tourists. Sugiyarto et al. (2003), attempted to combine the increase in trade globalization with economic

impacts of tourism in Indonesia. Nevertheless, the parameters and economic behavior model in the model are important issues for this method. Akkemik (2012), indicated that the selection of parameters and functional form is most appropriate in the Computable General Equilibrium model.

The Tourism Satellite Account (TSA) analyses the relationship between the tourist demand for goods and services and the supply of goods and services as shown in the report of the World Tourism Organization. According to Smeral (2006), it analyzes the direct impact of tourism on the economy and is extended from the input-output framework. It indicates that tourists purchase goods and services from tourism and non-tourism sectors at a destination, but cannot explain the indirect impact of tourism. For Thailand, tourism satellite account is also extended from the input-output framework as shown in the report of the Department of Tourism. It measures the magnitude of the tourism related activities both internal and international tourism and the tourism impacts on the other economic sectors. Wattanakuljarus (2009), stated that there are unlimited intermediate and primary factors in the economy and a fixed proportion of intermediate and primary factors for production.

3.3 Conclusion

Tourism has importance in several ways from the literature review, for example in income generation, the distribution of income, international trade, employment, production, consumption, GDP, and the environment. There is a rise in the income of households, firms, and the government because of tourism. It leads to unequally distributed income for everyone. The demand for exports and imports, employment at tourist destinations, production, consumption, GDP and welfare also increases. In addition, the living of host people is positively and negatively influenced by the expansion of tourism, for example cooperation within the community, the development of infrastructure, and the damage to household relationships. The environment is also affected, such as damage to the natural environment and pollution.

The estimation method is reviewed in two ways. First, there are two main models in consumer demand studies: the single equation and the system of equations. Second, there are two ways of analyzing the impact of tourism: partial equilibrium analysis and general equilibrium analysis.

CHAPTER 4

The Price and Income Elasticities of Tourist Demand

This chapter describes the determinants of international tourist demand and the consumption of inbound tourists is discussed. Finally, the model and data, results, and conclusions are presented in this chapter.

4.1 Introduction

The majority of earlier studies on inbound tourist behavior concentrated on overall inbound tourism demand (Bull 1994; Lim 1997; Garin-Mun oz 2006; Phakdisoth 2007). Total inbound demand may not include all types of tourist expenditure., which reflect the differences in the demand for commodities by tourists. Therefore, a change in the total consumption of inbound tourists may result from a change in the consumption of inbound tourists in various categories. Inbound tourist expenditure by item is, therefore, considered.

The importance of inbound tourist expenditure is different for each item. Inbound tourist expenditure in Thailand can be divided into seven main categories (Tourism Authority of Thailand, 2013).The Tourism Authority of Thailand (2013) reported that accommodation, shopping, food and beverage, entertainment, transport, sightseeing, and miscellaneous expenditure accounts for 29.9%, 23.9%, 18.7%, 11.9%, 10.3%, 3.9%, and 1.5% of inbound tourist expenditure, respectively.

This study proves whether the determinants of foreign tourist consumption affect the tourist expenditure of a country differently for each item. The objective of this study is to estimate the income and price elasticities of foreign tourist demand for each category.

4.2 Model and Data

4.2.1 Model

The Linear Expenditure System for this study is based on Stone (1954). There are five commodities, namely eating out, non-food, alcoholic beverages and tobacco, transport, and lodging places. On the utility maximization principle, consumers' utility is maximized subject to a limited budget. The demand for goods i will be presented in the equation (4.1).

$$Q_i = \gamma_i + \frac{\beta_i}{P_i}\left(E - \sum_{i=1}^{6} P_i \gamma_i\right) \tag{4.1}$$

Where Q_i is the quantity of consumed good i, γ_i is the minimum committed consumption level of good i, β_i is the marginal budget share of good i, P_i is the price of good i, and E is total expenditure.

The estimates of income and price elasticities are formulated by Lluch and Williams (1975) as presented in equations (4.4)-(4.8).

$$\Phi = -1 + \left(\frac{1}{E}\sum_{i=1}^{6} P_i \gamma_i\right) \tag{4.2}$$

$$w_i = \frac{E_i}{E} \tag{4.3}$$

$$\Im_i = \frac{\beta_i}{w_i} \tag{4.4}$$

$$\varepsilon_{ii} = \Im_i\left(\Phi - w_i(1 + \Im_i\Phi)\right) \tag{4.5}$$

$$\varepsilon_{ij} = -\Im_i w_j\left(1 + \Im_j\Phi\right) \tag{4.6}$$

$$\eta_{ii} = \Im_i\left(1 - \beta_i\right)\Phi \tag{4.7}$$

$$\eta_{ij} = -\Im_i\beta_j\Phi \tag{4.8}$$

Where Φ is the supernumerary ratio, w_i is the expenditure share of good i, $\mathfrak{I}_i$ is the income elasticity of demand for good i, ε_{ii} is the uncompensated own price elasticity of demand of good i, ε_{ij} is the uncompensated cross price elasticity of demand of good i and good j, η_{ii} is the compensated own price elasticity of demand of good i, and η_{ij} is the compensated cross price elasticity of demand of good i and good j.

4.2.2 Data

The data set of the Tourism Authority of Thailand and the Department of Tourism, at the Ministry of Commerce were taken in the years between 1997 and 2012. The expenditure of inbound tourists, eating out, non- food, alcoholic beverages and tobacco, transport, and lodging, are used in this study. Non-food expenditure is the sum of entertainment, shopping, and sightseeing expenditure. Inbound tourist expenditure is associated with ten major tourism markets; Lao People's Democratic Republic, the People's Republic of China, Malaysia, Japan, Korea, the Russian Federation, India, Australia, the United Kingdom and the United States of America. The price of all goods is assumed to be equivalent in this study.

4.3 Results

The results of the estimates of the marginal budget shares and minimum committed consumption level are presented in Table 4.1.

Table 4.1 Results of the Estimates of the Marginal Budget Shares and the Minimum Committed Consumption Level

	Marginal Budget Share			**Minimum Committed Consumption Level**		
	Coefficient	**t-statistic**	**Prob.**	**Coefficient**	**t-statistic**	**Prob.**
Eating out	0.1470	99.7800	0.0000	145,148,392	3.4200	0.0000
Non-food	0.4910	115.3600	0.0000	452,948,944	13.5200	0.0000
Alcohol &	0.0060	64.1000	0.0000	10,944,680	11.1500	0.0000

Table 4.1 Results of the Estimates of the Marginal Budget Shares and the Minimum Committed Consumption Level

	Marginal Budget Share			**Minimum Committed Consumption Level**		
	Coefficient	**t-statistic**	**Prob.**	**Coefficient**	**t-statistic**	**Prob.**
Tobacco						
Transport	0.0830	55.6800	0.0000	79,215,751	3.9000	0.0000
Lodging	0.2730	87.5500	0.0000	245,274,252	6.7600	0.0000

Source: Author

The marginal budget share of non-food is the largest compared with other commodities as shown in Table 4.1. The marginal budget share of non-food is approximately 0.50. The share of lodging, eating out, transport, and alcoholic beverages and tobacco is 0.27, 0.15, 0.08, and 0.006, respectively. It implies that when there is an increase in non-food price under a budget limitation, foreign tourists may consume other goods. Therefore, foreign tourists will focus on non-food within the constraints of their budget. This could be attractive to foreign tourists.

Like the results of the marginal budget share, the minimum committed consumption level of tourists on non-food is rather high compared with other commodities as shown in Table 4.1. The consumption level of tourists on non-food, accounts for 452,948,944 units. The consumption levels of lodging, eating out, transport, and alcoholic beverages and tobacco account for 245,274,252, 145,148,392, 79,215,751, and 10,944,680 units, respectively. It implies that the minimum committed consumption level of tourists for non-food might not decrease compared with other goods.

The marginal budget share and minimum committed consumption are used in the estimates of the income demand elasticity and the price elasticity of demand as shown in Tables 4.2, 4.3, and 4.4.

Table 4.2 Results of the Estimates of Expenditure Elasticity

	Eating out	**Non-food**	**Alcohol & Tobacco**	**Transport**	**Lodging**
Expenditure Demand Elasticity	0.9500	1.0100	0.5500	0.9800	1.0300

Source: Author

All commodities are normal goods as presented in Table 4.2. There is an increase in the demand for all commodities due to an increase in income. Non-food and lodging are luxury goods. The results reveal that the expenditure elasticities of these commodities are greater than unity. The increase in lodging expenditure of tourists is higher than the increase in their income. The remaining commodities are necessity goods. The results show that the expenditure elasticities of these commodities are less than unity. The increase in the expenditure of these goods is lower than the increase in their income. The findings are similar to the expenditure elasticities of Divisekera (2010). This study indicated that the range of elasticity values for the five commodities was from 0.86 to 1.33. It seems that international tourism demand would be sensitive to changes in the economy in the origin countries.

The value of income elasticity for each commodity and overall also depend on the origin and destination countries according to the results of previous studies. Most of the elasticity values for East Asian tourists to Thailand for transportation (above one) are higher than those of New Zealand, the UK, the USA and Japan to Australia for transportation (below one) (Boolnim, 2004; Divisekera, 2010). With regard to tourist demand for lodging, the elasticities of New Zealand, the UK, the USA and Japan to Australia (more than one) are higher than those of East Asian tourists to Thailand (less than one) (Boolnim, 2004; Divisekera, 2010). On the whole, the results of Chokethaworn (2010), Li et al. (2004), Sookmark (2011), Vogt and Wittayakorn (1998) indicated that the value of income elasticity for international tourists traveling to various destinations is more than one. These studies are contrary to the elasticity values for foreign travel to Lao as shown in the study of Phakdisoth and Kim (2007)

and for European tourists to some Mediterranean countries as revealed in the study of A. Papatheodorou (1999). The two studies specify that the income elasticity values are less than one. It is believed that international demand would not only be determined by the economy of the origin countries, but also depends on the consumption behavior of each tourist group.

The uncompensated demand elasticities for food, eating out, non-food and alcoholic beverages and tobacco, transport, and lodging are presented in Table 4.3.

Table 4.3 Results of the Estimates of Uncompensated Price Elasticity

Uncompensated Price Elasticity of Demand	**Eating out**	**Non-food**	**Alcohol & Tobacco**	**Transport**	**Lodging**
Eating out	-0.2750	-0.3898	-0.0094	-0.0683	-0.2111
Non-food	-0.1324	-0.5719	-0.0100	-0.0723	-0.2236
Alcohol & Tobacco	-0.0727	-0.2269	-0.0928	-0.0397	-0.1229
Transport	-0.1285	-0.4008	-0.0097	-0.2246	-0.2171
Lodging	-0.1353	-0.4221	-0.0102	-0.0739	-0.3912

Source: Author

The uncompensated own price elasticities of demand for all commodities are less than one as presented in Table 4.3. The sign of these elasticities is negative. It indicates that an increase in the price of goods is more than the reduction in demand for goods under budget constraints. It is evident that the price of a commodity slightly attracts international tourists to that commodity. The results are consistent with the study of Boolnim (2004) and Divisekera (2010) who concluded that the elasticity values of the five groups of tourism goods are rather low. Contrary to these findings, Papatheodorou (1999) revealed that the uncompensated own price elasticities of European tourists to Mediterranean countries are above one. Like Papatheodorou (1999), the result of Vogt (1998) indicated that demand for Thailand tourism has a high elasticity value. Also, for the overall demand for international tourism, Peng (2014) indicated that own price elasticity is more than one. Therefore, the destination is of importance to the results of the uncompensated own price

elasticities. A possible rationale for the different results is that the decisions of foreign travelers should be considered separately as different travel patterns.

The results show that the sign of the uncompensated cross price elasticity of all commodities is negative as shown in Table 4.3. All commodities in the consumption of tourists are complementary. The values of cross-price elasticities are rather low except for non-food. This results from non-food having a relatively large budget share to lead to greater cross-price elasticities. The uncompensated cross price elasticity of non-food with respect to lodging is the highest (-0.42212). It indicates that the consumption of tourists of non-food and lodging will be highly complementary compared with the other consumption of tourists. According to Boolnim (2004), the expenditure of East Asian tourists on the five tourism products are complementary. The tourist demand for New Zealand, British, American and Japanese tourists for the five commodities is also complementary (Divisekera, 2010).

The compensated demand elasticities for eating out, non-food and alcoholic beverages and tobacco, transport, and lodging are presented in Table 4.4.

Table 4.4 Estimation results of compensated price elasticity of demand

Compensated Price Elasticity of Demand	**Eating out**	**Non-food**	**Alcohol & Tobacco**	**transport**	**Lodging**
Eating out	-0.1280	0.0737	0.0009	0.0125	0.0410
Non-food	0.0234	-0.0809	0.0010	0.0132	0.0434
Alcohol & Tobacco	0.0128	0.0429	-0.0868	0.0073	0.0239
Transport	0.0227	0.0758	0.0009	-0.1416	0.0421
Lodging	0.0239	0.0798	0.0010	0.0135	-0.1182

The compensated own price elasticities of demand for all commodities are less than the uncompensated own price elasticities of demand for all commodities as presented in Table 4.4. The compensated price elasticity considers the price change on the demand for a good under budget constraints, where the expenditure

of the consumer is constant. Like the uncompensated own price elasticities of demand, the sign of these elasticities is negative. It is evident that the increase in the price of goods is less than the reduction in demand for goods. The most price sensitive good is transport. The findings are contrary to the elasticity values of Li (2004), which indicated that most of the compensated own price elasticities are above one.

The compensated cross price elasticities of demand for all commodities are less than the uncompensated cross price elasticities of demand for all commodities as presented in Table 4.4. All commodities in the consumption of tourists are substitutes according to the estimation results of the compensated cross price elasticities. The results show that the sign of these elasticities is positive. It is contrary to the results of the uncompensated cross price elasticities.

4.4 Conclusion

The analysis of income and price elasticities for tourism demand for Thailand illustrates that the estimated expenditure elasticities of five commodities are between 0.55 and 1.03. These commodities are regarded as normal goods for inbound tourists. The estimated uncompensated and compensated own price elasticities of these commodities are negative and below one. These commodities are price inelastic in the study. The estimated uncompensated cross price elasticities of these commodities are negative and below one. These commodities are complementary. In contrast, the estimated compensated cross price elasticities of these commodities are estimated to be positive and below one. These commodities are substitutes.

CHAPTER 5

The Expenditure of Inbound Tourism and the Environment

This chapter describes the estimation of the expenditure of inbound tourism and its effect on the environment. The components of this chapter are the introduction, the methodology for data collection, the results, and the conclusion.

5.1 Introduction

Tourism expansion is evident in every destination. However, the results of previous studies show that tourism also has negative impacts. Some destinations and surroundings suffer from noise, respiratory mortality, river bank erosion, traffic accident, water demand and wastewater discharge, which have all changed dramatically (Juan & Piboonrungroj, 2007; Lundie, Dwyer, & Forsyth, 2007; Matarrita-Cascante, 2010; Sheng & Tsui, 2009; Wattanakuljarus & Coxhead, 2008).

The impacts of tourism on environmental dimensions depend on tourism activities. Lundie et al. (2007) suggested that tourism activities can be measured directly using tourist expenditure. According to Lenzen and Foran (2001), consumer spending has a greater effect on the environment than consumer income.

The activities of tourists have different impacts on the environment. According to Lundie et al. (2009), low environmental impacts were found in business travelers, convention visitors, and Japanese honeymooners, while high environmental impacts were found in Canadian and German holidays.

Transport and accommodation services are the first sector related to tourism activities. Firstly, the use of public transport is related to the number of tourists at tourist destinations. It was found that increased use of transportation results from tourism both between the origin and destination country and inside the destination country (A. Papatheodorou, & Zenelis, P., 2013). In Thailand, the transport expenditure of international tourists accounts for eight percent of all tourist expenditure in Thailand (Tourism Authority of Thailand, 2003). Moreover, the

emissions of transport are also interrelated with tourism. Travelling by tourists causes increased levels of carbon dioxide emission. Secondly, tourists travel to find accommodation and facilities, for example hotels, restaurants, entertainment, golf, and so on. Increased water, sewage and electricity usage also results from tourism in accommodation services. For inbound tourism in Thailand, accommodation expenses represent twenty six percent of tourist spending (Tourism Authority of Thailand, 2003).

Therefore, the purpose of the analysis is to investigate how inbound tourist expenditure is associated with the three main environmental dimensions. Carbon dioxide emissions from transport, carbon dioxide emissions from accommodation sector, and the cost of wastewater management are investigated with regard to their environmental impacts in Thailand.

5.2 Methodology and Data

5.2.1 Methodology

The Ordinary Least Squares (OLS) regression is conducted to estimate the relationship between inbound tourism expenditure and each environmental dimension. The equation is as follows:

$$\mathrm{env_e} = \mathrm{te_e} + \alpha_e^2\, \mathrm{inbt}$$

Where $\mathrm{env_e}$ = environmental variables which are carbon dioxide emissions from transport (cartrans), carbon dioxide emissions from accommodation sectors (carpow), and the cost of wastewater management (wastewater) and inbt = inbound tourism expenditure, and where $\mathrm{te_e}$and α_e^2 = the parameters of the model.

The time series data must firstly examine the stationary properties. The estimates start with the Augmented Dickey-Fuller (ADF) test. Each variable is stationary or a unit root. The null hypothesis (Ho) is that the time series is non-stationary. The alternative hypothesis (H1) is that the time series is stationary.

5.2.2 Data

Data for this study were collected from the Energy Policy and Planning Office, the Ministry of Energy, the Bank of Thailand, the World Bank, World Tourism Organization and United Nations Environment Programme, Office of Natural Resources and Environmental Policy and Planning, the Ministry of Natural Resources and Environment, the Department of Tourism, the Tourism Authority of Thailand, the Water Quality Management Office, Department of Drainage and Sewerage, Bangkok Metropolitan Administration. Data were collected from 1998 to 2013.

Data for the study consist of carbon dioxide emissions from the transportation sector, carbon dioxide emissions from accommodation sector, the cost of wastewater management for foreign tourists and inbound tourism expenditure in value terms. The data of CO_2 emissions from the transport was collected from the Energy Policy and Planning Office. The data of CO_2 emissions from accommodation sectors was collected from World Tourism Organization and United Nations Environment Programme. The estimate of carbon dioxide (CO_2) emissions from the transport and accommodation sectors are the product of the amount of energy consumption of each fuel type and the coefficient of CO_2 emissions of each fuel type as determined by the Intergovernmental Panel on Climate Change (IPPC). The CO_2 emissions from transport in Thai baht terms are determined by carbon price and the exchange rate. Carbon price for the study is assumed to be a ton CO_2 price of $16 in accordance with the UK carbon price floor of the World Bank and ECofys (2014). The data of cost of wastewater management for foreign tourists were calculated from the product of the expenditure of wastewater management per person per day, the number of foreign tourists and the average length of stay. The expenditure on wastewater management per person per day is the total expenditure of wastewater management divided by the sum of the multiple between the product of the number of the Thai population in the wastewater management service area and the average length of stay, and the product of the number of foreign tourists and the average length of stay. The total number of wastewater management service areas in the study is 79 areas in Bangkok, the Northern region,

the Central region, the North-eastern region, the Eastern region and the Southern region as presented in the data of the Office of Natural Resources and Environmental Policy and Planning and Water Quality Management Office. Inbound tourism expenditure data were collected from the Department of Tourism and the Tourism Authority of Thailand.

