DEVELOPING 'TRAVELTHAI':

A DYNAMIC COMPUTABLE GENERAL EQUILIBRIUM MODEL FOR TOURISM OF THAILAND AND CASE APPLICATIONS ON TOURISM SETBACKS AND TOURISM-RELATED FISCAL POLICIES

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DOCTOR OF PHILOSOPHY

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A Thesis Submitted to Monash University
for the Degree of Doctor of Philosophy

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Words of Inspiration:

"The world is a book and those who do not travel read only one page."
St. Augustine

While people state 'travel' as one of the interests or hobbies…

Inspiration to make a contribution as the thesis upon the issue of Tourism for Thailand comes from the more-than-interest of the author upon 'travel'.

Life is a journey through time. It took the author a wait of one decade to have the opportunity to complete.

Words of Dedication:

While this thesis is the academic work for those who are passionate in the Computable General Equilibrium Modeling

It is one part dedicated to the Tourism of Thailand and the other for those managing fiscal policies, in hope that it be useful for policy planning.

But, the perseverance to complete it is for the author's mother and two of his aunts.

For one of them was the story teller in the time the inspiration was so in need, and for the other was the one who inspired and made 'travel' to be of more than interest.

Statement of Authorship

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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TABLE OF CONTENTS

ABSTRACTS i
ACKNOWLEDGEMENTS iv
LISTS OF TABLE vii
LISTS OF FIGURE ix
Page

CHAPTER 1: INTRODUCTION

1.1. INTRODUCTION 1-2
1.2. OBJECTIVES AND SCOPE OF THE STUDY 1-6
1.3. CONTRIBUTIONS OF THE THESIS 1-7
1.3.1'TRAVELTHAI'- A DYNAMIC CGE MODEL FOR THAI TOURISM 1-7
1.3.2 THE CONSTRUCTION OF A CGE DATABASE 1-8
1.3.3 DEVELOPING THE BASELINE FOR THAI ECONOMY OVER 2001-2011 1-10
1.3.4 FORECAST AND POLICY SIMULATIONS OVER 2012-2020 1-10
1.3.5 EXTENSION ON REGIONAL DISAGGREGATION 1-11
1.4. ORGANIZATION OF THE THESIS 1-12

CHAPTER 2: DEFINITIONS AND LITERATURE REVIEWS

2.1. DEFINITION OF TOURISM 2-1
2.2. SOME CONCEPTS ON TOURISM 2-4
2.3. TOURISM SATELLITE ACCOUNTS 2-5
2.4. LITERATURE REVIEWS 2-6
2.4.1. LITERATURES ON THAI TOURISM 2-6
2.4.2. LITERATURES ON CGE MODELLING 2-7
2.4.3. CONCLUDING REMARKS 2-15

CHAPTER 3: OVERVIEW OF THE THAI ECONOMY AND TOURISM INDUSTRY

3.1. RECENT DEMOGRAPHIC FACTORS AND ECONOMIC DEVELOPMENT 3-1
3.1.1. THAI ECONOMY BEFORE 2000 3-2
3.1.2. DECADE OF 2000-2009 AND BEYOND 3-5
3.2.THE STRUCTURAL CHANGES OVER THE DECADES 3-6
3.2.1. FROM 1990 TO 2000 3-7
3.2.2. FROM 2000 TO 2010 3-9
3.3. TOURISM INDUSTRY AND ITS SIGNIFICANCE 3-10
3.3.1. OVERVIEW OF THAI TOURISM INDUSTRY AND ITS SIGNIFICANCE 3-10
3.3.2. STRUCTURE OF TOURISM INDUSTRY FROM TSA 2000 3-23
3.3.3. INTERNATIONAL MARKET 3-25
3.3.4. THE ROLE OF THAI TOURISM 3-27
3.3.5. OVERALL POTENTIAL OF INDUSTRY 3-29
3.4. TOURISM GEOGRAPHY AND TOURIST DESTINATIONS OF THAILAND 3-31
3.4.1. OVERVIEW OF THAI TOURISM GEOGRAPHY 3-31
3.4.2. TOURISM RESOURCES AND TOURISM DESTINATION HITS 3-35

3.5. RECENT TRENDS IN TOURISM..... 3-39
3.5.1. SWOT ANALYSIS..... 3-39
3.5.2. CURRENT SITUATION, AGENDA, AND POLICY TRENDS..... 3-42

CHAPTER 4: THEORETICAL FRAMEWORK

4.1. OVERVIEW..... 4-1
4.1.1. GENERAL CHARACTERISTICS OF THE MODEL..... 4-1
4.1.2. SOLUTION METHOD AND LINEARIZATION..... 4-2
4.2. TRAVELTHAI MODEL..... 4-5
4.3. THEORETICAL STRUCTURE OF TRAVELTHAI MODEL..... 4-9
4.3.1. OUTPUTS AND INPUTS..... 4-14
4.3.2. HOUSEHOLD DEMANDS FOR COMMODITIES..... 4-19
4.3.3. DEMANDS FOR EXPORTS..... 4-21
4.3.4. GOVERNMENT DEMANDS..... 4-22
4.3.5. INBOUND TOURISTS' DEMANDS..... 4-22
4.3.6. DOMESTIC TOURISTS' DEMANDS (NATIONAL TOURISTS) 4-23
4.3.7. DEMANDS FOR MARGIN SERVICES..... 4-23
4.3.8. SUPPLY EQUALS DEMAND FOR COMMODITIES..... 4-23
4.3.9. ZERO PROFITS IN PRODUCTION, IMPORT, EXPORT & DISTRIBUTION..... 4-24
4.3.10. INDIRECT TAXES..... 4-25
4.3.11. MACRO VARIABLES..... 4-26
4.3.12. CAPITAL STOCKS, INVESTMENT, RATES OF RETURN..... 4-26
4.3.13. BALANCE OF PAYMENTS AND GNP..... 4-30
4.3.14. FUNCTION FOR PRIVATE AND PUBLIC CONSUMPTION..... 4-32
4.3.15. THE GOVERNMENT ACCOUNTS..... 4-32
4.3.16. STICKY-WAGE SPECIFICATION FOR POLICY SIMULATIONS..... 4-34
4.3.17. TECHNICAL AND PREFERENCE CHANGE..... 4-34
4.3.18. EQUATIONS FOR FACILITATING HISTORICAL AND FORECAST SIMULATIONS..... 4-34
4.3.19. TOP-DOWN REGIONAL EXTENSION..... 4-35
4.3.20. THE REST OF EQUATIONS..... 4-36
4.4. INTRODUCTION TO GEMPACK..... 4-38

CHAPTER 5: DATABASE

5.1 THE THORANI DATA FILE..... 5-1
5.2. THE 2000 TOURISM SATELLITE ACCOUNTS OF THAILAND..... 5-7
5.3. THE CONSTRUCTION OF THE THORANI DATA FILE 5-11
5.3.1. CONVERTING RAW DATA TO THE HAR FILES. 5-12
5.3.2. MAKING MARGINS TABLE..... 5-13
5.3.3. MAKING PRODUCER PRICE TABLE 5-13
5.3.4. COMPUTING INDIRECT TAXES ACROSS USERS 5-14
5.3.5. COMPUTING BASIC VALUE FLOWS..... 5-16
5.3.6. COMPUTING DOMESTIC & IMPORT MARGINS 5-17
5.3.7. CALCULATING THE FACTOR PAYMENTS 5-18
5.3.8. ESTIMAING TOTAL COLUMN SUMS OF INV MATRIX..... 5-19
5.3.9. CALCULATING INVESTMENT SHARE BY INDUSTRY..... 5-20
5.3.10. RAS FOR INVESTMENT SHARES..... 5-21

5.3.11. SPLITTING INVESTMENT COLUMN 5-22
5.3.12. COST EQUAL TO SALES..... 5-23
5.3.13. MAKING THE THORANI DATABASE FILE..... 5-23
5.4. DEALING WITH PARAMETERS..... 5-26
5.5. A BALANCE CHECK FOR THE THORANI DATA FILE 5-27
5.6. ADD-ONS FOR DYNAMIC MECHANISM..... 5-27
5.6.1. DATABASE FOR INVESTMENT AND CAPITAL ACCUMULATION..... 5-27
5.6.2. DATABASE FOR NET FOREIGN LIABILITIES..... 5-30
5.6.3. GOVERNMENT ACCOUNTS..... 5-30
5.6.4. DATABASE FOR WAGE ADJUSTMENT AND TAX RATE ON FACTOR INCOMES..... 5-32
5.6.5. ACCOUNTS WITH THE REST OF THE WORLD..... 5-32
5.7. DEALING WITH INDIRECT TAX MATRICES..... 5-34
5.8. REGIONAL SHARES..... 5-39
5.9. REMARKS ON DATABASE..... 5-40

CHAPTER 6: HISTORICAL SIMULATIONS

6.1. INTRODUCTION 6-1
6.1.1. TYPES OF DYNAMIC SIMULATIONS..... 6-1
6.1.2. NATURE OF DYNAMIC SIMULATIONS 6-3
6.2. BACK-OF-THE-ENVELOPE MODEL (BOTE) 6-4
6.3. CLOSURES OF THE BASELINE SIMULATION..... 6-6
6.4. DATA SOURCES AND DATA CONSISTENCY..... 6-8
6.5. BASELINE SIMULATION..... 6-10

CHAPTER 7: FORECAST SIMULATIONS

7.1. INTRODUCTION 7-1
7.2. BASELINE FORECAST..... 7-3

CHAPTER 8: POLICY SIMULATIONS: TOURISM SETBACK

8.1. EXTERNAL SHOCK 8-1
8.1.1. OVERVIEW OF 2011 FLOOD..... 8-2
8.1.2. BEHAVIORAL EFFECTS 8-5
8.1.3. RESOURCE LOSS EFFECTS 8-6
8.1.4. SUMMARY OF THE EXTERNAL SHOCK 8-14
8.2. EFFECTS OF THE FLOOD AS THE SETBACK TO TOURISM..... 8-18
8.2.1. A SHIFT IN INBOUND TOURISTS' DEMAND (COLUMN 1)..... 8-22
8.2.2. A CUT IN NUMBER OF DOMESTIC TOURISTS (COLUMN 2)..... 8-27
8.2.3. LOSSES IN AGRICULTURAL LAND (COLUMN 3)..... 8-30
8.2.4. LABOR PRODUCTIVITY CHANGES (COLUMN 4)..... 8-33
8.2.5. CAPITAL DAMAGES (COLUMN 5)..... 8-38
8.2.6. ANNUAL TOTAL (COLUMN 6)..... 8-40
8.2.7. AFTER-EFFECT FORECAST GROWTH TO 2020..... 8-43
8.3. POLICY SIMULATION..... 8-47

CHAPTER 9: SUMMARY AND FUTURE RESEARCH

9.1. OVERVIEW..... 9-1
9.2. TRAVELTHAI AND BASELINE SIMULATION..... 9-3
9.3. MAIN FINDINGS FROM FORECASTING AND POLICY SIMULATION..... 9-4
9.4. POTENTIAL APPLICATIONS, LIMITATIONS AND RECOMMENDATIONS..... 9-10
9.4.1. POTENTIAL APPLATIONS OF TRAVELTHAI..... 9-10
9.4.2. LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH..... 9-11

REFERENCES R-1

APPENDICES A-1
APPENDIX 4.1. Derivation of input demand functions from the CES production function A-2
APPENDIX 4.2. Derivation of elasticities from the household optimization problem with Klein-Rubin Utility function A-5
APPENDIX 5.1. Shares of value added components for 40 sectors (%) A-8
APPENDIX 5.2. Margin rates on composite commodities (%) A-9
APPENDIX 5.3. Industry cost shares (%) A-10
APPENDIX 5.4. Sales shares of domestic and imported commodities (%) A-12
APPENDIX 5.5. Industry shares in economy-wide production costs (%) A-14
APPENDIX 5.6. Commodity shares in economy-wide aggregate outputs and sales (%) A-16
APPENDIX 5.7. Industry shares in the use of composite commodities for intermediate purposes (%) A-18
APPENDIX 5.8. Composite commodity shares in industry intermediate input costs (%) A-22
APPENDIX 8.1A. Geographical depiction of the flood in October 2011, Bangkok and surrounded area A-26
APPENDIX 8.1B. Situation of the flood, year end of 2011, Northern & Central regions A-27
APPENDIX 8.2. More simulation results, deviations from baseline forecast A-28
APPENDIX 8.3. More results on policy simulations, Tax incidence A-30

ABSTRACTS

This thesis is aimed to develop a Monash-style medium-scale dynamic computable general equilibrium (CGE) model for Tourism of Thailand as the major contribution. The model is designed to be capable of analyzing not only the economic policies but also historical simulation and forecasting simulation. The comparative static version of the 'THORANI' model is first developed and later on improved it into the dynamic version of the 'TRAVELTHAI' model that comprises dynamic capability.

TRAVELTHAI's modeling structure is based upon the MyAGE and McHuge, which are successors of MONASH, the dynamic CGE model of the Australian economy (Dixon and Rimmer 2002) that contains the dynamic mechanism features. The TRAVELTHAI model captures the structure of the Thai economy using the coefficients attributing from the Thai Tourism Satellite Accounts (TSAs) which is the main distinction from the other kinds of CGE models, for which normally use the Input Output Tables, the adoption of proper substitution elasticities as the key parameters, and the portrayal of specific features regarding tourism which are also relevant to the Thai economy. The model contains a detailed disaggregation of industries, especially those related to Tourism, factors of production, technologies and preferences, taxes and margins, a comprehensive illustration of government accounts, balance of payment accounts, and net foreign liabilities. The dynamic mechanisms also include the links between stock and flow variables for physical capital accumulation, for debt and savings, and for wage-employment adjustment.

TRAVELTHAI possesses 3 types of tourism demands: Inbound, Domestic, and Outbound tourism. Although the thesis thematically focuses on inbound tourism or travel receipts in the Service accounts of the Balance of Payments, this gives the power to further study in terms of revenue and expenditure of the balance of travel.

The baseline historical simulation of the Thai economy over the period 2001-2011 and baseline forecast for 2012-2020 are performed. The decade has shown an interesting rapid growth with the contribution of tourism growth of seven percent per annum on the average despite adverse tourism setbacks ranging from epidemic flu, tsunami, the recent political turmoil and the flood. Six major simulations with TRAVELTHAI have

been conducted. The first is the historical simulation, for which observed changes in economic variables e.g. changes in GDP, outputs of industries, factors of production, household consumption or international trade become the exogenous shocks for the model, and changes in technologies and preferences are solved endogenously. This is aimed to develop the baseline for the Thai economy. Three projections to the year 2020 of the forecasting simulation have been carried out, bases on the evidence of the decade average, the first half and the second half of the previous decade. This time, the economic performance is evaluated from the structural changes in technologies and preferences obtained earlier and projects to the future to develop the baseline forecasts of these three projections. The fifth and the sixth are major simulations regarding the thesis objectives. They are those with external shocks and policy simulations. Simulation for external shocks of tourism setback in term of recent major flood is delivered. Behavioral effects of demand side and resource losses effect of supply side shocks are then applied in five sub-total shocks. Two behavioral effects are inbound tourism shift and the cut in the number of domestic tourists. Other three resources losses shocks are related to the losses or damages of factors of production: labor, capital, and land. The sixth simulation is the tourism-related fiscal policy on the tax cut for inbound tourism. The comparison between tax cut and without tax cut scenarios is also presented. This is aimed to pursue for alleviating measure to soothe the effect of tourism setback.

Apart from historical and forecasting simulations which are aimed to create the benchmark as the baseline forecasts, the results from the setback simulation show that in the short run the flood causes the declines of real GDP and its compositions relative to the baseline. Trade balance deteriorates. Inbound tourism also decreases but not as much as outbound and domestic tourism. Domestic tourism revenue, thus, drops. Travel receipts accordingly weaken, but less than travel expenses worsen, which improves travel balance. For the supply side, the labors migrate to non-tourism industries from the tourism-related industries. Output productions are all reduced, with non-tourism industries most worsening. The flood damages the economy. In all, resource losses effects show domination over other effects.

The after effect forecast growths to the year 2020 show that both behavioral and resource-loss effects of flooding reduce real GDP and its components overtime.

Labors migrate to the non-tourism industries from direct tourism industries and tourism-connected industries. Direct tourism industries suffer more than tourism-connected industries in terms of labor reduction and the releases of labor rising through the period. All sectors produce less output, accordingly. Over-time slight deterioration in terms of trade subsequently improves balance of travel.

Simulation on a tax cut as an incentive for the inbound tourist shows a plus to the falling real GDP relative to the baseline. Tax cut creates a larger impact on inbound tourism. Travel receipts increase accordingly, comparing to the decrease in the scenario without any tax cut. Tax cut improves balance of travel towards a surplus comparing to the lower gain of that without the tax cut. It also generates more outputs in the direct tourism industries as expected, though not enough to make a positive outcome for the total but the fall in the reduction of output production is a better off. This is in line with the greater amount of labor hired in the sector. For other two industries, they are worse off as their own labors migrate to the direct tourism industries. Their productions follow the falls in their sectoral employment.

For the after effect tax cut forecast growth to 2020, only real inbound tourism and tourism receipts have considerable changes comparing to that without tax cut. For real inbound tourism, the after-flood growth is negative for without tax cut scenario in the short run and recover to be positive in the long run. With the tax cut, the deviation from base case forecast is positive and growing further in the long run. Tourism receipts show similar pattern. Nonetheless, the effect on the deviation over real GDP is very tiny and it reveals the same trend for both tax cut and without tax cut. Outputs and employments of direct tourism industries with tax cut decline less than that of without tax cut, though with similar declining trend. For tourism-connected industries, the reductions are about the same with the similar trend. For non-tourism industries, there are further output and employment reductions comparing to the without tax cut scenario.

Tax cut incentive could be one of alleviating measures to soothe the tourism setback. Political-wise, a mix of incentives could be further pursued for what-if analyses to examine all inclusive effects other than tourism-focused. Such policy planning is helpful to understand trade-offs among economic agents to minimize incurring costs.

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LISTS OF TABLE

Page

CHAPTER 1: INTRODUCTION

1.1. Major incidents considered as setbacks to Thai Tourism industry year 2001-2011 1-5

CHAPTER 2: DEFINITIONS AND LITERATURE REVIEWS

2.1. Brief Summary of Literature Reviews of Some Important CGE Models in Thailand 2-17
2.2. Brief Summary of Literature Reviews about Dynamic CGE models 2-19
2.3. Brief Summary of Literature Reviews about the CGE application on Tourism and related issues 2-20

CHAPTER 3: OVERVIEW OF THE THAI ECONOMY AND TOURISM INDUSTRY

3.1. Major macroeconomic and sectoral changes in two decades 3-7
3.2. Target achievement in National Economic and Social Development Plans 3-11
3.3. Travel Receipts and Value of Major Exported Commodities, 2000-2011 3-12
3.4. Travel Expenses and Value of Major Imported Commodities, 2000-2011 3-17
3.5. Some information on Domestic Tourism during 2000-2010 3-22
3.6. World's international tourist arrivals by Regions 3-25
3.7. World's international tourism receipts by Regions 3-25
3.8. World's International Tourist Arrivals by Regions of Origins 3-26
3.9. World's Top Spenders 3-26
3.10. World's Top Tourism Destinations (absolute numbers) 3-27
3.11. World's Top International Tourism Receipts (US$ billion) 3-28
3.12. Top ten TTCI of countries in Asia & Pacific Region 3-29
3.13. Thailand's score and ranking in TTCI 2011 3-30
3.14. Seasonal effects of Thailand and original tourist countries 3-33
3.15. Number of Attractions in the Perception of Tourists 3-35
3.16. Regional Distribution of Tourists in 2007 3-38

CHAPTER 4: THEORETICAL FRAMEWORK

4.1. Stylized version of TRAVELTHAI equations 4-10
4.2. Notation of variables in the stylized model 4-12
4.3. List of Items in the Current Account Balance 4-31
4.4. List of Items in the Financial Accounts 4-31
4.5. Lists of programs in GEMPACK concerning its functional tasks 4-39

CHAPTER 5: DATABASE

5.1. List of sets and associated dimensions 5-4
5.2. List of coefficients and associated dimension 5-5
5.3. List of Parameters and associated dimension 5-6
5.4. List of the TSA industries by categories 5-7
5.5. List of Parameters and associated values 5-26
5.6. Capital Stock of Thailand in year 2000 (in Million Baht) 5-28
5.7. Growth of Capital Stock of Thailand in year 2000 5-29

5.8. Net Foreign Liabilities of Capital Accounts in Balance of Payments 5-30
5.9. Government account items in TRAVELTHAI, for 2000, in Million Baht 5-31
5.10. Gross Fixed Capital Formation of 1999 – 2001 in Million Baht. 5-32
5.11. Current Accounts in Balance of Payments, for 1999-2001, in Million Baht 5-33
5.12. Transfers with the rest of the world, 1999-2001, from NIA 5-33
5.13. Indirect taxes and subsidies in 2000 (in Million Baht) 5-35
5.14. List of sets and associated dimension of TRAVELTHAI 5-42
5.15. Dimension of the TRAVELTHAI Coefficient Database 5-42

CHAPTER 6: HISTORICAL SIMULATIONS

6.1. The BOTE model and its standard short-run and long-run closures 6-5
6.2. Status summary of some variables under the historical closure 6-7
6.3. Historical Macroeconomic Data 2001 – 2011 (real terms) 6-11
6.4. Adjusted average of macro inputs for baseline Simulation and GDP result 6-11
6.5. Some associated preferences, structural and technological terms 6-12
6.6. Some Sectoral structural changes in the economy, 2001-2011 (%) 6-14

CHAPTER 7: FORECAST SIMULATIONS

7.1. Status of some variables under the historical and forecast closures 7-2
7.2. Historical and forecast simulation: macroeconomic indicators, per cent 7-3
7.3. Population growth assigned for forecast closures 7-5

CHAPTER 8: POLICY SIMULATIONS: TOURISM SETBACK

8.1. Scenarios on the Tourists Forecast of Flooding Incidence of 2011 8-6
8.2. Employment in 2011 and Q1 of 2012 (whole country in thousands persons) 8-7
8.3. Labour Productivity Index per employed persons by sectors (2010-11) 8-8
8.4. Information on damages and losses by group of sectors (million baht) 8-10
8.5. Information on the cost and value added (per month) before flooding 8-12
8.6. Regional agricultural area and percentage of flooded agricultural area (in Rai) 8-12
8.7. Damages from Flooding 1989 – 2010, whole country 8-13
8.8. Areas Affected from Flooding and Subsidization 1989-2010 8-14
8.9. Summary of the effects of flood as Tourism setback for external shock 8-15
8.10. Macro perturbed solution with the sub-totals of external shock (2012) 8-19
8.11. Deviations from Baseline with the sub-totals of external shock (2012) 8-20
8.12. Sectoral perturbed solution with the sub-totals of external shock (2012) 8-21
8.13. Deviations from Baseline of Sectoral results with the sub-totals of external shock (2012) 8-21
8.14. Status of some variables under the policy and forecast closures 8-22
8.15. Deviations from Baseline of macro results with tax incentive (2012) 8-49
8.16. Deviations from Baseline of sectoral results with tax incentive (2012) 8-50

LISTS OF FIGURE

Page

CHAPTER 1: INTRODUCTION

1.1. Annual visitor arrivals and % year-on-year growth 1993 - 2007 (15 years) 1-2
1.2. Inbound and Outbound visitors (in persons) and domestic visitors (in trips) during 2000-2011 1-4

CHAPTER 3: OVERVIEW OF THE THAI ECONOMY AND TOURISM INDUSTRY

3.1. Travel Receipts and Other Major Export Commodities (Million Baht) 3-13
3.2. Ratio of Travel Receipts to Export of Services from 2000 to 2011 3-13
3.3. Ratio of Travel Receipts in Gross Domestic Products from 2000 to 2011 3-15
3.4. Number of the outbound tourists and its growth rates 2000-2011 3-16
3.5. Tourism Expense and Other Major Imported Commodities (Million Baht) 3-17
3.6. Ratio of Travel Expense to Both of Import Services from 2000 to 2011 3-18
3.7. Ratio of Travel Receipts and Expenses in GDP from 2000 to 2011 3-19
3.8. Domestic tourist trips and its percentage change (y-o-y) 3-20
3.9. Comparisons of ratios of Domestic Tourism revenue and the summation of Domestic Tourism revenue and Travel Expenses to Private Final Consumption 2000-10 3-21
3.10 Comparisons of ratios of Domestic Tourism revenue, Travel Receipts and Travel Expenses to GDP from 2000 to 2011 3-21
3.11. Structure of Thai economy with the Tourism categories 3-23
3.12. Structure of tourists' demand for each commodity 3-23
3.13. Cost structure of each Tourism-related sector in TSA 2000 3-24
3.14. Map of Thailand showing 5 regions and its neighbouring countries 3-32
3.15. Map of Thailand showing 6 regions (Bangkok within Central region) 3-34
3.16. Spatial Distribution of Some Important Tourist Attractions. 3-36

CHAPTER 4: THEORETICAL FRAMEWORK

4.1. Composition of output 4-14
4.2. Input technology for current production 4-16
4.3. Composition of investment 4-19
4.4. Structure of household demand 4-20
4.5. The equilibrium expected rate of return schedule for industry i 4-30
4.6. Information required to specify a simulation 4-40
4.7. Steps in the GEMPACK process 4-41

CHAPTER 5: DATABASE

5.1. Pattern of the THORANI Database 5-2
5.2. Components of Tourism Satellite Accounts in the Input-Output formulation 5-9
5.3. Steps for constructing the THORANI Data File 5-11
5.4. Database after stage 1 5-12
5.5. Database after stage 2 5-13
5.6. Database after stage 3 5-13
5.7. Database after stage 4 5-15
5.8. Filling the THORANI form after stage 4 5-15

5.9. Database after stage 5 5-16
5.10. Filling the THORANI form after stage 5 5-16
5.11. Database after stage 6 5-17
5.12. Filling the THORANI form after stage 6 5-17
5.13. Database after stage 7 5-18
5.14. Filling the THORANI form after stage 7 5-18
5.15. Database after stage 8 5-19
5.16. Database after stage 9 5-20
5.17. Database after stage 10 5-21
5.18. Database after stage 11 5-22
5.19. Filling the THORANI form after Stage 11 5-22
5.20. Filling the THORANI form and database after Stage 12 5-24
5.21. THORANI database file after stage 13 5-25
5.22. TRAVELTHAI Database in Full Format 5-41

CHAPTER 6: HISTORICAL SIMULATIONS

6.1. A sequence of solutions using the final solution for the year t-1 as the initial solution for year t 6-3
6.2. Steps for baseline simulations 6-6

CHAPTER 7: FORECAST SIMULATIONS

7.1. Steps from historical simulations to forecast simulations 7-2
7.2. Historical and forecast simulation: group sectoral shares in GDP, per cent 7-4
7.3. Three Forecasts on GDP growth (2012-2020) 7-7
7.4. Three forecasts on the number of inbound visitors (million) 7-8
7.5. Three forecasts on the number of domestic visitors (million trips) 7-9
7.6. Three forecasts on the number of outbound visitors (million) 7-10
7.7. Three forecasts on Travel receipts (Billion Baht) 7-11
7.8. Three forecasts on Travel expenses (Billion Baht) 7-12
7.9. Three forecasts on domestic tourism revenue (Billion Baht) 7-13
7.10. Three forecasts on Balance of Travel: 2012-2020 7-14

CHAPTER 8: POLICY SIMULATIONS: TOURISM SETBACK

8.1. Understand the size of the flood and its effects in 5 minutes 8-4
8.2. % Deviations from Base case Forecasts of Real GDP and its composition 8-45
8.3. % Deviations from Base case Forecasts of Terms of Trade and Real Exchange Rate 8-45
8.4. % Deviations from Base case Forecasts of Travel Receipts & Expenses and Domestic 8-46
8.5. % Deviations from Base case Forecasts of Real wage and Employment 8-46
8.6. % Deviations from Base case Forecasts of Outputs (2011-2020) 8-47
8.7. % Deviations from Base case Forecasts of Real GDP, Real inbound tourism, and Tourism receipts comparing between tax cut and without tax cut 8-54
8.8. % Deviations from Base case Forecasts of Outputs comparing between tax cut and without tax cut 8-54
8.9. Deviations from Base case Forecasts of Sectoral employments comparing between tax cut and without tax cut 8-55

Chapter 1

Introduction

"Future research on CGE tourism analysis is likely to focus on three main areas. The first involves further research on dynamic CGE analysis. This is currently at the frontier of developments in tourism modeling, in terms of both theoretical and empirical contributions…."

Adam Blake, Jonathan Gillham, and M. Thea Sinclair
'CGE tourism analysis and policy modeling' in
International Handbook on the Economics of Tourism (2006)

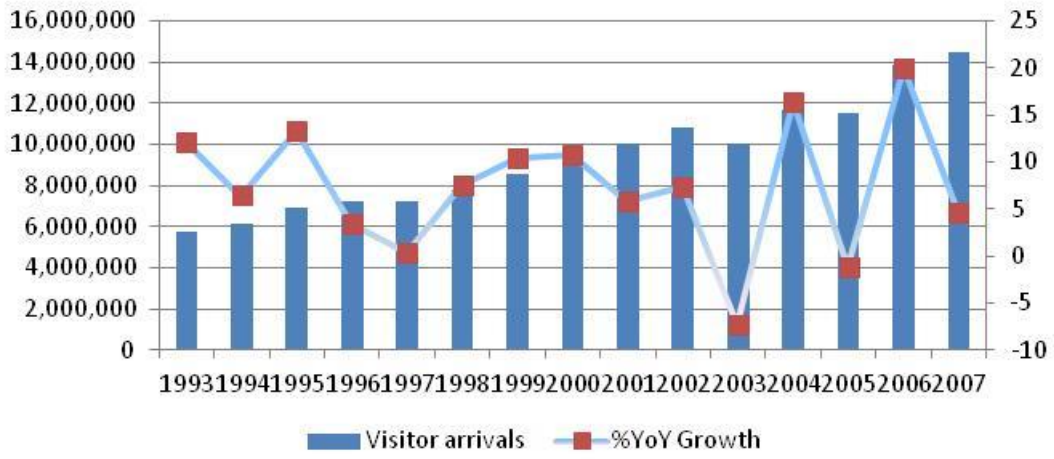
Tourism inevitably plays a substantial role in the economy (i.e. Narayan (2003), Ekoramaiphon (2004), RU (2004), Goeldner and Ritchie (2006)). Overall resources of a nation can be viewed as tourism products to sell either domestically or export to the world. These products range from tourist attractions: man-made and natural sites, culture including lifestyles and festivals, biodiversity and environment, tourism services, entertainment and recreation, souvenirs, to the people themselves (Goeldner and Ritchie, 2006).

The uniqueness of Tourism is derived from the fact that, in order to consume the tourism products, the consumers such as travellers or tourists need to travel to use the services or attain to the location of the tourist attractions. Such reason makes Tourism an amalgam of industries, such as, transportation, accommodation, food and beverage services, recreation and entertainment, security system, and travel agencies in order to provide tourist service system so as to comfort or facilitate or make the availability of products for the consumers (i.e. UNWTO (2010) and Goeldner and Ritchie (2006)). Tourism demand would generally be stimulated by the marketing system, via advertisements or words of mouth, and this leads to decision making for travellers. Paying to acquire such a composite of products would then result in the satisfaction and impression (or, else?) and deliver a travel experience. In a more economic sense, Tourism is a complex phenomenon and could be viewed as the sum total of tourist expenditure within the borders of a nation or a political/economic area of states (Goeldner and Ritchie, 2006). This is, thus, considered as the revenue for the nation.

1.1. Introduction

Thai Tourism industry has been growing at the consecutive high rates. Concerning Inbound Tourism, Tourism revenue has grown substantially from the receipts of 2,175 million Baht in 1970 to 253,018 million Baht in 1999 and ranks one of the top three major exporting sectors in Thailand for many consecutive years (TAT (2012) and RU (2004)). There have been more than 10 million annual visitor arrivals since 2001. In 2007, around 14.5 million international tourists visited Thailand, or 2.5 times those of 5.8 million in 1993 over the period of 15 years, which adds a rising trend of an average growth of 7.0 per cent annually (Figure 1.1). The number of the foreign visitor arrivals reached the highest peak in 2011 at 19.1 million visitor arrivals with the receipts of 800.6 billion baht, double of the amount in the year 2000 of 9.51 million visitor arrivals and 2.6 times higher of the receipts about 299.5 billion baht of that year (BOT, 2012), although with the worst flood in 70 years (Figure 1.2).

Figure 1.1: Annual visitor arrivals and % year-on-year growth 1993 - 2007 (15 years)



Source: Immigration Bureau, Royal Thai Police

Domestic Tourism is also considered to have a high growth. As shown in Figure 1.2, the number of domestic visitors (Thai residents) has grown from about 54.74 million trips in 2000 to 122.52 million trips in 2010, which is more than double over a decade. The domestic tourism revenue does also increase about double over a decade from 210.5 billion baht in 2000 to 402.5 billion baht in 2010 (TAT and MOTS, 2012). Outbound Tourism grows even larger over a decade. The number shows more than 3.7 times increase from about 1.91 million persons in 2000 to 7.11 million persons in 2011, although with only 1.5 times rising up from about 111.4 billion baht in 2000 to 172.3 billion baht in 2011 (BOT, 2012).

The high and increasing both the number of visitors and together the sum of the travel receipts and the domestic tourism revenue over the expenses of outbound tourists could support the significant role of Tourism very well.

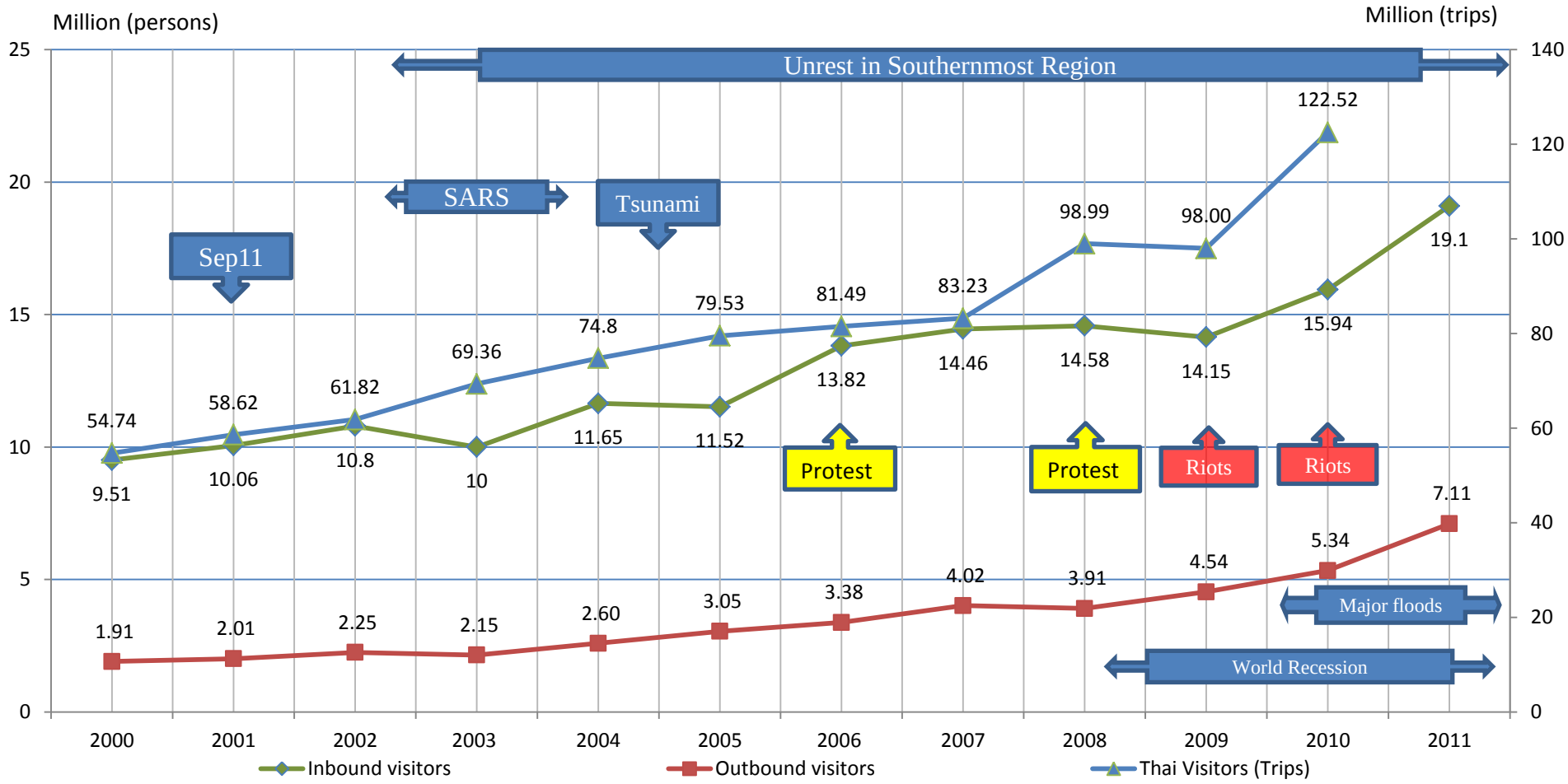
This increasing potential could prove to be an important catalyst for economic development since Tourism does not only generate income, but does bring about permeated employment all over the country, mitigate migration to big cities, revive the culture of each community, encourage regional and local economies, and improve living standards of people (Chancharas (2011) and RU (2004)).

Nevertheless, adverse situations may arise for the Tourism industry, causing busts. The major incidents considered as striking set-backs for Tourism industry listed in Table 1.1, of which are also shown in Figure 1.2, are well known, especially the recent political turmoil and natural disasters such as tsunami or flooding. It could be seen that, for example in Figure 1.2, the number of the inbound visitors dropped from 10.8 million persons to 10 million persons in 2003 in the presence of SARS as the epidemic in Asia. After Tsunami, the number of inbound visitors also slightly declined to 11.52 million visitors from 11.65 million visitors of the year earlier. The number of inbound visitors and domestic visitors also decreased in 2009 concerning on the impacts of world recession and political instability.

Such sudden shocks maybe regarded as temporary and not affecting the long term growth, however the series of the effects on some direct tourism and tourism-related sectors may lead to the economic costs due to the loss in revenues and the rise of unemployment caused by the event of set-backs and instabilities. The worst flood in 70 years in last quarter of 2011, for example, is estimated to deter the decision to visit of the inbound visitors of 0.7 million persons which costs 19 billion baht of revenue foregone and a decline of domestic tourists 6 million trips or around 13 billion baht (Bkkbiznews, 2011). This still excludes damage costs and losses from inoperability.

In order to implement any measures for economic stabilization, it is, therefore, necessary for the government authorities to be aware, to prepare, and thus, to assess the situation in the context accordingly. Evaluation of the policy implementation would also be useful and could give a foresight, especially for the ‘what if’ scenarios for any effects that may arise upon the issue before any actual policy enact.

Figure 1.2: Inbound and Outbound visitors (in persons) and domestic or Thai visitors (in trips) during 2000-2011



Source: Immigration Bureau of Royal Thai Police, Tourism Authority of Thailand (TAT) and Ministry of Tourism and Sports (MOTS)
Note: 2011 data for domestic visitors is not available, as of April 2012; Protest by PAD (Anti-Thaksin) and Riots by UDD (Pro-Thaksin)

Table 1.1: Major incidents considered as setbacks to Thai Tourism industry year 2001-2011

Incident	Period	Place	Details
1.Incidence of September 11	Sep 2001	World	Global concern on terrorism and biological war regarding anthrax. US & Muslim markets slow down.
2. Unrests in the southernmost region	Late 2003 –presents	Southern region	It has long been in a quest for peaceful measures to quell the five-year unrests in the southernmost region including a part of Songkhla, Pattani, Yala, and Narathiwat.
3. SARS and Influenza A H5N1 Bird flu	2003-2005	Central region	Death from SARS in East Asia scared out tourists. Avian flu led to the 'killing field' of poultry. It directly devastated poultry industry and also threatened the tourism industry with scares for outbreak and human transmission
4. Tsunami	26 Dec 2004	Southern region	Tsunami attacks devastated tourist areas in six provinces on the Andaman coast, including popular tourist destinations Phuket and Khao Lak in Phang-Nga
5. Big protest and Parliament dissolution	Feb-Mar 2006	Bangkok	Anti-Thaksin protest (PAD) gathered to put pressure on Prime Minister Thaksin Shinawatra to resign after the sell-off of his stake in Shin Corp with tax liability exemption
6. Military Coup	19 Sep 2006	Bangkok	Thai Army units loyal to the army chief of staff, Gen Sonthi Boonyaratglin, staged a coup attempt to unseat PM Thaksin Shinawatra to stop creation of social divisions as reasons
7. Government House seized and airports in the South closed	Aug 2008	Bangkok Hat Yai Phuket Krabi	PAD protestors occupied the Government House and closed down airports in Southern region against PM Samak Sundaravej as a nominee for former PM Thaksin
8. Big Yellow-shirt protest	Sep - Oct 2008	Bangkok	A state of emergency declared to pacify the clashes, but the crisis swelled after PM Somchai Wongsawat succeeded PM Samak and let the police disperse protestors violently
9. Seizure of Suvannabhumi and closure of Don Muang	Nov 25-26 2008	Bangkok area	PAD executed "Operation Hiroshima" to seize Suvannabhumi airport to force government to resign. All flights were soon canceled, leaving thousands of travelers stranded in the airport.
10. ASEAN Summit & Red-shirt protest	Apr 8-16, 2009	Pattaya & Bangkok	Thaksin Supporters called for People revolution over the government of PM Abhisit Vejjajiva disrupting ASEAN summit, then a state of emergency in Pattaya & Bangkok.
11. Influenza A H1N1 Swine flu	Apr-May 2009	World	Swine flu outbreaks discovered in Mexico could become a worldwide flu pandemic
12. UDD issues protest and a transfer of protest camp to financial zone	Mar 2010	Bangkok area	Red shirt or Thaksin supporter (UDD) protests result in 18 deaths and over 800 injured. Many countries, including Australia, Canada, Great Britain, Hong Kong, New Zealand, Philippines, and Singapore issued new travel advisories for their citizens.
13. More violence and clashes across Bangkok	Apr 2010	Bangkok area	Violence escalates as police and troops besiege protest camp. At least 35 people are killed and over 250 injured in clashes, including foreign journalists and medical workers. "Red Shirt" leaders warn of the possibility of civil war.
14. Arson attack after ceased fire, many buildings collapse	May 2010	Bangkok area	Army overruns red shirt camp resulting 12 deaths. Red Shirt leaders surrender and are arrested which is followed by rioting across Bangkok. Many buildings are destroyed by arson attacks including Central World shopping centre.
15. Big flood	Oct–Nov 2010	Central& Southern	Big flood in Central, part of North Eastern and Southern region, especially Songkhla province.
16. Gigantic flood	Sep–Dec 2011	Central& Southern	Catastrophic flooding in Central, part of North Eastern and Southern region, especially in Central region. Worst in 70 years.

1.2. Objectives and Scope of the Study

According to the need as mentioned in the introduction earlier, one major objective of this study is to build a medium-scale thematic framework as a comprehensive instrument for economic planning and policy analysis, especially upon the relevant issue of Tourism. This thesis proposes a Monash-style, dynamic computable general equilibrium model for the Thai economy with a specification of Tourism, named as TRAVELTHAI model, which can be applied either to examine a slice of historical period for the contributions of several changes of the economic variables or to perform a wide-range of economic analyses of forecasting and policy implementation. The CGE model is intended to be an explainable basis for the relationship of all the important economic variables either macroeconomic or sectoral: overall production, consumption, investment, employment, price level, international trade, GDP as well as important policy measure variables related to Tourism and non-tourism sectors.

The second relevant endeavour that relates to the abovementioned model is to construct the core database for such model for the Thai economy using Tourism Satellite Accounts of Thailand (TSA). This seeks to formulate the extensive data set which represents the structure and the relationship of each industry of the Thai economy especially for the Tourism industry, which happens to be interrelated with many other industries in terms of 'tourism-amalgam' grouping: direct tourism industries, tourism-connected industries, and non-tourism industries.

Apart from the important purposes of the model and the database development, the model applications on how to use it to assess the economic contribution of Tourism to the Thai economy for both macro-economy and Tourism industry are discussed as a case study for further in-depth applications. The normative dimension of the 'what if' scenarios that CGE model could put into practice would also be beneficial for the attentive policy makers. This includes the policy treatment to counter the unstable fluctuations of tourism flows over time, especially the economic loss when there is a sharp downturn of the setbacks which are normally unfavorable for the related economic agents. This policy simulation could put forward the recommendations to the related authority that has the task to mitigate such Tourism setbacks. Analyses for policy simulation, in terms of the possible 'what if' scenarios, are then carried out as a guideline for future research as another attention of the thesis.

Although there are three certain kinds of Tourism: inbound, outbound, and domestic tourisms (more definitions in Chapter 2), it is important to note that this thesis thematically focuses on inbounded tourism, a kind of export of services, over domestic and outbound ones, and concentrates on building TRAVELTHAI, "the tool", as the major priority to deal with this kind of tourism. Simulations are aimed to be the examples of how to implement the tool as the guidelines for further applications.

1.3. Contributions of the Thesis

There are five main contributions of this thesis listed as follows: (1) the construction of a dynamic CGE model for the Thai economy with the special specification on Tourism; (2) the database development for the model; (3) the baseline simulation from the model for the decade 2001-2011; (4) the simulations of forecast and policy scenarios for the decade of 2012-2020; and (5) extension on regional disaggregation via top-down approach.

1.3.1. **'TRAVELTHAI'- a Dynamic CGE Model for Thai Tourism**

The TRAVELTHAI was created with a core theoretical framework based on that of MyAGE, a Monash-style Applied General Equilibrium model for Malaysia (CoPs, 2010) and McHUGE (later on CHINAGEM by Mai et.al, 2010) which is the same style of model for China. They are successors of MONASH, the dynamic CGE model for Australia (Dixon and Rimmer 2001, 2002), which also has been developed from the comparative static version of ORANI model (Dixon et al. 1982). Likewise, this thesis starts by developing the comparative static version of THORANI over ORANI and later moves to TRAVELTHAI which concerns more on dynamic sense. Specifically, the TRAVELTHAI holds the neo-classical assumptions and incorporates the dynamic features of MyAGE and MONASH with the main contribution to those models in that TRAVELTHAI not only inhibits the application of the model to assess the Thai economy but also explicitly captures the 'amalgam' characteristic of Thai Tourism, which is a group of Tourism-related industries. There has never been this type of dynamic CGE model for Tourism in Thailand and most of the other studies about Tourism only focus on inbound type (more details in Chapter 2 about literature). TRAVELTHAI, however, incorporates all three types of Tourism: inbound, domestic, and outbound into one dynamic model. It also specifically provides the Balance of Travel to show the effects that Tourism may generate as a part of the Balance of

Payments explicitly. For this study, the model is calibrated with the Thai Tourism Satellite Accounts for the year 2000, with 40 industries and 40 commodities (in broad category as 12 Direct-tourism industries, 20 Tourism-connected industries, and 8 Non-tourism industries), 40 investors, three primary factors of production (i.e. capital, land, and labour), one representative household, one central government, and an international trade with net foreign liabilities.

TRAVELTHAI also includes the fiscal policy scheme with types of income taxes and important indirect taxes and subsidies. Commodity taxes and subsidies like value added taxes and its refunds, excise taxes, or export taxes and production taxes like business fee and production subsidies are provided. This constitutes the capability of the model to deliver the fiscal aspects concerning Tourism.

The power of dynamic mechanisms enables TRAVELTHAI to be applied tracing through the time upon "what if" simulations either historical or forecasting. With this kind of model flexibility, the model could also be specified to have different economic environments either short-run or long-run, rigidity or flexibility of the variables in attention through various choices of closures. Thus, this could be applied to the variety of economic issues ranging from the changes in fiscal policies like tax rates and tariffs to output distribution or labour market interactions. This is highly beneficial for any policy maker concerning decision making.

TRAVELTHAI has a few variations from MyAGE, McHUGE, and MONASH. In addition to the Tourism specification, it simplifies some parts of MyAGE, but also contains many coefficients, variables and equations those MONASH does not have, mainly to deal with the data consistency. The theoretical framework of the model is described in details in Chapter 4.

1.3.2. **The Construction of a CGE Database**

The major contributions concerning database construction are as follows:

(1) Different from other kinds of CGE models for which Input-Output Tables are used, Tourism Satellite Accounts for Thailand (later on called briefly as TSA) are the core database for THORANI and TRAVELTHAI. Compiling with other important data, the calibration could be carried out and provide the initial solution for the model.

The structure of the Thai economy in a particular year represented by TSA via cost or expenditure shares or shares of demand distribution portrays an initial point for the changes in all further simulations. Together with those shares, various elasticity parameters which reflect the behaviours of economic agents and signify the conditions of the international markets also determine the simulation results. TSA also gives the information on three types of Tourism: inbounded, domestic and outbound, which could deliver the complete aspects of the impacts.

TSA of year 2000 could be regarded as an out-of-date for the database of the study. However, year 2000 is the latest TSA data for Thailand that the Tourism Authority of Thailand released in 2001, as a product of a co-ordinating project (2000 – 2005) with National Economic and Social Development Board (NESDB). The project was suspended for the later years, until recently Ministry of Tourism and Sports has announced in October 2011 for its project to pursue for the new TSA. It aims to release in year 2013-15 (Manager, 2011).

Year 2000 also provides the advantage for historical simulation (explained later on), which together with the series of the annual macroeconomic data, the model could update the database to the recent year and could also deliver the economic structural adjustment through the period.

TRAVELTHAI could be concerned as a pilot project preparing for the ongoing TSA data to be published. The new TSA data could be employed once it is released as the model is priori verified in this study.

(2) The comprehensive sectoral data on capital stocks and labour are significant for the analysis of the contribution of the inter-sectoral movements of those factors of production to the growth of the economy.

(3) Making the coherence out of all inconsistencies in the Tourism Satellite Accounts year 2000 and data from other sources to construct the core database for the models.

(4) The compilation of various elasticities, including tourism demand elasticities, from existing literatures.

(5) The important by-product for baseline simulation is the creation of an updated Tourism Satellite Accounts database for the decade, as well as the relevant data on labor and capital stocks, which give an initial point for forecasts or policy analyses.

Constructing a database for any dynamic CGE model is a demanding task since there are issues like data unavailability or data in different formats other than that required by the model. In this thesis, it is an endeavour to develop the databases of THORANI and TRAVELTHAI for Tourism of Thailand. Chapter 5 of this thesis describes the developing procedure of the database for the models.

1.3.3. **Developing the Baseline for Thai economy Over 2001-2011**

Developing a baseline simulation for impacts of Tourism on the Thai economy during the decade of 2001-2010 using the dynamic CGE model is one of the major contributions of this thesis. Other studies having been conducted for this issue for Thailand were in comparative static analyses or concerned only a particular focus. (i.e. Wattanakuljaras (2006), see more details in Chapter 2)

The baseline simulation could inform how the economy evolves during the decade. It needs much attempt to not only make the compilation of macroeconomic and sectoral data on the changes of many economic variables during the decade, but also the consistency of those data. This also is about the above mentioned database updates, since developing the baseline from the historical simulation also gives the series of time slices of the economic structural adjustment. This baseline could perform as a benchmark for policy analysis.

The results of the baseline simulation are explained in Chapters 6.

1.3.4. **Forecast and Policy Simulations Over 2012-2020**

Forecast and policy simulations play crucial roles in this study. Forecast simulations are simply the projections for the most likely picture of the economy to the future period, of which it is over 2012 – 2020 in this study, based on the historical trend of the preference and structural terms obtaining from the historical simulation over the period of 2001 - 2011. There are three scenarios for the forecast simulations, which make three baseline forecasts: decade average, first half of the decade average, and

second half of the decade average. Such averages signify the averages of the preference terms used for projections taken from which part of the historical decade: the whole decade average (2001-2011), first half (2001-2006) or second half (2007-2011). This is because the study concerns on the different economic conditions according to the period. The baseline forecasts which mark as the point-of-reference projections for the economy are also the contribution of this study.

What-if scenarios are performed in order to make comparisons in different circumstances. The policy simulations are represented as the deviations from the baseline forecasts. This is viewed as another highlighted contribution of this thesis, since it verifies the effects of policy changes to the Tourism industry in scenarios. Scenarios of the forecast and policy simulations are carried out according to the threats and will be explained in details in Chapter 7 and Chapter 8. Chapter 7 delivers forecasting simulations with three projection scenarios and Chapter 8 focuses on policy simulations with simulations including the selected fiscal policy.

1.3.5. **Extension on Regional Disaggregation**

Regional extension is an optional add-on and is subject to data constraints. A Top-down approach is implemented for the model in this study. There are seven main regions: Bangkok & vicinities, Central, Eastern, North Eastern, Northern, Western, and Southern. Data of regional gross outputs by industry prepared by National Economic and Social Development Board (NESDB) are applied for a compatibility with the existing database. The regional extension is important when location matters for Tourism industry. Tourism concentration is not the same in each region. Southern region or Northern region could be regarded as the big tourism spots, while North Eastern and Central regions are comparatively less. However, this regional extension is provided for model sake, further applications are recommended for future study.

As a summary, this thesis could, in other words, be seen as the ‘how-to’ for the development and the application of the dynamic computable general equilibrium modelling upon the issue of Tourism as a case study. This template of TRAVELTHAI model could also be applied and adapted for other various economic aspects in focus, other than Tourism e.g. the effects of any fiscal policy or changes on the economy.

1.4. Organization of the Thesis

There are nine chapters in this study. It is structured as follows. Chapter 2 delivers definitions related to Tourism and literature reviews. Chapter 3 gives the overview of the Thai Economy and the contribution of Tourism to the economy. The current situation and the economic trend of Tourism and Tourism-related policies presented as well. Chapter 4 explains the theoretical structure of the dynamic CGE model of the Thai economy, with the special feature concerning Tourism, labelled TRAVELTHAI, employed in this thesis. Chapter 5 elaborates the details of the database arrangement for the CGE model with the use of Tourism Satellite Accounts introduced. Chapter 6 examines the historical simulation of the observed macroeconomic data of the Thai economy to develop the baseline. Chapter 7 provides the analysis of the model application on the forecasting simulation. Chapter 8 deals with external shock and policy simulations, especially the economic effects of the tourism-related fiscal policy on the economy. Chapter 9 summarizes main outcomes of the thesis and completes it with concluding remarks and policy implications and directions for future research.

The summary of the content of each chapter is as follows:

Chapter 3 briefly conveys the major attributes of Thailand's economic structure. The chapter pinpoints how important Tourism is for the Thai economy. It also gives the overview of the current situation, geographical matters, and the trend of some relevant existing tourism-related policies and measures.

Chapter 4 presents the theoretical framework of TRAVELTHAI, the dynamic computable general equilibrium model of the Thai economy. TRAVELTHAI bases upon the MONASH model with the special feature extended for Tourism. A system of model equations is derived from the optimization problems concerning the behaviours of various economic agents under the conventional neoclassical theme.

Chapter 5 explains the details of database arrangement for THORANI and then TRAVELTHAI. Description of data needed for the model, Tourism Satellite Accounts (TSA2000), and various sources are provided. This study intends to give the schematic representation of database construction. The chapter ends with the explanation of parameters and concluding remarks upon database.

Chapter 6 concentrates on the development of the baseline simulation from the TRAVELTHAI model using the observed macroeconomic data. The simulation is discussed in terms of underlying assumptions for updating information and time-paths.

Chapter 7 focuses on the forecasting simulations. Three projections from 2012 - 2020 are performed in certain scenarios.

Chapter 8 confers the policy simulation of the TRAVELTHAI model. There are two major model applications. First, it is the effect of the flood as the external shock. Second, the tourism-related taxation/subsidy policy e.g. tax cut incentive for inbound tourism is introduced in this chapter. The simulation on the issue intends to obtain policy implications concerning the effects with the tourism inflows. This simulation focuses on the alleviating implications regarding the sharp downturn of Tourism.

Chapter 9 ends the thesis by concluding the summary of the major findings from the application of TRAVELTHAI model. This includes the limitations of the study and the recommendations for future research.

Chapter 2

Definitions and Literature Reviews

"….This means that the impact of tourism on the economy is not fully reflected in the Tourism Satellite Account tables and must therefore be measured and analysed using other means. This can be done for instance using input-output or computable general equilibrium models based on the Tourism Satellite Account…"

International Recommendations for Tourism Statistics 2008 (2010)

This chapter firstly deals with the definition of Tourism and then with some related concepts. A brief background upon Tourism Satellites Accounts (TSAs) is provided in the next sub-section. The development of CGE modelling and the brief reviews of the important literatures regarding CGE model and Tourism are revised respectively.

2.1. Definition of Tourism

It is very important to note upon the beginning of the study the definition of the subject of interest. In a broad perception, people often regard 'Tourism' and 'Travel' as the activities that share something in common. However, people's perception and the definition for business use or even academic or statistical use may often be arguably different. International Recommendations for Tourism Statistics or IRTS 2008 (2010) defines 'Travel' as,

"Travel is a phenomenon which involves the passage of a person or a group of people which associates to various cultural, economic, environmental and social activities. In this context, a traveller is someone who moves between different geographic locations for any purpose and any duration"

Unlike 'Travel', nonetheless, it is somewhat difficult to explain or define the exact meaning for 'Tourism'. Tourism industry has been developed for at least a century, but has only recently been seriously considered in terms of business and economic benefits and its costs concerning impacts upon the environment and society and in terms of its own specific educational field to study with and research for. This kind of phenomenon could be viewed as multifaceted and multidimensional and related to many economic activities and often regarded as interdisciplinary (Wangpaijit, 2004).

There have been various concepts on the issue of 'Tourism' definitions. One of the original definitions of 'Tourism' by Burkart and Metlik (1974) has conceptually proposed the five characteristics of Tourism as

"*i) tourism is an amalgam of phenomena and relationships rather than a single one; ii) these phenomena and relationships arise from a movement of people to, and a stay in, various destinations; there is a dynamic element (the journey) and a static element (the stay); iii) the journey and stay are to and in destinations outside the normal place of residence and work, so that tourism gives rise to activities which are distinct from those of the resident and working populations of the places through which tourists travel and of their destinations; iv) the movement to the destinations is of a temporary, short-term character; v) destinations are visited for purposes not connected to paid work – that is, not to take up employment*."

Based on the above body of definition, British Tourism Society in 1979 made a precise and clearer definition of Tourism as

"*Tourism is deemed to include any activity concerned with the temporary short-term movement of people to destinations outside the places where they normally live and work, and their activities during the stay at these destinations."*

Tourism is, thus, more specific than travel, as it means a particular kind of trips, those which a traveller goes outside of the usual environment for less than one year with the main purpose other than employment (and implicitly obtained some earning) by any entity in the place visited (UNWTO, 2010). Usual environment here is defined as the geographical area within which an individual conducts his or her regular life routine. Individuals when taking such trips are called visitors. Tourism is therefore a subset of travel and visitors are a subset of travellers (IRTS 2008, 2010).

One of the very first concise definitions to set up the tourism statistical standard was practically issued by the UN conference on Travel and Tourism in 1960 where visitor in international statistics was

"For statistical purposes, the term 'visitor' describes any person visiting a country other than that in which he has usual place of residence, for any reason other than following an occupation remunerated from within the country visited."

Based on this abovementioned concept, International Recommendations for Tourism Statistics (IRTS 2008, 2010) has updated the latest definition of the 'visitor' as

"A visitor is a traveller taking a trip to a main destination outside his/her usual environment for less than a year and for any main purpose (business, leisure or other personal purpose) other than to be employed by a resident entity in the country or place visited"

Hence, to apply it with the economic sense, for a demand-side view, tourism refers to the activities of visitors and their role in the acquisition of goods and services, whereas from the supply-side, tourism is understood as the set of productive activities that make available mainly to the visitors (UNWTO, 2010).

In the case of Thailand, according to Tourism Authority of Thailand Act, B.E. 2522 (1979), "Tourism industry" means the industry which provides or gives services in return for remuneration, in connection with tourism within and outside the Kingdom and includes: (1) tour business; (2) tourist hotels business; (3) business relating to restaurants, service places and resorts for tourists; (4) business relating to the sale of souvenirs or other goods for tourists; (5) business related to sports for tourists; (6) exhibitions, shows, trade fairs, promotional advertisement or any other activities with the aim of encouraging and promoting tourism. It also defines "Tourism industry operator" as a person who is engaging in tourism industry; and "Tourist" means any person who freely travels from his normal place of residence to other place for temporary period with the objective other than to carry on his occupation or to earn income. The temporary period generally means at least one night within the country but not exceeding 90 days.

Nevertheless, the National Economic and Social Advisory Council of Thailand has also provided the meaning of 'Tourism' (Wangpaijit 2004) as

"The overall phenomena and all the relationships among the tour businesses and those related businesses connected to the tourism, government, private sectors, including the local people who own the tourist attractions those are embraced within the tourism activities or within any kinds of persuasive procedures to attract the visitors."

2.2. Some concepts on Tourism

According to the International Recommendations for Tourism Statistics 2008 (2010) of UNWTO, it is recommended that three basic forms of Tourism can be classified as:

(a) ***Domestic Tourism***: comprises the activities of a resident visitor within the country of reference either as part of a domestic Tourism trip or part of an outbound Tourism trip. *Domestic tourism expenditure* is the tourism expenditure of a resident visitor within the economy of reference;

(b) ***Inbound Tourism***: comprises the activities of a non-resident visitor within the country of reference on an inbound Tourism trip. *Inbound Tourism expenditure* is the expenditure of non-resident visitors being viewed as Tourism revenue of the country of reference;

(c) ***Outbound Tourism***: comprises the activities of a resident visitor outside the country of reference, either as part of an outbound Tourism trip or as part of a domestic Tourism trip. *Outbound Tourism expenditure* is the expenditure of resident visitors being viewed as Tourism expense of the country of reference;

The above-mentioned three basic forms of Tourism can be combined to derive other forms of Tourism. The following definitions should be used:

(a) ***Internal Tourism***: comprises domestic Tourism and inbound Tourism, that is, the activities of resident and non-resident visitors within the country of reference as part of domestic or international Tourism trips;

(b) ***National Tourism***: comprises domestic Tourism and outbound Tourism, that is, the activities of resident visitors within and outside the country of reference, either as part of domestic or outbound Tourism trips;

(c) ***International Tourism***: comprises inbound Tourism and outbound Tourism. This includes the activities of resident visitors outside the country of reference, either as part of domestic or outbound Tourism trips and the activities of non-resident visitors within the country of reference on inbound Tourism trips.

2.3. Tourism Satellite Accounts

Tourism Satellite Accounts presents the macroeconomic information regarding the direct economic contribution of tourism. The information provided in the accounts is not only Tourism's direct gross value added and Tourism direct gross domestic product, but also other similar aggregates for the total economy and economic activities in particular related areas of interest. This includes the data on tourism consumption with the extensive concept associated with the activity of visitors in some specific types and a description of the equilibrium where demand equals to supply. They are in details organized and derived from supply and use tables which can be compiled both at current and constant prices (IRTS 2008, 2010). Tourism Satellite Accounts also provide the detailed accounts of tourism industries, including data on employment, linkages with other productive economic activities and gross fixed capital formation. Some other information on tourism, such as number of trips (or visits), duration of stay, purpose of trip, modes of transport, etc., are specified to reflect the related characteristics of the economic variables.

Nevertheless, although Tourism Satellite Accounts give some details of economic contribution of tourism, it should also be noted that the 'more' comprehensive impact analysis could be enhanced by other instruments as suggested by International Recommendations for Tourism Statistics (IRTS 2008, 2010) as:

"The Tourism Satellite Account is mainly descriptive in nature and does not include any measurement of the indirect and induced effects of tourist consumption on the economic system as a whole. This means that the impact of tourism on the economy is not fully reflected in the Tourism Satellite Account tables and must therefore be measured and analysed using other means. This can be done for instance using input-output or computable general equilibrium models based on the Tourism Satellite Account or other modelling instruments which allow for comprehensive tourism impact analysis"

Tourism Satellite Accounts of Thailand used as a database in this study will be further discussed in Chapter 4. This thesis mainly deals with its usage for the tourism impact analysis according to the thesis objectives suggested by the above-mentioned reasons.

2.4. Literature Reviews

This section delivers brief reviews of literature in two categories. First, it is about the previous academic quantitative researches upon Thai Tourism. Second, it is the review on Computable General Equilibrium method and the literatures with CGE modelling; this includes the CGE modelling on Tourism, which is the main aim for this study. The last section gives the concluding remarks on the literature.

2.4.1. Literatures on Thai Tourism

Various techniques had been employed to study about Thai Tourism, mostly about inbounded Tourism. A few studies concerning Thai Tourism are reviewed to provide idea on how other studies dealing with this issue apart from CGE modelling.

Maleerat Suksri (1997) econometrically studies the determinants of Tourism demands using gross domestic products of the foreign tourists' countries, population of those countries, and air-ticket prices. The results show that the demand of foreign tourists had a positive relationship with the gross domestic products of the country that they came from; it shows that the higher gross domestic products, the higher demand of foreign tourists.

Atthaporn Ekoramaiphon (2004) employs Input-Output model to study about the impacts of international tourists' expenditure on the value of gross domestic products. Using Input-Output Table 1998 of 58 sectors as the database, the results show that the travel expenses of international tourists in 2002 generated about 10.9 per cent of the gross domestic products (GDP) in 2002. Wage or returns to labour was increased 1.4 per cent of GDP. Operating surplus was levelled up by 23.7 per cent for which Hotel and accommodation accounted about 23.69 per cent.

Employing Box-Jenkins autoregressive integrated moving average (ARIMA) models to analyse inbound trips and the trends in foreign tourist arrivals to Thailand, Chang et al. (2009) evaluated changes in tourism trends by analysing stationary and non-stationary tourist arrivals series by testing the unit roots and seasonal unit roots prior to the stage of estimation, model selection, and forecasting, respectively. Various ARIMA models and seasonal ARIMA models were estimated and they indicated the tourist arrivals series showing seasonal patterns.

Khamkaew and Leerattankorn (2008) assesses the Thai outbound tourism demand for five major destinations over the period of 1998-2007, within long run and short run Almost Ideal Demand (AID) frameworks on the monthly data. For long run AID model, U.S. was the most sensitive destination to the price change while the rest are with the same price sensitiveness, which made US the least competitive in terms of price. In terms of the acceptability of consumer behaviour restrictions, the dynamic model outperforms the long run model. The sensitivity of tourism demand to relative price change varies considerably between destinations in both long-run and short-run consideration, whereas the expenditure elasticities represents that travelling to all destinations could be concerned as normal goods in the short run.

Rittichainuwat and Chakraborty (2009) assessed tourist concerns on perceived travel risks while traveling abroad and investigated if such perceived risks affected tourist's decisions during crises using both qualitative and quantitative research techniques. The study found that perceived disease risk was mitigated by tourists' prior experience in visiting the foreign country.

In brief, the quantitative studies on Thai Tourism mostly concentrate on the inbound tourists' demand. Many of them estimate with econometric method on national and different markets. A few studies focus on Tourism impacts using Input-Output analysis as a means to measure.

2.4.2. Literatures on CGE modelling

According to the first major objective of this study which is to build a CGE model for Thai Tourism, this sub-section focuses on CGE modelling and firstly presents the development of the CGE method. The brief reviews of the CGE modelling literatures are provided subsequently.

Development of CGE Method

The development of CGE method was initially aimed to surpass the limitations of Input-Output and mathematical linear programming models which are the insufficient specification of agents' behaviors and roles of prices (Input-Output model pioneered by Leontief in 1950s; more on limitations of Input-Output models, see Dixon and Parmenter (1996)). It could be said to be the first implementation in the doctoral

dissertation of Leif Johansen, "A multi-sectoral study of economic growth" upon an analysis of Norwegian economic growth in 1960, for which his MSG model has later become the significant tool for long-term macroeconomic planning and forecasting by the Norwegian Ministry of Finance in 1970s (Siksamat, 1998).

Shoven and Whalley (1973), based on the tax incidence work pioneered by Harberger in 1962 and algorithm of Scarf in 1973, had also initiated and independently progressed on the development of CGE modeling focusing on policy impacts upon efficiency and income distribution in the early 1970s, with the main distinction of the model solution in the levels of endogenous variables to avoid the linearization error.

In the late 1970s, Peter Dixon and his colleagues of the Centre of Policy Studies and the IMPACT project (CoPs) developed the first CGE model of the Australian economy called ORANI (Dixon, Parmenter, Sutton, and Vincent, 1982). This comparative static version of Johansen approach has been widely used as a tool for policy analyses, not only in Australia, but as a major starting template for other countries since 1980s. The model has been continuously adapted into several versions of a single country model worldwide e.g. ORANI-F and ORANI-G (Horridge et al., 1993, 2001/2003), CAMGEM (by Chulalongkorn University, Thailand), ORANI-NT (Meagher and Parmenter, 1990), etc. It also has been modified to include a broader spectrum of economic aspects and towards multi-regional and multi-country features.

Unlike its predecessor, ORANI, MONASH, a dynamic CGE model of the Australian economy, had been developed with a high level of microeconomic details plus a stronger forecasting capability in 1993. The Centre of Policy Studies (CoPS) has the model specified with dynamic relationships and incorporated macroeconomic data to perform time-trended simulations: historical, decomposition, forecasting and policy analyses of the economic development (Dixon and Rimmer, 1998). Ever since, it has been widely adopted with a prominent example as USAGE (collaboration with US International Trade Commission for U.S. economy, see Dixon and Rimmer, 2003)

Concerning the application of CGE models in Thailand, it first started in 1970s with the early works implemented by the World Bank for government policy analyses. The implementation of the CGE models was mostly confined to only a few authorities due

to the fact that it required more technical computer skills to deal with the database and data inconsistency. The modelling application also needs the essential understanding of the idea of policy issues with a profound economic background, especially general equilibrium theory (Siksamat, 1998). The very first published CGE model was called SIAM1 and later on with SIAM2 by Grais (1981) and Amranand and Grais (1983). SIAM1 was a small model of four sectors used to examine the policy package dealing with macroeconomic imbalance and oil shocks during 1980-1990. In SIAM2, the study was aimed to examine the effect of the structural adjustment scheme and policy interventions during the Fifth National Economic and Social Development Plan (1982-1986) using a decrease in world prices of energy as the policy simulation with base year of 1975. A few other studies could be found in 1980s e.g. Ezaki (1987) or Vongpradhip (1987), but only in 1990s it became more prevalent.