5.3 Results

The values of the calculated Augmented Dickey-Fuller test statistics and the critical values are presented in Table 5.1. Inbound tourism expenditure (inbt), CO_2 emissions from transport (cartrans), CO_2 emissions from accommodation sectors (carpow) and the cost of wastewater management (wastewater) are stationary and non-stationary in levels and first difference.

Table 5.1 The Unit Root Test Results of the Augmented Dickey-Fuller Test

Variable	Augmented Dickey-Fuller test statistic		MacKinnon critical p-value	Conclusion
Inbt	Level	-0.6150	0.8677	I(1)
	First difference	-5.5950*	0.0000	
Cartrans	Level	-3.0930	0.0271	I(1)
	First difference	-17.5030*	0.0000	
Carpow	Level	-1.8770	0.3430	I(1)
	First difference	-3.9190*	0.0100	
Wastewater	Level	-3.7500*	0.0100	I(0)

Note: * The null hypothesis is rejected at a 1% significance level.

Most variables are non-stationary. The null hypothesis is accepted at a 1% significance level. The values of the calculated ADF test statistic are less than the critical values. Most variables are stationary in first difference at a 1% significance level, denoted by I(1). The rejection of the null hypothesis is at a 1% significance

level. Wastewater variables are stationary in levels at a 1% significance level, denoted by I(0). The rejection of the null hypothesis is at a 1% significance level.

The results of ADF test for the variables I(1)inbt, I(1)cartrans, I(1)carpow, and I(0)wastewater are determined in this study. The results of the relationship between total inbound tourism expenditure and each environment dimension are presented as follows:

$$I(1)Cartrans = -3192986 + 0.006\ I(1)Inbt \qquad (5.1)$$
$$(-0.21) \quad (2.83^*)$$

F = 7.98

R^2 = 0.0634 Adjust R^2 = 0.0554

The relationship between total inbound tourism expenditure and carbon dioxide emissions was positive. The increase in inbound tourism expenditure led to an increase in carbon dioxide emissions. It means that if total inbound tourism expenditure equals zero, the carbon dioxide emissions would fall. A reason is that tourists do not travel to and at a destination without energy using transport.

The findings do not differ considerably from previous studies. Inbound tourism expenditure influences carbon dioxide emissions. Wang et al. (2011) stated that carbon dioxide emissions are affected by economic growth. It is possible that the growth of inbound tourism expenditure would lead to more travel and the use of combustible fuel.

The result of the relationship between total inbound tourism expenditure and CO_2 from accommodation sectors is presented in the equation (5.2).

$$I(1)Carpow = 7.05 + 0.43\ I(1)Inbt \qquad (5.2)$$
$$(0.72) \quad (1.60)$$

F = 1.13

R^2 = 0.0702 Adjust R^2 = 0.0082

Total inbound tourism expenditure does not have a significant impact on CO_2 from accommodation sectors. It may be possible that the expenditure of foreign tourists might not affect the CO_2 from accommodation sectors but may have greater impact on tourism related sectors. The accommodation sectors are closely related to the main economic activities.

The result of the relationship between total inbound tourism expenditure and the cost of wastewater management for foreign tourists is presented in the equation (5.3).

$$I(0)\text{Wastewater} = -0.0940 + 0.54\ I(1)\text{Inbt} \qquad (5.3)$$
$$(-1.01) \quad (0.92)$$

$F = 0.84$

$R^2 = 0.05$ Adjust $R^2 = -0.0103$

The influence of total inbound tourism expenditure on the cost of wastewater management for tourists is insignificant. The result indicated that the cost of wastewater management for tourists is not affected by total inbound tourism expenditure. It is probable that other economic activities may be more strongly related with the cost of wastewater management than that of tourists.

5.4 Conclusions

The results show that the total inbound tourism expenditure is significant in relation to carbon dioxide emissions from transport. It means that inbound tourism expenditure has an impact on the emission of CO_2. Total inbound tourism expenditure has a positive relationship with carbon dioxide emissions. The carbon dioxide emissions from the accommodation sectors and the cost of wastewater management for tourists are not affected by the expenditure of foreign tourists. Therefore, the cost of carbon dioxide emissions is related to the expenditure of the tourists, but the burden of these costs falls on the destination.

CHAPTER 6

The Impacts of Inbound Tourism in Thailand

This chapter describes the computable general equilibrium model, the model structure and data, and the parameters. The results of the simulation of inbound tourism expenditure present the effects on macroeconomics, production, social factors, tourist consumption and the environment.

6.1 The Computable General Equilibrium Model

Tourism and other industries interrelate in tourist activities. Tourists travel to, and at, a destination. They use services of the banking sector to exchange currency, the transportation sector to travel at a destination, the accommodation sector to stay in a hotel, the restaurant sector for food, the retail sector to buy food and drinks and so on.

The Computable General Equilibrium (CGE) is an appropriate tool for the impact analysis of tourism on the economy. The Computable General Equilibrium (CGE) model shows the relationship between various economic agents in an economy and consists of many equations and presents all of the variables in the model in terms of values. CGE models are based on data from the Input-Output (I-O) table and Social Accounting Matrix (SAM) which is used as the representative of transaction values in all sectors. The equations in the model are transformed into the rate of change of all variables. The change of all economic variables can be classified in prices and in quantities. In addition, CGE can analyze the reaction of a specific policy in the form of the adjustment of whole variables in the economy. CGE models in the study investigate the short run effects of tourism.

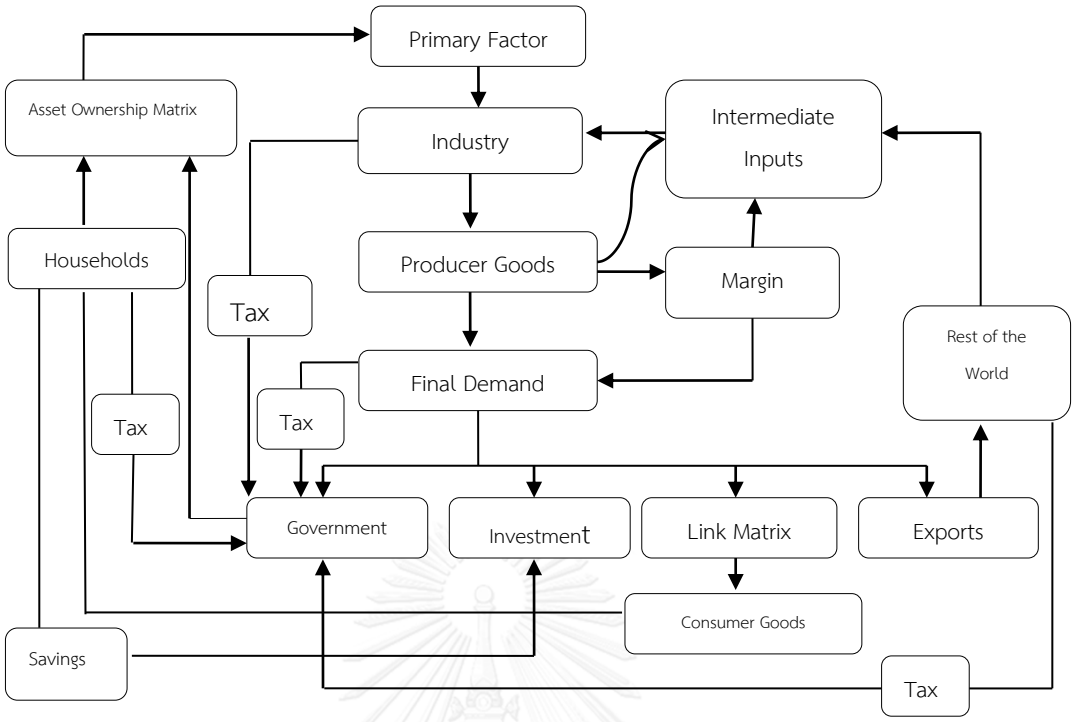

Figure 6.1 Diagram of the Computable General Equilibrium

The receipts and expenditure flows of the major sectors are shown in Figure 6.1. This figure shows the components, which are industries, producer goods, primary factors, intermediate inputs, margin, households, government, investment, consumer goods, export, rest of the world etc.

There are primary and intermediate factors. Primary factors consist of land, labor, and capital. Intermediate inputs cover domestic and imported goods. Each producer pays money for tax such as corporate income tax, special business tax etc. Each household who owns production factors gets income as wages, rent, and transfer incomes. It is called the Asset Ownership Matrix. Households will expend income to consume commodities, to pay tax and to save. Final demand is consumed by government, investment, consumer goods, and exports. Government incomes come from tax revenues and transfer income on households, industries, final demand, and the rest of the world. Tax revenues consist of direct and indirect taxes. Direct taxes include personal income tax, corporate income tax etc. Indirect taxes comprise general sales taxes, excise taxes, import taxes etc. The expenditure of government is

allocated to the consumption of commodities, savings or investment, and transfers to other agents. Total investment equals total savings. The sources of total savings include government savings, household savings, and capital injections after investing in each sector. Consumer goods are determined by how producers of consumer goods use domestic producer goods and imported producer goods to produce various consumer goods. This is the Link Matrix. Export goods come from domestic final demand exported to the rest of the world. In addition, margin includes transport and wholesale and retail trade. Some margin is spent to transport producer goods. Remainders are part of final goods and intermediate inputs.

The inflows of inbound tourism are additionally considered in a diagram of the Computable General Equilibrium (Figure 6.2). The dashed lines represent the receipts and expenditure of foreign tourists.

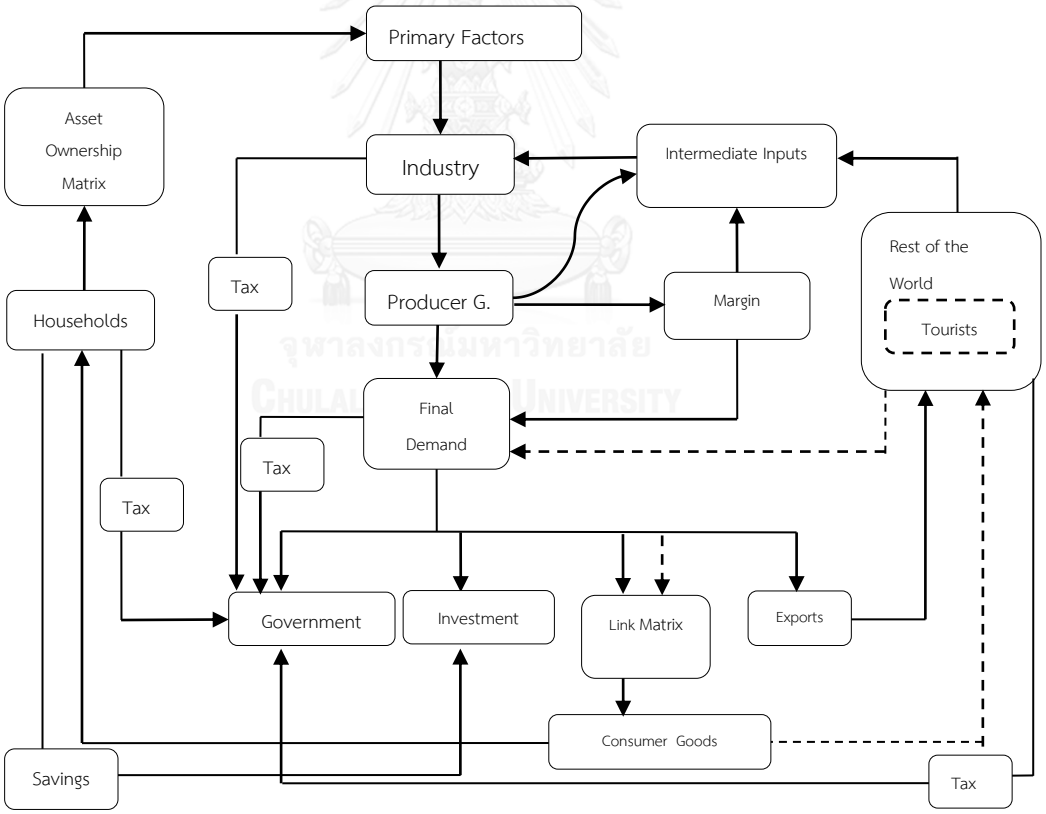

Figure 6.2 Tourism in a Diagram of Computable General Equilibrium

Figure 6.2 shows that inbound tourists from the rest of the world pay for consumer goods in different activities.

6.2 Model

The model can be considered with the following features: model structure, tourism in the model, tourism and the environment and model closure.

6.2.1 Model Structure

The computable general equilibrium model used in this research is based on the research of Sarntisart (1993). The model is composed of Production, Margin, Investment and Savings, Production of Consumer goods, Household, Export Demand, Government, Price Determination, Market Clearing Condition, and Miscellaneous equations.

6.2.1.1 Production

The sectors of production in the model are classified into six sectors. These are agriculture, manufacturing, hotel and restaurant, transport, services and other.

A production industry requires primary and intermediate input factors. There are three factors of production; labor, capital, and land. There are two types of labor; skilled labor and unskilled labor. Skilled labor is a worker with higher than secondary education and unskilled labor is a worker with secondary education or less than secondary education.

Production solves the cost minimization problem along with constant elasticity of substitution production and Leontif production. Production is explained by the set of equations below.

$$f_{1qj} = f_{1j} + \sigma_{1qj}\left[r_{1qj} - \sum_{q=1}^{2} A_{1qj} r_{1qj}\right] \qquad (6.1)$$

Where f_{1qj} = demand for labor type *q* by sector *j*

f_{1j} = sector *j*'s demand for (effective) labor

σ_{1qj} = substitution elasticity between labor *q* and labor (in general)

r_{1qj} = return to labor type *q* paid by sector *j*

A_{1qj} = share of labor type *q* in total wage of industry *j*

$$f_{nj} = z_j + \sigma_{nj}\left[r_{nj} - \sum_{n=1}^{3} A_{nj} r_{nj}\right] \quad (6.2)$$

Where f_{nj} = sector *j*'s demand for primary factor *n* (*n* = 1 = labor, *n* = 2 = capital, *n* = 3 = land)

z_j = effective output of sector *j*

σ_{nj} = substitution elasticity between primary factor type *n* and primary factor in general

r_{nj} = return to primary factor *n* paid by sector *j*

A_{nj} = share of each primary factor *n* in total cost of primary factors in industry *j*

$$x^1_{isj} = z_j + \sigma_{ij}\left[pr^1_{isj} - \sum_{s=1}^{2} H^1_{isj} pr_{isj}\right] \quad (6.3)$$

Where x^1_{isj} = the rate of change in demand for intermediate inputs to produce goods *i* from source *s* by sector *j*

σ_{ij} = substitution elasticity between demand for intermediate inputs *i* both sources by sector *j*

pr^1_{isj} = the rate of change in intermediate inputs price *i* from source *s* by sector *j*

H^1_{isj} = share of intermediate input *i* from source s in total cost of intermediate input *i* in production of industry *j*

$$x_{i1}^{0} = z_j \quad (6.4)$$

Equation (6.4) present single output

Where x_{i1}^{0} = the rate of change in the supply of domestic goods by sector *j*

$$r_{2j} = r_{3j} \quad (6.5)$$

Where *j* = non-agriculture industries; manufacturing, hotel and restaurant, transport, service, and other industries

6.2.1.2 Margin

The role of the margin leads goods to consumers in each industry. The model assumes that the margin is a constant proportion to deliver a unit of goods. The margin is different in the shares of purchaser price. That is

$$m_{isj}^{1} = x_{isj}^{1} \quad (6.6)$$

Where m_{isj}^{1} = the rate of change in margin which takes intermediate inputs *i* from source *s* to sector *j*

x_{isj}^{1} = the rate of change in demand for intermediate inputs *i* from source *s* by sector *j*

$$m_{is}^{2} = x_{is}^{2} \quad (6.7)$$

Where m_{is}^{2} = the rate of change in margin which takes goods *i* from source *s* for creating capital goods

x_{is}^{2} = the rate of change in demand for goods *i* from source *s* for creating capital goods

$$m_{isk}^{3} = x_{isk}^{3} \quad (6.8)$$

Where m_{isk}^{3} = the rate of change in margin which takes goods *i* from source *s* to produce the consumer goods

x_{isk}^{3} = the rate of change in demand for goods *i* from source *s* to produce the consumer goods

$$m_{i1}^{4} = x_{i1}^{4} \tag{6.9}$$

Where m_{i1}^{4} = the rate of change in margin of export goods *i*

x_{i1}^{4} = the rate of change in demand for export goods *i*

$$m_{is}^{5} = x_{is}^{5} \tag{6.10}$$

Where m_{is}^{5} = the rate of change in margin which takes goods *i* from source *s* to government

x_{is}^{5} = the rate of change in demand for goods *i* from source *s* to government

$$m = \sum_{i=1}^{6}\sum_{s=1}^{2}\sum_{j=1}^{6} A_{isj}^{1} m_{isj}^{1} + \sum_{i=1}^{6}\sum_{s=1}^{2} A_{is}^{2} m_{is}^{2} + \sum_{i=1}^{6}\sum_{s=1}^{2}\sum_{k=1}^{3} A_{isk}^{3} m_{isk}^{3} + \sum_{i=1}^{6} A_{i1}^{4} m_{i1}^{4} + \sum_{i=1}^{6}\sum_{s=1}^{2} A_{is}^{5} m_{is}^{5} \tag{6.11}$$

Where m = total demand for margin

A_{isj}^{1} = share of margin to take intermediate inputs *i* from source *s* to sector *j*

A_{is}^{2} = share of margin to take goods *i* from source *s* for capital per total margin

A^{3}_{isk} = share of margin to take goods *i* from source *s* for consumer goods *k* per total margin

A^{4}_{i1} = share of margin to take export goods *i* per total margin

A^{5}_{is} = share of margin to take goods *i* from source *s* by government per total margin