Siksamat (1998) has pointed out two main reasons that CGE analyses have later on become increasing in Thailand. One is the attractiveness of its own features and the other is the development in the skill of modellers and users. Among its features, the strength of general equilibrium models is their ability to handle inter-industry linkages (Dixon et.al., 1986:20). Along with its usefulness, first, CGE models could provide the possibility to gain the insights of the complex issues with the relevant analytical solution and, second, the order of the magnitude could be calculated, especially when the quantitative information really matter concerning impact analyses (Bergman, 1990), these distinctive qualities largely drew attention from the beginners. With the supports from foreign organizations, the development of the skills became fruitful through the collaboration to work on the large CGE models in Thailand e.g. PARA (Protection Areas of Regional Agriculture, 1994) as the collaboration between Office of Agricultural Economics, Ministry of Agriculture of Thailand and the Australian National University or CAMGEM (Chulalongkorn And Monash universities General Equilibrium Model, 1994). Later on, it became the CGE studies in the dissertations of Thai students in graduate level in various major universities e.g. THAITRADE by Cintrakulchai (1997) or GEMREG by Siksamat (1998) which were considered as the next wave, with the subsequent trend for dynamic simulation in 2000s.

Reviews of CGE Modelling literatures

This study aims to provide the brief literature reviews in three categories. First, it is about the important pieces of CGE literatures in Thailand, as shown in Table 2.1, which are PARA, CAMGEM, THAITRADE, and GEMREG. Second, the recent dynamic CGE models of MVN and CHINAGEM are reviewed as of Table 2.2. They are useful in developing TRAVELTHAI in a dynamic sense other than the templates of McHUGE and MyAGE that TRAVELTHAI follows. Third, the Tourism-related CGE analyses are provided as the background represented in Table 2.3. There are not so many literatures studying the impacts of Tourism in the context of CGE analysis, especially in Thailand. Only Wattanakuljaras (2006) is reviewed in Thai case. Others are Gooroochurn (2003), Forsyth (2006), ORANI-LA, and MONASH-Heatlh. This is projected to give the broad but relevant aspects on different ways of 'how-to' for modeling Tourism-related issues. All reviews are rather briefly discussed mainly for the application matter relevant to this study, with other major characteristics shown in those brief summary Tables 2.1-2.3. Further details could be found in the reference.

1) Important CGE literatures in Thailand

It could be straightforwardly stated that all those past five model literatures in Thailand of Table 2.1 share many structural features with ORANI, ORANI-F and MONASH model of the Australian economy. Some differences are the size, the parameters used, some forms of model specification and the application of the simulations.

PARA is a conventional micro-theoretic general equilibrium model with the focus on agricultural policies. To evaluate a protection scheme, PARA, which was constructed with ten households (five urban/ five rural with Stone-Geary utility function), 60 producer goods, 40 non-agricultural commodities and 20 agricultural commodities with four regions, four types of factors of production, and two sources of inputs (domestic and imported with Armington substitution) with market power only in rice and cassava was set in three main simulations. The comparative static simulations were carried out conventionally (See results in Table 2.1). The main contribution of PARA was the econometric estimation of all relevant parameters of the model. This has been regarded as the pioneer parameter estimation for CGE modeling in Thailand.

CAMGEM is a tool to conduct the policy impact analyses for historical simulation to observe the pattern of the changes in structural variables e.g. preferences. These observed macroeconomic variables e.g. consumption or outputs were set exogenously according to annual growth rates during 1985-1990. The simulation was also conducted in the way of reverse historical closure, with those previously set as exogenous became endogenous, and shocked the exogenous variables e.g. primary-factor saving technical change, from the results obtained earlier.

In another application, CAMGEM had been updated for forecasting the performance of the Thai economy over 1993 - 1997. Generating input-output table for 1993 by updating the input-output 1989 via historical simulation, CAMGEM was able to perform the forecasting simulations by extrapolating the preference and technological changes estimated in the historical simulation, see results in Table 2.1.

A major feature of THAITRADE in Cintrakulchai (1997) was to explicitly incorporate two parts of the world market which are other-ASEAN and non-ASEAN countries. It also defines the pattern of investment allocation which enables it to analyze the effects of tariff reduction under AFTA agreement upon investment allocation. All of four simulations were performed in a conventional comparative static style. The reduction of tariff led a lower consumer price index and government revenue, and also led to the improvement of the current account deficit with a slight increase of real GDP. It might be unfavorable for income distribution as unskilled labor employment declined.

GEMREG model in Siksamat (1998) has the distinguished feature of multi-regional analysis with its hybrid approach for regional disaggregation into seven regions. With the aim to examine the response of the Thai economy to a surge of capital flows, the model was constructed with 27 industries producing 27 commodities, three kinds of the primary factors with land assumed fixed and two types of labor. Labor-supply is different from ORANI as it is upward-sloping, not slack. Dynamics are set up via the stock-flow accumulation equation. The study uses some value of the parameters from PARA and other studies. Capital inflows pressured higher domestic prices and real appreciation, then the trade deficit. It also showed the Dutch disease effect as prices of the non-tradable goods rose, hence, a shift of resources from tradable counterparts. With the hybrid method employed, GEMREG is proved as better than the top-down regional approach.

2) Literatures on Dynamic CGE Models

Two main literatures about dynamic models are briefly reviewed in this sub-section. They are the successors of the MONASH model for Australian economy.

MVN (Tran and Giesecke, 2006) is the dynamic CGE model for Vietnam. It was mainly constructed to evaluate the structural changes with the historical and decomposition simulations, especially total factor productivity or TFP's contribution to real GDP over the period of 1996-2003. MVN has 93 industries with three primary factors: capital, land, and three types of labors are distinguished by skills. MVN follows the tradition by explaining Back-of-the-Envelope (BOTE) model as the key explanation. The observable macroeconomic variables were primarily chosen to perform historical closure. It was found that rapid growth in real GDP was due to the productivity and labor force growth. Policy reform e.g. reduction in trade taxes was the important explanation for rapid growth in both trade and the real GDP.

The stylized version of MVN with BOTE model simply followed what the MONASH model presented, but gave very detailed explanations of analytical patterns.

CHINAGEM model in Mai, Dixon and Rimmer (2010) is aimed to be an entry point platform framework for dynamic CGE simulations of the Chinese Economy with an emphasis on developing a realistic baseline to support policy analysis. It uses the 2002 Input-Output database and performs historical simulations to the year 2009 and later on deriving preferences and technology changes and using them to project the model of 137 sectors forward into the future year 2020. By incorporating the observed macroeconomic data into the model, the highlights of the study are to illustrate the way to perform the historical simulations in order to obtain the realistic baseline and to demonstrate the analytical scheme using the Back-of-the-Envelope (BOTE) model, as well as the procedure to deal with the forecasting and policy simulations. The main feature is the how-to that enriches with step-wise calibration.

Concerning the application of the dynamic CGE model of TRAVELTHAI, this thesis follows much of the technical procedure for developing the realistic baseline forecast in all simulations of CHINAGEM by Mai, Dixon and Rimmer (2010).

3) Literatures on the Tourism-related CGE Models

Gooroochurn (2003) did a Tourism taxation study on a CGE model following the Ramsey model with Mauritius as a case study. The efficiency effects and the redistributive effects were theoretically analyzed. The small open economy model includes 17 sectors with a constant elasticity of substitution aggregate of labor and capital. Tourism is treated as a demand phenomenon and tourists are already at the destination with a representative tourist for all homogenous tourists and the other case of the heterogenous tourists. Efficiency of tourism taxes was investigated using the marginal excess burden (MEB) per additional dollar of tax revenue, with the higher MEB, welfare improved. For income distribution, the study employs the Gini coefficient, the Atkinson index and Theil index as common measures. Results are shown in Table 2.3.

Apart from studying tourism demands with econometric estimation, Narayan (2003) studied the impacts of increasing tourism demand on the Fiji's economy and related fiscal policies. Main comparative static simulations are 1) 10 percentage expansion of tourism demand; 2) 25 percentage of value added tax imposed; and 3) 10 percentage cut across the board tariff. It was found that the rise in tourism exports outweigh the total fall in exports of traditional sectors and improved balance of trade. The price rose when value added tax imposed and led to a fall in the quantity of tourism services purchased in Fiji. In contrast, price of tourism services fell when the tariff was cut and the tourist expenditure rose accordingly. This improved net exports and increased real private consumption and real investment.

The study by Wattanakuljaras (2006) is the only, among not so many, Tourism-related CGE modeling for the Thai economy being reviewed in this thesis. With the objective to examine how Tourism affects the economy and the environment of Thailand, CGE analysis is performed using Social Accounting Matrices (SAM) 2001 provided by Thailand Development Research Institute (TDRI) as the database with the finalized version of Base SAM of 208 accounts, of which are 80 activities, 80 commodities, 18 types of occupations, land, two capitals, three margin services, four classes of households, five regional tourisms. The study also employs land, forest and water resources into SAM. The CGE framework is adapted from Lofgren, Harris and Robinson (2001). Tourism is assumed as a bundle of goods and services with Leontief

technology, or no chance for a substitution of transportation for food, for example. Inbound tourism demand is a function of tourism prices and exchange rates, whereas outbound tourism demand is a function of disposable income.

Forsyth (2006) studied the cost and benefits of regional airport subsidies with a CGE model aiming to evaluate them and if a region gains from offering such subsidies to attract tourists. In principle, the costs of subsidies are fairly easy to compute. However, calculating the benefits is not so simple. It is common that consumers' gains are less than the cost of the subsidy, which also needs to be financed, and this could lead to the tax incidence. Five scenarios have been taken with $1.5 million of airport subsidies. Most of them dealt with $7.5 million of additional tourism expenditure from various sources and compared them with five different labor market scenarios on the flexibility of employment and real wage rigidity differing between host region and the rest. The paper concludes that it can be beneficial to subsidize for the economic interest of a region to attract economic activity. It is likely that other regions would suffer indirectly with the balance of the nation becomes ambiguous.

The regional economic consequences of a Dirty Bomb attack centered on the Los Angeles downtown area was estimated in ORANI-LA basing the attack on an event of magnitude of Radiological Dispersal Devices (DHS 2005). This terrorism effects were argued in four short run resource loss routes (business interruption, deaths, injuries, and capital damage and destruction) and three behavior routes (compensating wage premiums, required rates of return, and willingness to pay). The simulation designs for resource loss effects based on reasonable abstracting and calculations. The study also set implied movement in required rates of return implicit in property price movements via Tobin's Q, as the ratio of an asset's market value to its replacement cost. From ORANI-LA, it showed that short-run or event-year impacts of the Dirty Bomb scenario arise almost entirely from business interruption. Relative to that, resource loss and behavioral effects provide little short-run regional economic damage. In contrast to business interruption impacts, the short-run resource loss and behavioral effects are small. The former is due to the relatively small number of people killed and injured, and the latter to short-run stickiness in regional factor supplies.

MONASH-Health model is a detailed dynamic CGE model of Australian economy. It places an emphasis on the health sector regarding the H1N1 epidemic effects. It also

focuses on the likely effects upon the tourism sectors: domestic, inbound, and outbound. The quarterly model was introduced to capture the short & sharp effect of the outbreak accompanied with the annual model. The model has a sticky real wages and excess capacity assumption to reflect the inertia in labor market and avoid the misleading strong export upturn in the short run with the sharp setback by pandemic. There are 41 non-health sectors and 18 treatment activities. MONASH-Health contains three types of dynamic mechanism: capital accumulation; liability accumulation; and lagged adjustment processes. Two scenarios, 2009 outbreak and severe outbreak, of four economic shocks are constructed from the Susceptible-Exposed-Infected-Removed (SEIR) model of infectious disease transmission. Results are shown in Table 2.3.

2.4.3. Concluding Remarks

This thesis mainly concentrates on its objective of developing the dynamic CGE model for Tourism of Thailand. Brief reviews of the literature on various quantitative applications on Thai Tourism were presented in the first section and the more focus on the CGE modelling according to its prime objective in the subsequent section.

The fact that Tourism industry is an amalgam of industries, ranging from travel agents, Tourism-related transportation, to souvenirs, it is more suitable to see any effects of external shocks or policy in terms of ‘what-if’ scenarios over this kind of amalgam in terms of the multi-sectoral model. Input-Output analysis has long-time served as a means for analysing the impacts concerning this characteristic. CGE modelling, nevertheless, has overcome the constraint that Input-Output analysis has on the insufficient specification of the economic agents’ behaviours and the role of prices as stated in Dixon and Parmenter (1996) and also in Narayan (2003: 185-189). Narayan (2003) also commented that tourism sector, being a multi-sector activity, is one of those industries that rationally fit well using a CGE model. Tourism Satellite Accounts could also be operated as a database for such analyses as suggested by IRTS 2008 (2010).

PARA and CAMGEM are regarded as important literatures for CGE modelling in Thailand. PARA provided a major reference for parameters as they were primarily estimated. CAMGEM, THAITRADE and GEMREG deliver the excellent case studies

for CGE applications on the Thai economy in comparative static version.

Concerning dynamic CGE modelling, two main literatures are reviewed: MVN and CHINAGEM. Their ways of application are the main influence for this study, especially on how-to for applications on historical and forecasting simulations.

There has never been any dynamic CGE study on Thai Tourism. Wattanakuljaras (2006) could be seen as the only comparative static study for Thailand focusing on the effects of inbounded tourism to the Thai economy. This study concerns Gooroochurn (2003), Narayan (2003) and Forsyth (2006) as good examples for fiscal application on Tourism. ORANI-LA and Monash-Health model are proved to be good references for the scenario application for this study regarding the economic loss on the economy.

Table 2.1: Brief Summary of Literature Reviews of Some Important CGE Models in Thailand.

Author(s) or Model name	Country & Base year	Main database	Major simulation	Results
1.PARA (1994)	Thailand (1985)	SAM (Social Accounting Matrices 1985) with the econometric estimation of the parameter values.	1) Tariff cut 25% across the board on keeping constant real budget deficit by increasing personal income tax rates as the offset. 2) Tariff cut 24% on agricultural commodities (among other followers of GATT rules of 20% reduction) 3) Finding the optimal welfare from various rates of export tax on rice	1) Highly protected industries (owner of the fixed factors of production i.e. capital) tend to transfer income to the wage earners 2) GATT rules would benefit Thailand 3) At the elasticity of export demand for rice of -2.5, the optimal export tax rate was 0.425
2.CAMGEM (1994)	Thailand (1989)	Input-Output Table 1989 as database & updated data by historical simulation to obtain 1993 Input-Output data.	Historical simulation for taste and technological change during 1989-1993. Forecasting simulation for 1993-1997.	Increasing required rates of return has negative impacts on GDP, investment, consumption but positive to trade balance to GDP ratio. Higher term of trade and labour-saving technical change gave rises to GDP, investment, and consumption but lower exports. A fall in GDP happened in case of the increases in the propensities of public/private consumption.

Author(s) or Model name	Country & Base year	Main database	Major simulation	Results
3. CAMGEM (1997)	Thailand (1985)	Input-Output database of 1985/1990 & created data for 1993 by historical simulation	Historical simulation for taste and technological change during 1985-1990. Decomposition simulation for the impact of such changes on output.	Technical changes in intermediate inputs and labour have (-) impact on GDP growth while (+) impact for all-primary factor technical change.
4.Cintrakulchai/ THAITRADE (1997)	Thailand (1990)	Input-Output database 1990 for a comparative static simulation on Thai trade policy	1) 25% tariff reduction under GATT on imported goods of all sources. 2) Same experiment but on imported goods from other-ASEAN countries 3) Same experiment but from non-ASEAN. 4) Tariff reduction under AFTA on CEPT scheme.	In brief, a free trade by tariff reduction stimulates production, real GDP, investment in manufacturing export industries, but reduced employment of unskilled labour with unfavourable income distribution.
5.Siksamat/ GEMREG (1998)	Thailand (1990)	Input-Output database 1990 with the ratio from National Income Accounts for top-down approach of the regional simulation for a surge of capital flows for 7 regions of Thailand	1) 5% reduction of required economy-wide rate of return. 2) 6257% increase government demand for infrastructure goods in Bangkok (BKK).	1) Capital inflow pushed demand up and domestic price rose accompanied with real appreciation (in fixed regime) and term of trade declined with Dutch disease and a shift to capital intensive technologies. 2) Employment rose in BKK& crowding out effect on investment. Bangkok gained with real appreciation and real GDP fell.

Table 2.2: Brief Summary of Literature Reviews about Dynamic CGE models

Author(s) or Model name	Country & Base year	Main database	Major simulation	Results
6. Tran and Giesieke/ MVN (2007)	Vietnam (1996)	Input-Output Table (1996) as the core database for Monash-Vietnam model (MVN).	Used observed macroeconomic data of 1996 -2003 to perform historical and decomposition simulations mainly for structural change analysis.	Significant structural change that period, technical improvement accounted 34% of the real GDP growth. Favourable shifts in foreign preferences for exports and terms of trade improvement (23% of real GDP growth) and 17% of real GDP growth came from employment growth.
7. Mai, Dixon & Rimmer/CHINAGEM (2010)	China (2002)	The core database is the Input-Output Table (2002) of China.	Showed historical and decomposition simulations step-wisely 2002-2009. Also, gave the forecasting and policy simulations to the year 2020.	- Big outward shift in export demand was due to rapid growth in the exports of heavy manufacturing sector. Simulations showed the higher import during 2002-2007. APC or average propensity to consume declined with the trend from 1997 onwards. - Future trend to 2020 of rising savings rate and declining APC with less favorable export demand. Higher labor costs with the growing of services sector are pinpointed.

Table 2.3: Brief Summary of Literature Reviews about the CGE application on Tourism and related issues.

Author(s) or Model name	Country & Base year	Main database	Major simulation	Results
8.Gooroochurn (2003)	Mauritus (2003)	Data of Mauritus for the Ramsey model	A small increase (0.1%) in the sales tax rate to each sector, keeping the other tax rates constant. Test for various indexes eg. Gini coefficient	Taxing tourism related sectors is relatively more efficient than taxing other sectors. Tax reform shifting for taxing this tourism sectors prevents welfare to fall while increasing tax revenue.
9. Narayan (2003)	Fiji (1999)	Modification of the CGE (1999), Fiji case	10% increase in demand for tourism, 25% increase of value added tax, and 10% reduction in tariff	1) Trade balance improved, tourism gain outweighed the fall in exports 2) price rose from vat, lower tourism 3) price fell from tariff cut, tourism increased.
10.Wattanakuljaras (2006)	Thailand (2001)	Input-Output Table (2000) and the corresponding databases of the Social Accounting Matrices, SAM (2001) for comparative static CGE model	10% and 20% inbound tourism expansion rate and a removal of piped water subsidy	Growth in inbound tourism can stimulate real GDP and improve the current account deficit. Piped water subsidy reduction benefits more than the costs.
11. Forsyth (2006)	Australia (2006)	Database of the STCRC model (extended from MMRF model of Centre of Policy Studies)	$1.5 million subsidies lead to $7.5 million of additional expenditure/ intrastate expenditure to specific region for five scenarios with five economic conditions	Possible for offering subsidies to attract economic activity. Other regions may face negative impacts, but the nation as a whole can be either positive or negative. Impacts depend on circumstances.

Author(s) or Model name	Country & Base year	Main database	Major simulation	Results
12.Giesecke, Burns, Barret, Bayrak, Rose and Suher/ORANI-LA (2010)	U.S.A. (2009)	ORANI-LA is an LA-County part of the single US region model ORANI-R by Giesecke (2009). Using IMPLAN data for LA-County and some relevant parameter values from USAGE, a large scale CGE model of USA	1) Resource loss effects with $26.2 million of lost labour input, no capital damage and $1.4 billion of lost output 2) Behavioural effects with 3 types: a rise in regional wage premium, a rise in regional required rate of return, and fall in willingness to pay for regional exports	1) Fall in real GDP $5 million and fall in regional labour supply with a small rise in regional wage rate. Business interruption costs higher in the short run. 2) Behavioural effects are small in short run but big in the long run. Effective public policy would minimise the cost of interruption.
13.Verikios, McCaw, McVernon and Harris/ Monash-health model (2010)	Australia (2009)	Input-Output Data 2009 of Monash-Health model with details for health treatment industries that based on the International Classification of Diseases of the 10th Revision. Using data from Australian Bureau of Statistics (2009b) to determine the size and composition of Tourism sectors	2 Scenarios: 2009 outbreak & severe on these 4 economic shocks: 1) Surge in demand for hospital and other medical services 2) Temporary upsurge in sick leave & school closures leading to withdrawal of parents from the labour force 3) Some deaths with a related permanent reduction in labour force 4) temporary reductions in inbound and outbound international tourism and business travel	1) 2009 outbreak peak in 2009:4, GDP and employment are 0.9% & 0.7% below the baseline The decline in GDP relative to employment reflects the loss in labour productivity and the stronger fall in capital in use relative to employment. 2) Severe outbreak peak in 2009:4, with 6 to 7 times larger than scenario 1 at peak. It reduces GDP and employment by 3.6% and 2.2% later recovers but still recessed.

Chapter 3

Overview of the Thai Economy and Tourism Industry

"Some results of the study found that Thai residents and international visitors confirmed that cultural sightseeing, friendly people and food were significantly important when thinking of Thailand as a tourist destination, while international visitors felt that nightlife and entertainment were significantly more important than that of Thai residents…."

Henkel et al. (2006)

This chapter provides a brief overview of the basic information and the performance of the Thai economy. The section starts with the recent demographic factors and the economic development of the country. It then discusses the structure of the economy over the decades and outlines the role of Tourism and its trends in the economy as well as the strategic plans on the move by the authorities.

3.1. Recent Demographic Factors and Economic Development

Thailand locates in the heart of South-East Asia having tropical climate. The country is a kingdom with a constitutional monarchy. His Majesty King Bhumibol Adulyadej, the ninth king of the Chakri dynasty is the world's longest-serving head of state and the longest reigning monarch in the Thai history. Bangkok is the capital city. The official language is Thai, with her own Thai alphabet. National religion is Theravada Buddhism. Thailand is the world's 50th largest country in terms of total area (of approximately 513,000 sq.km.) and 20th largest country in terms of population.

The population of Thailand was approximately above 67.2 million in 2010 with median age of 33.7 years. The average annual population growth rate from 2000-2009 was 0.6 per cent per annum with people under 15 comprising about 20 per cent in 2009 (NSO's estimates, 2010). Thailand has obtained the new 2010 estimates of 0.654 for overall human development indicators ranking 92 in the medium division. Literacy rate was 92.6 per cent in 2000 (NSO, 2000), and the average life expectancy in 2010 was 73.36 years with female 75.82 years and male 71.02 years (NSO,2009).

Majority of the labour force are under 35 years of age with the size of around 38.3 million (NSO, 2009). It is estimated that each year about 0.8 million people join this amount. Minimum daily wage was 206 Baht in Bangkok and it was slightly lower in other provinces (Ministry of Labour, 2010).

3.1.1. **Thai economy before 2000**

The establishment of the First National Economic and Social Development Plan (NESDP) in 1960s is, by far, concerned as the milestone of the modern economic development era for the Thai economy, with the subsequent plans as the important guidelines for the continuous 50 years of Thai economic development onwards. There was the major single objective in the very beginning, for which economic growth was the fundamental assumption and regarded as the key to the development in the first plan (1961-1966) (Paitoonpong and Abe, 2004). While manufacturing sector was the central target to pursue such objective, it was the infrastructure development that was in need as the bird's nest with various financial allocation plans. Things went well with the averaged 8.1 per cent of annual GDP growth, but mainly from the infrastructure and construction (Warr and Bhanupong, 1996).

The additional alteration of the title of the plan by filling in 'Social' to the original name of the National Economic Development Plan signified the main concern extended to the social issues, mainly education and manpower, in the Second plan (1967-1971). It also paid attention to regional development and inequality with some touches upon the role of private sector. This included the enactment of several investment and industrial promotion acts, especially for foreign investment. It was successful with the average real GDP growth rate of 7.5 per cent (Warr and Bhanupong 1996). Infrastructure had been well accompanied and structured, particularly road network. This increased agricultural output through the land expansion, rather than production efficiency (Abonyi and Bunyaraks, 1989).

The Third plan (1972-1976) emphasized on maintaining economic stability while still pursuing for economic growth. There was a focus on equitable income distribution and social services in response to frequent political changes including labour unrests, student uprising, and international conflicts. Economic growth had slowed down to 6.2 per cent on average under the pressure of the first energy crisis (1973-1974) and

the threat of external environment (Warr and Bhanupong, 1996). The troubles had immediate impacts not only on the economy but also on the budget for development and economic management, which was reduced for the increasing of the defence budget. Note that the industrial development was focused in greater Bangkok for 80 per cent of total industrial output in this period (Paitoonpong and Abe, 2004).

The rapid growth of import-substitution industries led to the greater dependence on the import of raw materials and capital equipment with respect to the promotional privileges provided by the authorities that time. This ruined the balance of payment, especially when the export incentives were not appropriate for the overall markets. Development during the Fourth plan (1977-1981) was not only dampened from the political instabilities and global economic recession as well as the oil crisis, but also the structural difficulties. Structural adjustment took place for the first five-year funding program with the help of World Bank and IMF (Paitoonpong and Abe, 2004).

The continuing effects from the Fourth plan period had made the government find various difficulties to implement measures in hand. Targets of restoring financial stability, maintaining creditability as well as restructuring the economy had been emphasized in the Fifth plan (1982-1986) as stated in Paitoonpong and Abe (2004). The economic growth averaged about 5 per cent per year with foreign reserves declined from 12 per cent of GDP in 1970 to 3 per cent in 1985. The debt-service ratio rose from 17 per cent in 1980 to 26 per cent in 1985 as well as a decline in saving to about 16-17 per cent of GDP in 1985 (Warr and Bhanupong 1996).

Along with the progressing emphasis upon the efficiency, development qualities, international competitiveness, and self-reliance of the economy, the Sixth plan (1986-1991) was aimed to diversify the product-market base of the economy as well as to accelerate the economic restructuring. This intended to spread the risk burden for overall producers, which also benefited the economy as a whole. It was this period that was regarded as the golden age of Thailand (Pasuk and Baker 2002). The economy experienced the leap of the growth to around 13.3 per cent in 1988, on average of 10.3 per cent per year. Three principal forces behind the boom were the depreciation of the U.S. dollar relative to other currencies, which in turn, made Thai export more competitive (as Baht pegged to U.S. dollar); foreign investment from the newly industrialized economies to avoid the rising labour costs in their own countries;

and the lower prices of international petroleum relative to export commodities (Warr and Bhanupong 1996). In addition, the political stability during this period was another beneficial factor for overall economic development. According to Dixon (1999), Thailand became an investment hotspot and was able to take advantage of a clustering of favourable global, regional, and national circumstances.

Sustainable development was the main theme for the Seventh plan (1992-1996). It is aimed to foster the economic sustainability with improved income distribution, human resource development, and quality of life and environment (NESDB, 1991). The Thai Economy was among the world's fastest growing with a rate of 8 - 9 per cent per year before Asian crisis in 1997-1998. It was in this period that the financial liberalization played a critical role off the track. Money flooded into the economy in the form of bank loans and portfolio investment upon the domestic market boom and bubbles in asset markets (Paitoonpong and Abe, 2004). Thus, despite the growth, the vulnerable economy began to collapse when there was a trigger, in this case it was the export downturn with the zero growth in 1996 after enjoying two-digit growth for a decade.

Finance industry continuously devastated, but the Eighth plan (1997-2001) had been drawn prior to the financial crisis in the mid 1997 regarding the Baht floated. In the plan, economic growth was first considered as a means to improve people's well-being rather than the main objective of the development. It was aimed to enable higher participation of all parties within the development processes. The plan was revised accordingly. Troubles from the decline in international reserves, Bath instability, financial system collapse, high level of non-performing loans, liquidity shortage, a great deal of capital outflow, GDP contraction, and high unemployment were targeted (NESDB, 2003). This financial crisis brought the negative GDP growth rate for the first time in 1997 for -1.4 per cent and it reached -10.5 per cent in 1998. Government tried to reduce the loss by launching various stimulus measures including a decrease in value-added tax rate from 10 to 7 per cent to boost consumption and investment. The economy started to be recovered in 1999 with the real GDP growth of 4.1 per cent led by the manufacturing sector and increased domestic demand. Tourism increased around 10 per cent, partly because of the exchange rate (Paitoonpong and Abe, 2004).

3.1.2. **Decade of 2000-2009 and beyond**

In the beginning of this decade, many major reform policies were implemented to boost up the economy from the economic crisis following the Eighth plan. The Ninth plan (2002-2006) was also created in order to deal with the problems in hand. It adopted the philosophy of a sufficiency economy of the King as the manner of conduct upon the basis of the Eighth plan's people-centered development (Paitoonpong and Abe, 2004).The growth was on average around 5-6 per cent throughout the plan despite the effects of Tsunami. It had again been embarked with infrastructure development like in the early 1990s, prior to the financial crisis in 1997, when much of government expenditure went directly to investment in infrastructure. Mega-projects, for instance, Suvarnabhumi international airport or the first subway mass transit or MRTA had been executed in order to help boost the country's competitiveness and core infrastructure (Yuthamanop and Theparat 2005).

The Ninth plan was aimed to establish the good governance and reduce the poverty.
The grassroots' participation concept in relation to sufficiency living stated in this plan has also been investigated by Paetyangkul (2011). It was found that communication between officials and villagers seemed to be fluent, even when misunderstandings arose. The study, nevertheless, remarks that it is also obvious that the barrier to effective communication between both groups is the culture, despite the culture identity together with religious principles are of the major guiding principles of the new national development and management system employed within this plan.

The Tenth National Economic and Social Development Plan still paid attention upon the Sufficiency Economy philosophy as guidance for another five years (2007-2011). The holistic people-centered development of the 8th plan was integrated with the philosophy of Sufficiency to become the main principle of this plan so as to maintain the balance and sustainability in all areas of national development while facing with several changing contexts internally and externally. Not only to develop human resource quality and to strengthen local communities for better income distribution, the aims to restructure the economy towards the international competitiveness and to improve the natural resource base for country development as well as to increase the good governance for the country are well strategized (NESDB, 2006).The size of GDP was approximately 269.6 billion dollar with the estimation of GDP per capita of

around 8,343 international dollars (Definition of Geary-Khamis dollar, with GDP derived from Purchasing Power Parity, calculated by the IMF) in 2010. Thailand, however, saw average annual economic growth of 3.4 per cent, reflecting the impacts of both domestic political conflicts and the global economic crisis, which caused a contraction of 2.3 per cent in 2009 and another down-turn of 2.3 per cent from the worst flood in 70 years in 2011 (NESDB, 2011). The result of the political instability has continuously discouraged the country's development in all due respects.

3.2. The Structural Changes over the Decades

This section briefly compares the broad structure of the Thai economy and the structural changes over the decades – the period under baseline simulation in this thesis with 2000 as the starting point comparing to the decade before of the year 1990 and the decade after of the year 2010 as the reflection for change over the decade.

As mentioned before, Thailand has initiated the first National Economic and Social Development Plan in 1960s. The first and the second NESDPs were to stress on the import substitution, then a shift to export-oriented in the third NESDP. This has subsequently altered the face of the economic structure in Thailand - drastically. From the agricultural base to industrialized engine of growth, the shares of the agricultural sector has been downsized from 40.2 per cent of GDP in 1960 to 9 per cent of GDP in 2000 and to 12.4 per cent of GDP in 2010, whereas the shares of industrial sector has been upsized from 18.3 per cent of GDP in 1960 to 42 per cent of GDP in 2000 and to 44.6 per cent in 2010. The service sector with Tourism as a major part, nonetheless, still retains its significant shares through the years as 41.5 per cent of GDP in 1960 to 49 per cent in 2000 and a slight decline in 2010 of about 43 per cent of GDP (1960 data from Kulkokarn, 2008).

In addition to the sectoral share changes, macro variables during the two decades evidently indicate that the international trade is significant. From Table 3.1, exports and imports grew much faster than GDP. This constitutes the conversion from deficit to surplus in the balance of Trade. Tourism receipts and expenses both continue to have the same pattern of about 5 - 6 per cent of GDP and 1.5 – 2 per cent of GDP, respectively.

Table 3.1: Major macroeconomic and sectoral changes in two decades

Economic Indicators	1990	2000	2010	Average annual growth rate (%)
Gross Domestic Product (Real: year base 2002)				
Nominal GDP (Billion Baht)	2,259	5,060	10,807	8.24
Real GDP (Billion Baht)	3,363	5,243	8,176	4.63
Expenditure categories (Real: year base 2002)				
Nominal export values (Billion Baht)	747	3,287	7,207	12.37
Nominal import values (Billion Baht)	916	2,862	6,525	11.11
Real investment (Billion Baht)	1,553	1,169	2,013	2.48
Real private consumption (Billion Baht)	1,877	2,843	4,275	7.30
Real public consumption (Billion Baht)	392	712	1,218	5.86
Factor inputs				
Number of employed people ('000 persons)	26,177.5	31,292.6	38,037.3	-
Population ('000 persons)	54,548.5	62,404.7	67,275.5	-
Price indexes				
Consumer price index (year base 2005)	57.48	89.25	115.53	-
Nominal exchange rate (Baht/USD)	25.585	40.111	31.686	-
Real interest rate (average, %)	8.17	6.40	2.19	-
Balance of payment indicators				
Ratio of balance of trade to GDP	-8.3	4.30	4.08	-
Ratio of travel receipts to GDP	5.05	5.92	5.76	-
Ratio of travel expenditures to GDP	1.67	2.20	1.48	-
Sectoral shares				
Agriculture (% of value added in GDP)	12.5	9	12.4	-
Industry (% of value added in GDP)	37.2	42	44.6	-
Services (% of value added in GDP)	50.3	49	43	-

Source: NESDB, BOT, WDI, NSO, and author's calculations

Note: 1. NESDB is in the process of applying the new methodology in calculating National Income Accounts from Fixed-Weighted Volume Measures to Chain Volume Measures (CVM). As of April 2012, the process of updating the series still not fully finished in some parts e.g. quarterly value and some parts of GDP on income side. Annual series of CVM has been completely updated for the series of 1990-2010. This study follows this new series with reference year base 2002.

2. CVM is the method in calculating GDP and National Income. Mainly, it contains more information on all sides of GDP identity concerning on the new innovations on technologies and financial intermediaries, NGOs, Off-budget items, Non-banks, cable services, internet providers, etc. It also updates the new way of calculating many items e.g. applying Harmonized system code 2007 or using ISIC Rev. 4 following United Nations Statistics. More information on CVM of National Income Accounts is available at the website of NESDB http://www.nesdb.go.th .

3.2.1. From 1990 to 2000

The macroeconomic condition in 1990s was favourable before 1997 crisis. The gain from international trade was the major source of growth. High growth rates from the 1980s to mid of 1990s made the golden age of Thailand as cited in Pasuk and Baker (2002), satisfactorily from export boom (1986-1995). This mainly accounted to foreign direct investment from Japan, South Korea, Taiwan, Hong Kong and Singapore came to establish the production base and enjoyed the cheap and relatively

abundant labour and natural resources in Thailand and exported products back (Kulkokarn, 2008). In 1990, manufacturing industry (as a major part of Industrial sector) could contribute 26 per cent of GDP albeit employing only about 10 per cent of the labour force whereas the agricultural sector employing almost 64 per cent of the labour force but accounted less than 13 per cent of GDP. This foreign direct investment had gradually made a shift of the labour and pulled migration from the agricultural sector in rural area into the industrial sector, particularly manufacturing industry in the sub-urban area. Among these sectors, Textiles, Pharmaceuticals, and Automobile assembly were the rising stars. The Thai Government had also initiated variety of supports, including export incentives e.g. privileges for export activities like import duty and tax refund from the Board of Investment. This open foreign investment policies and private sector encouragement had made the export structure changed, although with high import content. In 2000, values of exports were 4.4 times jumped up from those in 1990, although partly from the devaluation after 1997 financial crisis.