6.2.1.3 Investment and Savings

Total savings comprise the savings of households, the sector of production, the government and the rest of the world. The rate of change of total savings equals the savings change rate of each part in the economy. The set of equations is as follows:

$$s = \sum_{h=1}^{10} H^{s}_{h} s_{h} + \sum_{j=1}^{6} H^{s}_{j} s^{j}_{j} + H^{s}_{g} s^{g} + H^{s}_{w} s^{w} \qquad (6.12)$$

Where H^{s}_{h} = savings proportion of household *h* in total savings

H^{s}_{j} = savings proportion of industry *j* in total savings

H^{s}_{g} = savings proportion of government in total savings

H^{s}_{w} = savings proportion of rest of the world in total savings

s = total nominal savings

s_{h} = household *h* saving rate of change

s^{j}_{j} = savings rate of change in sector *j*

s^{g} = government savings rate of change

s^{w} = savings rate of change in rest of the world

$$s = v + pik \qquad (6.13)$$

$$s^{j}_{j} = v^{j}_{j} + pik \qquad (6.14)$$

Where v = total investment *j*

v^{j}_{j} = investment real terms in sector *j*

pik = price of capital

$$s^w = v^w + \mathrm{pik} \tag{6.15}$$

Where v^w = investment real terms in rest of the world

$$x_{is}^2 = v + \sigma_i^2 \left[p_{is}^2 - \sum_{s=1}^{2} H_{is}^2 p_{is}^2 \right] \tag{6.16}$$

Where σ_i^2 = elasticity of substitution between goods *i* from each source

p_{is}^2 = rate of change in goods price *i* from source *s* to invest

H_{is}^2 = share of goods *i* from source *s* to invest

$$\mathrm{pik} = \sum_{i=1}^{6} \sum_{s=1}^{2} G_{is}^2 p_{is}^2 \tag{6.17}$$

Where pik = rate of change in price index of capital goods

G_{is}^2 = share of goods *i* from source *s* in total goods to produce capital goods

6.2.1.4 Production of Consumer Goods

Consumer goods consist of food, eating out, non-food, alcoholic beverages and tobacco products, transport and lodging. The equations are as follows:

$$x_{isk}^3 = c_k^3 + \sigma_{ik}^3 \left[p_{is}^3 - \sum_{s=1}^{2} H_{isk}^3 p_{is}^3 \right] \tag{6.18}$$

$$x_{is}^3 = \sum_{k} G_{isk}^3 x_{isk}^3 \tag{6.19}$$

Where c_k^3 = the rate of change of consumer goods *k*

σ_{ik}^3 = substitution elasticity of the goods *i* between domestic and import sources in the production of consumer goods *k*

p_{is}^3 = The rate of change of producer goods price *i* from sources *s* in the production consumer goods

H_{isk}^3 = share of goods *i* from source s to produce consumer goods *k* in goods *i* all sources in the production the consumer goods *k*

x_{is}^3 = total consumer goods demand for producer goods *i* from source *s*

G_{isk}^3 = share of goods *i* from source *s* in the production of consumer goods *k* in goods *i* from sources *s* in the production of all consumer goods.

6.2.1.5 Household

For the model in this study, there are two categories of household, namely urban and rural households. Urban households are households in municipal areas and rural households are households in non-municipal areas. Urban and rural households are separated into five groups according to income. The set of equations is as follows:

$$y_h = \sum_{q=1}^{2} O_{1qh}\left[f_{1q}^s + r_{1q}\right]H_{fh} + \sum_{j=1}^{6} O_{2jh}\left[f_{2j}^s + r_{2j}\right]H_{fh} + \sum_{j=1}^{6} O_{3jh}\left[f_{3j}^s + r_{3j}\right]H_{fh} + uH_{uh} \quad (6.20)$$

Where y_h = total income rate of change of households

O_{1qh} = share of return to labor type *q* in household *h*'s income

O_{2jh} = share of return to industry *j* specific capital in household *h*'s income

O_{3jh} = share of return to agriculture industry in household *h*'s income

f_{1q}^{s} = supply rate of change in labor type *q*

r_{1q} = return rate of change to labor type *q*

f_{2j}^{s} = supply rate of change to capital by sector *j*

r_{2j} = return rate of change to capital by sector *j*

f_{3j}^{s} = supply rate of change to land by sector *j*

r_{3j} = return rate of change to land by sector *j*

H_{fh} = share of primary factors to total income of household *h*

H_{uh} = share of non-primary factors to total income of household *h*

u = transfer income rate of change

$$y_h = H_h^d y_h^d + H_h^g d_h^r + H_h^u u_h \quad (6.21)$$

Where y_h^d = disposable income rate of change

d_h^r = household indirect tax rate *h* of change

u_h = household transfer income rate *h* of change

H_h^d = share of household *h* disposable income

H_h^g = share of household *h* indirect tax

H_h^u = share of household *h* transfer income

$$d_h^r = y_h + t_h^d \quad (6.22)$$

Where t_h^d = direct tax rate of change

$$u_h = \theta_h^u y_h \quad (6.23)$$

Where θ_h^u = transfer income elasticity of income

$$s_h^h = v_h^h + pik \quad (6.24)$$

Where s_h^h = saving value of household

v_h^h = real saving value of household

$$y_h^d = B_h^s s_h^h + B_h^c c_h + shift \quad (6.25)$$

Where B_h^s = share of saving value in total disposal income

B_h^c = share of income (expenditure) value for consumption in total disposal income

c_h = the rate of change of consumption value of households

$shift$ = shift variable

$$c_{hk}^3 = \sum_{q=1}^{3} \eta_{hkq} p_q^c + \eta_{hk} c_h \quad (6.26)$$

Where c_{hk}^3 = the rate of change of household demand for consumer goods *k* or consumption behavior of household

η_{hkq} = elasticity of price (own and cross price elasticity) of demand for consumer goods *k* by household

p_q^c = the rate of change of price of consumer goods *q*

η_{hk} = income (expenditure) elasticity of demand for consumer goods *k* by household.

$$u = \sum_{h=1}^{10} G_h^u u_h + G_g^u u_g + G_t^u u_t \quad (6.27)$$

Where G_h^u = share of household *h* transfer income in total transfer income

G_g^u = share of government transfer income in total transfer income

G_t^u = share of remittance from abroad in total transfer pool

u_g = government transfer income rate of change

u_t = remittance from abroad

6.2.1.6 Export Demands

In this case, Thailand is a small country in the world market. Export commodities of Thailand cannot determine world prices of export goods, except some goods such as rice. The equation is as follows:

$$p_{i1}^{w} = -\delta_i x_{i1}^{4} + f_{i1}^{4} \tag{6.28}$$

Where p_{i1}^{w} = export goods price *i* (f.o.b) in the world

δ_i = the reverse of price elasticity of Thai export goods *i*

f_{i1}^{4} = the change of shock with export goods *i* in the world

6.2.1.7 Government

The income and expenditure of government is an important part that influences the economy. Government income mainly comes from indirect taxes, tariffs and direct taxes. Government expenditure comprises consumption and transfer. The set of equations is as follows:

$$t^{w} = \sum_{i=1}^{6} G_{i1}^{x}(p_{i1}^{w} + t_{i1}^{x} + x_{i1}^{4} + e^{w}) + \sum_{i=1}^{6} G_{i2}^{m}(p_{i2}^{w} + t_{i2}^{m} + x_{i2}^{0} + e^{w}) \tag{6.29}$$

Where t^{w} = trade tax rate of change

G_{i1}^{x} = share of export tax of producer goods *i* in total trade tax

t_{i1}^{x} = rate of change of export goods *i* tax

e^{w} = rate of change of exchange rate (baht)

p_{i2}^{w} = the rate of change of import goods *i* price in the world

t_{i2}^{m} = rate of change of import goods *i* tax

x_{i2}^{0} = rate of change of quantity of import goods *i*

$$t^{i} = \sum_{i=1}^{6}\sum_{s=1}^{2} G_{is}^{i}(p_{is}^{0} + t_{is}^{i} + x_{is}^{0}) \tag{6.30}$$

Where t^i = rate of change of indirect tax

G^i_{is} = share of indirect tax in producer goods *i* from source s to total indirect tax

p^o_{is} = price of producer goods *i* from source *s*

t^i_{is} = rate of change of indirect tax in producer goods *i* from source *s*

x^o_{is} = rate of change of producer goods *i* from source *s*

$$t^d = \sum_{h=1}^{10} G^d_h(y_h + t^d_h) \tag{6.31}$$

Where t^d = rate of change of direct tax

G^d_h = share of direct tax from household *h* to total direct tax

t^d_h = rate of change of direct tax in household *h*

$$t^f = \sum_{j=1}^{6} O^g_{2j}(f_{2j} + r_{2j}) \tag{6.32}$$

Where t^f = rate of change of government revenue to invest in all own-stated sectors

O^g_{2j} = share of capital income in sector *j* to total capital income

f_{2j} = rate of change of capital demand for sector *j*

r_{2j} = rate of change of return to capital in sector *j*

$$y^g = H^w t^w + H^i t^i + H^d t^d + H^f t^f + H^{row} t^{row} \tag{6.33}$$

Where y^g = rate of change of total government income

H^w = proportion of trade tax to total government income

H^i = proportion of indirect tax to total government income

H^d = proportion of direct tax to total government income

H^f = proportion of capital income in all sectors to total government income

H^{row} = proportion of government borrowing from rest of the world to total government income

t^{row} = government borrowing from rest of the world

$$x_{is}^5 = y^g - cpi \tag{6.34}$$

Where cpi = consumer price index

$$s^g = v^g + pik \tag{6.35}$$

Where s^g = saving value of government

v^g = real saving value of government

$$u^g = \eta_g^5 y^g + \theta_g^5 cpi \tag{6.36}$$

Where η_g^5 = elasticity of government transfer to income

y^g = rate of change of government income

θ_g^5 = elasticity of government transfer to inflation

$$c^g = \sum_{i=1}^{6}\sum_{s=1}^{2} G_{is}^5 (x_{is}^5 + p_{is}^5) + G^{5s} s^g + G^{5u} u^g \tag{6.37}$$

Where c^g = rate of change of government expenditure

G_{is}^5 = share of government purchase of goods i from source *s* in total government expenditure

p_{is}^5 = rate of change of goods *i* price from source s by government expenditure

G^{5s} = share of government saving in government expenditure

G^{5u} = share of government transfer in government expenditure

$$100\,dG = R^g y^g - E^g c^g - \sum_{i=1}^{6} E \cdot S_{i1}^0 (e^w + x_{i1}^4) \quad (6.38)$$

Where dG = government impact from shock

R^g = total government revenue

E^g = government expenditure in the base year

E = total export revenue

S_{i1}^0 = share of goods *i* in total export revenue

$$t_{is}^i = exot_{is} + tbar_s^i + tbaris \quad (6.39)$$

$$exot_{is} = 0 \quad (6.40)$$

$$tbar_s^i = 0 \quad (6.41)$$

$$t_h^d = exotd_h^h + tbardh \quad (6.42)$$

$$exotd_h^h = 0 \quad (6.43)$$

$$tbardh = 0 \quad (6.44)$$

Where $exot_{is}$ = Exogenously set/determined indirect tax rate on goods *i*

$tbar_s^i$ = Average indirect tax rate on producer goods *i* from source *s*

$tbaris$ = Average indirect tax rate

$exotd_h^h$ = Exogenously set/determined direct tax rate on goods *i*

$tbardh$ = Average direct tax rate

6.2.1.8 Price Determination

Price determination explains the return of primary factors, intermediate inputs, and final demands. It is composed of a set of equations as follows:

$$r_{1qj} = r_{1q} + d_{1qj} \quad (6.45)$$

Where r_{1q} = rate of change of average wage in labor type *q*

d_{1qj} = rate of change of wage gap for labor type *q* during sector *j*

$$r_{1j} = \sum_{q=1}^{2} H_{1qj}^{1} r_{1qj} \tag{6.46}$$

Where r_{1j} = rate of change of average wage in sector *j* paid

H_{1qj}^{1} = share of wage that sector *j* paid for labor type *q* in average wage of sector *j*

$$rw_{1q} = r_{1q} - cpi \tag{6.47}$$

Where rw_{1q} = rate of change of real wage in labor type q

cpi = consumer price index

In the zero profit condition, equation (6.48) and (6.49) show that the percentage of change in revenue equals the percentage of change in the cost of production

$$\begin{aligned} p_{i1}^{0} + z_j = & \sum_{i=1}^{6}\sum_{s=1}^{2} G_{isj}^{0}(x_{isj}^{1} + p_{isj}^{1}) + G_{1j}^{0}(f_{1j}^{0} + r_{1j}) \\ & + G_{2j}^{0}(f_{2j} + r_{2j}) + G_{2j}^{s} s_j^{j} \\ & - \sum_{i=1}^{6} H_{i2j}^{*}(t_{i2}^{w} + p_{i2}^{w} + e^{w} + x_{12j}^{1} + x_{i1}^{4} - z_j) \end{aligned} \tag{6.48}$$

$$\begin{aligned} \sum_{i=1}^{6} B_{i1j}^{0}(x_{i1j}^{0} + p_{i1}^{0}) = & \sum_{i=1}^{6}\sum_{s=1}^{2} G_{isj}^{0}(x_{isj}^{1} + p_{isj}^{1}) + G_{1j}^{0}(f_{1j}^{0} + r_{1j}) + \\ & G_{2j}^{0}(f_{2j} + r_{2j}) + G_{3j}^{0}(f_{3j} + r_{3j}) + G_{2j}^{s} s_j^{j} \end{aligned} \tag{6.49}$$

Where $\sum_{i=1}^{6}\sum_{s=1}^{2} G_{isj}^{0} + \sum_{i=1}^{6} G_{ij}^{0} + G_{2j}^{s} s_j^{j} - \sum_{i=1}^{6} H_{i2j}^{*} = 1, \sum_{i=1}^{6} B_{i1j}^{0} = 1$

f_{nj}^{0} = industry *j* demand for primary factors (n = 1 = labor, n = 2 = capital, n = 3 = land)

$G_{isj}^{0}, G_{1j}^{0}, G_{2j}^{0}, G_{2j,}^{s} G_{3j}^{0}$ = cost share of intermediate inputs, labor, capital, land, and sector saving in total cost of sector *j* (already deduct refund tax)

H_{i2j}^{*} = share of import tax in total cost of sector *j* (already deduct refund tax)

$$pp_{is} = S_{is}^{pp} p_{is}^{0} + S_{is}^{ipp}\left(p_{is}^{0} + t_{is}^{i}\right) \quad (6.50)$$

Where pp_{is} = producer price of producer goods *i* from source *s*

S_{is}^{pp} = share of basic price in producer price

S_{is}^{ipp} = share of indirect tax in producer price

$$p_{i1}^{w} + e^{w} = p_{i1}^{4} + ctr_{i1}^{4} + D_{i1} t_{i1}^{x} \quad (6.51)$$

Where p_{i1}^{4} = rate of change of export goods *i* price

ctr_{i1}^{4} = controller for shift in world prices for Thai export

D_{i1} = share of tariff in world price of exported good *i*

t_{i1}^{x} = rate of change of export goods *i* tax

$$p_{i2}^{0} = e^{w} + p_{i2}^{w} + D_{i2} t_{i2}^{m} \quad (6.52)$$

Where p_{i2}^{w} = rate of change of price in the world in import goods in baht terms

D_{i2} = share of tariff in world price of imported good *i*

t_{i2}^{m} = rate of change import tax by government impose import tax at price of the world

$$p_{41}^{m} = p_{41}^{0} \quad (6.53)$$

$$p_{51}^{m} = p_{51}^{0} \quad (6.54)$$

Where p_{41}^{m} = price of margin on transport

p_{51}^{m} = price of margin on service

$$p^{1}_{isj} = H^{01}_{isj}p^{0}_{is} + H^{g1}_{isj}\left(p^{0}_{is} + t^{i}_{is}\right) + H^{m1}_{isj}\left(G^{m}_{41}p^{m}_{41} + G^{m}_{51}p^{m}_{51}\right) \quad (6.55)$$

Where $H^{01}_{isj}, H^{g1}_{isj}, H^{m1}_{isj}$ = share of base price, indirect tax, margin in purchaser price of producer goods *i* from source s

G^{m}_{41}, G^{m}_{51} = share of output value from transport and service industry in margin service

The government has promoted some industries which import raw materials and produce some export goods. Some industries are exempted from import tariff.

$$pr^{1}_{isj} = G^{*}_{ij}p^{1}_{isj} - K^{*}_{ij}\left(p^{w}_{i2} + t^{m}_{i2} + e^{w} + x^{4}_{ji} - z_{j}\right) \quad (6.56)$$

$$prb^{1}_{i1j} = p^{1}_{i1j} \quad (6.57)$$

$$prb^{1}_{i2j} = p^{1}_{i2j} \quad (6.58)$$

Equation (6.56) presents the price of output in an export industry that refunds tax.

Where G^{*}_{ij} = share of intermediate input *i* from source s by sector *j*

K^{*}_{ij} = share of import good *i* price by sector *j*

pr^{1}_{isj} = price of output in export industry that refunds tax

$$p^{n}_{is} = H^{on}_{is}p^{on}_{is} + H^{gn}_{is}\left(p^{o}_{is} + t^{i}_{is}\right) + H^{mn}_{is}\left(G^{m}_{41}p^{m}_{41} + G^{m}_{51}\,p^{m}_{51}\right) \quad (6.59)$$

$$p^{4}_{i1} = H^{04}_{i1}p^{0}_{i1} + H^{g4}_{i1}\left(p^{0}_{i1} + t^{i}_{i1}\right) + H^{m4}_{i1}\left(G^{m}_{41}p^{m}_{41} + G^{m}_{51}p^{m}_{51}\right) \quad (6.60)$$

Equation (6.59) presents rate of change of goods *i* price from source *s* any objectives *n* (n =2; investment, n = 3; the consumption of household, n = 5; the expenditure of government) so that the sum of H^{on}_{is}, H^{gn}_{is} and H^{mn}_{is} equals one. Export is presented by equation (6.60).

$$p_k^c = \sum_{i=1}^{6}\sum_{s=1}^{2} C_{isk}^3 p_{is}^3 \quad (6.61)$$

Where C_{isk}^3 = the cost share of producer goods *i* from source *s* in the production of consumer goods *k* 1 unit so that $\sum_i \sum_s C_{isk}^3 = 1$

p_k^c = purchaser price of consumer goods *k*

6.2.1.9 Market Clearing Condition

The market clearing condition consists of a group of equations for composite commodities and primary factors as follows:

$$f_{1q}^s = \sum_{j=1}^{6} N_{1qj} f_{1qj} \quad (6.62)$$

Where f_{1q}^s = rate of change of total supply of labor type *q*

N_{1qj} = the proportion of labor type q is used by industry *j* in total supply of labor type *q*

$$f_{2j}^s = f_{2j} \quad (6.63)$$

Where f_{2j}^s = rate of change of total supply of capital in sector *j*

f_{2j} = rate of change of demand for capital in sector *j*

$$f_{3j}^s = f_{3j} \quad (6.64)$$

Where f_{3j}^s = rate of change of total supply of land in sector *j*

f_{3j} = rate of change of demand for land in sector *j*

$$f_{3j} = 0 \quad (6.65)$$

$$f_{no3j}^s = f_{3j} \quad (6.66)$$

Where f_{no3j}^s = rate of change of total supply of no land in sector *j* (*j* =non-agriculture industries; manufacturing, hotel and restaurant, transport, service, and other industry)

$$x_{i1}^{0} = \sum_{j=1}^{6} B_{i1j}^{1} x_{i1j}^{1} + B_{i1}^{2} x_{i1}^{2} + \sum_{k=1}^{3} B_{i1k}^{3} x_{i1k}^{3} + B_{i1}^{4} x_{i1}^{4} + B_{i1}^{5} x_{i1}^{5} + B_{i1}^{m} H_{i1}^{m} m \quad (6.67)$$

$$x_{i2}^{0} = \sum_{j=1}^{6} B_{i2j}^{1} x_{i2j}^{1} + B_{i2}^{2} x_{i2}^{2} + \sum_{k=1}^{3} B_{i2k}^{3} x_{i2k}^{3} + B_{i2}^{5} x_{i2}^{5} \quad (6.68)$$

Where H_{i1}^{m} = the rate of change in margin of domestic goods *i*

B_{i1j}^{1} = the shares of demand for domestic goods *i* by sector *j*

B_{i1}^{2} = the shares of demand for domestic goods *i* for creating capital goods

B_{i1k}^{3} = the shares of demand for domestic goods *i* for producing consumer goods *k*

B_{i1}^{4} = the shares of export demand for goods *i*

B_{i1}^{5} = the shares of demand for domestic goods *i* by government

B_{i1}^{m} = the shares of margin of domestic goods *i*

B_{i2j}^{1} = the shares of demand for import goods *i* by sector *j*

B_{i2}^{2} = the shares of demand for import goods *i* for creating capital goods

B_{i2k}^{3} = the shares of demand for import goods *i* for producing consumer goods *k*

B_{i2}^{5} = the shares of demand for import goods *i* by government

$$c_{k}^{3} = \sum_{h=1}^{10} G_{kh}^{3} c_{kh}^{3} \quad (6.69)$$

Where G_{kh}^{3} = shares of demand for consumer goods *k* by total household in total supply of consumer goods

c_{kh}^{3} = the rate of change in demand for consumer goods *k* by total households

6.2.1.10 Miscellaneous Equations

Miscellaneous equations contain the equations of the consumer price index, export revenue, import revenue, the trade balance, the balance of payments and Gross Domestic Product from expenditure, income, and factor costs as follows:

$$\mathrm{cpi} = \sum_{k=1}^{3} G_k^c p_k^c \tag{6.70}$$

$$e = \sum_{i=1}^{6} S_{i1}^e \ (x_{i1}^4 + \ p_{i1}^w + e^w) \tag{6.71}$$

$$\mathrm{im} = \sum_{i=1}^{6} S_{i2}^m \ (x_{i2}^0 + \ p_{i2}^w + e^w) \tag{6.72}$$

$$100\ \mathrm{dB} = E \cdot e - M \cdot \ \mathrm{im} \tag{6.73}$$

$$100\ \mathrm{dBOP} = \ -100\ \mathrm{dG} + F \cdot s^w + \ E \cdot e - M \cdot \mathrm{im} \tag{6.74}$$

Where G_k^c = share of consumer goods *k* price in consumer price index

e = The rate of change of value export

S_{i1}^e = value share of export producer goods *i*

im = The rate of change of value import

S_{i2}^m = value share of import producer goods *i*

$100\mathrm{dB}$ = change of value in balance of trade

E = export value in the base year

M = import value in the base year

$100\ \mathrm{dBOP}$ = change of value in balance of payment

$-100\ \mathrm{dG}$ = government loan

$F \cdot s^w$ = international inflow money

$$u_t = t^{row} \tag{6.75}$$

$$u_t = u_{t\$} + \ e^w \tag{6.76}$$

$$t^{row} = t^{row\$} + e^w \tag{6.77}$$

Where $u_{t\$}$ = remittance from abroad in dollars

$t^{row\$}$ = government borrowing from the rest of the world in dollars

$$y1 = \sum_{h=1}^{10} S_h^0 c_h + \sum_{i=1}^{6}\sum_{s=1}^{2} S_{is}^0 (p_{is}^5 + x_{is}^5) + S_s^0 s - S_w^0 s_w + S_e^0 e - S_m^0 im \quad (6.78)$$

Where $y1$ = the rate of change of gross domestic product (GDP): product approach

S_h^0 = share of consumption of household *h* in GDP value by expenditure

S_{is}^0 = share of expenditure of consuming goods *i* from source *s* in GDP value by expenditure

S_s^0 = share of total saving in GDP value by expenditure

S_w^0 = share of international saving in GDP value by product

S_e^0 = share of export in GDP value by expenditure

S_m^0 = share of import in GDP value by expenditure

$$y2 = \sum_{h=1}^{10} S_h^0 c_h + \sum_{i=1}^{6}\sum_{s=1}^{2} S_{is}^0 (p_{is}^5 + x_{is}^5) + S_s^0 s + S_e^0 e - S_m^0 im \quad (6.79)$$

Where $y2$ = the rate of change of gross domestic product (GDP): expenditure approach

$$y^{fct} = \sum_{j=1}^{6} S_{1j}^{0}\left(f_{1j}^{s} + r_{1j}\right) + \sum_{j=1}^{6} S_{2j}^{0}\left(f_{2j}^{s} + r_{2j}\right) + \sum_{j=1}^{6} S_{3j}^{0}\left(f_{3j}^{s} + r_{3j}\right) + \sum_{j=1}^{6} S_{j}^{0} s_{j} + \sum_{i=1}^{6} S_{i1}^{0}\left(p_{i1}^{4} + t_{i1}^{i} + x_{i1}^{4}\right) + \sum_{i=1}^{6} S_{i2}^{0}\left(p_{i2}^{4} + t_{i2}^{w} + x_{i2}^{0} + e^{w}\right) + \sum_{i=1}^{6}\sum_{s=1}^{2} S_{is}^{0}\left(p_{is}^{0} + t_{is}^{i} + x_{is}^{0}\right) \quad (6.80)$$

Where y^{fct} = the rate of change of gross domestic product (GDP): income approach

S_{1j} = share of wage which is paid by industry j in GDP value by income

S_{2j} = share of capital income which is paid by industry *j* in GDP value by income

S_{3j} = share of land income which is paid by industry *j* in GDP value by income

S_{j}^{0} = share of saving (depreciation) which is paid by industry *j* in GDP value by income

S_{i1}^{0} = share of income of goods *i* export tax in GDP value by income

S_{i2}^{0} = share of income of goods *i* import tax in GDP value by income

S_{is}^{0} = share of income of goods *i* indirect tax from source s in GDP value by income

6.2.2 Tourism in the Model

This section describes the tourism model to be included in the structure of the model. The tourism model comprise the consumption behavior of inbound tourists, the tax refunds for tourists, consumer goods for tourists in the market clearing condition, and miscellaneous equations.

6.2.2.1 Consumption Behavior of Inbound Tourists

Income and price affect the demand for international tourism most (Dwyer & Forsyth, 2006). Demand for international tourist is measured in terms of average expenditure per tourist from an origin country to Thailand. The price of tourism goods is measured in terms of relative prices. Relative prices are a ratio of the price of goods in terms of Thai baht and the price of the same goods in terms of the destination currency. It is based on the Consumer Price Index in Thailand divided by the Consumer Price Index in the origin country and multiplied by the nominal exchange rate in baht per unit of origin country currency.

Equation (6.81) explains the change in the rate of consumption by inbound tourists on consumer goods *k* (c_k^{To})

$$c_k^{To} = \epsilon_k^{To} \cdot \exp^{To} + \sum_{q=1}^{6} \epsilon_{kq}^{To} \cdot p_q^{To} \qquad (6.81)$$

Where ϵ_k^{To} = income elasticity of demand for tourists

$\exp^{To}$ = the rate of change of average expenditure of tourists

ϵ_{kq}^{To} = the cross and the own price elasticity of tourist demand for consumer goods

p_q^{To} = the rate of change of price of consumer goods *q*

Inbound tourism is incorporated into the model. Inbound tourists do activities at a destination. In the model, the expenditure of tourists can be divided into six categories. These are food, eating out, non-food, alcoholic beverages, transport services, and lodging.

$$inbt = \sum_{k=1}^{6} S_k^{To}\left(c_k^{To} + p_k^{c}\right) \qquad (6.82)$$

Where $inbt$ = total inbound tourism

S_k^{To} = share of consumer goods *k* on total inbound tourism

6.2.2.2 Tax Refunds for Tourists

Government policy gives the privilege of tax refunds for tourists, so that total government revenue is reduced (Equation 6.83).

$$y^g = H^w t^w + H^i t^i + H^d t^d + H^f t^f + H^{row} t^{row} - H^{vrt} vrt \quad (6.83)$$

Where H^{vrt} = share of value-added tax refund for tourists on consumer goods *k* in total government revenue

vrt = value-added tax refund for tourists

$$vrt = vt + p_3^c + c_3^{To} \quad (6.84)$$

Where vt = value-added (VAT) tax for tourists on consumer goods

p_3^c = purchaser price of non-food

c_3^{To} = tourist demand for non-food

6.2.2.3 Market Clearing Condition

There is an increase in demand for consumer goods k. Tourist demand for consumer goods k (c_k^{To}) is included with the household demand for consumer goods k (c_{kh}^3). It can be written as the consumer goods market clearing condition in terms of the rate of change as shown in Equation (6.85).

$$c_k^3 = \sum_{h=1}^{10} G_{kh}^3 c_{kh}^3 + G_k^{To} c_k^{To} \quad (6.85)$$

Where G_k^{To} = share of tourist demand for consumer goods *k* in total demand for consumer goods.

c_k^{To} = tourist demand for consumer goods *k*

6.2.2.4 Miscellaneous Equations

Total inbound tourism affects the balance of trade. The expenditure of inbound tourism (inbt) is included in exports of goods and services. This study separates it from exports. The equation of the trade balance, the balance of payments and Gross Domestic Product from expenditure, income, and factor costs are as follows:

$$100\ \mathrm{dB} = \mathrm{E} \cdot \mathrm{e} - \mathrm{M} \cdot\ \mathrm{im} +\ \mathrm{TO} \cdot \mathrm{inbt} \tag{6.86}$$

$$100\ \mathrm{d\ BOP} =\ -100\ \mathrm{dG} + \mathrm{F} \cdot\ \mathrm{s^{w}}\ +\ \mathrm{E} \cdot \mathrm{e} - \mathrm{M}\ \cdot \mathrm{im} +\ \mathrm{TO} \cdot \mathrm{inbt} \tag{6.87}$$

Where TO = value in total inbound tourism

$$\mathrm{y1} = \sum_{\mathrm{h=1}}^{10} \mathrm{S_h^0 c_h} + \sum_{\mathrm{i=1}}^{6} \sum_{\mathrm{s=1}}^{2} \mathrm{S_{is}^0 (p_{is}^5 +\ x_{is}^5)} +\ \mathrm{S_s^0 s} +\ -\mathrm{S_w^0 s_w} + \mathrm{S_e^0 e} - \mathrm{S_m^0 m} -\ \mathrm{S_{exp}^{To}\, exp^{To}} \tag{6.88}$$

Where $\mathrm{y1}$ = the rate of change of gross domestic product : product approach

$\mathrm{S_{exp}^{To}}$ = share of tourist expenditure in national expenditure

$\mathrm{exp^{To}}$ = the rate of change of average expenditure of tourists

$$\mathrm{y2} = \sum_{\mathrm{h=1}}^{10} \mathrm{S_h^0 C_h} + \sum_{\mathrm{i=1}}^{6} \sum_{\mathrm{s=1}}^{2} \mathrm{S_{is}^0 (p_{is}^5 +\ x_{is}^5)} +\ \mathrm{S_s^0 s} +\ \mathrm{S_e^0 e} - \mathrm{S_m^0 m} -\ \mathrm{S_{exp}^{To}\, exp^{To}} \tag{6.89}$$

Where $\mathrm{y2}$ = the rate of change of gross domestic product : expenditure approach

$\mathrm{S_{exp}^{To}}$ = share of tourist expenditure in national expenditure

$\exp^{To}$ = the rate of change of average expenditure of tourists

6.2.3 Tourism and Environment

$$env_e = te_e + \alpha_e^2 \, inbt \tag{6.90}$$

where env_e = environmental type *e*

te_e = constant term of environmental type *e*

α_e^2 = the effect on environmental type *e* of a unit of inbound tourism consumption

$inbt$ = inbound tourism consumption

6.2.4 Model Closure

The achievement of a solution to a CGE model requires the selection of some exogenous variables. The main reason is that a number of endogenous variables equal the number of equations. In general, a number of variables in a CGE model are more than the number of equations. The remaining variables are exogenous.

For the CGE tourism model, the number of required exogenous variables is 80. It results from the difference between the number of variables and the number of equations. There are 965 variables and 885 equations as shown in Appendix 4 and 3.

The set of exogenous variables in this simulation are shown in Appendix 5. The change in the rate of total supply of industry j capital (f_{2j}), the change in the rate of total supply of land (f_{3j}), agriculture industry demand for land (f_{31}), return on land by agriculture industry (r_{31}), the change in the rate of total supply of skill labor (f_{11}^s), the change in the rate of return for unskilled labor (r_{12}), the wage differential of industry j labor (d_{1qj}), the real savings of households (v_h^h), the real savings of industry (v_j^j), real government investment (V^g), real foreign investment (V^w), the shift variable (shift), the shift in world demand for Thai exports (f_{i1}^4), ad valorem trade tax for exports and imports ($t_{i1}^x$and t_{i2}^m), average indirect tax rate (tbaris), the change in the rate of demand for export goods *i* (i =hotel and restaurant, transport, service

and others), controller for shifts in the world price for Thai exports *i* (i = manufacture), value-added tax for tourists ($\mathbf{t^{VAT}}$), remittances from abroad in dollars ($\mathbf{u_{t\$}}$), the exchange rate ($\mathbf{e^{w}}$), c.i.f. the price of import goods ($\mathbf{p_{i2}^{w}}$), the balance of trade ($\mathbf{dB}$), tourist consumption expenditure ($\mathbf{exp^{To}}$), constant tourist expenditure and Co2 emissions ($\boldsymbol{\alpha_{CO2}^{1}}$), constant tourist expenditure and energy demand ($\boldsymbol{\alpha_{ED}^{1}}$), and constant tourist expenditure and the cost of wastewater mangement ($\boldsymbol{\alpha_{WU}^{1}}$) are exogenous.

The supply of skilled labor, capital, and land is fixed. Skilled labor will not move suddenly to other industries. The supply of capital and land is limited and is difficult to change. The demand and return on land from agricultural industry cannot shift because of the slight movement of these variables. The return on unskilled labor and the wage differentials of industries are fixed because changes in wages take a long time.

Real savings from households, industries, government and foreign are fixed. It indicates that prices influence the nominal savings of households, industries, government, and foreign sources. Remittances from abroad in dollars and the exchange rate are fixed. It is believed that the adjustment of these variables is minimal.

Ad valorem tax for exports and imports, the average indirect tax rate, and value-added tax for tourists are fixed. These variables may influence tourism. Export demand for producer goods is fixed. Producer goods for hotels and restaurants, transport, service and others are exogenous. The price of import goods is fixed. Thailand is small country in terms of its influence on the world market price of goods, which are not significantly affected by Thai demand for goods.

Tourist consumption expenditure is exogenous. It leads to fix constant tourist expenditure and Co2 emissions, constant tourist expenditure and energy demand, and constant tourist expenditure and water usage. The study considers the impact of tourism on Thailand. The balance of trade is fixed, so this study concentrates on inbound tourism which directly affects the balance of trade.

6.3 Data and Parameters

This section describes the main database and other databases for this study. The main database is obtained from the input-output table. In addition to the main database, the elasticities and other parameters for the study will also be reviewed and conducted.

6.3.1 Data

Data for this study are obtained from several sources. The main sources of data will be obtained from the 2005 input-output table from the Office of the National Economic and Social Development Board (NESDB), Thailand. In addition to the input-output table, other data sources are required, for example, the socioeconomic and national income account data from the National Statistical Office, savings data from the Fiscal Policy Office, and the expenditure of inbound tourists from the Department of Tourism, and the Tourism Authority of Thailand.

The input-output table is adjusted to a pattern appropriate for the research. The input-output table has been modified from 180 industries to 6 industries as shown in Table 6.1 These are agriculture, manufacturing, hotel and restaurant, transport, services, and other. The six industries are separated according to the nature of inbound tourism expenditure.

Table 6.1 The Classification of Industries

Industry	Code on the input-output table (180x180 sectors)
Agriculture	001-029
Manufacturing	030-134
Hotel and Restaurant	147-148
Transport	149-159
Service	135-146, 160-178
Other	180

These data of the model are used to construct a Social Accounting Matrix (SAM), which explains the flow of economic activities as presented in Table 6.2. It is a database of receipts and payments of the agents in the economy. Agent i in column gets some revenue from agent j in row (Si,j).

Table 6.2 Social Accounting Matrix of Tourism

Si,j	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)			X								
(2)	x	X						x		x	
(3)											
(4)		X									x
(5)		X	x	x			X		x	x	
(6)		X	x	x					x		
(7)		X	x	x					x	x	
(8)					x	x					
(9)		X								x	
(10)						x					
(11)										x	

The basic structure of the Social Accounting Matrix in the study consists of eleven groups. In Table 6.2, they are primary factor production (1), institutions (2), producing sectors (3), producers of consumer goods (4), domestic producer goods (5), imported producer goods (6), margin sector (7), tax (8), capital account (9), the rest of the world (10) and tourism (11). S1,3 refers to the receipts and payments between primary factors and industries. S2,1 refers to the receipts and payments between primary factors and institution. S2,2 refers to the receipts and payments in institution. S2,8 refers to the government receipts from indirect tax. S2,10 refers to the transfers from the rest of the world to institutions. S3,5 refers to the expenditure of the producing sector. S4,2 refers to the expenditure of each household for each consumer good. S5,2 refers to the government expenditure on domestic goods. S5,3 refers to the demand for domestic goods as intermediate factors in industries. S5,4

refers to the demand for domestic goods to produce consumer goods. S5,7 refers to the demand for domestic goods to margin. S5,9 refers to the demand for domestic goods to produce capital goods. S5,10 refers to the demand for domestic goods on the rest of the world. S6,2 refers to the demand for imported goods by government. S6,3 refers to the demand for imported goods as intermediate factors in industries. S6,4 refers to the demand for imported goods to produce consumer goods. S6,9 refers to the demand for imported goods to produce capital goods. S7,2 refers to the demand for margin on goods for government. S7,3 refers to the demand for margin on intermediate factors for production. S7,4 refers to the demand for margin on goods to produce consumer goods. S7,9 refers to the demand for margin on goods to produce capital goods. S7,10 refers to the demand for margin on exported goods. S8,5 refers to total indirect tax and trade tax from buying domestic goods but subsidies are excluded. S8,6 refers to total indirect tax and trade tax from buying import goods but subsidies are excluded. S9,2 refers to savings of institutions. S9,3 refers to depreciation or savings of industries. S9,10 refers to foreign savings or foreign direct investment. S10,6 refers to the value of imported goods on the c.i.f. price. S4,11 refers to the expenditure of inbound tourists. S11,10 refers to the payments of rest of the world by inbound tourists.