The financial crisis in 1997 had caused a great impact. Warr (1998) cited it was a collapse of the boom resulting from the vulnerability of the economy stemmed from high capital mobility. The boom in the non-tradable sectors i.e. Real Estate led to the high expectation of its rising price. Soaring price in non-tradable sector pulled in the resources from the tradable sector and this 'Dutch disease' effect caused the real appreciation of Baht. Slow-down in export was a real trigger of the crisis. Exchange rate shooting after the floating of the exchange rate was as high as 56 Baht/US Dollar in the early 1998. It dropped to around 40 Baht/US Dollar in 2000, comparing to 25.6 Baht/US Dollar in 1990. Real Estate, Construction and Financial sector were the most affected, with a lay-off of workers in the financial sector as high as 45.9 per cent of total employment in the sector. In 1997-1999, the total amount of lay-offs was high as 114,773 persons comparing to amount of 17,921 persons during 1994-1996. Nevertheless, the face of the economic structure still progressed with the continuing pattern. The employment in the industrial sector became averagely similar to the pattern of other developing countries (Kulkolkarn, 2008). Averagely of the world indicator in 2000, the share of the employment in agricultural sector was 42.8, in industrial sector it was 20.3 and in service sector was 36.9 per cent. For Thailand in 2000, they were 42.3, 20.5 and 37.1 per cent, respectively.

3.2.2. From 2000 to 2010

The economic recovery was well reserved after a few years of crisis. Populist policies administered by the former Prime Minister Thaksin Shinawatra who took office in early 2001 had increased domestic activities and proved popular among the poor at that time. 'Dual track' economic policy or so called 'Thaksinomics' that combined domestic activities with the traditional export oriented and foreign investment promotion gave a revival of the economic performance. In the early half-decade of 2000s, the economy moved gradually, with the threats from natural disaster like tsunami and bird flu that caused the economic setbacks, especially on Tourism. The populist policies became politically controversial for its behind-the-scene agenda and led to many uprising rallies headed by the opposing group called People's Alliance for Democracy (PAD) in 2005-6. The protest brought about the exile of the former Prime Minister after the military coup silently took place in 2006, but he still arguably regarded as the puppet-master in various political occasions between the Anti-Thaksin and Pro-Thakin demonstrations as partly listed in Table 1.1 of Chapter 1. After the government coalition of one military-appointed former Prime Minister, there were two Pro-Thaksin former Prime Ministers publicly concerned as Thaksin's nominees from the 2007 general election and another former Prime Minister Abhisit Vejjajeva, leader of the Democrat Party, as Anti-Thakin who came into power after the Constitutional Court's ruling upon Pro-Thaksin Party's dissolution. The situation escalated in the early 2010 with the marching of 'Red shirt' protesters, composed mainly of Thaksin supporters, and the encampment of them at the financial district in Bangkok. The clashes resulting from restoring the situation to normalcy made fatalities and injuries. It could be said that, for the latter half-decade, the political turmoils have played as the major internal factor, other than drought and flood, for economic instabilities with the threats from the rising oil price and the world economic recession resulting from the Sub-primes in the US and the EU financial problems. It was fortunate that the Thai financial system was not directly affected in a significant way (Sussangkarn and Jitsuchon (2009)). Higher trade diversification makes Thailand less direct exposure to such threats, yet, there were shock transmissions from the indirect linkages with those countries through trade supply chain (Cheewatrakoolpong and Manprasert (2012).

Despite political instabilities and external threats, in terms of macro-indicators, real GDP 2010 was about 1.6 times of 2000. This was quite the same size for real final

private consumption and real final public consumption of 1.5 times and 1.7 times respectively. Although real investment in 2000 was lower from 1990, it was doubled the amount in 2010. International trade were more than double in nominal terms, the same as nominal GDP in 2010 comparing to 2000. Exchange rate has been managed to gradually decline to about 30-32 Baht/US Dollar in 2010. The Bank of Thailand has carefully looked after the inflation with inflation targeting adopted in May 2000. Recently, the effectiveness of the monetary policy with the decade of inflation targeting had been evaluated from the outsiders. It was indicated that, in overall terms, the practice recorded excellent performance in price stability and it has not been achieved at the expense of the economic growth (Thanapase, 2010).

3.3. Tourism Industry and its Significance

This section explains the overall basic information of the Tourism industry and its significance for the Thai economy. The section begins with the overview of the industry including all three types of Tourism. The subsequent sections talk about the international market and the role of Thailand, and overall potential of the country.

3.3.1. Overview of Thai Tourism Industry and its Significance

❖ ***Inbound Tourism***

In response to its fast-growing and distinct portion within the Thai economy, the Ministry of Tourism and Sports (MOTS) was established in 2002, incorporated the Tourism Authority of Thailand (TAT), which has officially been initiated to look after this industry in 1979 (transformed from Tourism Promotion Organization of Thailand first started in 18 March, 1960), under its umbrella according to the prodigious public attention on Tourism as one of the main engines for nation's economic development.

With the concerns, not only continuously pinning down Tourism within all of the NESDPs, the Thai Government had overtime launched a series of promotional campaigns ranging from 1987's "Visit, Thailand Year", 1998's "Amazing Thailand" during economic crisis with an effort to assist recovery regarding its quick income generating role, the 2003-2004's "Unseen Thailand", the revisited 2009's "Visit Thailand Year" and the 200 million Baht campaign 'Miracle Thailand 2012' to reboot Tourism from the worst floods in 70 years happening in the last quarter of 2011. The outcome of such concerns and promotional efforts has become fairly fruitful as

Thailand is clearly one of the top tourist hotspots of the world in terms of reputation and media press recognition. According to the Travel + Leisure Magazine, Bangkok, the capital city and one of the most important air transport hubs of the Southeast Asia, is Asia's best tourist destination, the third in the world in 2006-2007 and overall best city in the world in 2008. Bangkok, in addition, retains its number one ranking in the world's best city for another two consecutive years (2010-2011) announced by the Travel + Leisure World's Best Awards 2011 Readers' Survey, despite in the context of political upheaval concurrently.

Table 3.2: Target achievement in National Economic and Social Development Plans

NESDP	Target			
	No.of tourists (million)	Average length of stay (day)	Average expense Baht/pax/day	Tourism Revenue (million Baht)
PLAN 4 (1977-1981)	2.2	5.5	966	11,700
Actual Results	*2.01*	*4.96*	*2,146*	*21,455*
PLAN 5 (1982-1986)	2.9	5.5	3,100	49,500
Actual Results	*2.81*	*5.93*	*2,233.28*	*37,321*
PLAN 6 (1987-1991)	3.7	8	3,000	7.4% p.a.
Actual Results	*5.08*	*7.09*	*2,772.82*	*100,004 21.25% p.a.*
PLAN 7 (1992-1996)	9	8	3,800	274,000
Actual Results	*7.19*	*8.23*	*3,706.02*	*219,364*
PLAN 8 (1997-2001)	12	8	n.a.	490,000
Actual Results	*10.06*	*7.93*	*3,747.87*	*299,047*
PLAN 9 (2002-2006)	10% p.a. 16	8.2	4,100	7-8% p.a.
Actual Results	*11.56*	*8.22*	*3,904.89*	*392,031*
PLAN 10 (2007-2011)	7% 20	8.5	4,500	7-8% p.a.
Actual Results (until 2010)	*14.78*	*9.20*	*4,088.28*	*556,338*

Source: Wangpaijit (2004), NESDB, TAT, and author's calculation (p.a. = per annum)

Note: There is rough information on the targets of Plan 9 and Plan 10. Notably, the targets of the plans have been shifted to "quality" tourists in the later NESDPs and the National Tourism Agenda have been set up with a specific role to manage the tourism 'system' with Ministry of Tourism and Sport as the main task force. The information of Plan 9-10 are partly taken from the TAT's Tourism plan.

In terms of public awareness, the first National Tourism Development Agenda (2007-2011) had been released to specifically administer the Tourism system in 2006, in addition to the NESDP, which is aimed for the country's overall development. Tourism has been regarded as very significant as in the Agenda, the Prime Minister acting as the Chief of the committee and Ministry of Tourism and Sport has become the main task force to drive and control the Tourism system. The second National Tourism Development Agenda (2012-2016) has just been launched in 2011 aiming to control the system's image and competitiveness i.e. the innovative technology or the low-cost airlines, and changing circumstances including the instabilities either from natural disasters or political reasons. This also involves the green concern on Tourism, more on the agenda in section 2.5.2.

In term of milestone, as shown and mentioned before in the introduction of Chapter 1 about the increasing trend of more than 10 million annual visitor arrivals since 2001, despite the worst flood in 2011 that dampened GDP of the fourth quarter negative of 9 per cent (NESDB, 2012), there were 19,098,323 visitor arrivals in just one year, the highest in the history. This could prove the outstandingly increasing demand for Thai Tourism and its significance. Table 3.2 informs the target achievement according to the series of the National Economic and Social Development Plans overtime.

Table 3.3: Travel Receipts and Value of Major Exported Commodities, 2000-2011

Year	Travel Receipts (Million)	Value of Major Exported Commodities (Million Baht)				
		Computers & Parts	Automobiles & Parts	Rubber	Jewelry	Integrated Circuits
2000	299,536	348,118	96,520	60,712	69,397	179,302
2001	313,999	351,798	117,614	58,708	81,312	154,880
2002	339,658	319,129	125,270	74,604	93,081	148,064
2003	324,733	339,944	164,706	115,797	104,526	191,540
2004	403,578	368,867	220,788	137,454	106,278	196,444
2005	385,749	474,445	310,307	148,680	129,339	238,455
2006	506,435	565,807	362,374	205,483	139,865	267,598
2007	575,171	597,060	447,108	194,339	185,147	290,350
2008	603,246	605,314	513,154	223,628	274,093	237,973
2009	535,768	545,469	378,349	146,188	333,700	219,509
2010	622,434	596,678	561,109	249,262	366,818	255,322
2011	800,592 p	513,709	511,484	397,080	371,239	238,173

Source: Balance of Payments of Bank of Thailand and Ministry of Commerce, p = preliminary.
Note: For Travel Receipts and Expenses in BOP, see the definition recommendations in **Box 3.1**

It could be said that the development of the Tourism industry has been outstanding since being included in the fourth NESDP. From that time when rice was the top export commodity through the country's industrialization, the value of this type of export of services remains one of the highest when comparing the value among the major exported commodities as listed in Table 3.3 for the recent 11 years (commodity ranking upon 2011), Travel Receipts are over the years among the top three in terms of revenue generating source for the country. This amount, more importantly, is still not considered about the import content and the assembly role of the other sectors. See also, Figure 3.1.

Figure 3.1: Travel Receipts and Other Major Export Commodities (Million Baht)

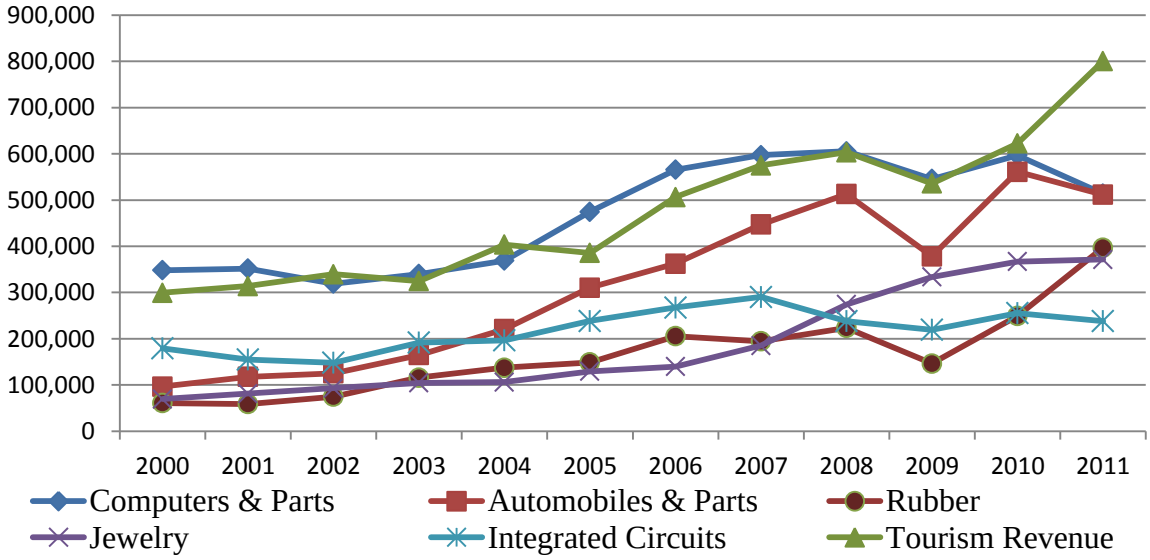
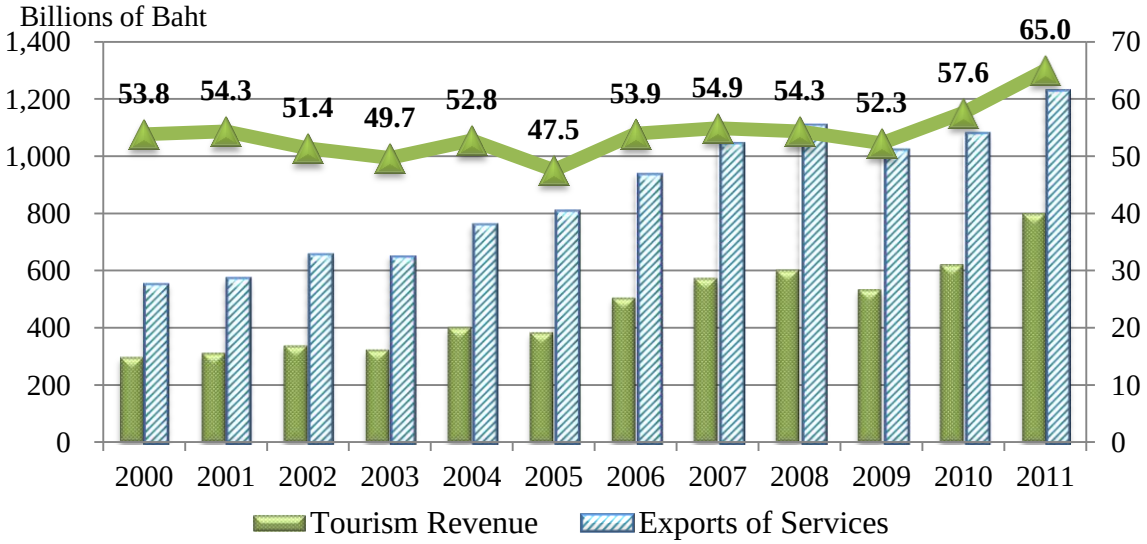


Figure 3.2: Ratio of Travel Receipts to Export of Services from 2000 to 2011



Source: Balance of Payments of the Bank of Thailand (BOT) and NESDB
Note: Preliminary data for year 2011 and value of the Travel receipts in BOPs

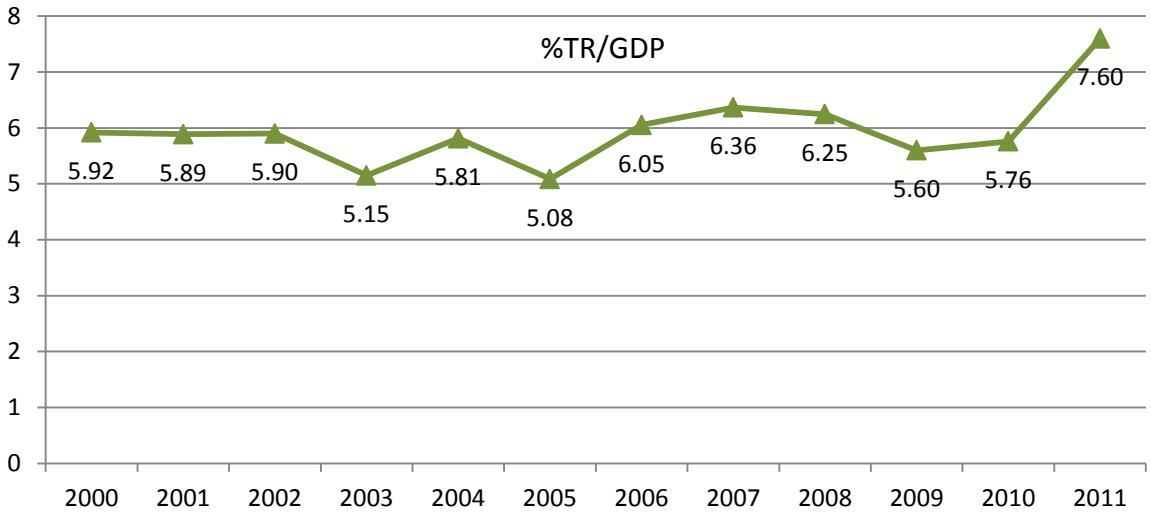
BOX 3.1: Note on bridging Travel item in Balance of Payments (BOP) and Inbound/Outbound Tourism Expenditure of Tourism Statistics.

According to the International Recommendations for Tourism Statistics (IRTS) 2008 (2010) of UNWTO, the definitions of Travel item and Inbound/Outbound Tourism Expenditure are distinguished to make a clear understanding.

The Balance of Payments (BOP) focuses on the explanation of the economic relationship between residents and non-residents of the country of reference. Transactions associated with international Tourism are on the same basis of a concept of residence using in Balance of Payments and System of National Accounts. However, Tourism statistics has a narrower definition as the scope of individuals regarding Travel item in BOP includes border workers, seasonal workers and other short-term workers, frequent border crossers who are within their usual environment, students taking long-term courses outside their country of residence and long-term patients who are being treated outside their country of residence. The new concept for the BOP applied by the Bank of Thailand (for which also in line with NESDB's CVM) also has a breakdown on the Travel item under business and personal by purpose. But, those two items are still in broader sense, for which are different concepts from Tourism statistics. The Balance of Payments Manual, Sixth edition, recommends the breakdown of the Travel item into various types of services that would adjust well with the Tourism statistics and TSA. Travel item, however, is widely used as a first approximation to the total amount of Tourism expenditure, although in some cases the flows of non-visitors within travellers are important. For TSA, it is recommended in IRTS 2008 (2010) to allow breakdowns as supplementary items to the standard components of the BOP. This is also explicitly mentioned in BOP compilation.

This study concerns this notice and hopes that it be classified in the new project of Thai TSA to be completed in 2013-4 by MOTS. Meanwhile, this study uses the Travel item as Tourism revenue and expense to be in line with all other categories of National Income Accounts and BOP. Note that TSA of the year 2000 that is used as database in this study still follows the 1993 Recommendations on Tourism Statistics. See Annex 1 of IRTS 2008 (2010) for the main difference.

Figure 3.3: Ratio of Travel Receipts in Gross Domestic Products from 2000 to 2011



Source: Bank of Thailand (BOT) and NESDB
Note: GDP taken from the Chain Volume Measures, except only 2011 value is from Fixed-Weighted Volume Measures as the only released data as of April, 2012.

In addition, Tourism industry shares relatively around 50 - 60 per cent of the total export of services for more than a decade (on average is 54 per cent, See Figure 3.2) and it also accounts for around 5 - 7 per cent of the nominal gross domestic products (averagely 5.95 per cent of GDP) of the country (Figure 3.3). From the definition of Macroeconomic International Tourism Related Indicators (MITRI) provided by UNWTO, the share or the ratio of Inbound Tourism expenditure over exports of services reflects *"the importance of tourism as an internationally traded service relative to other categories of exports. At the same time, such measures reveal the degree of tourism specialization in a country's export structure and the relative capability of tourism in generating foreign revenues"* whereas the ratio of Inbound Tourism expenditure over GDP reflects *"the weight of expenditure by inbound visitors as a part of the total value of economic activity in the economy of reference. From the perspective of international trade, this indicator captures the economic importance of foreign revenue inflow associated to expenditures by such visitors."* In 2007, for example, Travel receipts as an approximate of Tourism revenue, account 575,170.9 million Baht or a share of 54.9 per cent of total export of services or of 6.36 per cent of GDP that year. This truly supports its income generating role for Thai economy.

Furthermore, the industry's revealed comparative advantage index (Balassa 1965), computed as the ratio of its tourism exports (as a fraction of total exports) to global

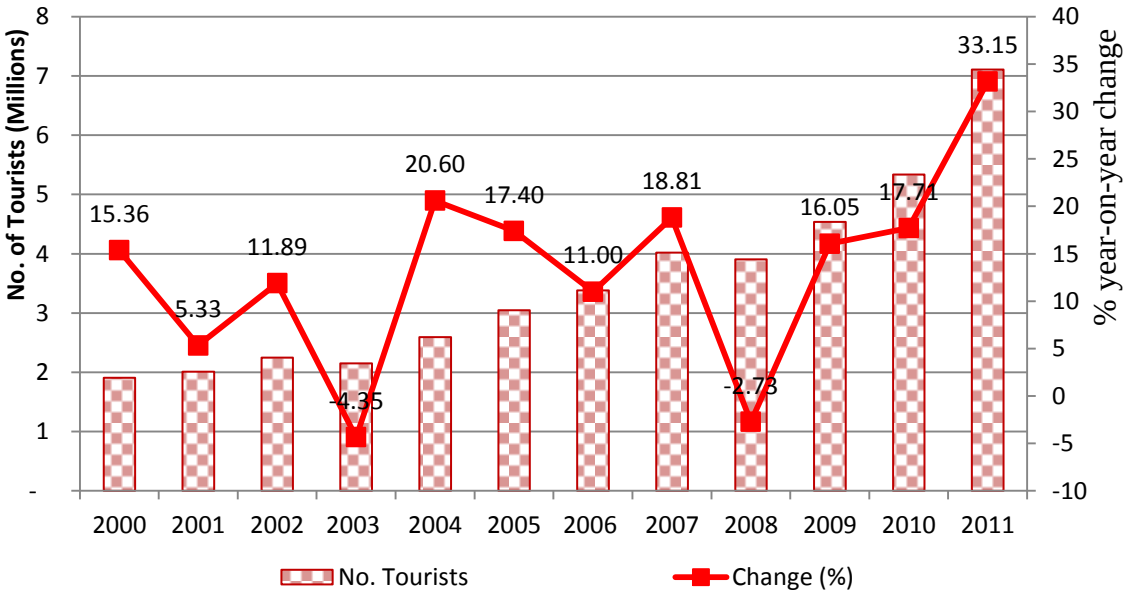
tourism exports (as a fraction of global total exports), is about 2. This indicates significant comparative advantage relative to world markets, and also among Thai tradable industries (Wattanakuljaras and Coxhead 2006, p.8). Tourism in Thailand is also recognized as an important contributor to employment and wealth creation with a large flow through linkage effect which impacts all sectors of Thailand's economy. Wattanakuljaras (2006) stated that

"Using the industry's GDP share as a measure, Thailand is ranked #60 of 174 countries in the World Tourism and Travel Council's global Tourism Satellite Accounts (TSA). On average during 1998-2005, Thai tourism directly and indirectly accounted for 13% of GDP (655 billion baht), 10% of employment (3 million jobs), 13% of exports (417 billion baht), 12% of investment (117 billion baht) and 3% of government budget (13 billion baht)."

❖ Outbound Tourism

Outbound Tourism is in another dimension comparing to the Inbound Tourism. The attention is comparatively less for the public in many aspects. The outbound Tourism in Thailand actually grows moderately through time and normally follows the trend of GDP as it is often the case for higher income, higher spending. The number of the outbound tourists has averagely grown with the increasing rate for a decade.

Figure 3.4: Number of the outbound tourists and its growth rates 2000-2011



Source: MOTS

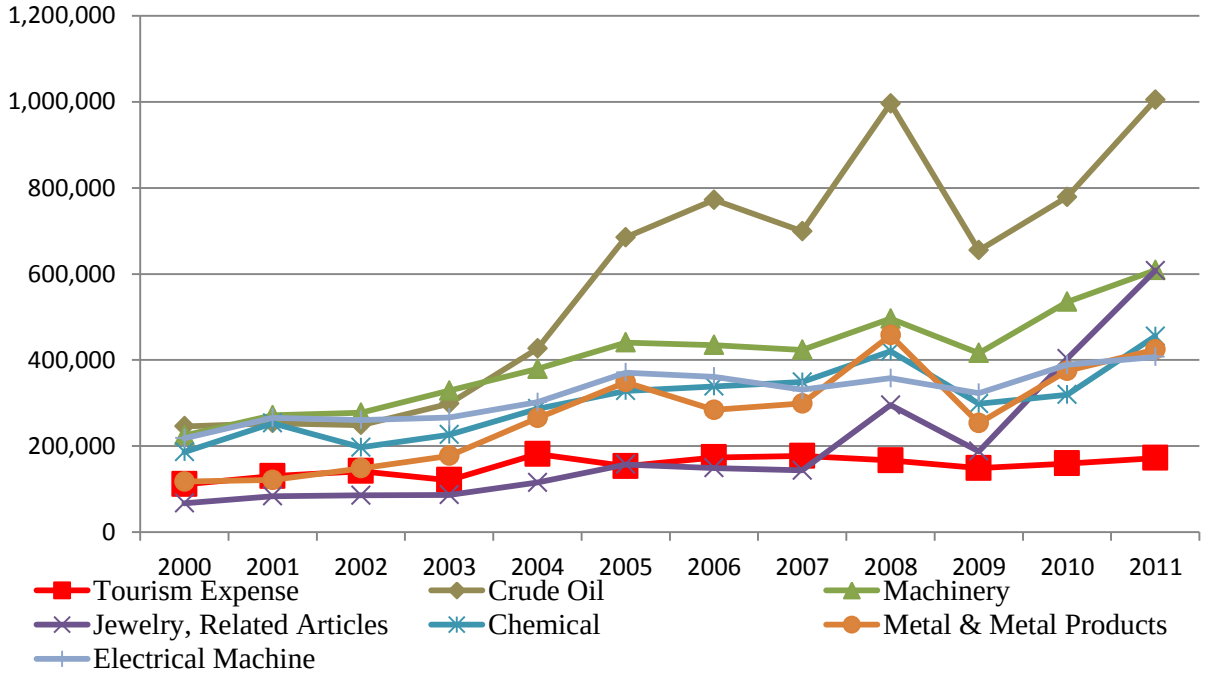
Comparing the Travel expenses with other major imported commodities, it also could be stated that the outbound travel expense is around 17.15 per cent of the imported Crude oil in 2011 comparing to the 45.3 per cent of the value in 2000, see Table 3.4.

Table 3.4: Travel Expenses and Value of Major Imported Commodities, 2000-2011

Year	Travel Expenses	Value of Major Imported Commodities (Million Baht)					
		Crude Oil	Machinery	Jewelry, Related Articles	Chemical	Metal & Metal Products	Electrical Machine
2000	111,424	246,035	225,122	67,394	186,345	117,568	218,188
2001	130,172	253,321	271,432	83,579	253,321	121,114	265,857
2002	141,714	248,661	277,513	85,493	197,046	148,512	260,614
2003	120,882	298,717	328,621	86,803	226,462	177,581	266,347
2004	181,686	426,570	379,423	115,473	286,657	265,014	302,053
2005	153,294	684,952	440,686	157,478	328,538	348,618	370,911
2006	173,712	772,054	434,717	149,205	338,960	284,193	360,997
2007	177,031	699,174	423,644	143,417	348,879	298,863	330,848
2008	166,615	995,965	495,977	295,287	420,135	458,002	357,781
2009	148,615	654,851	416,333	188,032	298,225	253,249	323,338
2010	159,735	778,746	535,242	403,162	319,318	375,048	389,188
2011	172,281 p	1,004,478	608,912	607,509	455,350	424,271	407,144

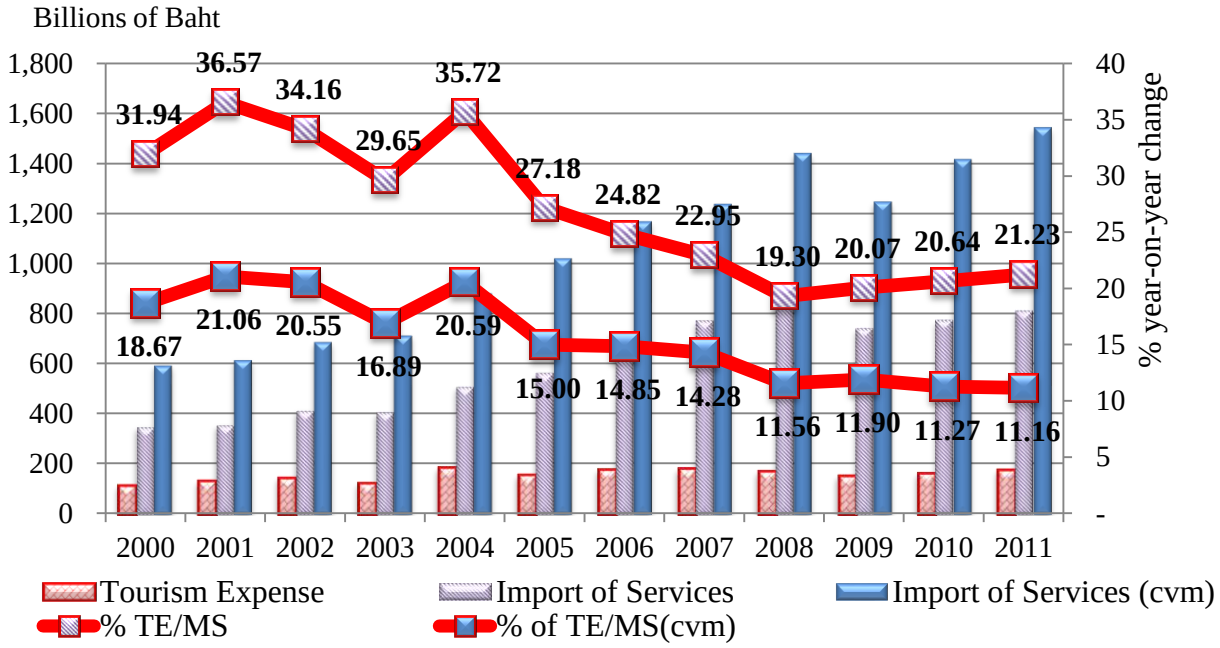
Source: Balance of Payments of Bank of Thailand and Ministry of Commerce, p = preliminary.

Figure 3.5: Tourism Expense and Other Major Imported Commodities (Million Baht)



From Figure 3.5, it is easy to see that the structure of the important imported commodities is changing overtime, with Crude oil, which ranks the first in the top 6 major imported commodities, becomes the commodity that the Thai economy relies on heavier and heavier. This stems from the rising oil price and Thailand is still the oil dependent developing country. Jewelry and related articles, in turn, has a sharp changing pattern from the value even lower than the travel expense in 2000 to the more import dependent in the late few years, implying on the import content of export value shown earlier of this category. This implicitly represents the fact that Thailand is exporting the skill of craftsmanship on this kind of product. Travel expense, on the other hand, has the moderate value overtime, although with a small increasing pace.

Figure 3.6: Ratio of Travel Expense to Both of Import Services from 2000 to 2011.

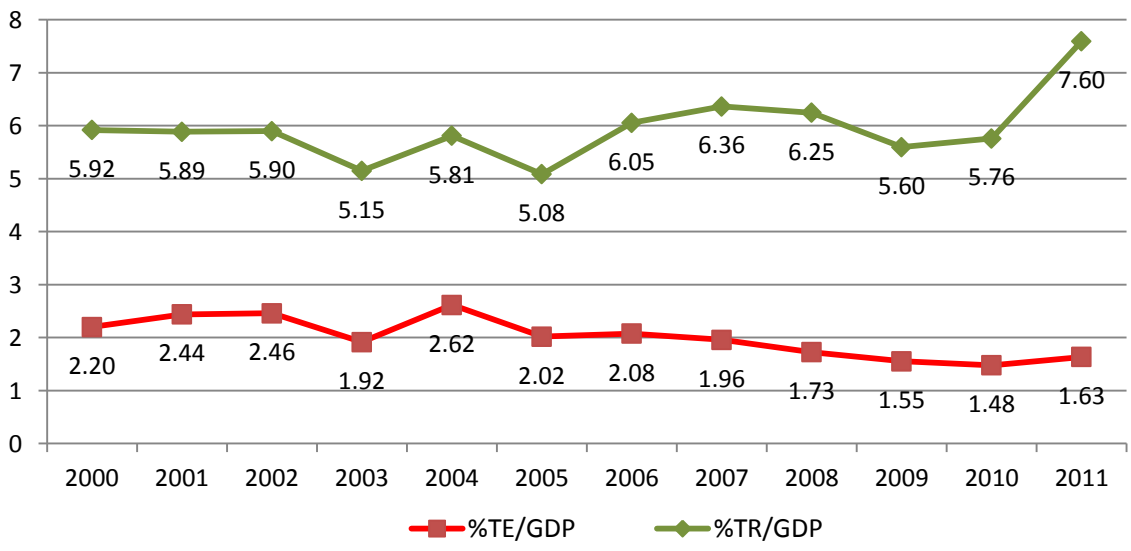


Source: Bank of Thailand (BOT) and NESDB
Note: Preliminary data for year 2011; TE = Tourism Expense; MS = Import of Services

Figure 3.6 represents the ratio of outbound travel expense over two types of imports of services concerning the methodology employed by NESDB: the conventional Fixed-Weighted Volume Measures and the new Chain Volume Measures (CVM). This study calculates both ways since the values of the import of services are vast different, although the same trend. The CVM with new definition includes other items of import services those were previously excluded i.e. import of innovations and technological services, and the related maintenance services, etc. This is also in line with the new

definition of the Balance of Payments provided by the Bank of Thailand that includes manufacturing service on physical inputs owned by others and maintenance and repair service. Note that this is not the case for the Export of services since the values of the export of services by both methodologies are almost the same. This ratio reflects the importance of the outbound Tourism as a traded service relative to other categories of imports. It also reveals the predilection for Tourism in the import structure and the degree of revenue outflows relatively regarding the outbound Tourism. With the ratios, it shows a declining trend of Tourism expense within the import of services, although the Travel expense has a small increasing trend itself shown in Figure 3.7. This gives the implication on the relative smaller importance comparing to the other imported service categories which become of higher demands.

Figure 3.7: Ratio of Travel Receipts and Expenses in GDP from 2000 to 2011



Source: Bank of Thailand (BOT) and NESDB
Note: GDP taken from the Chain Volume Measures, except only 2011 value is from Fixed-Weighted Volume Measures as the only released data as of April, 2012.