6.3.2 Parameters

Various elasticities come from both the literature review and econometric estimations. The elasticities from the literature review are the elasticity of substitution for producer goods *i* in the production of consumer goods *k* (σ_{ik}^{3}), the substitution elasticity between primary factor type *n* and primary factor in general (σ_{nj}), the substitution elasticity between demand of intermediate inputs *i* both sources by sector *j* (σ_{ij}), the substitution elasticity of producer goods *i* (σ_{i}^{2}), the substitution elasticity of substitution between labor *q* and labor in general (σ_{1qj}) and the reverse price elasticity of Thai export goods *i* (δ_{i}). The elasticities from econometric estimations are the elasticity of price (own and cross price elasticity) of demand for consumer goods *k* by households (η_{hkq}), the income (expenditure) elasticity of demand for consumer goods *k* by households (η_{hk}), the income

elasticity of demand for inbound tourists (ϵ_{k}^{To}), the cross and own price elasticities of tourist demand for consumer goods *k* (ϵ_{kq}^{To}) and the effect on the environmental type *e* per unit of inbound tourism expenditure (α_{e}^{i}).

These elasticity parameters are different from the literature review. The elasticity of substitution for producer goods *i* in the production of consumer goods *k* (σ_{ik}^{3}) are between -0.46 and 4.33 (Centre for Development Policy, Faculty of Economics, Chulalongkorn University, 2007 and Wianwiwat, 2011). The substitution elasticity between primary factor type *n* and primary factor in general (σ_{nj}) range from -1.2 to 0.45 (Centre for Research, Faculty of Economics, Chulalongkorn University, 2007; Economic Research and Training Center, Faculty of Economics, Thammasart University, 2004; Sarntisart, 1993 and Wianwiwat, 2011). The substitution elasticities between demand of intermediate inputs *i* both sources by sector *j* (σ_{ij}) vary from -0.46 to 4.33 (Centre for Development Policy, Faculty of Economics, Chulalongkorn University, 2007; Wianwiwat, 2011 and Wattakuljarus, 2007). The substitution elasticities of producer goods *i* (σ_{i}^{2}) are between -0.46 and 4.33 (Centre for Development Policy, Faculty of Economics, Chulalongkorn University, 2007; Wianwiwat, 2011 and Wattakuljarus, 2007). The substitution elasticity of substitution between labor *q* and labor in general (σ_{1qj}) is -0.031 (Centre for Development Policy, Faculty of Economics, Chulalongkorn University, 2007). The range of price elasticity of Thai exported goods *i* is between -0.2 and 0.83 (Centre for Development Policy, Faculty of Economics, Chulalongkorn University, 2007; Economic Research and Training Center, Faculty of Economics, Thammasart University, 2004 and Wattakuljarus, 2007).

6.4 Simulation Results

The simulation results present the analysis of the impacts of an increase in inbound tourism expenditure by 10 per cent on the economy of Thailand in percentage terms. It accounts for approximately 77,621.65 million baht.

6.4.1 Macroeconomic Effects

The impacts of the expansion of inbound tourism on Gross Domestic Product (GDP), the Consumer Price Index (CPI), the balance of payments total exports without tourism, total imports, foreign savings, total government revenue and total government expenditure are shown in Table 6.3.

Table 6.3 Macroeconomic Effects of Simulations

Variable	Changes in Macroeconomic Variables (percentage)
Gross Domestic Product (GDP)	1.2260
Consumer Price Index	1.1320
Capital Price Index	0.1280
Balance of Payments	0.3450
Total Exports without Tourism	-1.3800
Total Exports with Tourism	10.0017
Total Imports	0.0014
Foreign Savings	0.1280
Total Government Expenditure	0.5710
Government Transfer Payments	0.3780
Government Nominal Savings	0.1280
Total Government Revenue	0.3780
Direct Tax	1.2210
Property	0.3350
Trade Tax	-0.0580
Indirect Tax	0.3270

A change in GDP will link with the income and expenditure side. On the income side, total exports without tourism decreases but total exports with tourism increases. The price level may be a cause of the decrease in total exports without tourism. On the expenditure side, total imports, foreign savings, government expenditure and household consumption increase. An increase in income level will

cause an increase in imports or demand for inbound tourism will concentrate on the importation of goods and services. According to the results presented in Table 6.3, Gross Domestic Product increases by 1.266% or 138,543.95 million baht. This is nearly two times the 10% shock in inbound tourism expenditure of 77,621.65 million baht. The Consumer and Capital Price Index increase by 1.132% and 0.128%, respectively. It leads to total exports without tourism decreasing by 1.38%. This is an increase of 0.128% in foreign savings, of 0.57% in government expenditure, of 10.0017% in total exports with tourism and of 0.0014% in total imports.

The impact of inbound tourism on the balance of payments is a surplus (Table 6.3). The expenditure increase of foreign tourists is related to the balance of payments. Total exports without tourism, total imports and foreign savings are also included in the balance of payments as presented in Table 6.3. The balance of payments increases by 0.345%. This is an increase of 10.0017% in total exports with tourism, of 0.0014% in total imports, and of 0.128% in the foreign savings while total exports without tourism decrease by 1.38%. It is clear that the expansion of inbound tourism expenditure may induce an increase in the importation of goods and services.

Government gets some benefits from the expansion of inbound tourism expenditure (Table 3). Government expenditure increases because government revenue increases. The increase in total government expenditure is approximately 0.57 per cent of their expenditure. It results from an increase of 0.37 per cent of government transfer payments and an increase of 0.128 per cent in nominal savings. For the income of government, there is a rise of 0.378% in government revenue. An increase in government revenue from direct tax is the largest, at about 1.221 per cent. The percentage of government revenue from property and indirect taxes is approximately 0.33 and 0.32, respectively. There is a decrease in government revenue from trade taxes at about 0.058 per cent. This is because of the impact of 1.38% decrease in export without tourism that outweighs the impact of 0.0014% increase in import.

6.4.2 Production Effects

6.4.2.1 Total Output

The results of the change in supply of total output by an increase in inbound tourism expenditure are presented in Table 6.4. A 10% increase in inbound tourist expansion will result in a significant expansion of total output in the tourism- related sector as shown in Table 6.4.

Table 6.4 Effects of Simulations – Total Output by Industry

Industry	Changes in Total Output (percentage)
Agriculture	0.1490
Manufacturing	-0.8090
Hotel and Restaurant	0.6840
Transport	0.3960
Service	0.2050
Other	-0.0760

The output of the hotel and restaurant sector has a greatly increased impact (0.684%) compared with the others. The output of the transport and service sector has a 0.396% increase and a 0.205% increase, respectively. Demand for inbound tourism is indirectly related with agriculture, manufacturing and other industries. The sectors achieved varied changes in output. There is a reduction in the output of manufacturing (-0.80%) and other sectors (-0.07%) because there is a movement of primary factors to produce the output of the tourism-related sector. The agriculture sector has a positive impact in output (0.14%). Two possible reasons for the increase in output of the agriculture sector are the expansion of export demand for agriculture, and the relationship between the agriculture sector and the hotel and restaurant sector, both of which are linked with foreign tourist consumption. It implies that the output change of industries is related to the use of primary factors that these industries compete for.

6.4.2.2 Supply of Producer Goods

The simulation results of the change in the supply of producer goods by an increase in inbound tourism expenditure are presented in Table 6.5.

Table 6.5 Effects of Simulations – Total Supply of Producer Goods

	Changes in Supply of Producer Goods (percentage)	
	Domestic	**Import**
Agriculture	0.1495	-0.0989
Manufacturing	-0.8097	-0.0574
Hotel and Restaurant	0.6846	0.8483
Transport	0.3970	0.7304
Service	0.2052	0.6013
Other	-0.0769	0.0099

The changes in the supply of domestic producer goods and imports increase at different rates in tourism-related producer goods such as hotel and restaurant, transport, and services. The increase in supply of imported producer goods is greater than the supply of domestic producer goods. It is caused by the increase in the domestic producer price level. In contrast, the supply of domestic and imported manufactured producer goods fall because a slowdown in export demand for manufactured producer goods may cause a reduction in the supply of producer goods. For agriculture, there is a decline in the imported agricultural producer goods, as with manufacturing, but there is an increase in domestic producer goods. The increase in export demand for agriculture is a result of the increase in the agricultural producer goods. In contrast, other imported producer goods increase, but other domestic producer goods decrease. The results presented in Table 6.5 show that the percentage increase in the imports of hotel and restaurant, transport and services is about 0.84%, 0.73% and 0.60%,respectively, while the values for hotel and restaurant, transport and service supply of domestic producer goods is lower

and varies from approximately 0.20% to 0.68%. For manufacturing, the decrease in the producer domestic and imported goods is 0.80% and 0.05%, respectively. There is a 0.149% increase in domestic agricultural producer goods, while there is a 0.09 decrease in imported agricultural producer goods. It is caused by a 17.44% increase in export demand for producer goods. For 'other', there is a 0.07% decrease in domestic producer goods, while the imported producer goods increase by 0.009%.

6.4.2.3 Producer Price

There is an increase in producer prices because of the expansion of inbound tourism expenditure as shown in Table 6.6.

Table 6.6 Effects of Simulations –the Producer Price

	Changes in Producer Price (percentage)
Agriculture	9.9094
Manufacture	0.4669
Hotel and Restaurant	2.2060
Transport	0.7054
Service	0.5833
Other	0.7459

The percentage change in producer price rises for some producer goods. The price change in producer goods may be explained by the change in demand for producer goods and in returns to primary factors. The producer prices increase because demand for producer goods and returns to primary factors decrease. However, the price of manufactured and other producer goods still increases, although some demand for producer goods and returns to primary factors will decrease. It may cause an increase in the price of manufactured and other producer goods are higher than the decrease in demand for producer goods and the returns to primary factors. The price of manufactured producer goods has a small effect compared with the price of other producer goods because manufactured

producer goods have a greater decrease in demand for producer goods and in the returns to primary factors. The results in Table 6.6 show that the producer price in agriculture, hotel and restaurant, transportation and service producer goods increase 9.90%, 2.20%, 0.70% and 0.58% respectively. The prices of agricultural producer goods have greatly changed compared to others. The export demand for agricultural producer goods may be a cause of the increased price. The price of hotel and restaurant, transportation and service producer goods increases due to an increase in the demand for producer goods. The price of manufactured and other producer goods increases by 0.46% and 0.74%, respectively, although the demand for producer goods and the returns to primary factors decrease.

6.4.2.4 Primary Factors

The demand for labor in industry is influenced by the increase in inbound tourism expenditure according to the simulation result presented in Table 6.7.

Table 6.7 Effects of Simulations – Demand for Labor

	Changes in Demand for Labor (percentage)	
	Skilled labor	**Unskilled labor**
Agriculture	0.0000	2.3408
Manufacturing	-2.5186	-2.5973
Hotel and Restaurant	4.3248	4.2406
Transport	1.0231	0.9416
Service	0.5313	0.4502
Other	-0.3811	-0.4615

There are both positive and negative effects with regard to the demand for labor in each industry. There is a decrease in the demand for both types of labor in manufacturing and other industries. A possible reason is that a reduction in the output of these two industries is caused by the movement of labor into tourism-related industries. In contrast, the demand for skilled and unskilled labor in

hotel and restaurant, transport and service increase. The change of demand for skilled labor in these industries is higher than the change of demand for unskilled labor in the industries. It is probable that the tourism related industries should concentrate on skilled labor. According to the results in Table 6.7, it is revealed that there is a 2.51% and 2.60% decrease in demand for skilled and unskilled labor in manufacturing industries, while the demand for skilled and unskilled labor, in other industries has a smaller decrease of 0.38% and 0.46%, respectively. In contrast, the increase in labor demand for hotel and restaurant industries is rather high compared to transport and service. The demand for skilled labor in hotel and restaurant, transport and service increase by 4.32%, 1.02% and 0.53%, respectively, and the demand for unskilled labor in hotel and restaurant, transport and service increases by 4.24%, 0.94% and 0.45%, respectively.

The returns on primary factors in the industries are influenced by the increase in the expenditure of inbound tourism according to the simulation result in Table 6.8.

Table.6.8 Effects of Simulations – Return on Primary Factors

Industry	Changes in Return on Primary Factors (percentage)	
	Labor	Capital
Agriculture	0.0000	23.5320
Manufacturing	0.1550	-3.2410
Hotel and Restaurant	0.1190	3.1770
Transport	0.2100	1.6840
Service	0.2130	0.8960
Other	0.2840	-0.0970

The output change for industries will affect the return on primary factors under fixed primary factor supply. An increase in the output for industries affects the increase in the returns on primary factors, while a decrease in the output for industries affects the increase in the returns on primary factors and a slowdown in the returns on primary factors. In the model, agricultural industries combine land

with capital. The return on capital in agricultural industries is rather high, while there is no change in the return on unskilled labor that is assumed to perfectly mobile. The return on capital in manufacturing and other industries falls, while the return on labor, especially skilled labor, in both industries increases. In contrast, the return on labor and capital in hotel and restaurant, transport and service industries increases. The increase in the percentage return on capital in these industries is higher than the increase in the percentage return to labor in these industries. As shown in the results in Table 6.8, the return on capital in agricultural industry increases by 23.53%. There is a 3.24% and 0.09% decrease in the return to capital in manufacture and other industries, respectively. The return on capital in hotel and restaurant, transport and service industries increases by 3.17%, 1.68% and 0.89%, respectively. The return on labor in manufacturing, hotel and restaurant, transport and service industries increases by 0.155%, 0.119%, 0.210%, 0.213% and 0.284%, respectively. It is indicated that an increase in foreign tourist expenditure may lead to demand for capital in tourism- related industries by extraction from others.

6.4.3 Social Effects

The impacts of the expansion of inbound tourism bring about changes in distribution of household income and household expenditure. The results of a 10% increase in the expenditure of inbound tourism on household income and expenditure are shown in Table 6.9.

Table 6.9 Effects of Simulations - Household Expenditure and Income

Variable	Income		Expenditure	
	Value in Million Baht	Changes in Percentage	Value in Million Baht	Changes in Percentage
Urban households 1	2,041.7000	1.2350	25,377.7600	0.9936
Urban households 2	3,606.6000	1.2290	4,461.4300	0.9935
Urban households 3	5,606.5000	1.3430	7,081.4200	1.0633
Urban households 4	9,735.0700	1.5420	13,202.0700	1.1371
Urban households 5	26,925.0900	1.8440	41,015.6600	1.2105

Table 6.9 Effects of Simulations - Household Expenditure and Income

Variable	Income		Expenditure	
	Value in Million Baht	Changes in Percentage	Value in Million Baht	Changes in Percentage
Rural households 1	2,441.2300	1.4400	3,028.2900	1.1608
Rural households 2	4,449.7800	1.3720	5,366.7000	1.1376
Rural households 3	7,073.8000	1.5140	8,769.6800	1.2212
Rural households 4	10,519.4700	1.5030	12,915.9400	1.2241
Rural household 5	25,338.7400	1.6380	31,413.6400	1.3212

Inbound tourism has contributed to all households in both the income and the expenditure side. The expansion of inbound tourist expenditure brings considerable benefits to rural areas. Also, the higher the income class of the household, the more benefits the household gets. An increase in household consumption may result from an increase in household income. As shown in the results in Table 6.9, on the income side, the expansion of foreign tourism expenditure leads to an increase in their revenue. Urban household 1, urban household 2, urban household 3, urban household 4, and urban household 5 revenue increase by approximately 2,041 (0.99358%), 3,606 (0.99351%), 5,606 (1.06%), 9,735 (1.13%) and 26,965 (1.12%) million baht, respectively. Rural household 1, rural household 2, rural household 3, rural household 4 and rural household 5 revenue increase by approximately 2,441 (1.16%), 4,449 (1.13%), 7,073 (1.221%), 10,519 (1.224%) and 25,338 (1.321%) million baht, respectively. On the expenditure side, the expansion of foreign tourism expenditure will increase their ability to pay. For rural household consumption, there is a 1.44% (3,028 million baht), 1.372% (5,366 million baht), 1.514% (8,769 million baht), 1.503% (12,915 million baht), and 1.638% (31,413 million baht) increase of rural household 1, rural household 2, rural household 3, rural household 4 and rural household 5, respectively. For urban household consumption, a change in urban household 1, urban household 2, urban household 3, urban household 4, and urban household 5 consumption account for

1.235% (2,537 million baht), 1.229% (4,461 million baht), 1.343% (7,081 million baht), 1.542% (13,202 million baht), and 1.844% (41,015 million baht) respectively.

An increase in inbound tourism which influences the household consumption is divided into six main categories of commodity as shown in Figure 6.3.