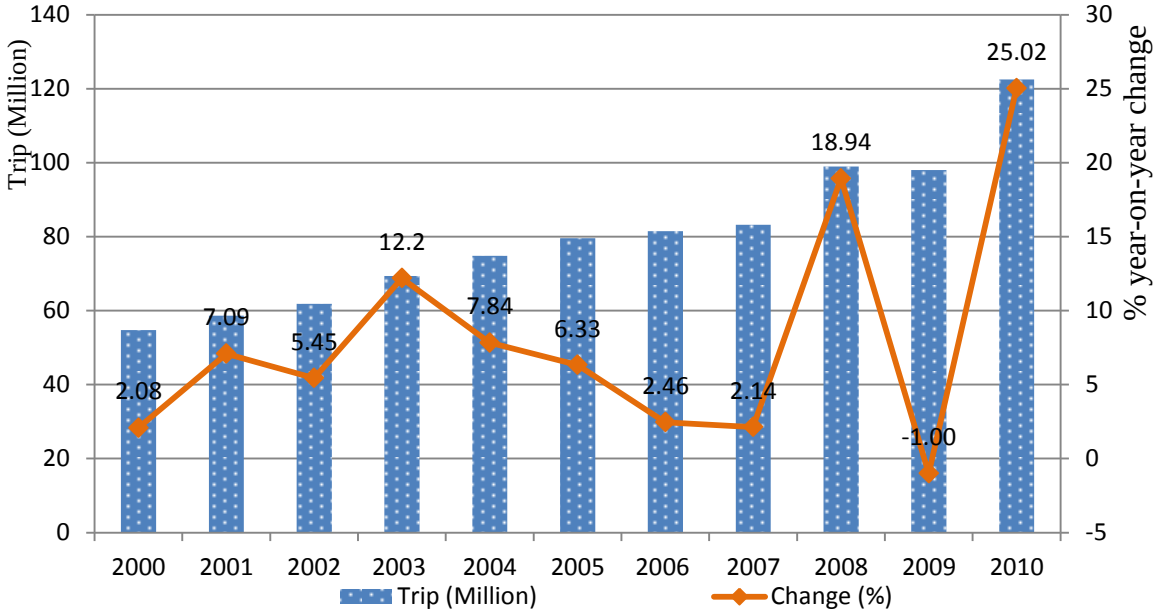
From MITRI provided by UNWTO, Outbound tourism expenditure over GDP represents *"the importance of the spending abroad by outbound visitors, expressed in terms of the national economy. From the perspective of international trade, this indicator captures the economic importance of domestic revenue outflow by means of such visitors."* This ratio of Travel expenses in GDP is shown in Figure 3.7 comparing with the Travel receipts in GDP ever presented earlier. It obviously shows how much important the Travel receipts have been to the Thai economy overtime.

❖ Domestic Tourism

It is somewhat common for the Tourism sector, including the study and the research community, to focus mainly on international both inbound and outbound tourism in terms of visitor arrivals, receipts and expenditures. This is also confirmed by the fact that the statistics and information on international Tourism as reported by the UNWTO are more or less consistent, comprehensive and up-to-date (Eijgelaar et.al, 2008). Nevertheless, domestic Tourism is another big portion that could be several times larger than international Tourism, but with less consistent data that are not widely available as its movements are difficult to trace and the estimation can be different depending on the definition used with regard to domestic trips (Eijgelaar et.al, 2008). This leads to a distorted image of Tourism.

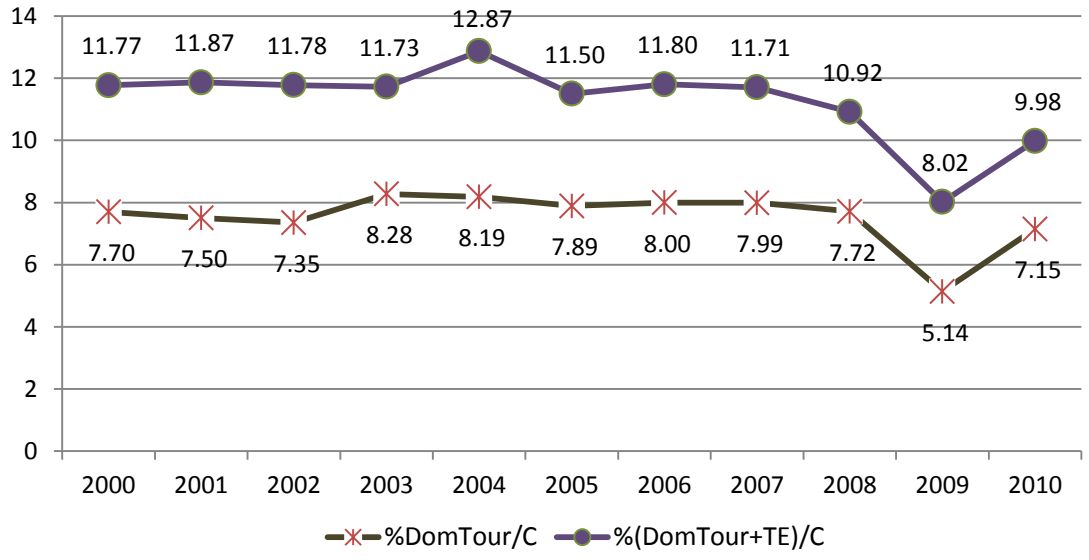
Total domestic tourism in 2005 has been estimated to be of 4 billion arrivals around the world (UNWTO, 2006) and Thailand saw 80 million domestic tourist trips in 2005 and later reached 100 million trips in 2010 after a sharp decline of -12.73 per cent in 2009 due to the political riots by the Red-shirt clan and the world economic recession. The number of the domestic tourist trips is the result of excluding the repeated number of domestic visitors after summing up the visitors by province. That is one visitor could visit more than one province in one trip. After deducting, it is the visitor-trip.

Figure 3.8: Domestic tourist trips and its percentage change (y-o-y)



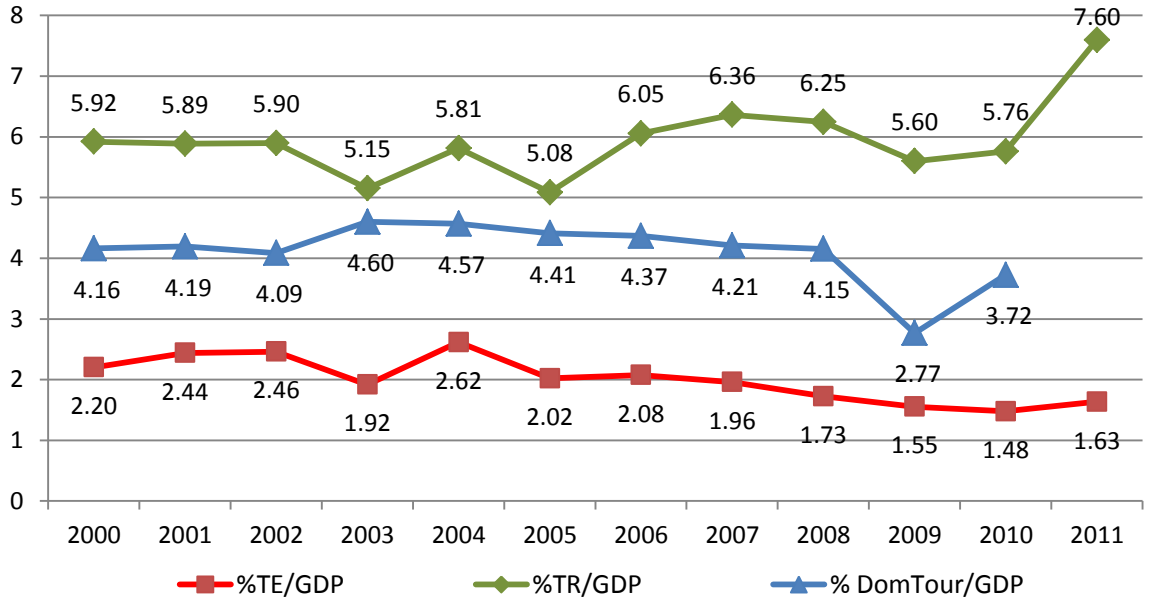
Source: TAT and MOTS; Note: 2008 data was the estimate by MOTS as survey data was incomplete.

Figure 3.9: Comparisons of ratios of Domestic Tourism revenue and the summation of Domestic Tourism revenue and Travel Expenses to Private Final Consumption 2000-10



Source: TAT, MOTS, Bank of Thailand (BOT) and NESDB
Note: Private Final Consumption taken from the Chain Volume Measures, and 2008 Domestic Tourism Revenue data was the estimate by MOTS as survey data was incomplete. There is no available data for Domestic Tourism Revenue in 2011, as of April, 2012.

Figure 3.10: Comparisons of ratios of Domestic Tourism revenue, Travel Receipts and Travel Expenses to GDP from 2000 to 2011



Source: TAT, MOTS, Bank of Thailand (BOT) and NESDB
Note: GDP taken from the Chain Volume Measures, except only 2011 value is from Fixed-Weighted Volume Measures as the only released data and there is no available data for Domestic Tourism Revenue in 2011, both as of April, 2012.

The ratios of domestic tourism revenue to the private final consumption and the summation of domestic tourism revenue and outbound travel expense to the private final consumption are shown in Figure 3.9. This represents the portion of the national spending on traveling in the total final consumption. National in this sense means the domestic visitors reside inside the country travel within the country and the residents travel abroad or outbound visitors. The spending of the domestic visitors within the country over the decade has been about 7 – 8 per cent of the private consumption. It is around 11 – 12 per cent when including the travel expenses of the outbound type.

Figure 3.10 shows the comparisons of the ratios of Domestic tourism revenue, Travel receipts and Travel expenses to GDP, with Travel receipts and Travel expenses as the approximation of inbound Tourism revenue and outbound Tourism expense. It clearly represents the important of the inbound tourism type over other two types in terms of income generating role. Internal Tourism, which means domestic tourism and inbound tourism, could mark as a significant portion of about 10 per cent of GDP over decade.

Table 3.5: Some information on Domestic Tourism during 2000-2010

Year	Domestic						
	Thai Visitor		Avarage	Average Expenditure		Revenue	
	Trip	Change	Length of Stay	/person/day	Change	Million	Change
	(Million)	(%)	(Days)	(Baht)	(%)	(Baht)	(%)
2000	54.74	2.08	2.48	1,717.77	12.75	210,516.15	3.61
2001	58.62	7.09	2.51	1,702.70	-0.88	223,732.14	6.28
2002	61.82	5.45	2.55	1,689.52	-0.77	235,337.15	5.19
2003	69.36	12.2	2.61	1,824.38	7.98	289,986.81	23.22
2004	74.8	7.84	2.6	1,852.33	1.53	317,224.62	9.39
2005	79.53	6.33	2.73	1,768.87	-4.51	334,716.79	5.51
2006	81.49	2.46	2.65	1,795.09	1.48	365,276.28	9.13
2007	83.23	2.14	2.63	1,767.35	-1.55	380,417.10	4.15
2008	98.99	18.94	2.61	1,838.93*	4.05	401,199.36	5.47
2009	86.39	-12.73	2.35	1,540.63	-16.22	264,780.93	-34.00
2010	101.33	17.29	2.59	1,736.38	12.71	402,574.39	52.04

Source: TAT and MOTS
Note: 2008 Domestic Tourism data was the estimate by MOTS and the author's estimate (*) as survey data was incomplete. There is no available data for Domestic Tourism in 2011, as of April, 2012.

Over the decade, the average length of stay of domestic visitors is about 2.6 days with the amount of 1,748.5 Baht on average of the average expenditure per person per day. As the domestic visitors are the resident of the country, the trip can be made with more frequency and relatively less amount of average expense since it is easier for the resident to travel with less costs and barriers like languages and information costs.

3.3.2. Structure of Tourism Industry from TSA 2000

As Tourism has a unique characteristic concerning its property as the 'amalgam' of industries, structurally, the economy can be disaggregated into 3 main sectors: Direct-Tourism or Tourism Industry (TI), Tourism-connected (TC), and Non-Tourism (NT). The list of the sector categorization in details can be seen in Table 4.4 of Chapter 4. Tourism Satellite Accounts of Thailand year 2000 reports that there were shares of 7 per cent of TI, 27 per cent of TC and 66 per cent of NT in the Thai economy, respectively. It made Tourism-related industry with a portion of 34 per cent in the Thai economy. See Figure 3.11.

Figure 3.11: Structure of Thai economy with the Tourism categories

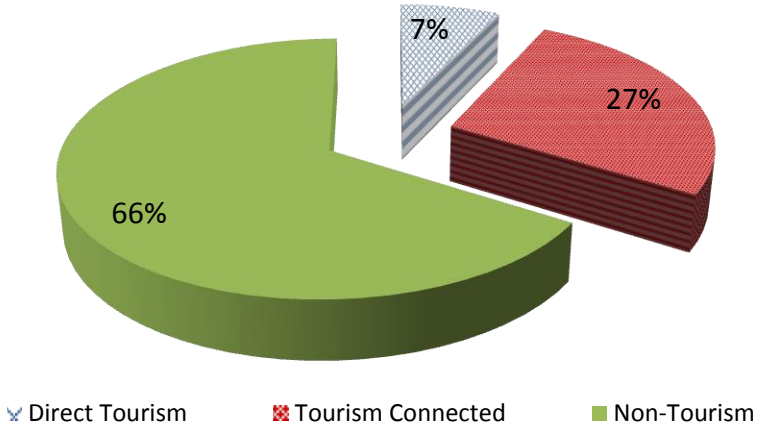
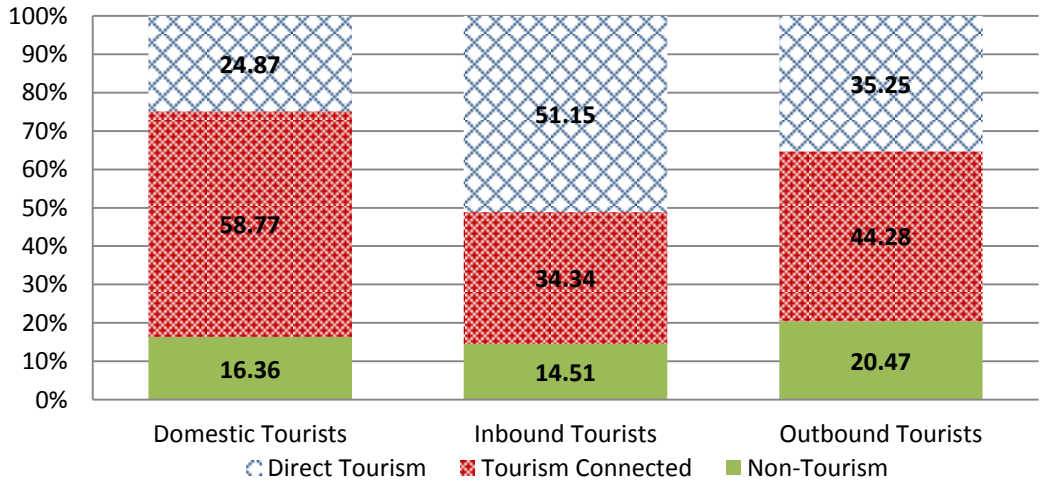


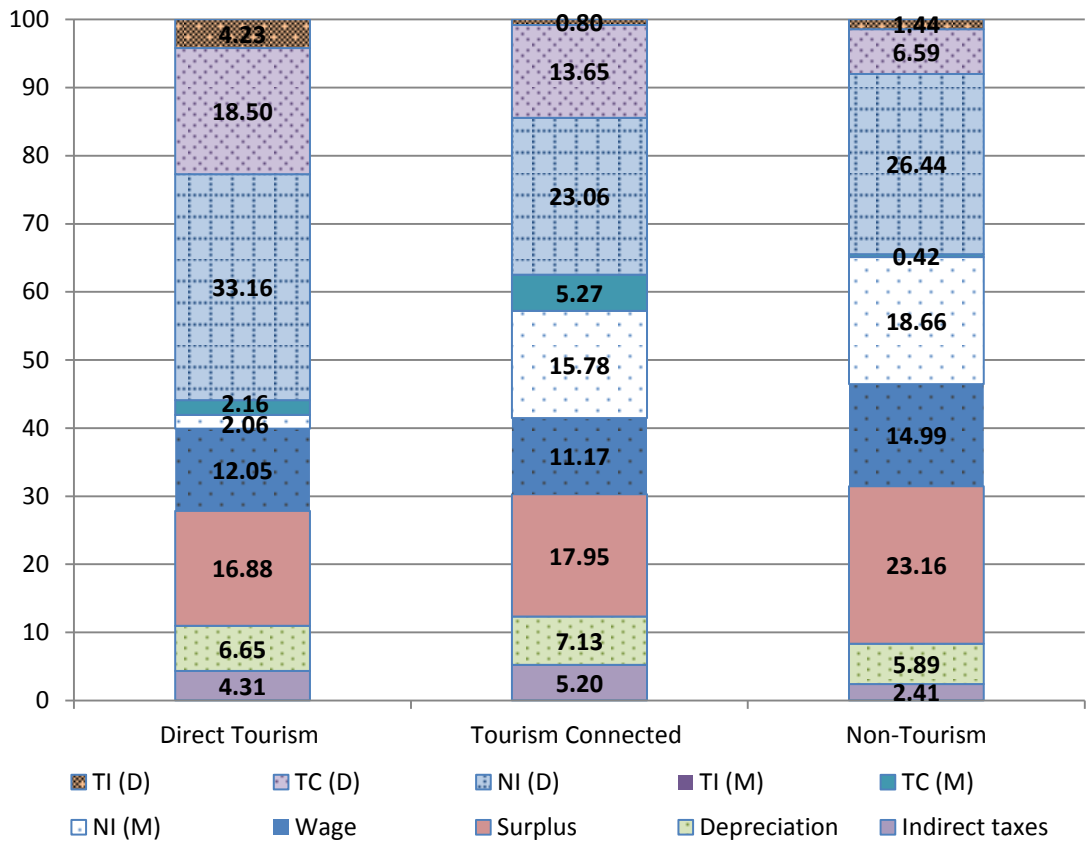
Figure 3.12: Structure of tourists' demand for each commodity



Note: the latest data on Thai TSA is year 2000. MOTS plans to issue the new one within 2013-14. The updated structure are presented in chapter 5 as the results of historical simulation.

With the demand from each type of the tourists (visitors), each group demanded the composition of tourism-related commodity differently. From Figure 3.12, the inbound tourists bought direct-tourism commodity about 51.15 per cent of total 3 types of commodity whereas the domestic tourists bought tourism-connected commodity about 58.77 per cent of overall. The outbound tourists from Thailand consumed/imported tourism-connected commodity the highest for 44.28 per cent within their composition. These sizes of demand suggest on the target for further sectoral development.

Figure 3.13: Cost structure of each Tourism-related sector in TSA 2000



Note: D means domestic and M means imported sources for all types of commodity served as the intermediate inputs. TI(M) value in all industries are trivial and not shown in the figure.

From Figure 3.13, the cost structure of each industry is shown in percentage of total. TI utilized the domestic NT intermediate inputs the most, sharing of 33.16 per cent of all cost in order to produce its own commodity. The pattern is the same for TC and NT themselves but with less portion. TI also used small amount of imported intermediate inputs. About 56 per cent of the cost was domestic inputs. Other costs are returns on factors of production and net indirect taxes, which accounted about 40 – 45 per cent of the total cost of each sector. This suggests the high content of domestic usage for TI.

3.3.3. International Market

It could rather be said that the number of international tourists grows fast. The World Tourism Organization (UNWTO) released the data on average growth of international tourists in 2010 of 6.6 per cent over the previous year exceeding its expectations with 940 million international tourist arrivals. The industry has recovered from the negative growth -3.8 % of the previous year as a result of the global financial crisis, which made 3.4 % average annual growth of 2000-2010. The 2011 preliminary data shows 4.4 % growth with a decline in Middle East due to political unrests in the region.

Table 3.6: World's international tourist arrivals by Regions

Region	International Tourist Arrivals (Billion)				Change from previous year (in per cent)			Market share		% Avr Annual growth
	2000	2005	2010	2011	2009	2010	2011	2010	2011	(00-10)
World	675	798	940	980	-3.8	6.6	4.4	100	100	3.4
1 Europe	385.6	439.4	476.6	502.3	-4.9	3.3	5.8	50.7	51.2	2.1
2 Asia& Pacific	110.1	153.6	203.8	217.1	-1.7	12.7	6.1	21.7	22.1	6.3
3 Americas	128.2	133.3	149.8	156.0	-4.9	6.4	4.2	15.9	15.9	1.6
4 Africa	26.5	35.4	49.4	50.0	3.7	7.3	0.2	5.2	5.1	6.4
5 Middle East	24.1	36.3	60.3	54.8	-4.3	14.1	-8.4	6.4	5.6	9.6

Source: World Tourism Organization (UNWTO) © and 2011 regional data as of mid-March 2012.

Table 3.7: World's international tourism receipts by Regions

Region	International Tourism			Change from previous year (constant price in per cent)			Market share
	Receipts (in Billion US$)		per arrival				
	2009	2010	2010	2008	2009	2010	2010
World	851	919	980	1.7	-5.6	4.7	100
1 Europe	410.9	406.2	850	-0.9	-6.7	-0.4	44.2
2Asia & Pacific	203.1	248.7	1,220	4.6	0.7	12.8	27.1
3 Americas	166.2	182.2	1,220	4.9	-9.9	5.0	19.8
4 Africa	28.8	31.6	640	-2.5	-4.1	4.0	3.4
5 Middle East	42.0	50.3	830	5.5	0.8	14.4	5.5

Source: World Tourism Organization (UNWTO) ©

UNWTO estimated that worldwide receipts from international tourism have reached US$ 919 billion with an increase by US$ 68 billion from 2009. In the past few years, Asia & Pacific has become the second-most visited region after Europe. It grows at a faster pace than it does in the Americas both in terms of arrivals (12.7% in 2010 and 6.1% in 2011) and receipts (12.8% in 2010). However, in absolute term, Europe is still the greatest gainer with the share of international tourist arrivals (50.7 % in 2010 and 51.2% in 2011) and tourism receipts of 44.2 % of the total for overall regions in 2010.

Table 3.8: World's International Tourist Arrivals by Regions of Origins

Region	International Tourist Arrivals (Billion)					Change from previous year (in per cent)		Market share	% Avr Annual growth
	2000	2005	2008	2009	2010	2009	2010	2010	(00-10)
World	675	798	917	882	940	-3.8	6.6	100	3.4
1 Europe	389.4	450.8	507.5	479.7	496.1	-5.5	-3.4	52.8	2.5
2 Asia& Pacific	113.9	152.7	182.3	178.8	197.4	-1.9	10.4	21.0	5.6
3 Americas	130.8	136.5	151.5	146.3	154.4	-3.4	5.5	16.4	1.7
4 Africa	14.0	23.0	31.9	32.7	36.0	2.7	10.2	2.9	6.2
5 Middle East	15.0	19.6	25.8	25.8	27.5	-0.1	6.5	3.8	9.9
6 Origin not shown	11.4	15.5	17.7	18.6	28.5	-	-	3.0	-
Same region	532.9	632.1	715.9	689.2	721.3	-3.7	4.7	76.7	3.1
Other region	130.2	150.5	183.1	174.2	190.1	-4.9	9.1	20.2	3.9

Source: World Tourism Organization (UNWTO) © and 2010 Regional data as of mid-March 2012.

In term of outbound tourism, market share of 76.7% of international tourist arrivals by regions of origins from total shows that most travellers stay in their own region. The source markets are mainly Europe, Americas, and Asia & Pacific, which are mostly the industrialized countries. Europe is the world's largest source of market with its share in the total of 52.8%, following by Asia & Pacific of 21%, although it has consecutive negative growth rates of -3.4% and -5.5% in 2010 and 2009, derived from the financial crisis and continuing debt crisis in EU countries.

Table 3.9: World's Top Spenders

Rank	International Tourism Expense (US$ billion)		Change from previous year (in %, local currency)		Market share	Pop (million)	Expense per capita
	2009	2010	2009	2010	2010	2010	US$
World	851	919			100	6,879	134
1 Germany	81.2	77.7	-5.9	0.7	8.5	82	952
2 United States	74.1	75.5	-7.9	1.9	8.2	310	244
3 China	43.7	54.9	20.9 ($)	25.6 ($)	6.0	1,341	41
4 United Kingdom	50.1	48.6	-13.6	-2.4	5.3	62	780
5 France	38.5	39.4	-1.9	7.6	4.3	63	625
6 Canada	24.2	29.5	-4.8	10.0	3.2	34	866
7 Japan	25.1	27.9	-18.4	4.0	3.0	127	219
8 Italy	27.9	27.1	-4.3	2.0	2.9	60	449
9 Russian Federation	20.9	26.5	-12.1($)	26.8 ($)	2.9	140	189
10 Australia	17.6	22.5	2.5	9.0	2.5	22	1,014

Source: World Tourism Organization (UNWTO) © and 2010 Regional data as of mid-March 2012.

China has shown by far the farthest growth in the top ten big spenders in past decade, multiplying expenditure 4 times since 2000. Russian federation showed the strongest growth (27%) whereas U.K. is the only market record a drop due to weak economy.

3.3.4. The Role of Thai Tourism

Thai Tourism industry has continuously been growing with the consecutive high rates. It could rather be said that its natural diversities, Thai smile and Thai ways of courtesy indigenous arts and cultural distinctions, especially the relatively cheaper travelling costs comparing to other countries appealingly pull people from all over the world. Thailand has become one of the big four destinations within Asia Pacific region with more than 10 million of annual visitor arrivals (other destinations are China, Malaysia and Hong Kong). In the year 2010, Thailand has achieved 16th of world ranking in terms of the top tourist destinations with 12 per cent growth, see Table 3.10.

Table 3.10: World's Top Tourism Destinations (absolute numbers)

Rank	International Tourist Arrivals (Million)			Change from the previous year (%)		Market Share
	2008	2009	2010	2009	2010	2010
World	916,820	882,074	939,862	-3.8	6.6	100
1 France	79,218	76,824	76,800	-3.0	0.0	8.17
2 United States	57,937	54,962	59,745	-5.1	8.7	6.36
3 China	53,049	50,875	55,665	-4.1	9.4	5.92
4 Spain	57,192	52,178	52,677	-8.8	1.0	5.60
5 Italy	42,734	43,239	43,626	1.2	0.9	4.64
6 United Kingdom	30,142	28,199	28,133	-6.4	-0.2	2.99
7 Turkey	24,994	25,506	27,000	2.0	5.9	2.87
8 Germany	24,886	24,223	26,875	-2.7	10.9	2.86
9 Malaysia	22,052	23,646	24,577	7.2	3.9	2.61
10 Mexico	22,637	21,454	22,395	-5.2	4.4	2.38
11 Austria	21,935	21,355	22,004	-2.6	3.0	2.34
12 Ukraine	25,449	20,798	21,203	-18.3	1.9	2.26
13 Russian Federation	21,566	19,420	20,271	-10.0	4.4	2.16
14 Hong Kong	17,320	16,926	20,085	-2.3	18.7	2.14
15 Canada	17,142	15,737	16,095	-8.2	2.3	1.71
16 Thailand	*14,584*	*14,150*	*15,842*	*-3.0*	*12.0*	*1.69*
17 Greece	15,939	14,915	15,007	-6.4	0.6	1.60
18 Egypt	12,296	11,914	14,051	-3.1	17.9	1.50
19 Poland	12,960	11,890	12,470	-8.3	4.9	1.33
20 Macao	10,610	10,402	11,926	-2.0	14.7	1.27

Source: UNWTO © and 2010 is the most updated country data, as of mid-March 2012

That amount of the international tourist arrivals has in turn generated the great deal of international tourism receipts. Thailand has reached 11th of the world regarding the tourism receipts and has earned the second highest growth of 26.2 per cent in the top twenty, see Table 3.11.

Table 3.11: World's Top International Tourism Receipts (US$ billion)

Rank	International Tourism Receipts (US$ million)			Change from previous year (in %)		Market share
	2008	2009	2010	2009	2010	2010
World	939,787	851,021	919,048	-5.6	4.7	100
1 United States	110,423	94,191	103,505	-14.7	9.9	11.26
2 Spain	61,628	53,177	52,525	-13.7	-1.2	5.72
3 France	56,573	49,398	46,319	-12.7	-6.2	5.04
4 China	40,843	39,675	45,814	-2.9	15.5	4.98
5 Italy	45,727	40,249	38,786	-12.0	-3.6	4.22
6 Germany	39,912	34,650	34,675	-13.2	0.1	3.77
7 United Kingdom	36,028	30,149	30,400	-16.3	0.8	3.31
8 Australia	24,755	25,384	30,103	2.5	18.6	3.28
9 Hong Kong	15,304	16,450	22,951	7.5	39.5	2.50
10 Turkey	21,951	21,250	20,807	-3.2	-2.1	2.26
11 Thailand	*18,173*	*15,663*	*19,760*	*-13.8*	*26.2*	*2.15*
12 Austria	21,587	19,404	18,663	-10.1	-3.8	2.03
13 Malaysia	15,277	15,772	17,819	3.2	13.0	1.94
14 Canada	15,668	13,707	15,787	-12.5	15.2	1.72
15 Switzerland	14,401	13,789	14,841	-4.2	7.6	1.61
16 Netherlands	13,342	12,368	13,062	-7.3	5.6	1.42
17 Greece	17,114	14,506	12,741	-15.2	-12.2	1.39
18 Egypt	10,985	10,755	12,528	-2.1	16.5	1.36
19 Mexico	13,289	11,275	11,872	-15.2	5.3	1.29
20 Sweden	11,206	10,261	11,079	-8.4	8.0	1.21

Source: World Tourism Organization (UNWTO) ©

Top twenty ranking of both Table 3.10 and 3.11 marked some certain differences since there are many factors of the destinations attracting tourists. The type of tourists, the average length of stay and the amount of spending per trip and per night vary according to each of tourism destination. Apart from China and Hong Kong as the top two in the big 4 destinations in Asia Pacific, Thailand attracts a greater portion of higher spending and longer-stay tourists comparing to Malaysia where there were more of arrival-hits, but less of associated tourism receipts (the high-lighted case is the United States as the top in the world ranking where geographical location clings on longer stay and higher spending tourists comparing to other destinations which rely more on shorter stay). The global financial crisis and Thailand's political turmoil since late 2008 have resulted in a decline in the number of inbound tourists, with -16% in the first half of 2009. The greatest decline included visitors from Northeast Asia, with a drop of more than 30%, followed by Americas and Oceania. ASEAN and Europe markets were affected slightly, while South Asia and the Middle East were able not only to maintain their market base but to show actual growth.

3.3.5. Overall Potential of the Industry

World Economic Forum has released the 2011 Travel & Tourism Competitiveness Index (TTCI) Report comparing 139 countries upon the competitiveness of the Tourism industry under the theme "Beyond the Downturn", which reflects the forward-looking attitude after a recovery from the world economic recession. According to the report, TTCI is aimed to measure the factors and policies that make it attractive to develop the Tourism sector in different countries. It based on three broad categories that drive Travel & Tourism competitiveness: T&T regulatory framework, T&T business environment and infrastructure, and T&T human, cultural and natural resources. There are many indicators and they are grouped into 14 pillars concerning each aspect of competitiveness.

In 2011, Rich in cultural and natural resources, Switzerland ranks the first with index of 5.68. With high quality in human resources (ranked 2nd) and strong environmental sustainability (ranked 5th), this business travel hub are also famous for its best hotel management schools. In Asia & Pacific, Singapore is the top-ranked country with the overall rank at 10th. It mainly benefits from transport infrastructure, quality of human resources, policy environment and very well-known among the safest countries. Hong Kong ranked the second in the region with the high marks for cultural resources. It is China which has come to the 9th in the region and overall 39th with the same score as Thailand of 4.47. Its richness of natural resources and unique culture ranked 5th and 16th, although its tourism infrastructure remains underdeveloped as being ranked 95th. Table 3.12 presents the top ten TTCI of countries in Asia & Pacific region.

Table 3.12: Top ten TTCI of countries in Asia & Pacific Region

Country	Overall Index			T&T Regulatory		T&T Business Environment		T&T Human, Cultural, Natural	
	Regional	Overall	Score	Rank	Score	Rank	Score	Rank	Score
Singapore	1	10	5.23	6	5.72	4	5.39	23	4.59
Hong Kong	2	12	5.19	4	5.80	13	5.19	24	4.59
Australia	3	13	5.15	36	5.08	17	5.11	4	5.28
New Zealand	4	19	5.00	13	5.60	25	4.80	22	4.60
Japan	5	22	4.94	27	5.24	32	4.72	14	4.86
Korea, Rep.	6	32	4.71	50	4.86	28	4.76	27	4.53
Malaysia	7	35	4.59	60	4.71	40	4.35	18	4.72
Taiwan	8	37	4.56	46	4.95	31	4.73	55	4.00
China	9	39	4.47	71	4.52	64	3.84	12	5.06
Thailand	10	41	4.47	77	4.45	43	4.32	21	4.64

Source: World Economic Forum

Thailand achieved 41st which ranked lower than 2009 Index which was 39th for the overall categories. It ranks 10th in Asia & Pacific Region. Table 3.13 lists Thailand's score (1-7 scale) and ranking among 139 countries. The report summarizes the trait for Thailand as endowed with rich natural resources and a strong affinity as ranked 21st and 24th, respectively. Worth mentioning are two good indicators: Hotel price index and Attitude of population toward foreign visitors; both ranked the eighth of all 139 countries. This means the cheap price of accommodation is relatively competitive as well as the friendly attitude of the Thai people on how to treat the foreign visitors which escalated the overall level of competitiveness. Strong prioritization of the sector by the government with good marketing campaigns and best-valued price (ranked 16th) are also the supportive factors.

Nonetheless, business costs of terrorism was the 120th regarding the recent political instabilities. Some aspects of the regulatory environment as told in the report i.e. visa restrictions and long time required for starting a business in the country are not conductive to developing the sector as being ranked 76th .

Table 3.13: Thailand's score and ranking in TTCI 2011

Pillars	Rank	Score
2011 Index	41	4.5
2009 Index	39	4.4
T&T regulatory framework	77	4.5
Policy rules and regulations	76	4.4
Environmental sustainability	97	4.2
Safety and security	94	4.4
Health and hygiene	80	4.4
Prioritization of Travel & Tourism	38	4.9
T&T business environment and infrastructure	43	4.3
Air transport infrastructure	23	4.5
Ground transport infrastructure	56	4.1
Tourism infrastructure	40	4.9
ICT infrastructure	81	2.9
Price competitiveness in the T&T industry	15	5.2
T&T human, cultural, and natural resources	21	4.6
Human resources	74	4.8
Education and training	76	4.6
Availability of qualified labor	67	5.1
Affinity for Travel & Tourism	24	5.3
Natural resources	21	4.6
Cultural resources	32	3.9

Source: World Economic Forum

3.4. Tourism Geography and Tourist Destinations of Thailand

This section shortly describes the Tourism geography of Thailand. The important issue is the remarkable regional destinations regarding geographical feature. The section starts with the overview of the Thai tourism geography explaining the regional traits and the nature of the tourism according to each region. The concentration of the tourism and the destination hits are considered in the next section. Tourism activities and products are also different in each region and vary in different seasons.

3.4.1. Overview of Thai Tourism Geography

Located in the heart of Southeast Asia, the Kingdom of Thailand lies between latitude 6° and 21° N and between longitude 97° and 106° E, with a length of 1700 km and a greatest width of 770 km. (TAT, 2012) Amazingly, the country's geographic borders form the rough shape of the head of her own national animal, which is the elephant, looking to the west with the right ear for the mountainous northern, the left ear of Korat plateau as the mostly landlocked north-eastern, central and eastern provinces are the head and its mouth, and the trunk for the southern region extending down the peninsula between the Gulf of Thailand and Andaman sea of the Indian Ocean.

From the map in Figure 3.14, Thailand shares the natural borders with neighboring countries. With Myanmar (Burma),the country has a mountainous border to the north and west. Separating Thailand from Laos to the north and northeast is a long borderline of the Mekong River around the Korat Plateau. This Isan region of Northeastern is the most populous region of Thailand. Mekong River and the Dongrak Mountains also form the border of Cambodia to the east. Stretching down the Malaysian peninsula, the elephant's trunk sheltered coves of the narrow Isthmus of Kra with beaches and islands like Phuket and Koh Samui along the opposing shores, of which at the tip of the trunk, Sankalakhiri Mountains delineate the country from Malaysia in the southern-most part of the country.

Concerning on the climate, Thailand is mostly tropical. The weather is hot and humid all year round with cool temperatures degree only in the mountainous area in the northern region of Thailand. Tourism Authority of Thailand briefly summarizes 3 seasons of Thailand in the website as following.

Figure 3.14: Map of Thailand showing 5 regions and its neighbouring countries

Source: Wikitravel

Winter ranges from November to around the end of February. Not much raining and temperatures are at their lowest where temperatures can fall below five degree celcius in the high mountainous area in the north. This is the peak time to visit Thailand, especially Christmas and New Year or a few weeks later for Chinese New Year. Weatherwise, it is nice to tramp around the country.

Summer is the regular period from March to June. During this time Thailand normally overheats in temperatures as high as forty degree. Tourists may find this discomforted,

but the Songkran festival of water throwing ceremony around the country is the cool-down high-light. Beaches along the coasts and the islands in the southern region are popular among the tourists with exclusive activities like snorkeling or scuba diving.

Rainy season falls between late June and early November. From August to the end of October, tropical monsoons strike almost all regions in the country and flooding is not uncommon, especially the river basins in the middle region and along the peninsula of the southern region. The rainforest is at its best, although it is obvious to be a low season for Tourism.

The southern region has got the highest rainfalls due to its peninsula characteristic. Overall, the southern parts of Thailand obtain by far the most rain with about 2,400 millimetres every year, comparing to the central and northern regions of Thailand of around 1,400 millimetres. Some local deviations could also be found. It could be said that there are only two seasons for this part of Thailand, the rainy season and, of course, the summer, which is regarded as the peak season for Tourism in the region. In particular, the south-east coast along the peninsula has the rainy season reversed, with the peak season being May-October and the rainfalls in October-February, especially in November, whereas the Andaman zone (south-west) has its summer from November to April and the heavy storms commonly occur from May-October.

Table 3.14: Seasonal effects of Thailand and original tourist countries

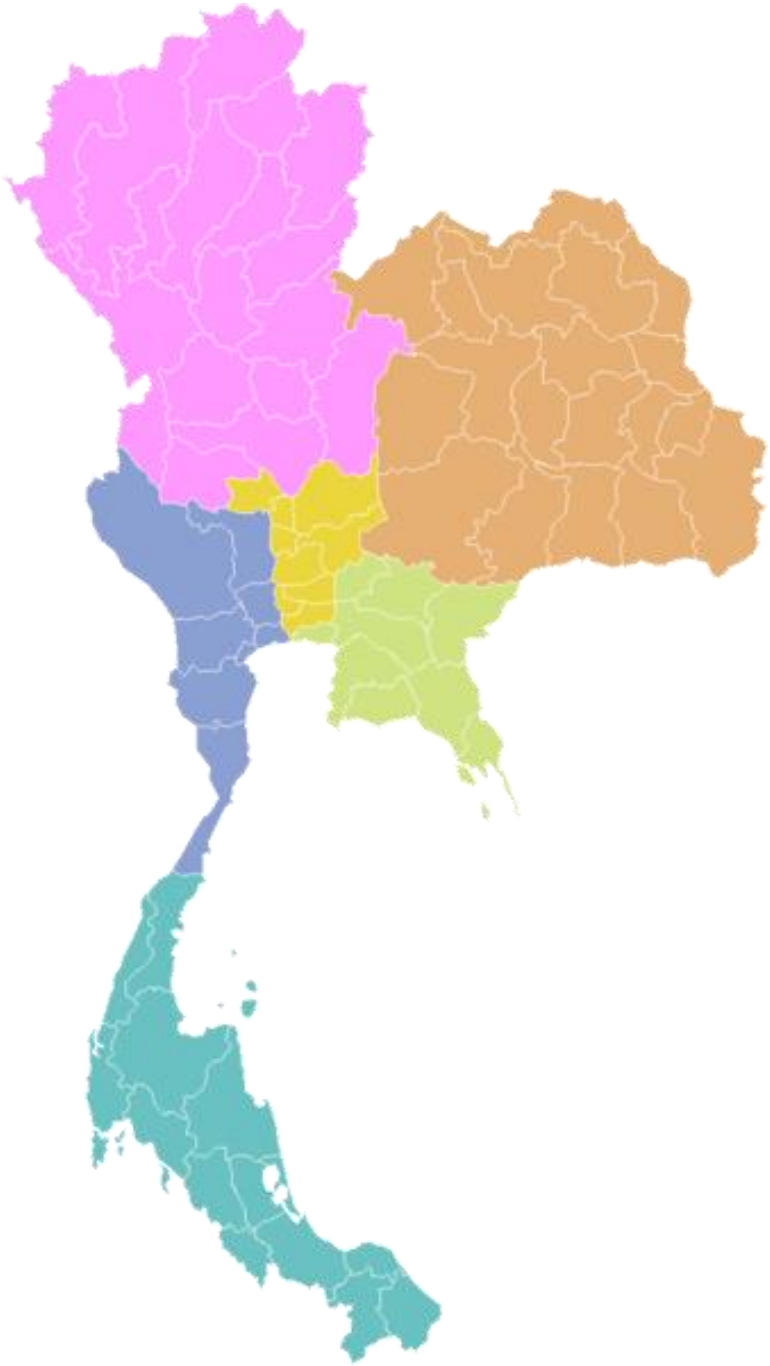
Season	Original Countries	Destination Country (Thailand)
1st	North: winter	C, E, N, NE: Dry and cool
	South: summer	S: Rainy
2nd	North: spring	C, E, N, NE, S: Hot
	South: autumn	
3rd	North: summer	C, E, N, NE, S: Rainy
	South: winter	
4th	North: autumn	C, E, N, NE: Rainy and cool
	South: spring	S: Rainy

Source: adapted from http://www.mapsofworld.com/referrals/weather/seasons/ and Jintranun (2011)
Note: 1) 5 regions of C: Central; E: East; N: North; NE: North Eastern; S: South
2) Original Countries: 'Northern' Hemisphere and 'Southern' Hemisphere

Thailand is divided into 77 political provinces, of which Bangkok is the capital city with its own political management called Bangkok Metropolitan Administration. It is important to note that Thailand could be disaggregated to be 4, 5, 6 or 7 regions depending on general concepts if it is geographical, climate, political or cultural. The common 5 regions could be Northern, North Eastern, Central (including Bangkok),

Eastern, and Southern whereas 7 regions could be Bangkok (normally shown in Central), Northern, North Eastern, Central, Eastern, Western, and Southern. While it is at best to understand the geographical regions according to the five region concept, this study follows National Economic and Social Development Board (NESDB) and adopts the 7-region concept, largely according to the available economic data and economic concept. See Figure 3.15 for the economic regional map following NESDB.

Figure 3.15: Map of Thailand showing 6 regions (Bangkok within Central region)



Source: National Economic and Social Development Board (NESDB)

3.4.2. Tourism Resources and Tourism Destination Hits

Overall, Thailand has been regarded as one of the beautiful countries with exotic culture of the East. Thai food is increasingly popular worldwide and many of them were placed in World's 50 most delicious foods released in 2011 by CNNgo with Massaman curry ranked number one and Tom Yum Koong ranked number eight of the top ten. The Land of smile is not just the marketing phrase as Thai people are generally nice and outgoing. It was also hailed as "Famous for its authentic culture, spectacular beaches and noteworthy nightlife, Thailand is also one of the most affordable destinations in the world." by Country Brand Index (CBI) ranking the first for "Best Country Brand for Value for Money" three years in a row.

The above ranking and honors are not just a made-up story out of nowhere. They observably came from the international tourists' perception of the country's overall distinguished characteristics, and of course, its so-called tourism resources of a nation. As mentioned before, tourism resources for any country range from tourist attractions either man-made or natural sites, lifestyle and cultural events, tourism services, entertainment, souvenirs to the impression from meeting the local people. Of all those resources, tourist attractions for the tourists could normally be regarded as a crucial part of the country's supply that significantly draws tourists in. Table 3.15 represents the survey of the perception of tourists on tourist attractions of some countries in Asia. It shows that Thailand is very well known with the beaches, for which many locate in the Southern region and a few popular in the Eastern region.

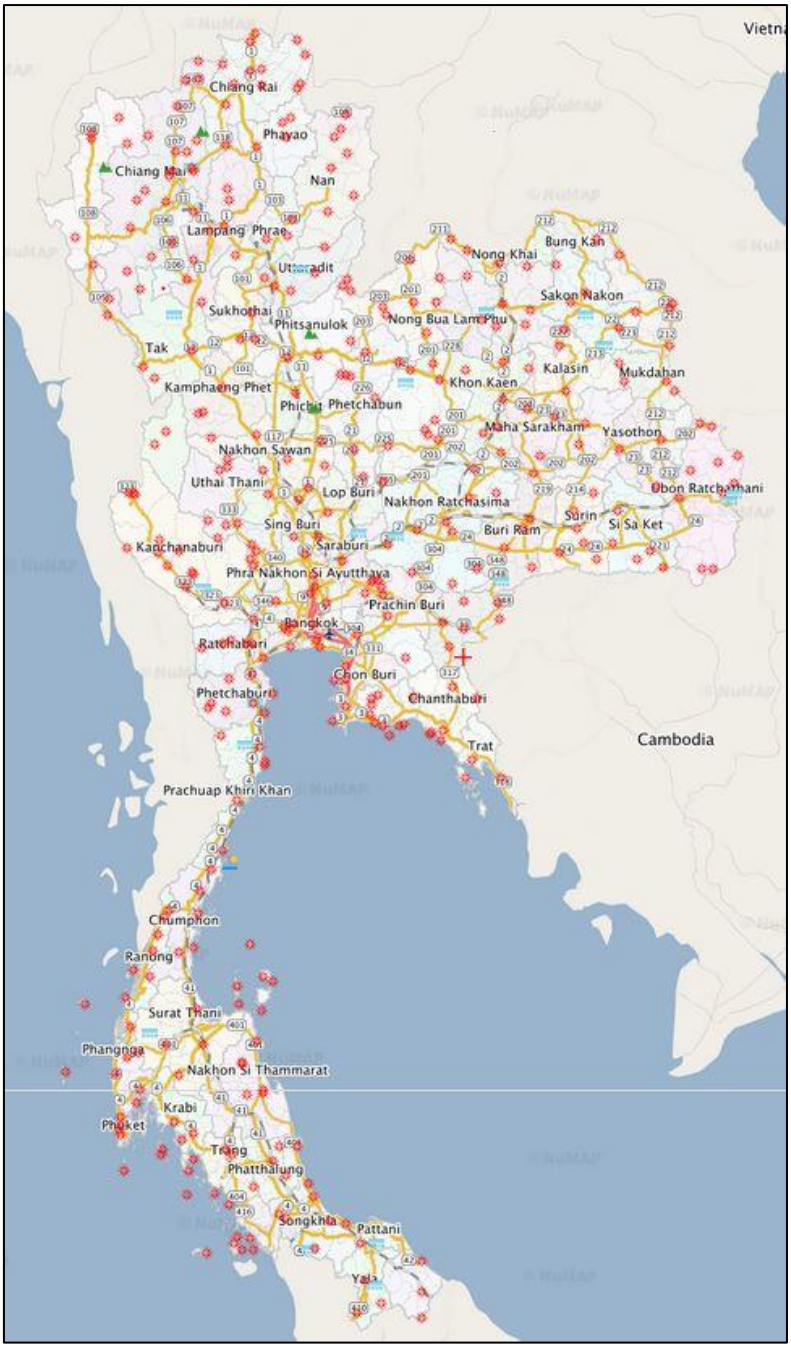
Table 3.15: Number of Attractions in the Perception of Tourists

Country	Beaches	Shopping places	All attractions	Golf club
Thailand	17	9	104	200
Taiwan	1	n.a.	20	61
Hong Kong	3	7	35	6
South Korea	2	n.a.	19	251
Japan	3	9	214	2500
China	6	21	210	310
India	9	5	212	200
Malaysia	5	2	48	189
Indonesia	9	1	96	125
Philippines	8		33	70
Singapore	n.a.	1	6	20
Cambodia	n.a.	2	43	4
Vietnam	3	3	45	18

Source: National Tourism Agenda (2012-2016), Worldreviewer.com, Euromonitor International, agoda.com, worldtravelguide.net, and SCB EIC

Tourism Authority of Thailand has defined 'Tourism resources' as the tourist attractions which contain outstanding attributes to attract tourists and classified them into 3 types: natural, historical and religious, and cultural. In 1997, there were overall 2,857 places. Of these, 1,200 places were natural attractions whereas 1,040 places were historically and religiously related with some other 397 cultural attractions and 220 newly classified as attractions (Wangpaijit, 2004). The spatial distribution of some important tourist attractions is graphically presented in Figure 3.16.

Figure 3.16: Spatial Distribution of Some Important Tourist Attractions.



Source: Longdomap

Tourism destination hits, on the other hand, could be implicitly represented as the tourists' demand concerning the regional or area preferences. It simply is an issue as it is not how many the tourist attractions there are but rather how popular the tourist attractions or the preference of the tourists that they seek.

Regional distribution of the tourists in 2007 is represented in the Table 3.10 with the details upon related factors included. It is very important to note that the numbers of visitors shown in the Table 3.10 are higher than the number of foreign visitors coming to Thailand that year (14.5 million inbound visitors) as averagely one inbound visitor visits 2.30 provinces per trip. For domestic visitors, this concept is still applicable as the number of the domestic visitors (83.23 million of visitor/trip) but on average the domestic visitor visits 1.33 provinces per trip. This makes the total number of visitors become 144,301,357 visitors as on average each visitor make 1.48 provinces per trip from the total number of visitors (foreign and domestic) of 97.73 million visitor/trip.

Although shown a single year of 2007 (a few years after tsunami clashes in December 2004 and a few years before the world economic recession in 2009 and serious flood in 2010 and 2011), it could be said that, other than Bangkok, the southern region is popular among foreign visitors with 7.8 million visitors. On the other hand, there are domestic visitors went to the Northeastern region with 21.32 million visitors, a little less than 24.32 million visitors to Bangkok.

The average expense per person per Baht per day is comparatively high for foreigners spending in Bangkok. They spent a bit lesser in the Southern region of 3,654 Baht but still a lot more than what spent in other regions. The pattern is quite similar for the domestic tourists' spending with a lower proportionate amount, although, in total, with the slightly higher revenue generating from a greater number of domestic visitors of 3.34 times over the foreign visitors (380 billion baht from domestic visitors comparing to 367 billion baht from inbound visitors). Of the revenue generating from inbound visitors, about 75 per cent were the part coming to Bangkok and Southern region (19.45 million inbound visitors or 58.5 per cent of the total inbound visitors) while 32 million domestic visitors (31.8 per cent) generated income for 60.6 per cent in total revenue from the domestic visitors. This truly supports the fact that when there was the disastrous effect like tsunami in the Southern region or serious flood in the Central region including Bangkok. Tourism industry would be affected so much.

Table 3.16: Regional Distribution of Tourists in 2007

Region	Total		Nights	Share	Average	Revenue	Δ (%)	Average Expense	Δ (%)
	No. Visitors	Δ (%)			Length of Stay	(Million Baht)		(Baht/person/day)	
Total	**144,301,357***	**+ 5.91**	**271,410,109**	**100.00**	**2.96**	**747,628.31**	**+ 6.04**	**2,306.33**	**+ 0.25**
North	16,989,171	+ 3.83	30,820,282	11.36	2.61	68,715.42	+ 1.44	1,909.19	- 1.95
Bangkok	35,953,546	- 0.60	95,205,307	35.08	3.54	333,411.69	- 0.95	3,197.07	- 1.22
Central	16,421,137	+ 13.76	10,093,376	3.72	1.86	18,520.27	+ 20.62	878.48	+ 4.99
West	14,114,554	+ 7.11	12,444,589	4.59	2.16	29,704.49	+ 9.00	1,427.92	+ 0.37
East	19,656,273	+ 10.34	33,800,886	12.45	2.65	91,487.49	+ 17.39	2,248.53	+ 3.69
Northeastern	22,321,969	+ 5.43	35,021,852	12.90	2.63	34,518.41	+ 5.09	784.41	+ 1.82
South	18,844,707	+ 10.12	54,023,817	19.90	3.48	171,270.54	+ 16.28	2,987.59	+ 4.63
Domestic	**111,037,859**	**+ 7.18**	**168,132,805**	**100.00**	**2.63**	**380,417.10**	**+ 4.15**	**1,767.35**	**- 1.55**
North	13,905,389	+ 6.93	23,358,625	13.89	2.48	45,369.37	+ 7.70	1,628.57	- 0.31
Bangkok	24,325,088	+ 2.20	56,645,973	33.70	3.53	186,145.30	- 2.53	2,866.98	- 1.95
Central	13,823,002	+ 13.68	8,506,500	5.06	1.87	14,172.81	+ 17.05	797.64	+ 2.89
West	12,795,603	+ 8.27	9,956,302	5.92	2.00	22,556.49	+ 13.30	1,269.26	+ 1.55
East	13,843,582	+ 9.77	15,503,819	9.22	2.10	35,215.62	+ 21.63	1,603.53	+ 4.47
Northeastern	21,321,836	+ 5.51	34,053,076	20.25	2.62	32,586.82	+ 5.10	769.09	+ 1.87
South	11,023,359	+ 10.21	20,108,510	11.96	2.36	44,370.69	+ 10.37	1,963.78	+ 2.10
Foreign	**33,263,498**	**+ 1.90**	**103,277,304**	**100.00**	**3.74**	**367,211.20**	**+ 8.08**	**3,371.49**	**+ 2.19**
North	3,083,782	- 8.18	7,461,657	7.22	3.09	23,346.05	- 8.87	2,870.38	+ 0.90
Bangkok	11,628,458	- 6.01	38,559,334	37.33	3.56	147,266.39	+ 1.11	3,743.02	- 0.56
Central	2,598,135	+ 14.15	1,586,876	1.54	1.82	4,347.46	+ 33.95	1,311.92	+ 10.38
West	1,318,951	- 3.01	2,488,287	2.41	3.21	7,148.00	- 2.66	2,358.13	+ 3.67
East	5,812,691	+ 11.71	18,297,067	17.72	3.40	56,271.86	+ 14.89	3,004.96	+ 4.75
Northeastern	1,000,133	+ 3.73	968,776	0.94	2.90	1,931.59	+ 4.88	1,181.53	+ 0.59
South	7,821,348	+ 10.01	33,915,307	32.84	4.84	126,899.85	+ 18.49	3,653.61	+ 4.68

Source: TAT; * the unit is the number of visitor to each region (not visitor per trip), a visitor can visit frequently and many provinces per trip

3.5. Recent Trends in Tourism

To update the recent trends of Tourism in Thailand, the study revised the concept of SWOT analysis for the industry, the perspective for current situation and supplies the information on Tourism-related agenda and policy alleviations as following.

3.5.1. SWOT Analysis

SWOT analysis usually means the strategic planning method concerning on evaluating the internal and external situation for any business in order to deal with the economic transition. SWOT stands for Strengths, Weaknesses, Opportunities, Threats and the analysis mostly deals with the issues regarding those four aspects. For the Tourism in Thailand, this study refers to what National Tourism Agenda (2012-2016) identifies in the released plan and adds some more points. The aim is to provide a short analytical overview for the recent situation.

Strength:

1) The government concerns Tourism as a very important sector. That is, not only specifically delivering the 1st and 2nd National Tourism Agendas, but also pinning down Tourism within NESDPs, including11th NESDP (2012-2016).
2) Thailand has won many international awards and prizes regarding Tourism as mentioned earlier. The related authorities are well aware of the potential background of Tourism and they have a great deal of experience upon variety of marketing campaigns and Tourism development strategies.
3) Locational advantage of the country is a plus. Geographically, Thailand is in the middle of the South East Asia. It could perform as a hub for traveling to other countries within the region i.e. Laos, Cambodia or Myanmar.
4) Exotic culture, abundant of natural resources, Thai style of escort and comfort.
5) Well-organized of the local infrastructure and related services including variety of accommodations, restaurants, ease of transportation, and Tourism system.
6) High level of private investment. Many of Tourism products and niche market.

Weakness:

1) Tourism attractions are clustered only some area, no linkage to nearby area.
2) Most of the businesses are Small & Medium Enterprises (SMEs). Overall, they lack synergies, human resources, and budgets.
3) Although with good marketing campaign and high level of public concerns, it still lacks of coordination among the relevant authorities. Administrative system and bureaucratic style of management prove to be weak.
4) More on quantity of tourists with low rate of expense
5) Existence of negative public perception on safety, scam, sex tour, sham and smuggling.
6) The need to improve the skills and quality for human resources to catch up the high level of potential growth of the industry and to enhance the standard on tour guides and related personnel to deal with tourists from various cultures. It takes time to develop human capital.
7) Local communities are not fully aware of the appropriate administration of the Tourism in their own area. There is a high level of investment upon tangible Tourism assets i.e. construction, but low level of participation of local people. Local people are still lack of understanding and still low of management skills, including language barrier.
8) Degradation of natural resources and poor conservation on Tourism-related attractions to accommodate the tourists. Lack of understanding upon how to conserve the cultural assets either tangible or intangible.
9) Low level of awareness on preparing and managing the natural disasters. The public awareness arose only after the incidents of natural disasters and gradually subsided.
10) Logistics and transportation systems are not well connected.
11) Although with high competitiveness in many aspects, the innovations and technologies related to Tourism e.g. e-commerce, new Tourism-related products still needs to improve and it would take a great deal of budget to overall upgrade and connect the Tourism system in all levels.

Opportunities:

1) The world's economic growth is increasing, including Tourism growth. With China becomes the country with high purchasing power, especially outbound Tourism expenditure. Other countries like Russia, Taiwan, and South Korea are worth mentioned.
2) Higher world population, increasing labor forces and late marriage.
3) Changing behavior of the tourists. Many niche markets are booming i.e. MICE and related markets, Health Tourism, Adventure Tourism, Spiritual Tourism or especially Youth & student market which is with high growth rate.
4) Low-cost airlines grow significantly. It is easier for people to make trips.
5) Variety of innovations and technologies including information system make the possibility of providing new products and channeling to the tourists.
6) Various international economic agreements, i.e. trade negotiations or economic cooperation, deliver the dynamism of capital, commodity, human resource, etc.
7) Higher awareness of the sustainable Tourism development

Threats:

1) Fiercer competition in the world market. New markets are developed and there are many countries promoting for Tourism.
2) Volatility in the world economy puts the uncertainty into decision to travel.
3) Natural disasters become very significant in a few recent years.
4) Terrorism and racism are also the factor determining the decision to travel.
5) Political unrests internally or externally make it difficult to travel.
6) Economic Cooperation could make a fiercer competition. Service liberalization and Trade liberalization can diverse the opportunities to gain in the emerging markets and difficult to venture for relative competitiveness.
7) For domestic Tourism, especially long holidays, seasonal high congestion in the popular tourist attractions makes difficult to accommodate and degrade the tourist attractions themselves. This includes the high risks of accident.
8) Low cost airlines deter the decision towards outbound

3.5.2. Current situation, Agenda and Policy Trends

❖ **Current situation**

2011 was regarded as the first year after the mid-century anniversary of the foundation of the first Tourism agency in Thailand. The trivial but interesting information was summarized by TAT (2011) as

- 1976 was the year that Thailand first welcomed 1 million visitors in one year, 2001 was the year that Thailand welcomed 10 million visitors in one year, and 2011 was the year that Thailand welcomed 19 million annual visitors recently.
- During 1960 – 2010, the number of inbound tourists declined 6 times. This stemmed from external factors: oil price rising, world economic recession, outbreaks, terrorism, and natural disasters.
- 'Thainess' has been the main theme for 50 years of development.
- Natural and Cultural assets have been the main tourism attractions, with the ongoing challenging innovations and technologies in the recent years.

It could be said that the current situation is so challenging after the 50 years of Thai Tourism development. In the context of the inconvenient Thai Politics and Terrorism, although ever faced, the conditional situation upon the political conflicts becomes the main concern for Tourism industry, as Tourism is one of the main industries with high sensitivity upon the bad news. In lieu of the anxiety upon the issue, there is a concern on the classification of the tourists using the sensitivity threshold criteria and on the administration for each group ranking on how to make confident on the safety. For the natural disasters, the major concern is about flooding, which has been serious in a few years and how to deal with the climate change, especially its effects upon the industry. Upon the development of Tourism and its income generating role, the relevant authorities are well conscious towards more 'quality' in terms of social and natural awareness of the tourists. Tourism sustainable development is concerned and publicly encouraged. Innovations and technological changes become important issues and are necessary to look after as a system.

All these issues have required the relevant authorities e.g. MOTS and TAT to cautiously prepare the strategic plans on the move.

❖ Agenda

National Tourism Agenda has been initiated by the Tourism Authority of Thailand since 2001. It has been aimed to guide the industry to move into the same direction. The restructuring of the related authorities became apparent for administrative purpose during 2005 – 2007 and later on the National Tourism Agenda Act has finally been formulated in 2008 and accepted by the government in 2009, with the Prime minister as the chief of the committee by position. The committee is obliged to convey the overall Tourism-related strategies and release the development policies or measures for the industry, including drawing the area for Tourism development and managing the Tourism development fund (MOTS, 2007).

The National Tourism Agenda (2012-2016) was framed to solve the problems in terms of structure and to maintain participation process from all related parties. The aims are to enhance the overall competitiveness of Tourism industry using Travel & Tourism Competitiveness Index (TTCI) as a means to measure the development. Targets are set by move-up in ranking and with the revenue of the industry to increase no less than 5 per cent.

There are five major strategies to drive the industry towards the aims: 1) to develop Tourism-related infrastructure 2) to enhance and improve overall Tourism-related resources, including green Tourism 3) to develop the products, services and any supports for Tourism industry 4) to build the confidence and promote the industry 5) to encourage the participation of all related parties including local people and local authorities to manage the industry's resources.

The highlights of the scheme to enact which are worth to mention are as follow: the development of the e-commerce and information technology system connecting all channels of the industry, the enforcement of the Liberal air policy, the development of the transportation system with the neighboring countries, the cooperation for developing the travel routes concerning ASEAN, IMT-GT, ACMECS, BIMSTEC and GMS, the development of the transportation routes regarding North-South Economic Corridor and East-West Economic Corridor as well as cross border tourism, the encouragement on the niche markets of Tourism such as Health Tourism, Adventure Tourism, Spiritual Tourism, MICE, Sports Tourism, Honeymoon, etc.

❖ Policy Trends and Marketing Strategies

To pursue the growth of Tourism industry, TAT has approved a strategic plan to deal with unprecedented change in the global environment of the regular unpredictable external factors. The plan takes into account of the emerging opportunities in a world of changing demographics and technological innovation. TAT has set a 2012 target of 20 million international tourist arrivals, generating revenue of about 760 billion Baht (24.85 billion USD) increasing 9 per cent above 2011. The target for domestic tourism is 93 million trips with revenue of 453 billion Baht (14.70 billion USD) (TAT, 2011).

"Amazing Thailand Always Amazes You" is the marketing theme used to support the country's strong brand and positioning the country as a destination that offers a unique culture, a wide variety of experiences to visitors and the many aspects of "Thainess". The six marketing strategies were identified by TAT as:

1) Promote balanced tourism in various dimensions, 2) generate sustainable growth for tourism income, 3) strengthen and sharpen Thailand's brand image, 4) develop tourism in line with a creative economy, 5) develop stronger and more effective partnership networks, and 6) optimize internal management.

TAT has also identified eight specific marketing opportunities: 1) Expanding the high-income market, 2) expanding niche customer-segments, 3) encouraging repeat travelers, 4) attracting new markets, 5) helping potential partners with win-win projects, 6) enhancing use of IT media applications, 7) helping products and services to attract quality tourists, and 8) increasing the capacity of industry stakeholders to deal with change and tap new opportunities.

For the longer-term target, MOTS and TAT had announced in March 2012 for the possibility of the revenue target of 2 trillion Baht in 2015. They plan to expand the scope other than the existing Tourism products to delivering the megaprojects upon Tourism. This may include the new way of expanding the industry into the more on public-private partnership upon investing the upcoming projects. The marketing campaign of 'Top 10 tourist destinations of Thailand' has also been released and expected it to be announced annually. Bangkok, Cholburi, Phuket, Ayudhaya, Kanchanaburi, Chiangmai, Rayong, Songkhla, Nakhonratchasima, and Krabi are the Top 10 tourist destinations for 2011.

Chapter 4

Theoretical Framework

"By 'General-Equilibrium' we refer to an analytical approach which looks at the economy as a complete system of interdependent components… It explicitly recognizes that economic shocks impacting on any one component can have repercussions throughout the system …"

Dixon et.al. (1982)

This chapter explains the theoretical structure of 'TRAVELTHAI' – a MONASH-style dynamic model for Thailand. The first 2 sections inform an overview of the models' basic characteristics, solution method, assumptions, economic agents and factors of production including dynamic features. The description of stylized version and important equations of the model is in Section 4.3. Section 4.4 is the introduction of GEMPACK: the program used to handle the model and find the solutions.

4.1. Overview

4.1.1. General Characteristics of the Model

The standard computable general equilibrium model normally consists of a theoretical structure and a database. The database will later be discussed in Chapter 4. The theoretical structure with its representation, explained in this chapter, describes the behavioural relationship of all economic agents i.e. industries, investors, households, the international trade, and the government. These macroeconomic relationships are represented in the form of several mathematical equations. Real economy with only markets for goods and services is treated with the neutrality of money. That is only the relative prices matter for the market mechanism and, often, either consumer price index or exchange rate is chosen as the numeraire. It is assumed that the markets are perfectly-competitive with zero pure profit. All agents are optimisers through cost minimisation and utility maximisation subject to their constraints. Government consumption is often set to be proportional with private consumption whereas government investment is assumed to be relative to the total investment. Export demand has a negative relationship with the export price.

According to Dixon et al. (1982) and Dixon and Rimmer (2001, 2002), the theoretical structure of the model is normally a system of simultaneous equations of 6 groups:

1. equations describing industry demand for primary factors and intermediate inputs;
2. equations describing household and other final demands for commodities;
3. pricing equations setting pure profits from all activities to zero;
4. market clearing equations for primary factors and commodities;
5. miscellaneous definitional equations, e.g. equations defining GDP, aggregate employment, and the consumer price index; and
6. equations for facilitation of historical and forecasting simulations (dynamic sense)

4.1.2. Solution Method and Linearization

From Dixon (1982), the model is originally a system of simultaneous equations (in 6 groups abovementioned) illustrating the economic activities in period *t* or written as

$$F(V_t) = 0 \qquad \text{(E4.1)}$$

where F is vector of *m* differentiable functions

V_t is vector of $n > m$ variables (prices, quantities and other variables at year *t)*

System of equations as (E4.1) contains various non-linear functional forms. The Johansen/Euler solution method involves converting the system of non-linear equations to a system of linear equations by taking total differentials of each equation (see procedure in BOX 4.1). Thus system (E4.1) becomes:

$$A\left(\overline{V_t}\right) v_t = 0 \qquad \text{(E4.2)}$$

where $A\left(\overline{V_t}\right)$ is an *m* x *n* matrix whose components are functions of $\overline{V_t}$.

v_t is the *n* x *1* vector of percentage changes (or ordinary changes) in $\overline{V_t}$

With the style of (E4.2), A(Vt) is evaluated at $\overline{V_t}$ or at the initial base year data, which could be V_{t-1}. Thus, in a Johansen/Euler solution, $\overline{V_t}$ is re-evaluated at the beginning of each step based on the solution for year *t-1*. The number of variables *n* is greater than the number of equations *m*, only *m* variables can be endogenous, and *n-m* variables could be treated as exogenous, then (E4.2) can be rearranged as:

$$\mathrm{A}^{a}\left(\mathrm{V}_{\text{t-1}}\right)v_{t}^{a}+\mathrm{A}^{b}\left(\mathrm{V}_{\text{t-1}}\right)v_{t}^{b}=0 \qquad \text{(E4.3)}$$

where v_t^a is the *m* x 1 sub-vector of endogenous components of v_t;

v_t^b is the (*n – m)* x 1 sub-vector of exogenous components of v_t;

$\mathrm{A}^{a}\left(\mathrm{V}_{\text{t-1}}\right)$ is the *m* x *m* matrix of coefficients (or derivatives if v_t is ordinary changes) corresponding to the endogenous variables, evaluated using the solution to the model for *t*-1; and

$\mathrm{A}^{b}\left(\mathrm{V}_{\text{t-1}}\right)$ is the *m* x (*n*-*m*) matrix of coefficients (or derivatives for ordinary changes) corresponding to the exogenous variables, evaluated using the solution to the model for *t*-1

The coefficient matrices are supposedly convertible, then (E4.3) could be solved for v_t^a in terms of v_t^b as

$$v_{t}^{a}=-\mathrm{A}^{a}\left(\mathrm{V}_{\text{t-1}}\right)^{-1}\mathrm{A}^{b}\left(\mathrm{V}_{\text{t-1}}\right)v_{t}^{b} \text{ or } B\left(\mathrm{V}_{\text{t-1}}\right)v_{t}^{b} \qquad \text{(E4.4)}$$

where $B\left(\mathrm{V}_{\text{t-1}}\right)$ is defined as $-\mathrm{A}^{a}\left(\mathrm{V}_{\text{t-1}}\right)^{-1}\mathrm{A}^{b}\left(\mathrm{V}_{\text{t-1}}\right)$

or, simply, elasticities of v_t^a with respect to v_t^b

With the values of coefficients and parameters, this provides an initial numerical solution of year *t* in terms of the change in exogenous variables. The simulation moves initial databases year *t* to another picture of year $t+\tau$, where τ is the number of study period.

This solution method gives acceptable solutions for any slight changes in exogenous variables, but linearization errors may arise for larger changes in exogenous variables. Nevertheless, for this sake, Pearson (2002) has demonstrated that the multi-step Euler method together with Richardson extrapolation can be used to solve the linearized models to reduce such errors. This means that the changes in exogenous variables are cracked down into N smaller pieces and the system is solved for those smaller changes in N consecutive steps, with matrix $\overline{\mathrm{V}_{\mathrm{t}}}$ re-evaluated after each single step. Hertel et al. (1992) cited in Tran (2006) states that the solution of a linearized model is the same as the true non-linear solution. This technique is applied with the GEMPACK program to solve for all of the simulations of the model.

BOX 4.1: Linearization

Regarding the linearization or converting the system (E4.1) into (E4.2), it is to take the total differentials of the equations in level form to obtain the percentage change or the ordinary change form of all the variables in the system. The procedure can be represented from the initial equation of $X = F(Y,Z)$ where F is a differentiable function. The equation's total differential is:

$$dX = \frac{\partial F}{\partial Y} dY + \frac{\partial F}{\partial Z} dZ$$

To obtain the percentage change form of variables:

$$\frac{dX}{X} = \left(\frac{\partial X}{\partial Y}\frac{Y}{X}\right)\frac{dY}{Y} + \left(\frac{\partial X}{\partial Z}\frac{Z}{X}\right)\frac{dZ}{Z}$$

Multiply through with 100 and

let $x = \frac{dX}{X} * 100,\ y = \frac{dY}{Y} * 100,\ z = \frac{dZ}{Z} * 100$

Thus, $x = \left(\frac{\partial X}{\partial Y}\frac{Y}{X}\right) y + \left(\frac{\partial X}{\partial Z}\frac{Z}{X}\right) z$

or simplified as $x = \varepsilon_{X,Y} y + \varepsilon_{X,Z} z$

where x, y and z are percentage change of the variables X, Y *and* Z

$\varepsilon_{X,Y}$ and $\varepsilon_{X,Z}$ are elasticities of X with regard to Y and Z respectively.