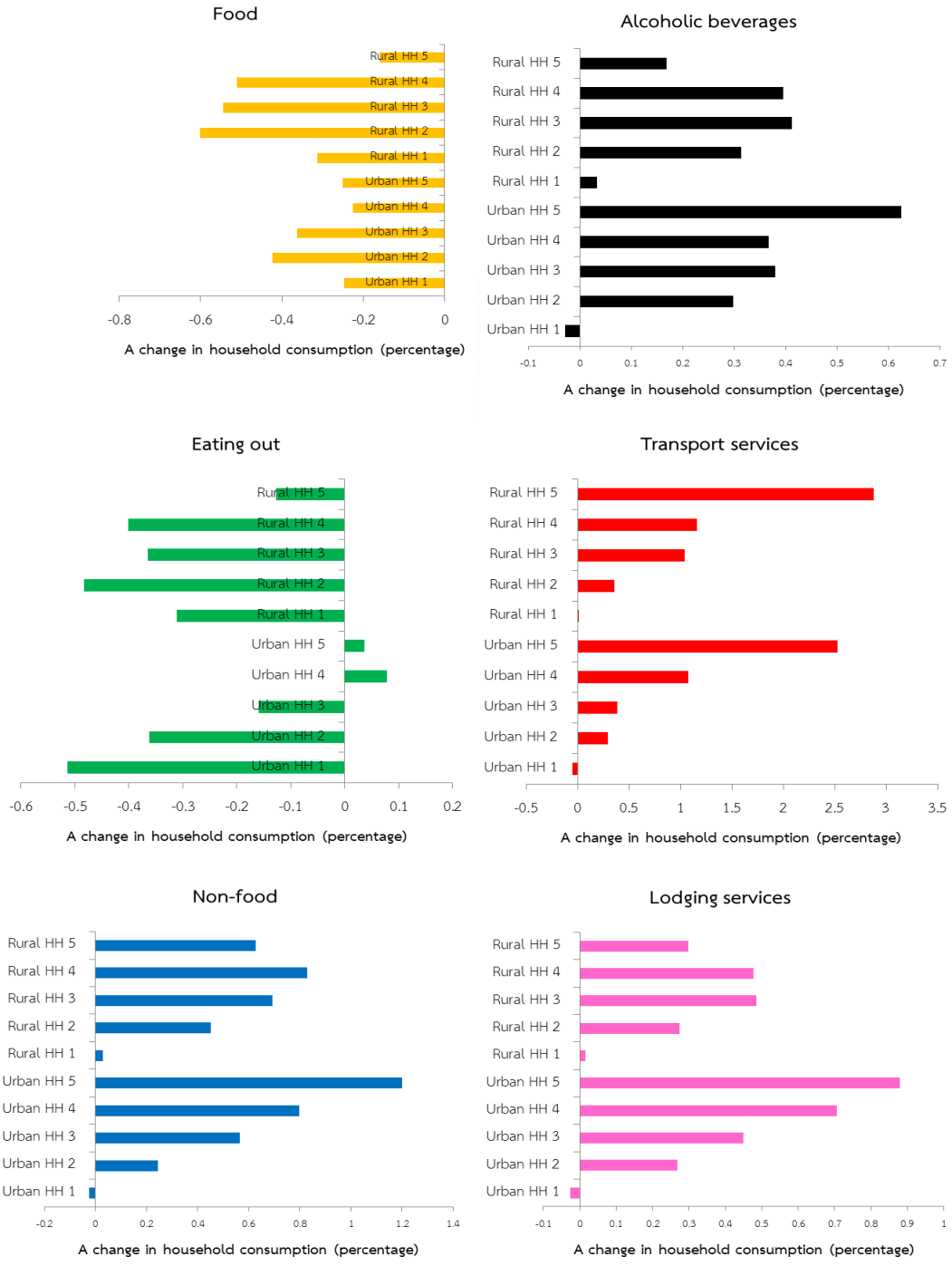

Figure 6.3 Effects of Simulations - Household Consumption by Each Item

Household consumption increases for most categories. The consumption of food in both urban and rural households falls, while the consumption of eating-out falls in nearly all households except two lower classes in urban area. It may result from the high price increases of food and eating-out. Also, this is partly explained by the own-price responsiveness of demand for food and eating-out that are estimated around -0.13 and -0.74, which are higher than those of past studies.[1] The results presented in Figure 6.3 show that the percentage of their consumption on transport is the highest. A change in the consumption of the high-income class is higher than the change in consumption of the low-income class, especially in rural households. The results indicate that rural households will travel frequently. On alcoholic beverage consumption, the increase in alcoholic beverage consumption is highest for high-income rural households, although the largest change in the consumption is in urban household 5. On non-food and lodging service consumption, the results show that an increase in foreign tourist consumption will stimulate an increase in the consumption of most high-income rural households. In contrast, the consumption of food and eating-out significantly decreases in almost all households.

6.4.4 Impacts on Tourist Consumption

The effects of a 10% increase in inbound tourism expenditure are shown in Table 6.10.

Table 6.10 Effects of Simulations – Inbound Tourism Consumption of Each Item

	Changes in Inbound Tourist Consumption (percentage)
Eating out	8.5390
Non-food	9.4266
Alcoholic Beverages	4.6619

[1] Estimates of past studies show that the own price elasticity of demand for food is very inelastic. For example, the price elasticities of rice demand are from -0.01 to -0.027 (Barker, Herdt, & Rose, 1985; Lipp, Isvilanonda, Seebens, & Qaim, 2010). The price elasticities of food demand are approximately -0.02 (Thammatinno, 1973).

Table 6.10 Effects of Simulations – Inbound Tourism Consumption of Each Item

	Changes in Inbound Tourist Consumption (percentage)
Transport Services	9.0933
Lodging Services	9.6856

All inbound tourism consumption items increase. The change in lodging services and non-food is substantial in inbound tourist consumption. The increase in inbound tourist expenditure has an effect on lodging service and non-food consumption by 9.68% and 9.42%, respectively. The increase in eating-out, transport and alcoholic beverages and food consumption is approximately 8.53%, 9.09% and 4.66%, respectively. The smallest effect is on food consumption as the consumption of inbound tourists is low on food items. It is indicated that foreign tourists mainly concentrate on accommodation and non-food including entertainment, shopping, and sightseeing.

An increase in inbound tourism expenditure affects the purchase price of consumer goods as shown in Figure 6.4.

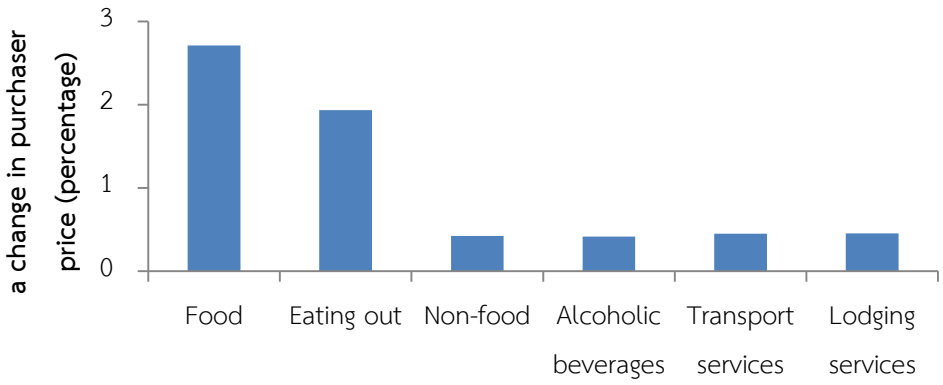

Figure 6.4 Effects of Simulations –the Purchase Price of Consumer Goods

The increase in inbound tourism expenditure affects the price of all consumer goods. The increase in food price is the largest (2.70%). There is a 1.93%,

0.42%, 0.41%, 0.44%, 0.45% increase in eating out, non-food, alcoholic beverage, transport and lodging price, respectively.

The effects of an increase in inbound tourism expenditure on the supply of consumer goods in percentage terms are presented in Figure 6.5.

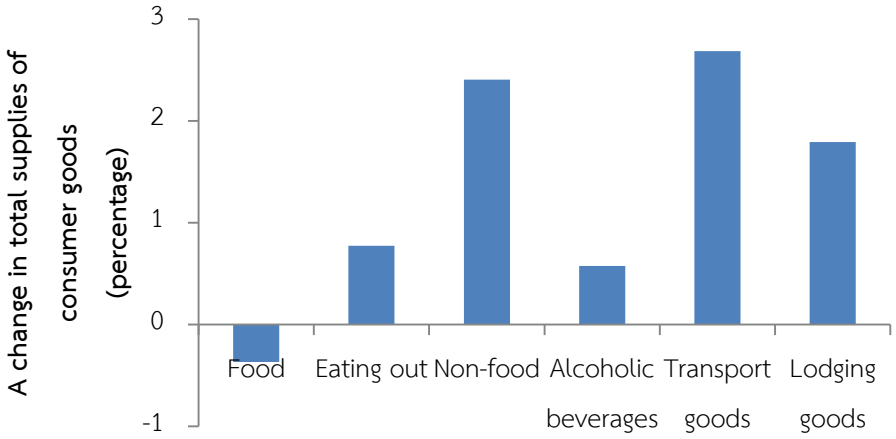

Figure 6.5 Effects of Simulations – Total Supply of Consumer Goods

Tourism leads to both increases and decreases in the total supply of various consumer goods. A decrease in the supply of food may result from the decreased demand for food as a result of increases in food prices. The results in Figure 6.5 show that the supply of eating out, non-food, alcoholic beverages, transport and lodging service increases 0.77%, 2.40%, 0.57%, 2.68% and 1.79%, respectively. In contrast, the supply of food decreases by 0.36%.

6.4.5 Environmental Effects

The environmental effects of an increase in inbound tourism expenditure are shown in Table 6.11.

Table 6.11 Environment Effect of Simulations – CO_2 Emissions from Transport, Accommodation and the Cost of Wastewater Management

	Value in Million Baht[2]	**Changes in Environmental Effect (percentage)**
CO_2 Emissions from Transport	67.6811	0.0060
CO_2 Emissions from Accommodation	630.5624	0.43
Cost of Wastewater Management	385.1971	0.5400
Total	1,083.4406	

An increase in inbound tourism expenditure will lead to an increased effect of CO_2 emissions from transport. The results show that carbon dioxide emissions from transport increases by 0.006% or accounts for approximately 67.68 million baht. Carbon dioxide emissions from accommodation increases by 0.43% or accounts for approximately 630 million baht. The cost of wastewater management increases by 0.54% or accounts for approximately 385.20 million baht. Carbon dioxide emissions from accommodation and the cost of wastewater management are not as significant from the expansion of foreign tourist expenditure as estimates. However, foreign tourists may be considered a part of energy consumption and the cost of wastewater management in Thailand.

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[2] The estimated results are calculated using the result of the equation (5.1) and (5.2). The value of Baht 67.68 million is equal to 3,808 tons Co2. The value of Baht 630.56 million is equal to 35,483 tons Co2. The value of Baht 385.20 million is calculated using the result of the equation (5.3).

Inbound tourism contributes benefits to Thailand. A comparison of the results of an increase in Gross Domestic Product with an increase in the effect on the environment shows that the contribution to GDP (138,543.95 million baht) is higher than the environmental cost (1,083.44 million baht).

6.5 Conclusion

The simulation results reveal that inbound tourism is a significant sector in Thailand. Inbound tourism affects increases in GDP, the price level, total exports from tourism, total imports, foreign savings and government revenue and consumption at the macro level, while there is a decrease in total export revenue income without tourism. Inbound tourism has a positive effect on production. Total output, the demand for labor and the return on primary factors increase, excluding manufacturing and other. For social effects, the increase of inbound tourism positively affects household income and consumption. The benefit of an increase in inbound tourism focuses on rural households. The importance of foreign tourist expenditure concentrates on lodging, non-food and transport expenditure. For the environmental effects, CO_2 emissions from transport are affected by the expansion of foreign tourist expenditure. Results indicate that the economic and social effects of are greater than the environmental effect. However, it should be noted that there are other social cost of inbound tourism that are not included in this study. These are the adverse effect of cultural shock, natural resource deterioration and so on.

CHAPTER 7
Summary and Conclusions

7.1 Summary

The impacts of inbound tourism in Thailand can be summarized in seven topics. The first chapter identifies the details of the significant problems in assessing the effects of inbound tourism to Thailand. It specifies the three main objectives of the study within the scope of the study, including the benefits of the study.

The second chapter describes the tourism situation in Thailand. International tourists to Thailand can be divided into seven groups. Most international tourists in Thailand come from East Asia. Bangkok is the favorite destination for foreign tourists. Most of these tourists stay longer in Thailand. The per capita daily expenditure of international tourists from all regions is between 2,800 and 5,200 baht. Accommodation and shopping are the main items of expenditure of international tourists to Thailand. Tourism significantly affects the growth of the Thai economy as shown by the data of Gross Domestic Product, tourism revenue, employment and wages. In addition, tourism activities also lead to changes in the environment.

The third chapter provides the literature relating to the impacts of tourism and the estimation method. Past studies have assessed the impact of tourism in several ways. Several methods are conducted with regard to the issues of consumer demand, tourism and the environment, and the effects of tourism.

The fourth chapter estimates the income and price elasticities of inbound tourist demand for eating out, non-food, alcoholic beverages and tobacco, transport, and lodging in Thailand.

The fifth chapter analyses the expenditure of inbound tourism and the effects on the environment. This study focuses particularly on carbon dioxide emissions from transport, carbon dioxide from accommodation, and the cost of wastewater management.

The sixth chapter describes the structure of the model and the data, and the simulation results shown in this section analyse the impact of inbound tourism in

Thailand. This model based on Sarntisart's model which features ten main categories: production, margin, investment and savings, production of consumer goods, household, export demand, government, price determination, market clearing conditions and miscellaneous. This study will add inbound tourism and the environment into this model. Furthermore, the solution to a CGE model assumes some variables to be exogenous. There are 885 equations and 965 variables. Therefore, 80 variables are selected to be exogenous variables, known as model closure. The database consists of the main database from the input-output table and the parameters from both a literature review and the econometric estimation. This chapter analyses the impacts of an increase in the expenditure of inbound tourism.

Finally, this chapter will summarize the findings, propose tourism policies and make recommendations for further research.

7.2 Conclusions

The results indicate that five commodities are normal goods from the value of expenditure elasticities. It appears that the economy of the home countries affects the demand for foreign tourists to Thailand differently. International tourists are price inelastic. It seems that price is slightly sensitive to the demand of international tourists. However, the cost of carbon dioxide emissions from transport is related to the expenditure of tourists. Total inbound tourism expenditure has a positive relationship with carbon dioxide emissions.

The results of the simulations indicate that an increase in the expenditure of inbound tourism contributes to the Thai economy. The expenditure of inbound tourism causes economic growth and an increase in the price level. This increase is mainly reflected on the income side with an increase in total exports for tourism and foreign savings, but there is a decline in total exports without tourism. On the expenditure side, there is also a slight increase in total imports. In addition, the simulations reveal that an increase in the expenditure of foreign tourists causes changes in government revenue and expenditure.

An increase in foreign tourist consumption positively and mainly affects the production of tourism sectors. Hotels and restaurant, transport and services are

significantly affected by the expansion of foreign tourist consumption. There is a rise in their output, but the total output of manufacturing and other decrease because of the movement of primary factors to the tourism-related sectors. It leads to more employment mainly in tourism industries, especially skilled labor. The return on labor and capital in hotels and restaurant, transport and services also increase as a result of the increase in total output. In contrast, the return on capital in manufacturing and other decreases, due to the slowdown in their output.

The expansion of foreign tourist consumption has a positive impact on the income distribution of households and the expenditure of households. Rural households are the main beneficiary of the increase in inbound tourism. The higher income class will gain more benefit than the lower income class. Households increasingly consume all goods, except for the consumption of food and eating-out, for which the change in the price of the two goods is quite high. Also, to some degree, the decrease in the consumption of food and eating-out is caused by the estimates of own-price elasticity of demand that are not very inelastic as many past studies.

For the expenditure of foreign tourists, the expansion in inbound tourism expenditure has a considerable direct impact on lodging services, non-food, transport and eating-out consumption.

The consumption of inbound tourism results in environment costs. Carbon dioxide emissions are more likely to rise from the increase in the expenditure of inbound tourists. However, the expansion of inbound tourism expenditure will bring greater benefits to Thailand than the cost to the environment.

7.3 Policy and Recommendations

There are some suggestions for tourism policies to enhance the efficiency of the tourism sector in Thailand.

Primary factors should be more effectively developed. Government agencies should plan to produce direct primary factors according to the use of related tourism. The findings of this study support a significant increase in foreign tourist

consumption to increase demand for labor and returns on labor and capital. Previous tourism development in terms of the issues was inadequate to reach slowly developing tourism targets. At the same time, awareness of the increase in foreign tourist consumption may cause negative effects. Manufacturing and other experience a slowdown in demand for labor and return on capital. It means that an increase in foreign tourist consumption affects the production of other industries.

Poor rural people should be able to develop as a result of local tourism. This suggests that tourism development should focus on the participation of poor rural people in tourism. It leads to generate income directly to local people and communities. The findings of this study support the idea that an increase in foreign tourist consumption benefits the high income class in households instead of the low income class households, especially in rural areas. The previous tourism plans emphasized quantitative development such as infrastructure and the number of tourists.

The expansion of tourism-related production should be conducted continuously. Lodging services, non-food and transport services should be supported. Lodging services, non-food and transport services are significant goods as shown by the findings of this study. It suggests that some industries related to these commodities should be promoted in terms of investment and financial support from other agencies. Appropriate production management should leads to increases in their earnings and tourism revenue.

Price promotion of tourism should be employed in various commodities and tourist groups to attract tourists. The reason is that there is a different response of inbound tourists to the price for different commodities. Some international tourist groups may be sensitive to price, but other international tourist groups may not. Therefore, tourism industries should determine price promotions according to the main characteristics of the inbound tourists. It will lead to increased inbound tourism revenue. However, packages for tourists should be developed and offered by tourism entrepreneurs to add value to tourism goods and services. As shown in the findings, all tourism items and services are complementary.

Tourism policy should incorporate the cost of tourism. Due to the vagueness of the management of tourism with regard to the environment, the management of CO_2 emissions in the development planning of tourism should be undertaken. According to the empirical results, inbound tourism expenditure increases CO_2 emissions from transport. Tourism seems to be relevant to the environment. Consequently, the goal of tourism growth cannot focus only on the expenditure of tourists or tourism revenue or tourist arrivals, but should also consider the environmental aspects.

7.4 Limitations of the Study and Further Research

The limitation of the study is the size of the Thai population in the wastewater management service area for the data on the cost of wastewater management. The number obtained of the Thai population in the wastewater management service area comes from available information from reliable public sources, but there is a lack of data in some areas. The size of the Thai population in the wastewater management service area for the study might therefore be understated. Therefore, the cost of wastewater management in some areas should be incorporated into the figures.

The main limitation of the computable general equilibrium models for this study is the precision of the values of the main behavior parameters, especially the income and price elasticities of households on food and eating-out. For this study, the demand changes for a good will react to a change in the price of the good and a change in income. The findings indicate that food and eating-out consumption of households should have a declining trend in most households. It is probably that the elasticities of the two items should be a significant cause of the change in the demand for goods. The estimated results indicate that the coefficients of own-price elasticities of food (-0.13 to -0.52) and eating-out (-0.24 to -0.74) are inelastic. For income elasticities, the estimated results indicate that the food income elasticities of households are inelastic (0.15 to 0.92) while the eating-out income elasticities for households are inelastic or elastic (0.29 to 1.66). The obtained values of the parameters may not be enough inelastic and are higher than the values of the parameters from Lipp et al. (2010), Sarntisart (1993) and Thammatinno (1973). Also,

several important aspects of the estimates of the elasticities should be investigated. First, some data used in the estimates of the elasticities should be updated because these elasticities are conducted with available data from reliable public sources. Second, it is probable that the estimation of the parameters by a different method would affect the uncertainty of the values. It suggests that a comparison could be made with the values of the parameters by another method to lead to the improvement of the coefficient. Third, there is a variety of food such as rice, fruit, vegetables, meat, and seafood. The elasticities of each item should be different. There are also differences in the groups of consumers that eat-out. For example, street food is purchased by both poor and rich households, but expensive restaurants are only likely to serve specific higher income groups. It may affect the coefficients of the elasticities. Therefore, some work on the current elasticity estimates should be conducted for a more complete analysis.