Dixon et al. (1982) has shown the following three rules for deriving percentage change forms, where β and α are parameter, as :

$X = \beta YZ$	$\rightarrow\ x = y + z$	(Multiplication rule)
$X = Y^{\alpha}$	$\rightarrow\ x = \alpha y$	(Power rule)
$X = Y + Z$	$\rightarrow\ x = S_Y y + S_Z z$	(Addition rule)

S_y and S_z are the shares of Y and Z in X or

$S_y = Y/(Y+Z)$ and $S_z = Z/(Y+Z)$.

Interchangably, from $x = \frac{dX}{X} * 100$ we have $dX = Xx/100$, then some equations in the model can be linearised and written in the intermediate form as follows:

$Z = X + Y \quad \Rightarrow \quad Zz = Xx + Yy$

$Y = X - Z \quad \Rightarrow \quad Yy = Xx - Zz$

$P_1 Y = P_2 X + P_3 Z \quad \Rightarrow \quad P_1 Y(p_1 + y) = P_2 X(p_2 + x) + P_3 Z(p_3 + z)$

4.2. TRAVELTHAI Model

TRAVELTHAI is a single-country dynamic computable general equilibrium model for Thailand. In this study, it is developed to deal with the analyses of the effects of the economic changes, regarding Tourism, on the macro-economy in general.

TRAVELTHAI is a medium-scale model with 40 industries/activities, each of which produces only one of the 40 commodities/activities, and each commodity is produced only by one industry. This is in line with the Thai Tourism Satellite Accounts, which are compiled with the assumption of homogeneous production for all industries. That is no joint-production industry. The industries/activities directly follow the sectoral definition of the Thai Tourism Satellite Accounts. They also are arranged into three main broad categories related to tourism: direct tourism industries, tourism-connected industries, and non-tourism industries. This enables to analyse the possible effects of any economic changes over categorized industries in a more relevant manner.

TRAVELTHAI characterizes three types of flows associated with commodities: basic, margins, and taxes. Basic flows are valued at the basic price which is the unit cost of production for domestically-produced commodities; that is the basic price is the price received by the producer. This includes not only the cost of primary factors, but also production taxes e.g. business fee, and other cost tickets which are costs incurring in the stage of production i.e. the costs of administration fees and charges. The basic price for all imported commodities is the c.i.f. price plus import duties. Value added taxes are defined as the taxes imposed on the flows of goods and services from producers to users. TRAVELTHAI explicitly models margins following MONASH. Margins can be viewed as the transport services used to carry commodities from producers to users. The explicit margins accounts enable to make a correct analysis upon specific uses of margins especially with imported commodities.

There are three factors of production, which are labour, capital and land. No disaggregation of labour has been made although it could be disaggregated based on skills, locations or sex e.g. skilled/unskilled; urban/rural; male/female. The extension to have such disaggregation can later be done to analyse possible effects beyond this in the future. Capital is sector-specific and fixed in the comparative static assumption. TRAVELTHAI has 40 investors and each has fixed capital for its own industry, this

allows investments to respond to the rate of return in each industry. This one-country model concentrates on the analyses of changes in the economic activities within the economy and between the economy and the rest of the world. International trading conditions are represented by a single downward sloping demand schedule for export of each commodity and infinitely elastic supply curves for imports of each commodity with respect to foreign currency prices. Nevertheless, it is possible to make a further study with the disaggregation for many trading partners and even for Tourism partners itself to understand the different patterns of trade or travel.

The main contribution here is to have the explicit specifications of tourism demand, mainly inbound tourism demand (also, domestic tourism demand, of which outbound tourism demand can be viewed as the tourism import of domestic residents in the model). The inbound tourism demand bundle follows the fashion of export demand alike while the domestic tourism demand bundle is set to be a component of household consumption. Using Tourism Satellite Accounts data that provide inbound tourism explicitly, this enables the arrangement to analyse Tourism in dynamic sense.

It is assumed to have one government in the model. The central government makes most of the policy decisions and tax collection. Although with the ongoing decentralization process, local governments still can only administer a few of local taxes e.g. land-use or signs/symbols in Thailand. Thus, it is possible to model only one government, which consumes goods and services and makes its investment decisions.

There is only one representative household in the model since income distribution is not the main issue for the study. However, Tourism could create impacts on income distribution, and thus, more disaggregated types of households, either by income class or by other means, can be added into the model to conduct the analysis in specific e.g. Micro-simulation in the future research.

Technologies in all production activities are incorporated within production functions as the denominator e.g. 1/A, unlike the conventional way of representation in the form of Y= A*F(X). This represents the technical change similar to the input-output coefficients in the input-output tables with Leontief production function (See Dixon et. al. (1982)). Hence, if A decreases, it means higher productivity or less of inputs required to produce the same level of output. This also is applicable for preference taste of household.

TRAVELTHAI has a mixed structure of MyAGE, McHuGE, (and later on CHINAGEM), three successors of MONASH, by incorporating three types of 'dynamic' features: physical capital accumulation, accumulation of financial assets and liabilities (e.g. net foreign liabilities in MyAGE), and lagged adjustment processes in the labour market (See MONASH in Dixon and Rimmer (2001, 2002)).

Concerning the capital accumulation, as explained in MyAge (CoPs , 2010), changes in any industry capital stock over a period are equal to the initial capital stocks plus investment less depreciation during the period. Changes in the value of any financial asset or liability are related to the beginning values of the period, the accumulation during the period, and the average rate of interest (or dividend rate) of the asset or liability during the period. In the case of labour market, sticky real wages happen in the short run, but flexible in the long run. Any deviation of the real wage rate from the base case forecast is assumed to increase in proportional to the deviation in aggregate employment from the base case forecast. Note that year-on-year simulations real wage rates adjust so as to return employment to its long-run level.

TRAVELTHAI belongs to a recursive dynamic kind. As compared in Tran (2006), while inter-temporal models assume that agents are rational and forward-looking with the future expectation on the economy, economic agents in recursive models instead have static or adaptive expectations. Hence, a series of transitory equilibria of simulation can be calculated by the model period by period, which is more practical in terms of computing efficiency. The rare possibility of perfect foresight assumption for inter-temporal models also makes the recursive method advantageous.

It is also an attempt to provide the add-ons upon 3 other areas. First, TRAVELTHAI disaggregate the Balance of Travel from Balance of Trade and makes it separately to be conformed to the standard Balance of Payments. Second, the model also extends the types of indirect taxes, instead of only the amount of net indirect taxes provided in the data source of TSA. Third, the model also incorporates a Top-down approach for its regional feature. This is aimed, at least, to reflect the regional effects of Tourism apart from the national results. The model theme concentrates on 3 categories of tourists (inbound, outbound, and domestic visitors) and 3 broad sectors related to Tourism industry: direct tourism, tourism-connected, and non-tourism industries.

BOX 4.2: Notation Notice

This BOX informs how all variables and coefficients in the model are arranged in pattern. They all are in the same style as ORANI and MONASH. All the sets and their elements are shown as following.

Percentage change in variable X corresponds to the lower case x. Being shown earlier, x = (dX/X)100. In the same well known convention, X represents quantities, P represents prices, V represents values (sometimes, W), and *A* represents technology. Their percentage changes, hence, are represented by x, p, v (or w), and a.

Numbers are used for an abbreviation to stand for all 8 economic agents in the model.

1 = Intermediate Industries	5 = Government	0 = all users
2 =Investors	6 = Changes in Inventories	
3 = Households	7 = Inbound Tourists	
4 = Exports	8 = Domestic Tourists	

Subscript is used to indicate the variable belonging to which industries, commodities, flows, sources, or other characteristics associated while superscript signifies the variable according to which users, $p_c^{(0)}$ is the basic price of commodity *c* for all users, whereas $x_c^{(7)}$ is the quantities of that commodity c for inbound tourists. This algebraic notation of $x_{c,s,i}^{(1)}$ would also mean the same to TABLO notation (programming language in GEMPACK) of *X1(c,s,i),* which means quantities of intermediate commodity *c* from source *s* to industry *i* for current production.

Summation over the set is represented by an underscore with the set abbreviation. Hence, *V1TOT_SI(c)* or $V_{tot_si}^{(1)}$is the sum of the value of composite commodity c in intermediate production in all industries. Shifters are indicated by the letter *f* with the name of the associated variable. *f_a1(i),* or $f_{a,i}^{(1)}$, is the shifter for industry *i*'s all-input-using technology.

BAS means basic value flows while PUR means value at purchaser's price. TAX and MAR are values of the associated taxes and values of the associated margins.

4.3. Theoretical Structure of TRAVELTHAI Model

This section describes the core structure representation of TRAVELTHAI model. The representation of the stylized version in this section is emphasized on the specification of Tourism as the main contribution of the thesis.

TRAVELTHAI is theoretically a successor of MyAGE, McHUGE and CHINAGEM models, the framework in this chapter is immensely referred to ORANI in Dixon et al. (1982), MONASH model in Dixon and Rimmer (2002, 2005) as pioneer works, ORANI-G in Horridge (2003), McHUGE in Mai (2006), CHINAGEM in Mai (2010) and MyAGE in CoPs (2010). More details can refer to those sources with MyAGE of CoPs (2010), McHUGE and CHINAGEM of Mai (2006, 2010) as main references.

The stylized version in this section follows MONASH in Dixon and Rimmer (2002) and CHINAGEM in Mai (2010) with some parts adapted from MyAGE in CoPs (2010). It includes the specification of Tourism for TRAVELTHAI model. This is aimed to give the intuitive understanding of TRAVELTHAI, especially the specification of Tourism. The patterns of the group of equations are then represented in figures and briefly explained following the stylized version in Table 4.1. Table 4.2 tells the definitions of the notations used. This includes the closure set of the exogenous and endogenous variables for this stylized version of TRAVELTHAI.

The full equations in TABLO code of TRAVELTHAI is processed with GEMPACK. Note that all the variables and coefficients in TABLO are named to be able to easily indicate their economic interpretations. The full version is graspable from understanding the stylized version and it is better to comprehend the complex model from the mini stylized model as a guideline map.

It is noteworthy that in specifying the type of functional forms for any behaviour in the model, Dixon et al. (1980) emphasized that flexibility of the function would reflect the fact more precisely, but it also required more data for estimation. Thus, it depends on the assumptions concerning those behaviours and on the data availability to estimate behavioural parameters themselves e.g. those elasticities of substitution. Nested functions are normally used to reduce the number of such parameters. This makes any specification of any substitutability between different inputs more flexible.

Table 4.1: Stylized version of TRAVELTHAI equations

Groups of Equations	Eq.	Dimension
1. Outputs and inputs		
$X0(i,1,j) = X1TOT(j)*\mu 0_{i1j}(P_1)$	4.1	CxI
$X0COM(i) = \Sigma j\ X0(i,1,j)$	4.2	C
$X1(i,s,j) = X1TOT(j)*\ \mu_{1isj}\ (P_1(i), P_2(i), A_{1i}, A_{TWIST})$	4.3	CxSxI
$L(j) = X1TOT(j)*\ \mu_{Lj}(W, Q(j), A_{PFj})$	4.4	I
$K(j) = X1TOT(j)*\ \mu_{Kj}(W, Q(j), A_{PFj})$	4.5	I
2. Inputs to capital creation and asset prices		
$X2(i,s,j) = X2TOT(j)*\mu_{2isj}(P_1(i), P_2(i), A_{2j}, A_{TWIST})$	4.6	CxSxI
$PI(j) = \mu_{PIj}(P_1, P_2, A_{2j})$	4.7	I
3. Household demands for commodities		
$X3(i,s) = \mu 3_{is}(C, P3_1, P3_2, A_3(i), A_{TWIST})$	4.8	CxS
4. Exports		
$X4(i) = \mu_{4i}\ (PE(i)) + A_4(i)$	4.9	C
5. Government demands		
$X5(i,s) = A_5(i,s)*A_{(5)}$	4.10	CxS
6. Inbound Tourists' demands		
$X7(i) = X7TOT + A_{7i}$	4.11	C
$X7TOT = \mu_7\ (P7, A_7)$	4.12	1
$P7 = \mu_{P7i}(P_1(i), A_{7i})$	4.13	1
7. Domestic Tourists' demands (National tourists)		
$X8(i,s) = X8TOT(s) + A_8(i,s)$	4.14	CxS
$X8TOT(s) = X8_S - \mu 8(P8(s), A_8)$	4.15	S
$P8(s) = \mu_{P8s}(P_1, P_2, A_{8s})$	4.16	S
8. Demands for margin services		
$X3MAR(k,s,i) = A3MAR(k,s,i)*X3(k,s)$	4.17	CxSxC
9. Supply equals demand for commodities		
$X0COM(i) = \Sigma jX1(i,1,j) + \Sigma jX2(i,1,j) + X3(i,1) + X4(i) + X5(i,1) + X7(i) + X8(i,1) + \Sigma k\Sigma sX3MAR(k,s,i)$	4.18	C
$X0IMP(i) = \Sigma jX1(i,2,j) + \Sigma jX2(i,2,j) + X3(i,2) + X5(i,2) + X8(i,2)$	4.19	C
10. Zero profits in production, import, export & distribution		
$\Sigma iP_1(i)X0(i,1,j) = \Sigma i\Sigma sP_s(i)X1(i,s,j) + W*L(j) + Q(j)\ *K(j)$	4.20	I
$P_2(i) = [PM(i)/\Phi]*TM(i)$	4.21	C
$P_1(i) = [PE(i)/\Phi]/T4(i)$	4.22	C
$P3_s(k) = P_s(k)*T3(k,s) + \Sigma iP_1(i)*A3MAR(k,s,i)$	4.23	CxS

Groups of Equations	Eq.	Dimension
11. Indirect taxes		
$T4(i) = A_{0T}(i)*A_{4T}(i)$	4.24	C
12. Macro variables		
$CPI = \mu_{CPI}(P3_1, P3_2)$	4.25	1
$WR = W/CPI$	4.26	1
$LTOT = \Sigma jL(j)$	4.27	1
$KTOT = \Sigma jK(j)$	4.28	1
$GDP = C + \Sigma jPI(j)* X2TOT(j) + \Sigma s\Sigma iP_s(i)*X5(i,s) + \Sigma i[PE(i)/\Phi]*X4(i) + [P7/\Phi]*X7TOT + \Sigma sP8(s)*X8TOT(s) - \Sigma i[PM(i)/\Phi]*X0IMP(i)$	4.29	1
13. Capital stocks, investment, rates of return		
$K_+(j) = (1-D(j))*K(j) + X2TOT(j)$	4.30	I
$IKRATIO(j) = X2TOT(j)/K(j)$	4.31	I
$K_+(j)/K(j) - 1 = \mu_{KG}(EROR(j)) + A_{KG}(j) + A_{KGT}$	4.32	I
$EROR(j) = \mu_{EROR_j}(Q(j), PI(j)) + A_{EROR}(j)$	4.33	I
14. Balance of payments and GNP		
$NFLF_+ = NFLF + CAD*\Phi$	4.34	1
$CAD = \Sigma i(PM(i)/\Phi)*X0IMP(i) - \Sigma i(PE(i)/\Phi)*X4(i) - (P7/\Phi)*X7TOT + R0IF*(NFLF/\Phi)$	4.35	1
$GNP = GDP - R0IF*(NFLF/\Phi)$	4.36	1
15. Function for private and public consumption		
$C + \Sigma s\Sigma iPs(i)*X5(i,s)+ \Sigma s\Sigma iPs(i)*X8(i,s) = A_C*GNP$	4.37	1
16. The government accounts		
$PSD = \Sigma s\Sigma iPs(i)X5(i,s) - \Sigma s\Sigma k[T3(k,s) - 1]Ps(k)X3(k,s) - \Sigma i(TM(i)-1)[PM(i)/\Phi]X0IMP(i) - \Sigma i(T4(i)-1)*P_1(i)*X4(i) - \Sigma i(T7(i)-1)*P_1(i)*X7(i) - \Sigma s\Sigma i[T8(i,s) - 1]Ps(i)X8(i,s) + TRANSFERS$	4.38	1
17. Sticky-wage specification for policy simulations		
$\left[\frac{WR}{WR_f}-1\right]=\left[\frac{WR_{lag}}{WR_{flag}}-1\right]+\alpha\left[\frac{LTOT}{LTOT_f}-1\right]+A_{WR}$	4.39	1
18. Technical and preference change		
$A_3(i) = A_{3G}(i) * A_{3F}(i)$	4.40	C
$A_{3G}(i) = A_{CG}(q), \forall\ i \in G(q)$	4.41	C
19. Equations for facilitating historical and forecast simulations		
$CG(q) = \Sigma j \epsilon G(q)\ \Sigma sX3(j,s)$	4.42	Q
20. Optional Top-down regional extension	O	**(-)**

Total number of Equations: (CxSxC)+2(CxSxI)+(CxI)+4(CxS)+8I+10C+Q+2S+13

Note: The group 20th of optional Top-down regional extension could be added on as an attached detail with additional closure. This is shown here as the 'optional' item.

Table 4.2: Notation of variables in the stylized model

Variables	Notations	In Eq.	Dimension
	I. Endogenous variables		
$A_{3G}(i)$	Household preferences corresponding to $A_{CG}(q)$	4.40	C
A_{WR}	Slack in wage-determination equation	4.39	1
$A_3(i)$	Household preferences with respect to good i	4.40	C
$A_4(i)$	Slack in export-demand function for i	4.9	C
$A_8(i,s)$	Slack in domestic tourism demand function for (i,s)	4.14	CxS
CAD	Current account deficit	4.35	1
CG(q)	Consumption in q^{th} group of commodities	4.42	Q
CPI	Consumer price index	4.25	1
GDP	Gross domestic products	4.29	1
GNP	Gross national products	4.36	1
EROR(j)	Expected rate of return in industry j	4.33	I
IKRATIO(j)	Ratio of investment to capital in industry j	4.31	I
$K_+(j)$	End-of-year stock of capital in industry j	4.32	I
KTOT	Total start-of-year capital stock	4.28	1
L(j)	Employment in industry j	4.4	I
LTOT	Total employment	4.27	1
$NFLF_+$	End-of-year net foreign liabilities in foreign currency	4.34	1
PI(j)	Asset price of capital in industry j	4.7	I
PSD	Public sector deficit	4.38	1
P_1	Basic prices of domestic commodities	4.22	C
P_2	Basic prices of imported commodities	4.21	C
$P3_1$, $P3_2$	Vectors of household purchasers‟ prices (2 sources)	4.8	CxS
P7	Price of inbound tourism bundle	4.13	1
P8(s)	Price of domestic (national) tourism bundle	4.16	S
Q(j)	Rental rate on capital in industry j	4.4,5	I
T4(i)	Power of tax on exports of commodity i	4.24	C
W	Wage rate	4.26	1
X0(i,1,j)	Output of commodity (i,1) by industry j	4.1	CxI
X0COM(i)	Total output of commodity (i,1)	4.2	C
X0IMP(i)	Total imports of commodity i	4.19	C
X1(i,s,j)	Input of (i,s) to production in industry j	4.3	CxSxI
X1TOT(j)	Activity level in industry j	4.1	I
X2(i,s,j)	Input of (i,s) to j's capital creation	4.6	CxSxI
X2TOT(j)	Investment in industry j	4.6	I
X3(i,s)	Household consumption of commodity (i,s)	4.8	CxS
X3MAR(k,s,i)	Margin use of domestic good i in facilitating the flow of (k,s) from producers & ports of entry to households	4.13	CxSxC
X4(i)	Exports of commodity i	4.9	C
X5(i,s)	Government demands of commodity i	4.10	CxS
X7(i)	Inbound tourists' demand for commodity i	4.11	C
X7TOT	Inbound tourists' demand bundle	4.11	1
X8(i,s)	Domestic tourists' demands for commodity (i,s)	4.14	CxS
X8_S	Domestic (National) tourists' demand bundle	4.15	1
X8TOT(s)	Domestic (National) tourists' demand for bundle (s)	4.15	S

Total number of endogenous variables:
(CxSxC)+2(CxSxI)+(CxI)+4(CxS)+8I+10C+Q+2S+13

Variables	Notations	In Eq.	Dimension
	II. Exogenous variables		
A_C	Aggregate propensity to consume	4.37	1
K(j)	Start-of-year capital stock in industry j	4.30	I
NFLF	Start-of-year net foreign liabilities in foreign currency	4.34	1
WR_{lag}	Real wage rate in previous year	4.39	1
WR_{flag}	Forecast for real wage rate in previous year	4.39	1
WR_f	Forecast for real wage rate	4.39	1
$LTOT_f$	Forecast for total employment	4.39	1
TM(i)	Power of tariff on imports of commodity i	4.21	C
T3(k,s)	Power of tax on household consumption of good (k,s)	4.23	CxS
T7(i)	Power of tax on inbound tourism of commodity i	4.38	C
T8(i)	Power of tax on domestic tourism of commodity i	4.38	C
TRANSFERS	Transfers from the public sector to households,e.g., unemployment benefits and interest on the public debt	4.38	1
PM(i)	Foreign currency c.i.f. price of imports of commodity i	4.21	C
ROIF	Rates of interest or dividends applying to NFLs	4.35	1
Φ	Exchange rate	4.21	1
C	Total household expenditure	4.37	1
WR	Real wage rate	4.26	1
PE(i)	Foreign-currency price of exports of commodity i	4.22	C
All the A's	Potential slack and variables used to represent shifts in technology and preferences (except A_{WR}, $A_4(i)$, $A_{3G}(i)$ and $A_3(i)$ for all i)		(CxSxI)+Q +4C+5I+ S+4
	Total number of exogenous variables: (CxSxI)+(CxS)+Q+9C+6I+S+15		
	III: Other notations		
C	Number of commodities (40 commodities in the study)		
I	Number for industries (40 industries in this study)		
S	Number of sources (domestic and imported)		
Q	Number of commodity groups for which data on Household consumption are available		
D(j)	Depreciation rate in industry j, treated as a parameter		
G(q)	Set of industries in the group q		
All the μ's	Functions		
α	Positive parameter		

From Table 4.1, following section 4.1.2, the variables of the stylized version can be divided into 2 groups of endogenous and exogenous variables as shown in Table 4.2. The total number of endogenous variables is the same as the number of equations, leaving the number of exogenous variables to be determined by the model user.

Those 20 groups of equations of stylized version, as stated in Table 4.1, along with some explanations upon the full version are explained in 21 sub-sections (another sub-section is for the rest of equations in TRAVELTHAI the stylized version does not include) as following.

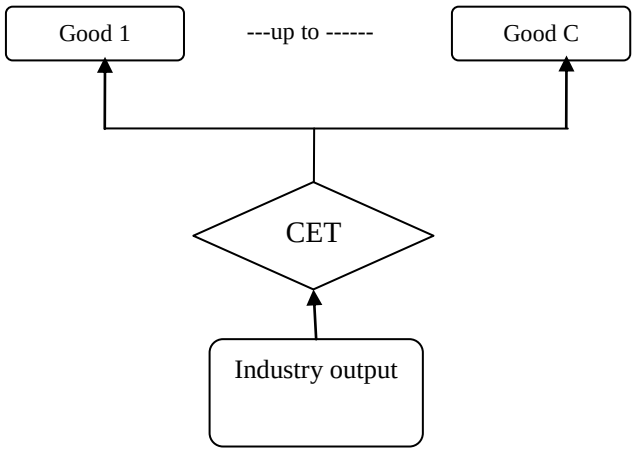
4.3.1. Outputs and Inputs

This first sub-section deals with the industry outputs and inputs composition of the first group of equations in the stylized model of Table 4.1. This study starts with the output supply of the first five equations.

Composition of outputs

It is important to note that the investigation on database concerning Input-Output Table or Tourism Satellite Accounts of the country is advisable. In Thailand, these kinds of database are based on the assumption of single commodity - single industry concept. That is one industry produces only one commodity or provides only one activity. However, the fact that the degree of substitutability exists, the industry-specific decision making on output composition is then assumed to maximize revenue subject to the CET production function which is described by Figure 4.1 and shown the relationship as Eq. 4.1 in Table 4.1.

Figure 4.1. Composition of output



Source: Adapted from CoPs (2010)

The Constant Elasticity of Transformation (CET) function captures almost the same property to the Constant Elasticity of Substitution (CES) function, only that the transformation parameter possesses the sign opposite to the substitution parameter. It tells that an increase in any commodity price relative to the average would induce production transformation to be in favour of that commodity output. X1TOT(i) or the level of each industry's activity determines the transformation frontier. Any per cent increase in activity requires the same increase in all inputs.

Eq. 4.2 of Table 4.1 shows that the total (domestic) output of (c,1) X0COM(c) is the adding up of all outputs of the industries, X0(c,1,i) where i = 1st , 2nd until I^{th}. This is normally shown in ORANI and other successors in terms of the MAKE matrix. From CoPs (2010), it is explained that MAKE is a CxI matrix showing the value of commodity $c \in COM$ produced by industry $i \in IND$. The MAKE matrix is normally symmetric as COM=IND, but not diagonal as one industry can produce several commodities, and one commodity can be produced by several industries. The MAKE matrix can be diagonal if it is the case of unique commodity production. It is shown in TABLO code as E_x0ind and E_x0dom meaning the total output of industry i is an addition of output of different commodities by i and total output of commodity c is the addition of output from different industries.

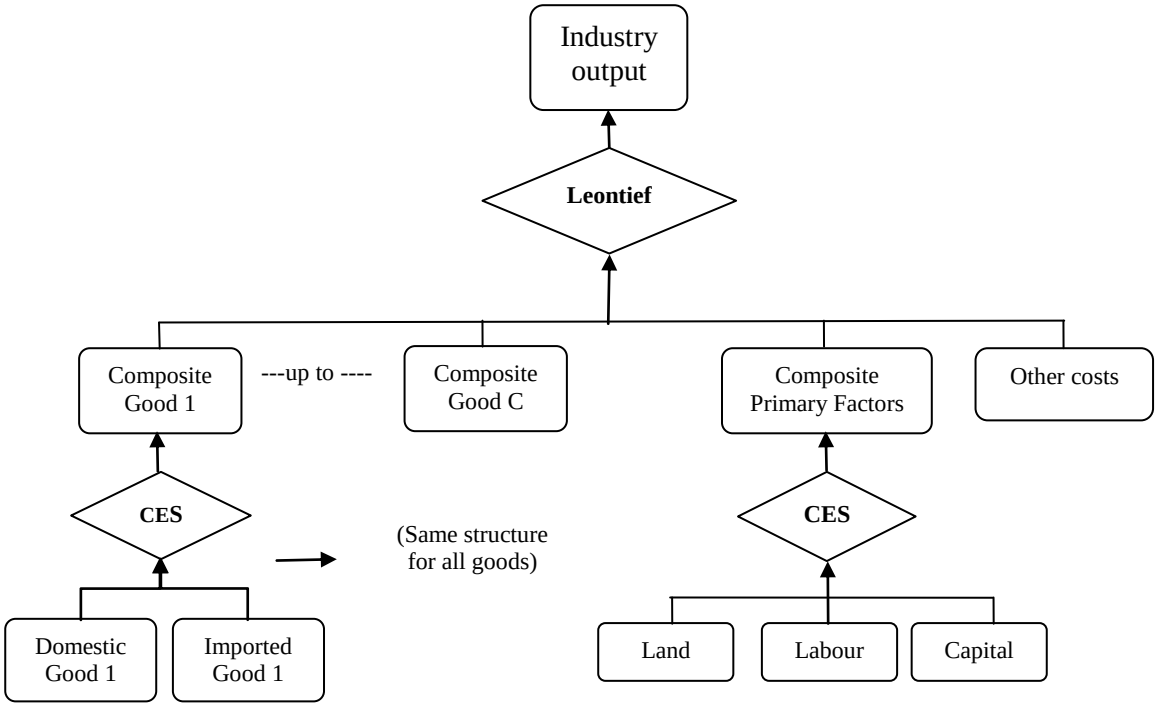
Composition of inputs

At the given input and output prices, producers are assumed competitive and efficient by choosing the composition of their output to maximise revenue and by deciding the mix of two broad categories of inputs: intermediate inputs and primary factors, which minimises the production costs for their level of output. The choices of inputs are bound by a three-level nested production technology. From Figure 4.2, each industry makes a decision to choose effective composite intermediate inputs and a composite primary input to minimise the total costs subject to the Leontief production function.

There is no substitutability between different kinds of materials or between materials and primary factors in producing output for Leontief production function. This is primarily a working assumption to suite a sophisticated model as it is difficult for intermediate inputs and primary factors can substitute for each other (Dixon et al. 1992:216). Nevertheless, it could be adapted for more suitable functional forms in case there is the support from the empirical evidence of substitution elasticities between different kinds of materials or primary factors.

The primary factor bundles and the intermediate input bundles are used in fixed proportions to output at the first level whereas in the second level, intermediate input bundles are set with the constant elasticity-of-substitution (CES) function of the two sources: import-composite commodities and domestic commodities. It is also a CES combination of labour, capital and land for the primary factor bundles.

Figure 4.2 Input technology for current production



Source: Adapted from CoPs (2010)

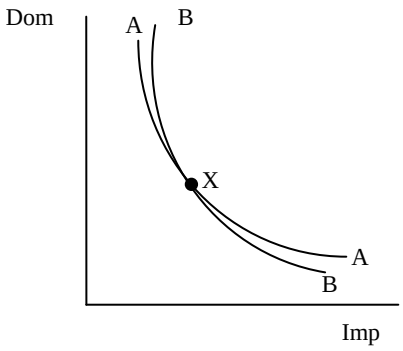
Demands and prices for domestic and imported intermediate inputs

Regarding industry demands for source-specific intermediate inputs of these production nests (the second level on the left-hand-side of Figure 4.2), each industry chooses the domestic and imported bundles of intermediate input demands and consequently makes a decision upon the composition of their import composite. Also cited in CoPs (2010), Dixon *et al.* (1982) informs that changes in the relative price of the domestic and imported combinations of a particular commodity will alter the import's share of the local market, while not driving one or the other of the domestic or imported good entirely from the local market. Assumption of imperfect substitution possibilities between domestic and import source of each intermediate input is set via Constant Elasticity of Substitution (CES) production functions (called Armington Elasticity for this type). The producers then choose each intermediate input from domestic or imported sources to minimise cost.

For Eq. 4.3 in the stylized model, three main terms in the RHS of equation are the percentage change in the composite intermediate good c used in industry i, the industry's all input augmenting technical change, and the price substitution effect,

respectively. The latter two are zero if there is no changes in prices and technology which means that the usage of input c expands proportionately with industry (i)'s overall usage of the composite good c or X1TOT(i). The price substitution effect shows in the form of an elasticity of substitution, μ_{1csi} in the stylized model or SIGMA1 (c) in the full version, multiplied by the percentage change in a price ratio of the price from the domestic source relative to the average cost of the domestic-import composite, which is vice versa for import source case. Thus, cheaper domestic price relative to the average cost leads to the change for domestic good. Likewise, the other terms indicate the effect of the technical change in the same manner to the former three terms. With a_{1i} is the technology term in the stylized model, a 10 per cent input-saving technical change by industry (i) means a saving of 10 percentage change of technical change or -10 per cent.

For A_{TWIST} term in Eq. 4.3, it could be understood as the device to allow for cost-neutral changes in domestic and import preference for each commodity. Horridge (2003:67) stated that the twist could be graphically depicted as a pivot of an isoquant AA around the chosen combination X of domestic and imported commodity to stay at the same production level of output becoming isoquant BB that still passes X.



Demands and prices for composite labour, capital, and land

Producers choose units of composite labour, capital and land to make a composite primary factor input at the second level of the production nest in Figure 4.2. They aim to minimise the total cost of producing such the primary factor composite input.

The substitution effects among the three factors are shown as the change in the price of one factor (e.g. labour) relative to the average cost of all primary factors. Industry *i* would obtain more (or less) of that factor and less (or more) of other factors. The

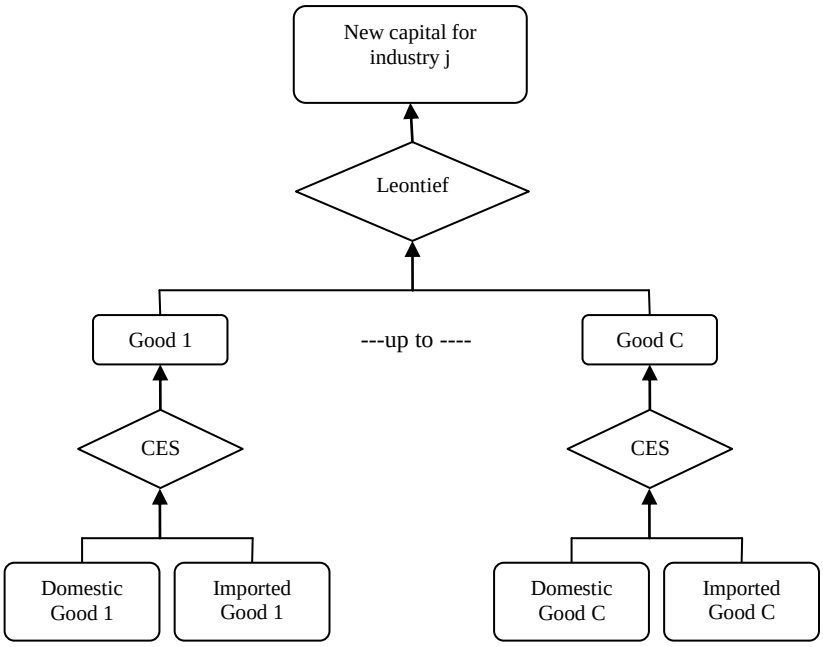
magnitude of the effects depends on the sizes of the elasticities of substitution, μ_{Li} and μ_{Ki} in the stylized version of two factors of production (only capital and labor) of Eq. 4.4 and 4.5, or SIGMA1PRIM(i) in the full version in the equation E_ x1lab_o, E_cap_at_t and E_p1lnd. Other variables present the effects of changes in technology, which is A_{PFi} in the stylized version. The interpretation is the same for the similar pattern of those technology variables earlier. In addition, for the full version, the percentage changes of the average effective price of primary factor composite of industry *i* are the cost-weighted Divisia index of individual prices and technical changes showed in E_p1prim whereas the average percentage changes in industry primary factor technology, a1prim as a cost-weighted Divisia index of technological changes by labour, capital and land. There is only the relative price between two factors of production (Q(i) for K(i) and W for L) for the stylized one.

Demands for inputs for capital creation and asset prices

The demand for inputs to create the new units of physical capital as given are derived from the cost minimisation of capital creation subject to a nested production function as shown in Figure 4.3. The top-level Leontief function determines such demands. Without technical change, any percentage change of units of capital to be used in a particular industry i would lead to a similar percentage change in demand for all composite commodity inputs to capital formation of that sector. The Leontief production function shows the fixed-proportion constant returns to scale property for the new units of physical capital created. Note that the total investment in each industry is exogenous. At the second level, imported and domestic inputs to capital formation represent a certain degree of imperfect substitution with CES functions. Note that in capital creation, employment of primary factors is indirectly handled in the process of producing the domestic goods as input to the formation process, thus not shown in this level of capital formation. This cost minimisation has the similar structure to that of cost minimisation for input demand, shown in Eq. 4.6.

Changes in relative input prices for source-specific varieties of the same commodity matter with the magnitude of the changes determined by elasticities of substitution, μ_{2isj} in the stylized form and SIGMA2 in the full version. PI(j), cost of a unit of capital of industry j depends on input prices and technology, which is also the asset price.