The study may be applied to outbound tourism for further research because outbound tourism broadly affects many aspects. This study lacks investigation of this issue. Researchers could also improve the database and model.

The study may also be applied to culture for further research because culture may be a major driver of the Thai economy. Culture should increasingly attract to produce and consume in tourism goods and services. Therefore, the effect of culture on tourism should be interested in the recent case and vice versa.

The model in this study may be developed to be a dynamic model. It would be more useful to reflect the change in tourism or other variables over time. This study is unable to address this issue because it employs a static CGE model.

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APPENDIX

Appendix 1 Summary of Past Studies of the Impact of Tourism

Impact	Studies
Income	Ruíz (1985), Lindberg and Johnson (1997), Alavalapati and Adamowicz (2000), Kweka et al. (2001), Taylor et al. (2003), Sinclair et al. (2005), Oul (2006), Zhang (2006), Kantamaturapoj (2007), Rabibhanada and Jatuworapruk (2007), Matarrita-Cascante (2010), Martí Selva et al. (2012)
Income Distribution	Lee and Kang (1998), Taylor et al. (2003), Oul (2006), Untong et al. (2006), Juan and Piboonrungroj (2007), Blake (2008), Blake et al. (2008), Wattanakuljarus and Coxhead (2008)
Employment	Lee and Kang (1998), Walpole and Goodwin (2000), Kweka et al. (2001), Taylor et al. (2003), Sinclair et al. (2005), Kantamaturapoj (2007), Blake et al. (2008), Akkemik (2012), Martí Selva et al. (2012)
Consumption	Kweka et al. (2001), Martí Selva et al. (2012)
Production	Kweka et al. (2001), Sugiyarto et al. (2003), Akkemik (2012), Martí Selva et al. (2012)
Export	Zhou et al. (1997), Narayan (2004),
Imports	Adams and Parmenter (1995), Walpole and Goodwin (2000), Narayan (2004), Wattanakuljarus and Coxhead (2008)
Local People	Walpole and Goodwin (2000), Juan and Piboonrungroj (2007),
Family	Zhang (2006), Stronza and Gordillo (2008),
Development	Walpole and Goodwin (2000), Kim and Konan (2004), Davenport and Davenport (2006), Juan and Piboonrungroj (2007), Stronza and Gordillo (2008), Matarrita-Cascante (2010), Matarrita-Cascante (2010)
Environment Problems	Inskeep (1987), Ceballos-Lascurain (1996), Lindberg and Johnson (1997), Davenport and Davenport (2006), Juan and Piboonrungroj (2007), Wattanakuljarus and Coxhead (2008), Matarrita-Cascante (2010), Katircioglu (2014), Saenz-de-Miera and Rosselló (2014)

Appendix 2 Summary of Past Studies of the Estimation Method

Impact	Studies
The Single Equation	Witt and Martin (1987), Eadington (1991), Choong-Ki et al. (1996), Li et al. (2004), Norsiah (2008), Stabler et al. (2009), Schiff and Becken (2011), Nonthapot (2013)
The Linear Expenditure System (LES)	Stone (1954), Fujii et al. (1985), Lim (1997), Narayana and Vani (2000),
The Extended Linear Expenditure System (ELES)	(Stone, 1954), Narayana and Vani (2000)
The Almost Ideal Demand System (AIDS)	Fujii et al. (1985), Lim (1997)
Econometric Models	Asafu-Adjaye (2000), Seetanah (2011), Fatai et al. (2004), Oh (2005), Fayissa et al. (2008), Sequeira and Nunes (2008), Halicioglu (2009), Chancharat and Chancharat (2010), Wang et al. (2011), Akkemik (2012), Gössling et al. (2012)
Input-Output Models	Fletcher (1989), Khan et al. (1990), Briassoulis (1991), Zhou et al. (1997), Frechtling and Horvath (1999), Kweka et al. (2001), Dwyer et al. (2004), Oosterhaven and Fan (2006), Hara (2008), Akkemik (2012), Martí Selva et al. (2012)
The Social Accounting Matrix Model	Zhou et al. (1997), Akkemik (2012)
The Computable General Equilibrium Model	Adams and Parmenter (1995), Sugiyarto et al. (2003), Dwyer et al. (2004), Oosterhaven and Fan (2006), (Akkemik (2012)),
The Tourism Satellite Account	Smeral (2006), Wattanakuljarus (2009)

Appendix 3 Number of Equations

No.	Equations	Description Equations	Number of Equations
Production			
6.1	$f_{1qj} = f_{1j} + \sigma_{1qj}\left[r_{1qj} - \sum_{q=1}^{2} A_{1qj} r_{1qj}\right]$	Industry demand for labor	12
6.2	$f_{nj} = z_j + \sigma_{nj}\left[r_{nj} - \sum_{n=1}^{3} A_{nj} r_{nj}\, r_{nj}\right]$	Industry demand for primary factors	18
6.3	$x^1_{isj} = z_j + \sigma_{ij}\left[pr^1_{isj} - \sum_{s=1}^{2} H^1_{isj} pr_{isj}\right]$	Industry intermediate demand for producer good	72
6.4	$X^0_{i1} = z_j$	Output industry	6
6.5	$r_{2j} = r_{3j}$	Return to land for non-agriculture industry	5
Margin Sector			
6.6	$m^1_{isj} = x^1_{isj}$	Margin for intermediate demand	72
6.7	$m^2_{is} = x^2_{is}$	Margin for capital creation demand	12
6.8	$m^3_{isk} = x^3_{isk}$	Margin for producing consumer goods	72

Appendix 3 Number of Equations

No.	Equations	Description Equations	Number of Equations
6.9	$m_{i1}^{4} = x_{i1}^{4}$	Margin for export	6
6.10	$m_{is}^{5} = x_{is}^{5}$	Margin for government demand	12
6.11	$m = \sum_{i=1}^{6}\sum_{s=1}^{2}\sum_{j=1}^{6} A_{isj}^{1} m_{isj}^{1} + \sum_{i=1}^{6}\sum_{s=1}^{2} A_{is}^{2} m_{is}^{2} + \sum_{i=1}^{6}\sum_{s=1}^{2}\sum_{k=1}^{3} A_{isk}^{3} m_{isk}^{3} + \sum_{i=1}^{6} A_{i1}^{4} m_{i1}^{4} + \sum_{i=1}^{6}\sum_{s=1}^{2} A_{is}^{5} m_{is}^{5}$	Total demand for margin	1
Investment and Savings			
6.12	$s = \sum_{h=1}^{10} H_{h}^{s} s_{h} + \sum_{j=1}^{6} H_{j}^{s} s_{j}^{j} + H_{g}^{s} s^{g} + H_{w}^{s} s^{w}$	Total savings	1
6.13	$s = v + pik$	Savings equal to investment	1
6.14	$s_{j}^{j} = v_{j}^{j} + pik$	Industry savings	6
6.15	$s^{w} = v^{w} + pik$	Inflow of foreign savings	1
6.16	$x_{is}^{2} = v + \sigma_{i}^{2}\left[p_{is}^{2} - \sum_{s=1}^{2} H_{is}^{2} p_{is}^{2}\right]$	Demand for the creation of capital	12

Appendix 3 Number of Equations

No.	Equations	Description Equations	Number of Equations
6.17	$\mathrm{pik} = \sum_{i=1}^{6}\sum_{s=1}^{2} G_{is}^{2} p_{is}^{2}$	Capital price	1
Production of Consumer goods			
6.18	$x_{isk}^{3} = C_{k}^{3} + \sigma_{ik}^{3}\left[p_{is}^{3} - \sum_{s=1}^{2} H_{isk}^{3} p_{is}^{3}\right]$	Consumer good producer' s intermediate demand	72
6.19	$x_{is}^{3} = \sum_{k=1}^{3} G_{isk}^{3} x_{isk}^{3}$	Total consumer good producer' intermediate demand	12
Household Behavior			
6.20	$y_h = \left[\begin{array}{l} \sum_{q=1}^{2} O_{1qh}\left(f_{1q}^{s} + r_{1q}\right) + \\ \sum_{j=1}^{6} O_{2jh}\left(f_{2j}^{s} + r_{2j}\right) \\ + \sum_{j=1}^{6} O_{3jh}\left(f_{3j}^{s} + r_{3j}\right) \end{array}\right] + H_{uh} u$	Household income	10
6.21	$y_h = H_h^{d} y_h^{d} + H_h^{g} d_h^{r} + H_h^{u} u_h$	Income equal expenditure	10
6.22	$d_h^{r} = y_h + t_h^{d}$	Household payment on direct tax	10

Appendix 3 Number of Equations

No.	Equations	Description Equations	Number of Equations
6.23	$u_h = \theta_h^u y_h$	Household assistance payment	10
6.24	$s_h^h = v_h^h + pik$	Household real savings decision	10
6.25	$y_h^d = B_h^s s_h^h + B_h^c c_h + shift$	Household savings-consumption decision	10
6.26	$c_{hk}^3 = \sum_{q=1}^{3} \eta_{hkq} p_q^c + \eta_{hk} c_h$	Household consumption behavior	60
6.27	$u = \sum_{h=1}^{10} G_h^u u_h + G_g^u u_g + G_t^u u_t$	Transfer pool	1
Export Demand			
6.28	$p_{i1}^w = -\delta_i x_{i1}^4 + f_{i1}^4$	Export Demand	6
Government Behavior			
6.29	$t^w = \sum_{i=1}^{6} G_{i1}^x (p_{i1}^w + t_{i1}^x + x_{i1}^4 + e^w) + \sum_{i=1}^{6} G_{i2}^m (p_{i2}^w + t_{i2}^m + x_{i2}^0 + e^w)$	Revenue from trade tax	1
6.30	$t^i = \sum_{i=1}^{6} \sum_{s=1}^{2} G_{is}^i (p_{is}^0 + t_{is}^i + x_{is}^0)$	Revenue from indirect tax	1
6.31	$t^d = \sum_{h=1}^{10} G_h^d (y_h + t_h^d)$	Revenue from direct tax	1

Appendix 3 Number of Equations

No.	Equations	Description Equations	Number of Equations
6.32	$t^f = \sum_{j=1}^{6} O_{2j}^g (f_{2j} + r_{2j})$	Revenue from property	1
6.83	$y^g = H^w t^w + H^i t^i + H^d t^d + H^f t^f + H^{row} t^{row} - H^{vrt} vrt$	Total government revenue	1
6.34	$x_{is}^5 = y^g - cpi$	Government expenditure on goods	12
6.35	$s^g = v^g + pik$	Total real government savings	1
6.36	$u^g = \eta_g^5 y^g + \theta_g^5 cpi$	Government transfer	1
6.37	$c^g = \sum_{i=1}^{6} \sum_{s=1}^{2} G_{is}^5 (x_{is}^5 + p_{is}^5) + G^{5s} s^g + G^{5u} u^g$	Total government expenditure	1
6.38	$100\, dG = R^g y^g - E^g c^g + \sum_{i=1}^{6} E\, S_{i1}^0 (e^w + x_{i1}^4)$	Balancing government budget	1
6.39	$t_{is}^i = exot_{is} + tbar_s^i + tbaris$	Indirect tax rate policy	12
6.40	$exot_{is} = 0$		1
6.41	$tbar_s^i = 0$		1
6.42	$t_h^d = exotd_h^h + tbardh$	Direct tax rate policy	10

Appendix 3 Number of Equations

No.	Equations	Description Equations	Number of Equations
6.43	$\mathrm{exotd}_{h}^{h} = 0$		1
6.44	$\mathrm{tbardh} = 0$		1
Price Determination			
6.45	$r_{1qj} = r_{1q} + d_{1qj}$	Wage equally adjusts across industries	12
6.46	$r_{1j} = \sum_{q=1}^{2} H_{1qj}^{1} r_{1qj}$	Return to effective labour	6
6.47	$rw_{1q} = r_{1q} - cpi$	Real wage	2
6.48	$p_{j1}^{0} + z_j = \sum_{i=1}^{6}\sum_{s=1}^{2} G_{isj}^{0}(x_{isj}^{1} + p_{isj}^{1}) + G_{1j}^{0}(f_{1j}^{0} + r_{1j}) + G_{2j}^{0}(f_{2j} + r_{2j}) + G_{2j}^{s} s_j^{j} - \sum_{i=1}^{6} H_{i2j}^{*}(t_{i2}^{w} + p_{i2}^{w} + e^{w} + x_{12j}^{1} + x_{j1}^{4} - z_j)$	Zero profit in export oriented industry	1
6.49	$\sum_{i=1}^{6} B_{i1j}^{0}(x_{i1j}^{0} + p_{i1}^{0}) = \sum_{i=1}^{6}\sum_{s=1}^{2} G_{isj}^{0}(x_{isj}^{1} + p_{isj}^{1}) + G_{1j}^{0}(f_{1j}^{0} + r_{1j}) + G_{2j}^{0}(f_{2j} + r_{2j}) + G_{3j}^{0}(f_{3j} + r_{3j}) + G_{2j}^{s} s_j^{j}$	Zero profit in non-trade industry	36
6.50	$pp_{is} = S_{is}^{pp} p_{is}^{0} + S_{is}^{ipp}(p_{is}^{0} + t_{is}^{i})$	Producer price	12
6.51	$p_{i1}^{w} + e^{w} = p_{i1}^{4} + ctr_{i1}^{4} + D_{i1} t_{i1}^{x}$	Zero profit in export	6

Appendix 3 Number of Equations

No.	Equations	Description Equations	Number of Equations
6.52	$p_{i2}^{0} = e^{w} + p_{i2}^{w} + D_{i2}t_{i2}^{m}$	Zero profit in import	6
6.53	$p_{41}^{m} = p_{41}^{0}$	Price of margin on transport	1
6.54	$p_{51}^{m} = p_{51}^{0}$	Price of margin on service	1
6.55	$p_{isj}^{1} = H_{isj}^{01}p_{is}^{0} + H_{isj}^{g1}(p_{is}^{0} + t_{is}^{i}) + H_{isj}^{m1}(G_{41}^{m}p_{41}^{m} + G_{51}^{m}p_{51}^{m})$	Purchaser prices for industry demand	72
6.56	$pr_{isj}^{1} = G_{ij}^{*}p_{isj}^{1} - K_{ij}^{*}(p_{i2}^{w} + t_{i2}^{m} + e^{w} + x_{ji}^{4} - z_{j})$	Purchaser prices of imported inputs for manufacture industry	72
6.57	$prb_{i1j}^{1} = p_{i1j}^{1}$		36
6.58	$prb_{i2j}^{1} = p_{i2j}^{1}$		36
6.59	$p_{is}^{n} = H_{is}^{on}p_{is}^{on} + H_{is}^{gn}(p_{is}^{o} + t_{is}^{i}) + H_{is}^{mn}(G_{31}^{m}p_{51}^{0} + G_{31}^{m}p_{51}^{0})$	Purchaser prices for capital creation, consumer good producing demand, and government demand	36
6.60	$p_{i1}^{4} = H_{i1}^{04}p_{i1}^{0} + H_{i1}^{g4}(p_{i1}^{0} + t_{i1}^{i}) + H_{i1}^{m4}(G_{41}^{m}p_{51}^{0} + G_{41}^{m}p_{51}^{0})$	Purchaser prices for export	6

Appendix 3 Number of Equations

No.	Equations	Description Equations	Number of Equations
		demand	
6.61	$p_k^c = \sum_{i=1}^{6}\sum_{s=1}^{2} C_{isk}^3 p_{is}^3$	Purchaser prices for consumer goods	6
Market Clearing Condition			
6.62	$f_{1q}^s = \sum_{j=1}^{6} N_{1qj} f_{1qj}$	Labour market clear	2
6.63	$f_{2j}^s = f_{2j}$	Capital market clear	6
6.64	$f_{3j}^s = f_{3j}$	Agriculture land markets clear	1
6.65	$f_{3j} = 0$		5
6.66	$f_{no3j}^s = f_{3j}$		5
6.67	$x_{i1}^0 = \sum_{j=1}^{6} B_{i1j}^1 x_{i1j}^1 + B_{i1}^2 + \sum_{k=1}^{3} B_{i1k}^3 x_{i1k}^3 + B_{i1}^4 x_{i1}^4 + B_{i1}^5 x_{i1}^5 + B_{i1}^m H_{i1}^m \, m$	Domestic markets clear	6
6.68	$x_{i2}^0 = \sum_{j=1}^{6} B_{i2j}^1 x_{i2j}^1 + B_{i2}^2 x_{i2}^2 + \sum_{k=1}^{3} B_{i2k}^3 x_{i2k}^3 + B_{i2}^5 x_{i2}^5$	Import markets clear	6
6.85	$c_k^3 = \sum_{h=1}^{10} G_{kh}^3 c_{kh}^3 + G_k^{To} c_k^{To}$	Consumer good markets clear	6
Miscellaneous Equations			
6.70	$cpi = \sum_{k=1}^{3} G_k^c p_k^c$	Consumer price index	1

Appendix 3 Number of Equations

No.	Equations	Description Equations	Number of Equations
6.71	$e = \sum_{i=1}^{6} S_{i1}^{e} \ (x_{i1}^{4} + \ p_{i1}^{w} + e^{w})$	Export revenue	1
6.72	$im = \sum_{i=1}^{6} S_{i2}^{m} \ (x_{i2}^{0} + \ p_{i2}^{w} + e^{w})$	Import bill	1
6.73	$100\ dB = E \cdot e - M \cdot \ im + TO \cdot inbt$	Balance of trade	1
6.74	$100\ d\ BOP = \ -100\ dG + F\ s^{w} \ + E \cdot e - M \ \cdot im + TO \cdot inbt$	Balance of payment	1
6.75	$u_t = t^{row}$		1
6.76	$u_t = u_{t\$} + \ e^{w}$		1
6.77	$t^{row} = t^{row\$} + e^{w}$		1
6.78	$y1 = \sum_{h=1}^{10} S_{h}^{0} c_h + \sum_{i=1}^{6}\sum_{s=1}^{2} S_{is}^{0}(p_{is}^{5} + x_{is}^{5}) + \ S_{s}^{0} s - \ S_{w}^{0} s_w + S_{e}^{0} e - S_{m}^{0} im - \ S_{exp}^{To} exp^{To}$	Gross domestic product : product approach	1
6.79	$y2 = \sum_{h=1}^{10} S_{h}^{0} c_h + \sum_{i=1}^{6}\sum_{s=1}^{2} S_{is}^{0}(p_{is}^{5} + x_{is}^{5}) + \ S_{s}^{0} s + \ S_{e}^{0} e - S_{m}^{0} im - \ S_{exp}^{To} exp^{To}$	Gross domestic product : expenditure approach	1

Appendix 3 Number of Equations

No.	Equations	Description Equations	Number of Equations
6.80	$y^{fct} = \sum_{j=1}^{6} S_{1j}^{0}\left(f_{1j}^{s} + r_{1j}\right) + \sum_{j=1}^{6} S_{2j}^{0}\left(f_{2j}^{s} + r_{2j}\right) + \sum_{j=1}^{6} S_{3j}^{0}\left(f_{3j}^{s} + r_{3j}\right) + \sum_{j=1}^{6} S_{j}^{0} s_{j} + \sum_{i=1}^{6} S_{i1}^{0}\left(p_{i1}^{4} + t_{i1}^{i} + x_{i1}^{4}\right) + \sum_{i=1}^{6} S_{i2}^{0}\left(p_{i2}^{4} + t_{i2}^{w} + x_{i2}^{0} + ew\right) + \sum_{i=1}^{6}\sum_{s=1}^{2} S_{is}^{0}\left(p_{is}^{0} + t_{is}^{i} + x_{is}^{0}\right)$	Gross domestic product : income approach	1
6.81	$c_{k}^{To} = \epsilon_{k}^{To} \cdot exp^{To} + \sum_{q=1}^{6} \epsilon_{kq}^{To} \cdot p_{q}^{To}$		6
6.82	$inbt = \sum_{k=1}^{6} S_{k}^{To}\left(c_{k}^{To} + p_{k}^{c}\right)$		1
6.83	$vrt = vt + p_{3}^{c} + c_{3}^{To}$		1
6.84	$env_{e} = te_{e} + \alpha_{e}^{2}\, inbt$	Tourism and environment	3
	Total number of equations		885

Appendix 4 Number of Variables

Variables	Description	Subscript	Number of Variables
c_k^3	total supply of consumer goods k	k = 6	6
c_h	the rate of change of consumption value of households	h = 10	10
c_{hk}^3	the rate of change of household demand for consumer goods k or consumption behavior of household	h = 10, k = 6	60
cpi	Consumer price index		1
c^g	Rate of change of government expenditure		1
ctr_{i1}^4	Controller for shift in world prices for Thai export	i = 6	6
c_k^{To}	Change rate of inbound tourism expenditure in consumer goods k	k = 6	6
d_h^r	household direct tax payment	h = 10	10
d_{1qj}	Rate of change of wage gap for labor type q during sector j	q = 2, j = 6	12
dG	Government impact from shock		1
$d\ BOP$	Balance of payment		1
e^w	Exchange rate		1
$exot_{is}$	Exogeneously set/determined indirect tax rate on goods i	i = 6, s = 2	12
$exotd_h^h$	Exogeneously set/determined direct tax rate on goods i	h = 10	10
e	Export revenue		1
exp^{To}	Change rate of inbound tourism expenditure		1

Appendix 4 Number of Variables

Variables	Description	Subscript	Number of Variables
$\mathrm{env_e}$	Environment e	e = 3	3
$\mathrm{f_{1qj}}$	Industry j demand for labour type q	q = 2, j = 6	12
$\mathrm{f_{nj}}$	Industry j demand for primary factors	n = 3, j = 6	18
$\mathrm{f^s_{1q}}$	total supply of labour type q	q = 2	2
$\mathrm{f^s_{2j}}$	Total supply of industry j capital	j = 6	6
$\mathrm{f^s_{3j}}$	Total supply of industry j land	j = 1	1
$\mathrm{f^s_{no3j}}$	rate of change of total supply of no land in sector j (j = non-agriculture industries; manufacturing, hotel and restaurant, transport, service, and other industry)	j = 5	5
$\mathrm{f^4_{i1}}$	world demand for Thai export goods i	i = 6	6
Im	import revenue		1
Inbt	Total inbound tourism expenditure		1
m	Total demand for margin		1
$\mathrm{m^1_{isj}}$	Intermediate input demand for margin	i = 6, s = 2, j= 6	72
$\mathrm{m^2_{is}}$	Capital creation demand for margin	i = 6, s = 2,	12
$\mathrm{m^3_{isk}}$	Consumer goods k demand for margin	i = 6, s = 2, k = 6	72
$\mathrm{m^4_{i1}}$	Export demand for margin	i = 6	6
$\mathrm{m^5_{is}}$	Government demand for margin	i = 6, s = 2	12
$\mathrm{p^1_{isj}}$	Purchaser price on intermediate demand	I = 6, s =2, j =6	72

Appendix 4 Number of Variables

Variables	Description	Subscript	Number of Variables
pr^{1}_{isj}	Purchaser price, including rebate, on intermediate demand	i = 6, s = 2, j= 6	72
Pik	capital price index		1
p^{2}_{is}	purchaser price on capital creation demand for producer goods i	i = 6, s = 2	12
p^{3}_{is}	purchaser price on consumer goods demand for producer goods i	i = 6, s = 2	12
p^{c}_{k}	the rate of change of price of consumer goods k	k = 6	6
p^{w}_{i1}	World price in US$	i = 6	6
p^{w}_{i2}	c.i.f price of import of goods i in $	i = 6	6
p^{4}_{i1}	Purchaser price on export demand for producer goods i	i = 6	6
p^{0}_{is}	price of producer goods i from source s	i = 6, s = 2	12
p^{5}_{is}	Rate of change of goods i price from sources s by government expenditure	i = 6, s = 2	12
pp_{is}	Producer price of producer goods i from source s	i = 6, s = 2	12
p^{m}_{41}	Price of margin on transport		1
p^{m}_{51}	Price of margin on service		1
r_{nj}	Return to each primary factor by industry	n = 3, j = 6	18
r_{1qj}	Return to labour type q in industry j	q = 2, j = 6	12
r_{1q}	Return to labour type q in general	q = 2	2

Appendix 4 Number of Variables

Variables	Description	Subscript	Number of Variables
rw_{1q}	Rate of change of real wage in labor type q	q = 2	2
s	total nominal savings		1
s_h^h	nominal savings of household h	h = 10	10
s_j^j	nominal savings of industry j	j = 6	6
s^g	government nominal savings		1
s^w	foreign savings		1
$shift$	Shift variable		1
t_h^d	direct tax rate on household h	h = 10	10
t^w	Government revenue from trade tax		1
t_{i1}^x	Ad volarem trade tax rates=1 for export	i = 6	6
t_{i2}^m	Ad volarem trade tax rates=2 for import	i = 6	6
t^i	Government revenue from indirect tax		1
t_{is}^i	indirect tax rate	i = 6, s = 2	12
t^d	Government revenue from direct tax		1
t^f	Government revenue from property		1
$tbar_s^i$	Average indirect tax rate on producer goods i from sources s	s = 2	2
$tbaris$	Average indirect tax rate		1
$tbardh$	Average direct tax rate		1
t^{row}	Change rate of government borrowing from rest of the World		1
$t^{row\$}$	Change rate of government borrowing from rest of the World in dollar		1

Appendix 4 Number of Variables

Variables	Description	Subscript	Number of Variables
te_e	Constant tourist demand and environment e	e = 3	3
u_h	household assistance payment to transfer pool	h = 10	10
u	transfer income rate of change		1
u_g	government transfer income rate of change		1
u_t	remittance from abroad		1
$u_{t\$}$	remittance from abroad in dollar		1
v_h^h	real savings of household h	h = 10	10
v_j^j	real savings of industry j	j =6	6
v	total (real) investment		1
v^w	real foreign investment (savings)		1
v^g	Real saving value of government		1
vrt	Change rate of value-added refund for tourists		1
vt	Value-added tax (VAT) for tourists on consumer goods		1
x_{is}^0	rate of change of quantity of goods i by source s	i = 6, s = 2	12
X_{isj}^1	Industry j intermediate demand for input I from source s	i = 6, s = 2, j = 6	72
x_{is}^2	Capital creation demand for producer goods I from source s	i = 6, s = 2	12

Appendix 4 Number of Variables

Variables	Description	Subscript	Number of Variables
x_{isk}^{3}	Demand for producer goods I from source s to produce consumer goods k	i = 6, s = 2, k = 6	72
x_{is}^{3}	total consumer goods demand for producer goods i from source s	i = 6, s = 2	12
x_{i1}^{4}	Export demand for producer goods i	i = 6	6
x_{is}^{5}	Government demand for producer goods I from source s	i = 6, s = 2	12
y_{h}	household income	h = 10	10
y_{h}^{d}	household disposable income	h = 10	10
y^{g}	Total government revenue		1
$y1$	the rate of change of gross domestic product (GDP): expenditure approach		1
$y2$	the rate of change of gross domestic product (GDP): product approach		1
y^{fct}	the rate of change of gross domestic product (GDP): income approach		1
z_{j}	Industry j activity level	j = 6	6
	Total number of equations		965

Appendix 5 Number of the Exogenous Variables

Variable	Number of Variables	Description
f_{2j}	6	change rate of sector j's supply of capital
f_{3j}	1	change rate of sector j's supply of land
f_{31}	1	agriculture industry demand for land
r_{31}	1	return for land by agriculture industry
f_{11}^{s}	1	change rate of total supply of skill labor
r_{12}	1	Change rate of average wage in unskilled labor
d_{1qj}	12	change rate of wage gap for labor type q during sector j
v_{h}^{h}	10	change rate of real saving value of household
v_{j}^{j}	6	change rate of investment real term in sector j
v^{g}	1	change rate of real saving value of government
v^{w}	1	change rate of real foreign investment
$shift$	1	Shift variable
f_{i1}^{4}	6	the change of shock with export goods i in the world
t_{i1}^{x}	6	change of rate of export goods i tax
t_{i2}^{m}	6	change of rate of import goods i tax
$tbaris$	1	change rate of average indirect tax rate
x_{i1}^{4}	4	change rate of demand for export goods *i* (i =hotel and restaurant, transport, service and others)
ctr_{i1}^{4}	1	Controller for shift in world price for Thai exports *i* (i = manufacture)
vt	1	change rate of value-added (VAT) tax for tourists on consumer goods
p_{i2}^{w}	6	change rate of c.i.f. price of import of goods in us dollar
dB	1	change rate of trade balance
$u_{t\$}$	1	change rate of remittance from abroad in us dollar
e^{w}	1	change rate of exchange rate
exp^{To}	1	change rate of average expenditure of tourists

Appendix 5 Number of the Exogenous Variables

Variable	Number of Variables	Description
$\mathbf{te_e}$	3	constant term of environment type e
Total	80	

Appendix 6 Estimates of Elasticity of Household Demand

		Income Demand Elasticity	Price Elasticity of Demand					
			Food	Eating Out	Non-Food	Alcoholic Beverages and Tobacco	Transport	Lodging
Urban1	Food	0.541789	-0.24815	-0.07167	-0.08132	-0.01079	-0.01945	-0.10852
	Eating Out	1.664397	-0.45811	-0.51756	-0.24822	-0.03296	-0.0594	-0.33117
	Non-Food	0.922339	-0.25506	-0.12175	-0.30456	0.018331	-0.03304	-0.18433
	Alcoholic Beverages & Tobacco	1.128276	-0.3116	-0.14876	-0.16878	-0.22597	-0.04038	-0.22521
	Transport	1.58486	-0.43644	-0.20842	-0.23647	-0.03139	-0.34168	-0.31549
	Lodging	0.801062	-0.22169	-0.10581	-0.12006	-0.01593	-0.02872	-0.30482
Urban2	Food	0.63435	-0.34527	-0.08629	-0.08526	-0.01004	-0.02249	-0.08228
	Eating Out	1.014832	-0.15511	-0.53346	-0.1361	-0.01604	-0.03592	-0.13136
	Non-Food	0.948951	-0.14509	-0.12886	-0.49754	-0.015	-0.0336	-0.12288
	Alcoholic Beverages & Tobacco	1.147074	-0.17519	-0.15559	-0.15372	-0.46551	-0.04057	-0.14837
	Transport	1.181031	-0.18034	-0.16016	-0.15824	-0.01865	-0.50219	-0.15273
	Lodging	1.10412	-0.16867	-0.1498	-0.148	-0.01744	-0.03906	-0.57308
Urban3	Food	0.727877	-0.37651	-0.10352	-0.09188	-0.0147	-0.04019	-0.09758
	Eating Out	0.944972	-0.0969	-0.52519	-0.11914	-0.01907	-0.05211	-0.12653
	Non-Food	1.172501	-0.12009	-0.16634	-0.63189	-0.02363	-0.06458	-0.15679
	Alcoholic Beverages & Tobacco	0.779161	-0.07997	-0.11078	-0.09832	-0.33885	-0.04301	-0.10442
	Transport	0.819335	-0.08408	-0.11647	-0.10337	-0.01654	-0.38479	-0.10978
	Lodging	0.956407	-0.09807	-0.13585	-0.12057	-0.0193	-0.05274	-0.52373
Urban4	Food	0.922282	-0.45539	-0.13419	-0.15146	-0.0234	-0.02963	-0.12266
	Eating Out	0.802579	-0.05202	-0.46125	-0.1319	-0.02037	-0.0258	-0.10681
	Non-Food	1.029781	-0.06667	-0.14974	-0.60996	-0.02611	-0.03306	-0.13687
	Alcoholic Beverages & Tobacco	0.471777	-0.03063	-0.06882	-0.07768	-0.21513	-0.01519	-0.0629
	Transport	1.407552	-0.09094	-0.20424	-0.23051	-0.03562	-0.64695	-0.18669
	Lodging	0.929669	-0.06022	-0.13526	-0.15267	-0.02358	-0.02986	-0.52218
Urban5	Food	0.500621	-0.38178	-0.05275	-0.04601	-0.00762	0.039496	-0.04993
	Eating Out	0.515337	-0.02269	-0.42444	-0.04736	-0.00784	0.040655	-0.0514
	Non-Food	0.996415	-0.04376	-0.1047	-0.80382	-0.01512	0.078434	-0.09912

Appendix 6 Estimates of Elasticity of Household Demand

		Income Demand Elasticity	Price Elasticity of Demand					
			Food	Eating Out	Non-Food	Alcoholic Beverages and Tobacco	Transport	Lodging
	Alcoholic Beverages & Tobacco	0.516002	-0.02272	-0.05436	-0.04742	-0.37865	0.040707	-0.05146
	Transport	2.127743	-0.09291	-0.2222	-0.19386	-0.03211	-1.34417	-0.21036
	Lodging	0.743915	-0.03272	-0.07828	-0.06829	-0.01131	0.058626	-0.60728
Rural1	Food	0.764244	-0.40979	-0.09125	-0.09022	-0.01098	-0.02462	-0.13347
	Eating Out	1.183258	-0.41776	-0.35622	-0.13935	-0.01696	-0.03804	-0.20615
	Non-Food	1.270282	-0.44822	-0.15124	-0.38051	-0.0182	-0.04082	-0.2212
	Alcoholic Beverages & Tobacco	1.3631	-0.48067	-0.1622	-0.16037	0.26756	-0.04378	-0.23723
	Transport	0.716747	-0.25385	-0.0856	-0.08463	-0.0103	-0.15401	-0.12521
	Lodging	0.948683	-0.33547	-0.11315	-0.11187	-0.01361	-0.03054	-0.33831
Rural2	Food	0.679734	-0.50386	-0.04842	-0.02946	-0.00666	-0.01376	-0.07397
	Eating Out	1.002832	-0.23483	-0.57859	-0.04339	-0.00981	-0.02026	-0.10893
	Non-Food	1.442517	-0.33688	-0.10233	-0.78964	-0.01409	-0.02908	-0.15632
	Alcoholic Beverages & Tobacco	0.985553	-0.23081	-0.07009	-0.04264	-0.50856	-0.01991	-0.10707
	Transport	1.193298	-0.2791	-0.08477	-0.05158	-0.01167	-0.62714	-0.12949
	Lodging	0.921329	-0.21585	-0.06554	-0.03988	-0.00902	-0.01862	-0.56633
Rural3	Food	0.663476	-0.52312	-0.0352	-0.03506	-0.0085	0.00671	-0.06471
	Eating Out	1.034406	-0.20571	-0.66287	-0.05456	-0.01323	0.010442	-0.10068
	Non-Food	1.206579	-0.23971	-0.06382	-0.77188	-0.01542	0.01217	-0.11733
	Alcoholic Beverages & Tobacco	0.711127	-0.14169	-0.03771	-0.03757	-0.42843	0.00719	-0.06934
	Transport	1.871514	-0.37035	-0.09866	-0.09828	-0.02384	-1.07499	-0.18133
	Lodging	0.875857	-0.17435	-0.04641	-0.04623	-0.01121	0.008848	-0.6007
Rural4	Food	0.565201	-0.46698	-0.02324	-0.01787	-0.00875	0.012476	-0.05812
	Eating Out	1.068119	-0.17556	-0.74766	-0.03369	-0.01649	0.02352	-0.10954
	Non-Food	1.248899	-0.20506	-0.05118	-0.86114	-0.01927	0.027477	-0.12796
	Alcoholic Beverages & Tobacco	0.588808	-0.09705	-0.02421	-0.01862	-0.39879	0.012996	-0.06054

Appendix 6 Estimates of Elasticity of Household Demand

		Income Demand Elasticity	Price Elasticity of Demand					
			Food	Eating Out	Non-Food	Alcoholic Beverages and Tobacco	Transport	Lodging
	Transport	1.797532	-0.29421	-0.07345	-0.05648	-0.02766	-1.13897	-0.18362
	Lodging	0.744006	-0.12252	-0.03057	-0.02351	-0.01151	0.016409	-0.56786
Rural5	Food	0.155595	-0.1393	-0.01755	-0.0162	-0.00422	0.042746	-0.02085
	Eating Out	0.290467	-0.04436	-0.24811	-0.03021	-0.00787	0.07976	-0.03889
	Non-Food	0.865382	-0.13173	-0.09722	-0.72785	-0.02337	0.237136	-0.11548
	Alcoholic Beverages & Tobacco	0.228427	-0.0349	-0.02575	-0.02377	-0.1757	0.062739	-0.03059
	Transport	4.103361	-0.61331	-0.45292	-0.4181	-0.10902	-1.86729	-0.5378
	Lodging	0.425401	-0.06492	-0.04791	-0.04422	-0.01151	0.116755	-0.37189

VITA

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