Figure 4.3: Composition of investment



Source: Adapted from CoPs (2010)

4.3.2. Household demands for commodities

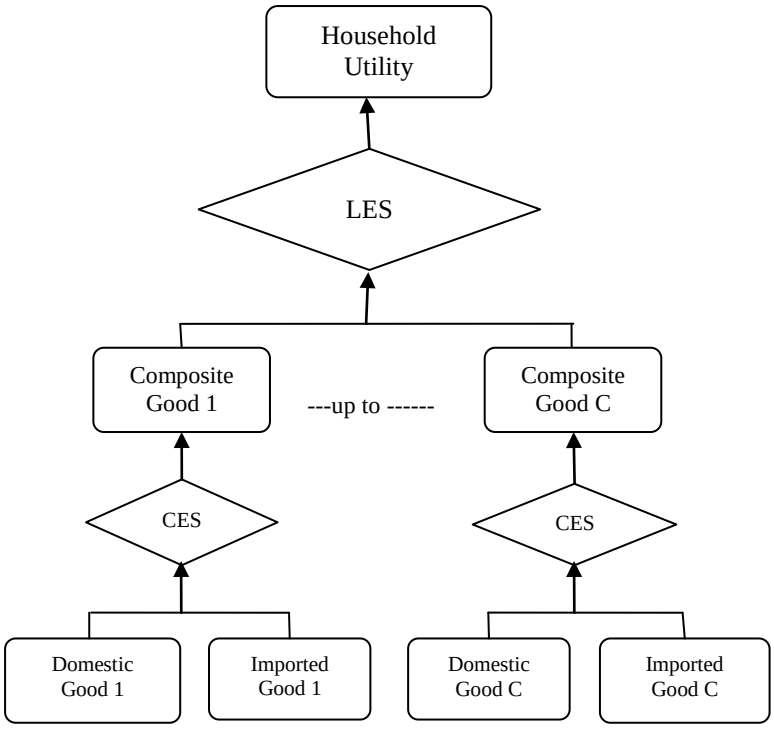
Figure 4.3 shows the two-stage decision for Household demands. It is a normal utility maximisation subject to a budget constraint for the first stage, which gives utility maximising demands for composite commodities. Households also pursue the cost minimisation by choosing among the available choices of composite commodities subject to the constraint of such alternative choices in the second stage. The household's utility function used is LES as this functional form makes demands independent from econometric parameter estimation.

Eq. 4.8 follows the same pattern of earlier explained demands and is a function of the household budget (C), the preferences (A_3) and the purchasers' prices to households of domestic and imported sources ($P3_1$ & $P3_2$). This stylized version follows what CHINAGEM simplifies, which is to assume that margins occur only on commodity flows to households and the only indirect taxes are tariffs, export taxes and taxes on consumption. However, for the full version, the net indirect taxes are made with 7 types of commodity taxes and 3 types of production taxes, more details in chapter 5.

Eq. 4.8 above could be thought of as a functional representation for the household demands for composite commodities of the full version TRAVELTHAI deriving from

the Linear Expenditure System (LES) utility maximization functional form, so called Klein-Rubin Utility function. Two bundles of commodities are consumed: subsistence & luxury. As the name of LES suggests, the expenditure on each good is a linear function of price and expenditure. Subsistence bundle is the quantity purchased regardless of price, hence, at the subsistent level. What remains from the consumer budget after that portion of subsistence bundle is deducted is the bundle called luxury or supernumerary expenditure. The total subsistence demand for each commodity c is proportional to the number of households (for this study, one aggregate household).

Figure 4.4: Structure of household demand



Source: Adapted from CoPs (2010)

It could be seen that household expenditure elasticities or EPS(c), average budget shares or S3_S and the Frisch parameter or FRISCH are the three main factors in the household demand equations of the full version. FRISCH is defined by tradition as the negative of the ratio between the expenditure (V3TOT) and supernumerary expenditure (V3LUX_C). EPS(c) is the negative of the multiplication of FRISCH and the share of the luxury bundle in the total expenditure on commodity c (B3LUX(c)). Note that the marginal household budget shares are the EPS(c) multiplied by S3_S(c). EPS(c) and FRISCH could be obtained from the literature while S3_S(c) can be calculated from TSA. For more details on derivations, see Horridge (2003).

4.3.3. Demands for exports

Eq. 4.9 represents the export demands in the stylized model. It relates foreign demand for domestic commodity i or X4(i) to the foreign currency price or PE(i) and the shift variable of A_4(i). By setting the shift variable as exogenous, it allows the simulation on the effects of the movements in the export demand curve for commodity i.

Unlike the stylized version, full TRAVELTHAI categorizes exports into two kinds: individual exports (high export contents) and collective exports (small proportion of export over their sales i.e. less than 20 per cent) and treat each kind differently.

Individual export commodities

Individual export commodities are defined as the commodities which export accounts 20 per cent or more of total sales at basic prices. There are two commodities belongs to this group in TRAVELTHAI. Commodities in INDEXP set are facing individual downward-sloping export demand curves in the form as following (CoPs, 2010):

$$X_c^{(4)} = \left[\frac{P_c^{(4)}}{\Phi \; FP_c^{(4)} FP_{gen}^{(4)}} \right]^{\varepsilon_{c,t}} FQ_c^{(4)} FQ_{gen}^{(4)}$$

where
- $X_c^{(4)}$ is the volume of exports of commodity *c*;
- $P_c^{(4)}$ is the f.o.b. export price of commodity *c*, in Thai Baht;
- Φ is the foreign exchange rate, defined as the price of a unit of country *t*'s currency in terms of Baht (foreign currency is US$, so it is Baht/US$);
- ε_c is elasticity of demand for good *c*; and
- $FP_c^{(4)}$ and $FQ_c^{(4)}$ allow shifts in price and quantity in commodity-specific
- $FP_{gen}^{(4)}$ and $FQ_{gen}^{(4)}$ allow uniform shifts in all export demand schedules.

Any change in the *FQ* shifters portrays the horizontal movements in export demand schedules and vertical for *FP* shifters. Examples are changes in the difference between the Thai f.o.b. price of exports and the purchasers' price of those imports in the importing country. Horizontal movements can be shifts in foreign preferences toward or away from Thai exports at any given price level or changes in the world demand. Foreign users are assumed to consider imports from different sources as imperfect substitutes to minimise the costs of producing a unit of imports, subject to their CES production function. For the derivation, see Dixon and Rimmer (2002, pp. 222-225).

Collective exports

Collective export bundle is set to be in the similar functional form as individual export demand curve. However, the price of the collective bundle is a divisia index of the prices of all collective exports.

4.3.4. Government demands

Changes in government demand for any commodity (i,s) or for all commodities can be introduced by shocks to A_5(i,s) or $A_{(5)}$ in Eq. 4.10, for which allows different treatments of government demands for commodities. $A_{(5)}$ can also be used as an endogenous variable which adjusts so government spending meets a budget constraint.

Full version treats similarly, only a few more links to other variables like consumption spending and aggregate private consumption, or Gross National Disposable Income. In such cases, the shifter must be endogenous to let the movements in X5(i,s) conform with aggregate public consumption determined in the model.

4.3.5. Inbound tourists' demands

This group of equation is the contribution for the thesis. With the information of TSA, it is possible to explicitly determine the relationship of the Tourism industry. In Eq. 4.12 of stylized version, the equation is clarified in the similar way to the export demand of Eq. 4.9, only with its own way representing the demand of its type (7) and the treatment of tourism as a bundle (so, only X7TOT and P7). This is because the study regards it as one type of export, only the inbound tourists as consumers come to visit the country to consume the Tourism commodities as a bundle. Eq. 4.13 tells the price composite linking to P_1. Eq.4.11 informs the bundle moves with its composition.

The full version follows the same way as collective export demand and treats tourism services in bundle as well. This is because the sizes of the tourism sectors are all small with less market power and it is possible to let this group of commodities/activities has the same export demand curve. The demand for tourism bundle is negatively related to the price of it, which is a divisia index of the prices of all tourism exports, including the shifters on prices and quantity as bundle. Any change in the quantity shifter (horizontal movements) results from changes in foreign preferences at any given price level or changes in foreign tourists' demand concerning income effects.

4.3.6. Domestic tourists' demands (National tourists)

Eq. 4.14 to 4.16 follow the style of the functional form of Eq. 4.8 of the consumer demand in the stylized version, but the key difference is the treatment of bundle. It is the same reason abovementioned in 4.3.5 on tourism services as bundle. This bundle is chosen upon optimising the constraints between the domestic price and imported price of P8(s), thus, whether to be domestic tourists or outbound tourists (National tourists are the residents in the country either travel within or abroad outbound).

The full version has treated the same way but with the explicit link to consumption. This is because the expenditure for travel as leisure follows as a part of consumption and it is common to look at it as a luxury commodity rather than subsistence one. The estimated income elasticities of demand commonly were found to be greater than one (Crouch, 1994). The microeconomic theory upon leisure and working for backward-bending labour supply curve could also be thought of for as background, since people tends to work to the certain limit of hours and after that threshold they would tend to choose leisure instead. The opportunity cost involved in working is the forgone hours of leisure. Travel is one type of leisure and leisure is among varieties of commodities consumed. This study assumes the link to consumption in certain ratio of shifter term.

4.3.7. Demands for margin services

Margins are services applied to facilitate flows of commodities from producers to users (for domestically-produced commodities), or from the point of entry to users (for imported goods) (CoPs, 2010). In the stylized version, it is assumed that there are no margins services associated with commodity flows except those to households. If A3MAR(k,s,i) is exogenous in Eq. 4.17, then it means the use of commodity k as a margin service in facilitating the flow of commodity (k,s) from producers or ports of entry to households is proportional to household demand for (k,s).

In the full version, there is this kind of equations applicable for all users. There are 6 margin services in the version; those are Trade and repair of goods, Railway passenger transport service, Transport supporting service, Waterway passenger transport service, Air passenger transport service, and Transportation and warehousing services.

4.3.8. Supply equals demand for commodities

In the stylized model, Eq. 4.18 tell that the supply of commodity (i,1) equals to the

sum of demands for (i,1) for domestic and Eq. 4.19 for imports (i,2). There is no re-exports. Note also that demands for margin commodities differ from non-margin commodity demands in 2 things: first, margin commodities are used directly and to facilitate the flow of other commodities and, second, margins are domestically produced. There is another equation to handle margin separately in the full version.

4.3.9. Zero profits in production, import, export & distribution

Eq. 4.20 to Eq. 4.23 informs the stylized versions of the TRAVELTHAI zero-pure-profits conditions for production, import, export and distribution as CHINAGEM does. Eq. 4.20 tells total output distribution of domestically-produced output equals to the cost of all output produced as demand equals to supply. Eq. 4.21 informs that the price, P2(i), perceived by importers of commodity i equals to the cost of importing a unit of i which is the conversion of the price in terms of foreign-currency PM(i) via the exchange rate, Φ, and inclusive of the power of the tariff, TM(i). Eq.4.22 informs an opposite manner as the export price of one unit of the commodity i is equal to the value received per unit of export composing of the foreign-currency price PE(i) converted to domestic currency via exchange rate and deflated by the power of the export tax, T4(i). Eq. 4.23 shows the price households paid for commodity (k,s) is equal to the cost of a unit of (k,s) supplied to households; it is comprised of the price perceived by producers or importers, Ps(k), inclusive of the power of the consumption tax T3(k,s) plus the transportation costs of shifting units of (k,s) from producers or ports of entry (in case of import) for households. Margin activities in this part are assumed to use only domestic activities e.g. domestic transport or retail trade. Hence, the transferring cost used for (k,s) units of commodity i perceived by households is the price of domestic commodity i, P1(i), multiplied by the number of units of i , A3MAR(k,s,i), required per unit of transfer. Note that the power of the tariff which is (1 + the tariff rate) is used since the simple tariff rate can change sign if the tariff becomes a subsidy and it may cause computational problems (CoPs, 2010).

The full version does the same way for zero profits condition. As in CoPs (2010), zero pure profits in the output distribution of each commodity is set when the purchaser's price is equal to the basic price plus any taxes and margins associated with the use of the commodity by that purchaser.

4.3.10. Indirect taxes

Eq. 4.24 in the stylized version expresses the power of an indirect tax as the product of various shift variables. The shift variable $A_{0T}(i)$ links the power of various taxes to the users of the commodity.

Thailand's indirect tax system is complicated. It can be divided into two main groups: commodity taxes and production taxes. Commodity taxes include tariff, export duties, excise duties, value added tax (VAT) and VAT refunds including Tourists' VAT refunds, other taxes on commodities, and commodity subsidies for commodities. Production taxes include: business fees, production subsidies and other taxes on production. For more information on each type, see section 4.7 of Chapter 4. The disaggregation of the types of indirect taxes could be done as optional to the model. This is because in the main database the net indirect taxes by industry are provided in TSA as the net of the total indirect taxes (total indirect taxes less subsidies). Disaggregation of types could provide the dimension upon the effects of each type of the indirect taxes upon the model. This proves to be beneficial to policy-makers.

For full version, since tax rates can either be positive or negative, of which negative rates indicate a subsidy. From CoPs (2010), the power of the relevant tax is calculated as one plus the ratio of tax revenue to the tax base to avoid zero:

$$T_{c,s,t}^{(u)} = \left(1 + TAXRATE_{c,s,t}^{u}\right) = \left(1 + \frac{TAXREV_{c,s,t}^{u}}{TAXBASE_{c,s,t}^{u}}\right)$$

where $T_{c,s,t}^{(u)}$ is the power of tax t on flows of (c,s) to user u.

$TAXRATE_{c,s,t}^{u}$ is the rate of tax t on flows of (c,s) to user u.

$TAXBASE_{c,s,t}^{u}$ is the base upon which tax t is levied.

$TAXREV_{c,s,t}^{u} = TAXRATE_{c,s,t}^{u} \times TAXBASE_{c,s,t}^{u}$.

Note that the full version shows the VTAX group with the dimension t in the model. The database chapter in chapter 4 provides the development of how to include the dimension of the types of indirect taxes with the disaggregation of the total indirect taxes e.g. from V1TAX(c,s,i) to be V1TAX(c,s,i,t). The dimension of the power of the taxes provided above has the t dimension to present this according to the full version.

4.3.11. Macro variables

Macroeconomic conditions are determined by Eq. 4.25 to Eq. 4.29 in the stylized version. Eq. 4.25 shows the consumer price index (CPI) as a function of $P3_1$ and $P3_2$ of domestic and imported prices that consumers perceived. Eq. 4.26 informs the real wage rate as the nominal wage rate deflated by the CPI. Eq. 4.27 and 4.28 define as sums of employment and capital stock across industries equal to total employment and total capital stock, and Eq. 4.29 gives the nominal GDP identity.

In the full version, all indicators concerning macroeconomic activity are presented both in income-side and expenditure-side of GDP identity, including price and quantity indexes and other useful ratios of national accounts aggregates i.e. aggregate employment, aggregate capital stock, terms of trade (ratio of export and import price index), real devaluation (ratio of the import price and GDP deflator), or associated deflators in the percentage change form with divisia indexes. In Johansen-style CGE models, these percentage change form of divisia indexes commonly arise. CoPs (2010) defines that divisia indexes are geometrically close to the average of the values of the Laspeyres (initial weights) and Paasche (final weights) indexes, and hold the property of using up-to-date weighting schemes. Nevertheless, as also cited in CoPs (2010), Dixon and Rimmer (2002: 188) note that it is important to realize that this means that the levels form of these equations are Divisia indexes by assumptions. The indexes can change over time, not only from changes in prices and quantities, but also from changes in weights. Note that this study also provides Laspeyres and Passche divisia indexes following CoPs (2010).

4.3.12. Capital stocks, investment, rates of return

Capital accumulation proves to be the important part for the dynamic CGE model. This study refers to Dixon and Rimmer (2002), Mai et. al. (2010), and CoPs (2010).

It is assumed that expectations are static or adaptive. The stylized version let Eq. 4.30 relate capital stock in industry j at the end of the year, $K_+(j)$, to the depreciated capital stock from the beginning of the year, (1-D(j))*K(j), and investment during the year, X2TOT(j). Eq. 4.31 defines the ratio of investment to capital in industry j. In Eq. 4.32, capital growth in industry j during the year is determined by industry j's expected rate of return, EROR(j), and the shift variable, $A_{KG}(j)$. Eq.4.33 determines the expected

rate of return in industry j as a function of the current rental rate, Q(j), and asset price, PI(j), of industry j's capital and its shift variable, AEROR(j).

In the full version, bases on the explanation in CoPs (2010) about the underlying assumptions on this capital accumulation and rates of return, Eq. 4.30 in the stylized version, which shows the basic relationship for capital accumulation, is expressed in the equation of E_cap_at_tplus1 in the percentage change form for the full version. E_p1cap is used to give shocks to starting capital in year-to-year simulation with the homotopy variable (del_unity) linking a sequence of year-on-year annual simulations via stock/flow dynamics. In CoPs (2010), homotopy variable is explained as:

$$\Delta K_{i,t}^{start} = \left(K_{i,t-1}^{end} - K_{i,t-1}^{start}\right)\Delta U$$

or equivalently:

$$K_{i,t}^{start} k_{i,t}^{start} = 100\left(K_{i,t-1}^{end} - K_{i,t-1}^{start}\right)\Delta U$$

where $K_{i,t-1}^{start}$ and $K_{i,t-1}^{end}$ are the start-of-year and end-of-year quantities of industry i's capital stock in the year t-1. These are database items.

$K_{i,t}^{start}$ is the start-of-year quantity of industry i's capital stock in the current step in the computation of the final solution for year *t*;

$\Delta K_{i,t}^{start}$ is the change in the start-of-year quantity of industry *i*'s capital stock between the initial and final solutions for year *t*;

$k_{i,t}^{start}$ is the percentage change in the start-of-year quantity of industry *i*'s capital stock between the initial and final solutions for year *t*; and

ΔU (homotopy variable) is an exogenous variable that is shocked equals to 1.

Homotopy variable (del_unity), thus, links the year-on-year movements in sequence of the capital stock. This variable is also applied with other variables with this stock and flow concept e.g. government and private foreign credit, foreign debts.

E_x2tot represents the similar role as Eq. 4.31 in the stylized version. These are the ratios of investment to capital by industry. It is noted in CoPs (2010) that in the comparative static long run simulations, the economy reaches a steady state in the solution year where the growth rate of capital returns to its counterfactual value, with depreciation treated as a constant parameter. Thus, this means the investment-capital ratio must also return to its counterfactual value in the solution year. Hence, while

E_x2tot simply calculates the movements of the ratios by industry in the short run comparative static and dynamic simulations, it is possible to determine the percentage change in the industry j's investment-capital ratio exogenously for long run comparative static simulations to find the long run industry-specific investment.

E_del_f_ac_p_y is similar to what Eq. 4.33 informs in the stylized version. It tells that the expected rate of returns on capital in industry i is the ratio of the net present value of purchasing a unit of physical capital for use in the industry i to the cost of creating a unit of capital for use in industry i. For the concept of net present value of the capital, it simply follows the finance term that it is the difference between the discounted benefit values of the year t+1 from that unit of capital and the cost of constructing a unit of capital for use in industry i in year t. The benefit values of the year t+1 include the post-tax rent earned on the unit of capital and the scrap value at the end of year t+1 (that is, less the depreciation). The discount rate is one plus tax-adjusted interest rate. From CoPs (2010), this could be written as

$$NPV_{i,t} = -P_{i,t}^{(2)} + \frac{P_{cap,i,t+1}^{(1)}(1-t_{i,t+1})}{1+R(1-t_{i,t+1})} + \frac{P_{i,t+1}^{(2)}(1-D_i)}{1+R(1-t_{k,t+1})}$$

where $P_{i,t}^{(2)}$ is the cost of constructing a unit of capital for use in industry i in year *t*;
D_i is the rate of depreciation of i's capital stock;
$P_{cap,i,t}^{(1)}$ is the rental rate on i's capital in year t;
$t_{i,t}$ is the tax rate on i's gross capital income in year t; and
R is the nominal rate of interest in year t.

Divided $NPV_{i,t}$ by $P_{i,t}^{(2)}$ or the cost of constructing a unit of capital, this gives the rates of return ($ROR_{i,t}$). Under static expectation assumptions cited in CoPs (2010), investors anticipate no change in the capital tax rate, and assume that per-unit capital rental rates and asset prices inflate by the current rate of general price inflation (INF_t). That is, $P_{i,t+1}^{(1)} = P_{i,t}^{(1)}(1+INF_t)$ and $P_{i,t+1}^{(2)} = P_{i,t}^{(2)}(1+INF_t)$. This helps define $E(ROR_{i,t})$ as:

$$E_t[ROR_{i,t}] = -1 + \left[\frac{P_{i,t}^{(1)}(1-t_{i,t})}{P_{i,t}^{(2)}} + (1-D_i)\right]\left[\frac{1+INF_t}{[1+R(1-t_{i,t})]}\right]$$

This gives E_del_f_ac_p_y after linearization, where R becomes the real post-tax, inflation-adjusted interest rate according to CoPs (2010).

E_d_f_eeqror_j is similar to Eq. 4.32 in the stylized version. It relates the expected equilibrium rate of return for industry i (*d_eeqror(j)*) to the current rate of growth of

capital in industry i (*del_k_gr(i)*) in linearized term. As shown in Figure 4.5, CoPs (2010) explains the relationship with an inverse logistic form as:

$$E_t[ROR_{i,t}] = (RORN_i + F_{eeqror,i} + F_{eeqror}) + \frac{1}{C_i} \cdot \ln\left[\frac{Kgr_{i,t} - Kgr_{\min,i}}{Kgr_{\max,i} - Kgr_{i,t}} \cdot \frac{Kgr_{\max,i} - Kgr_{trend,i}}{Kgr_{trend,i} - Kgr_{\min,i}}\right]$$

where $E_t[RoR_{i,t}]$ is the equilibrium expected rate of return on capital stock in industry *i* in year *t;*

$RORN_i$ is industry *i*'s historical normal rate of return. It is an estimate of the average rate of return being applied over the historical period in which the industry's average annual rate of capital growth was $Kgr_{trend,i}$;

$Kgr_{min,i}$ is the minimum possible growth rate of capital in industry *i*, which is the negative of *i*'s depreciation rate;

$Kgr_{trend,i}$ is industry *i*'s historical normal capital growth rate. This is an observed growth rate in *i*'s capital stock over a historical period;

$Kgr_{max,i}$ is the maximum feasible rate of capital growth in industry *i*. In current application, $Kgr_{max,i}$ is set as $Kgr_{trend,i}$ plus 0.1. That is, the maximum growth rate of capital is 10 percentage points higher than the industry's trend growth rate;

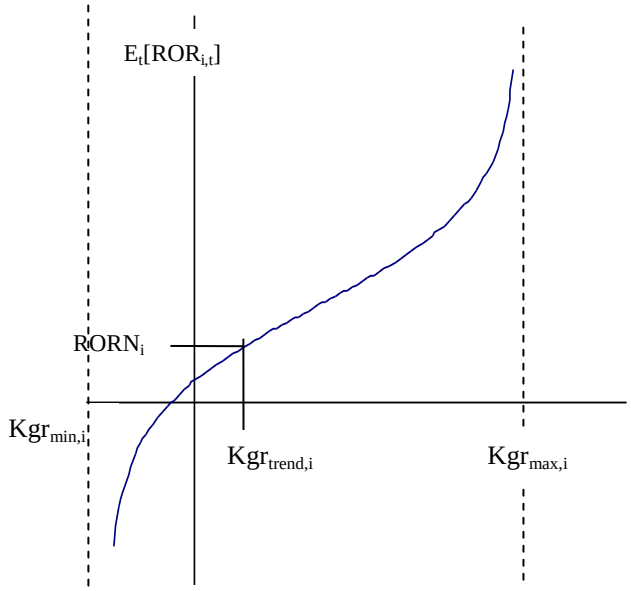
$Kgr_{i,t}$ is industry *i*'s capital growth rate in period *t*, $Kgr_{i,t} = \frac{K_{i,t+1}}{K_{i,t}} - 1$;

$F_{eeqror,i}$ and F_{eeqror} allow for industry-specific and uniform vertical shifts in the capital supply curves;

C_i is a positive parameter controlling the sensitivity of industry *i*'s capital growth to variations in its equilibrium expected rate of return. It can be determined from the slope of the capital supply curve in Figure 4.5 in the vicinity of (RORN, KGR_{TREND}). This slope can be set to be consistent with the available econometric evidence on the sensitivity of investment to changes in rates of return.

From Dixon and Rimmer (2002), for industry i to attract sufficient investment in year t to achieve a capital growth rate of $Kgr_{trend,i,}$ it must have an expected rate of return of $RORN_i$. In case that the industry i's expected rate of return is higher or lower than $RORN_i$, then investors will supply capital at a level above or below the level required to generate capital growth at the historical trend rate. Shifters are used for any intervention in the relationship between rates of return and investment given. Industry-specific elements of $F_{eeqror,i}$ can be treated endogenously to hold exogenous paths for industry-specific rates of investment growth. On the other hand, it could also be given either negative or positive exogenous shocks to capture the increase/decrease in investment at given rates of return.

Figure 4.5: The equilibrium expected rate of return schedule for industry i



Source: Dixon and Rimmer 2002, Figure 21.1

4.3.13. Balance of payments and GNP

The balance of payments is another important part in TRAVELTHAI. Apart from Trade balance, it also includes equations for the year-to-year accumulation of various types of foreign assets and liabilities and associated incomes and payments.

In the stylized version, Eq. 4.34 and Eq. 4.35, the former is the equation relating the end-of-year value of net foreign liabilities in foreign currency term to the start-of-year value and to the value of the current account deficit (CAD*Φ), both also in foreign currency term. The current account deficit in the latter is shown as the trade & travel deficit (total imports, including travel expenses as shown in Eq. 4.19, less exports and travel receipts) plus interest and dividend payments on net foreign liabilities. Eq. 4.36 defines GNP as GDP less the net interest and dividend payments to foreigners in terms of domestic currency.

For the full version, the equation list in Table 4.3 summarizes the items in current account balance defined in this study.

Note that in the normal V0CIF_C is the total import c.i.f. value including outbound tourist expenditure (as the import portion of V8TOT from the database). Thus, to

disaggregate for the balance of trade and balance of travel, this study makes separate outbound travel expenses (V8TOTO) from total domestic (national) tourists (V8TOT) and subtracts it from the total import value. This makes Balance of Trade free of Travel items and, in turn, the Balance of Travel is provided separately, as it normally is for the common Balance of Payments (where there are the services accounts, of which Travel balance is one major part, and other items, which are out of the scope of this study). Note that E_d_cad is simply shown the total of debit minus credit terms that is it does not disaggregate into Balance of Trade or Travel, and other items.

Table 4.3: List of Items in the Current Account Balance

Item	Coefficient	Variable	Equation
Exports	V4TOT	w4tot	E_w4tot
Imports	V0CIF_C	w0cif_c	E_w0cif_c
minus Travel expenses	V8TOTO	W8toto	E_w8toto
Balance of Trade	**BOT**	**delB**	**E_delB**
Travel receipts	V7TOT	w7tot	E_w7tot
Travel expenses	V8TOTO	w8toto	E_w8toto
Balance of Travel		**delTour**	**E_delTour**
Net compensation to foreigners	**NETCOE**	**Forlab**	**E_forlab**
Foreign transfers to Government	FTRANS_G	wftrans_g	E_intG_fd
Foreign transfers to household	FTRANS_P	wftrans_p	E_intP_fd
Interest on foreign debt, government	INTFD_G	d_intG_ave	E_d_intG_ave
Interest on foreign debt, private	INTFD_P	d_intP_ave	E_d_intP_ave
Interest on foreign debt, total		**D_int_fd**	**E_d_int_fd**
Current Account Deficit (CAD)		**d_cad**	**E_d_cad**

Table 4.4: List of Items in the Financial Accounts

Item	Coefficient	Variable	Equation
Financial accounts			
Net foreign liabilities, private	FDATTG_AVE	d_NFLG_ave	E_d_NFLG_ave
Net foreign liabilities, public	FDATTP_AVE	d_NFLP_ave	E_d_NFLP_ave
Net foreign liabilities		**d_NFLG_t, d_NFLP_t**	**E_d_NFL_t**
Errors and omissions	ERRORS_OMISS	d_err_omiss	E_d_err_omiss
Changes in foreign reserves	FOR_RES	d_for_res	E_d_for_res
Balance of payment	**BOP**	**d_BoP**	**E_d_bop**

For financial accounts, this study follows the short version of MyAGE, CoPs (2010) where the financial accounts are shown in terms of net foreign liabilities (NFL). Adding up the errors and omissions and changes in foreign reserves, this formulates the Balance of Payments defined in this study. More details on NFL, see CoPs (2010). Gross National Products is also defined as E_gnpnom. Changes in ratios of NFL to GDP and GNDI are also provided as in E_d_nfl_gdp_r and E_d_nfl_gndi_r

4.3.14. Function for private and public consumption

Eq. 4.37 links movements in total household and government expenditure to movements in GNP, with the ratio shown as the shift variable, AC.

In the full version, the household disposable income relates to domestic primary factor income, transfers from government, income taxes, non-tax revenue, transfers from foreigners, interest paid on private foreign debt and net compensation of employee as shown in Equation E_hdy. This group of equations also gives information on the household saving which is the difference between household disposable income and household consumption including the domestic tourism expenditure (national).

Equations E_apc, E_apc_gndi and E_aps_gnp link consumption to income. In E_apc, household consumption moves with household disposable income and average propensity to consume, apc, which is the common way of saying household consumption spending as some portion of the household disposable income. With E_apc_gndi, it allows aggregate nominal consumption to move with gross national disposable income. E_aps_gnp computes the average private propensity to save from GNP. E_x358tot informs aggregate real consumption spending as the sum of private & public consumption spending including domestic (national) tourism spending.

4.3.15. The government accounts

Following the stylized version of CHINAGEM, Eq. 4.38 tells the public sector deficit (PSD) as government consumption expenditure less tax collections from all users plus transfers. It is assumed that only the taxes (consumption taxes, import duties and export taxes) appearing in other stylized equations and transfers are the single item with no explaining equations.

In the full version, government accounts extend to present in details both the revenue and the expenditure. For revenue side, the income taxes from capital income and personal income taxes are shown with the revenue from indirect taxes ever mentioned. Other kinds are net foreign grant and non-tax revenue, which are also included. All these revenues are shown in the group of equations E_wgovrev.

Budget-neutral changes in taxes are possible to be done with the model. From the equation E_tax_k_r and E_tax_l_r, the percentage change in the rate of tax on capital

and labour income could be determined as typically exogenous shifters. These shifters f_tax_k(i) and f_tax_l allows changes in the capital income tax rates by industry and the change in the tax rate on labour income, suitable for studying the effects of any policy changes regarding the change in tax rates. On the other hand, the percentage change in the tax rates on both labour and capital incomes can endogenously be treated in both equations and control the budget as exogenous for a budget-neutral.

Government expenditures include government consumption, government investment, and transfers from government to households and other government expenditures. Government consumption is shown in the section 4.4.5 earlier. Government investment is calculated in terms of percentage change in government share of investment in industry i as shown in E_fgv2tot. These two components of fgv2tot(i) and fgv2tot_i in this equation are the industry specific and uniform shifters and these ratios are typically exogenously treated. Equation E_agginv_g and E_agginv_rg shows the aggregate nominal public investment and aggregate real public investment in the percentage change form, respectively. Equations E_p2tot_g calculates the percentage changes of a price index for aggregate government investment.

Government transfers to households are defined as the sum of welfare benefits and interest payments on domestic public debts. Aggregate nominal government benefits (bens) moves along with the population growth (pop) and the nominal economy-wide wage rate shown as p3tot + real_wage_c in equation E_bens. The percentage change in net interest payments made by government to the domestic private sector is included as E_int_g. It also relates to the group of the equations on interest rate on government domestic debt, for which the homotopy variable is applied for the debt (for more details, see CoPs (2010)). For other government expenditures, it is assumed to be changing proportionately to nominal GDP.

The government budget deficit is the difference between government expenditures and government revenues. Equation E_d_gov_def is the linearised form shown in the similar way to Eq. 4.38 for the full version. It is expressed as an ordinary change variable as the level of the deficits can change sign. Other related equations of E_d_gdef_gdp_r and E_d_gdef_gndi_r compute the change in the government deficit to GDP ratio and to GNDI ratio respectively. The level of the ratio of the government deficit to GDP in year t-1 is shown through Equation E_l_r_def_gdp.

4.3.16. Sticky-wage specification for policy simulations

One of the dynamic features of CGE model is to allow sticky real wages in the short run but flexible in the long-run, and flexible employment in the short-run but sticky in the long-run (CoPs, 2010). It is assumed that the deviation in the national real wage rate increases through time in proportion to the deviation in national employment from its base case-forecast level. Eq. 4.39 shows that assumption as the proportionate deviation in year t of the real wage rate from its forecast value (WR/WRf – 1) equals to the proportionate deviation in year t-1 (WRlag/WRflag – 1) plus a positive multiple of the proportionate deviation in year t in total employment (LTOT/LTOTf – 1). To make it clearer, while employment is above its forecast level, the real wage deviation will be increasing and further above the forecast level. This could lead to the lower demand for labour, and over time employment declines until it returns to the base case forecast level, at which point adjustment pressure on the wage rate ceases. The different approach for wage determination can be done by endogenizing the shift variable A_{WR}.

E_d_f_realw is the linearised version of Eq. 4.39 whereas E_d_f_realw_pt shows the post-tax wage relationship to the deviation in employment. . Equation E_realw_pt defines the economy-wide real wage as the economy-wide nominal wage deflated by the consumer price index.

4.3.17. Technical and preference change

Equation 4.40 and 4.41 give example on the technical and preference change terms. Variable $A_{3G}(q)$ is consumer preference with respect to groups of consumption goods. Each of these groups contains many commodities. The variable $A_{3G}(q)$ allow a change in consumer preference in favour of, for example, consumer durables to be simulated. Subsection of the model code also contains other technical change equations that allow changes in the ratio of capital to labour, domestic to imported goods, etc. TRAVELTHAI contains many equations that represent various technical and preference changes.

4.3.18. Equations for facilitating historical and forecast simulations

This group of equations are mainly to facilitate the simulations. Using the available

data from various sources i.e. TSA, NESDB, etc. TRAVELTHAI can include equations that define variables at different levels of aggregation. Eq. 4.42 is the example that defines consumption CG(q) in the qth group of commodities, e.g. all commodities in the direct-tourism sector. Mai et. al. (2010) informs that sectoral variables are normally endogenous. In historical simulations, nonetheless, they may be exogenized and given shocks reflecting observed movements. When CG(q) is exogenized, a variable to endogenize is A3G(q) in Eq. 4.42, which moves the preference of commodities in group q.

4.3.19. Top-down regional extension

The optional extension to TRAVELTHAI enables national quantity results to be disaggregated according to regions. The top-down approach is fully described in Chapter 6 of Dixon et al. (1982). The term "top-down" means that to compute all the national results first, after obtaining results, then, computing the regional results later. It is noted in CoPs (2010) that this method requires less data and computing resources than the alternative bottom-up approach of constructing the similar complex models for each region, linked by a matrix of inter-regional trade.

As described in Dixon et al. (1982) and CoPs (2010), to do this, the first is to split each user column into R columns (for R regions). It is assumed that each industry uses the same technology in each region, so the main additional data required is only a matrix showing the distribution of industry output among regions. Final demands are also split by region, either by using available data, or by default assumptions i.e. household budget shares are the same across regions. Thus, matrix of regional trade in each commodity is not necessary. From CoPs (2010), the regional equations assume that industry inputs follow the rule:

$$Xijr/Xij = Zjr/Zj$$

where Xijr is the use of input i by sector j in region r,

Zjr is output of sector j in region r, and

Xij and Zj are the corresponding national equivalents.

Household consumption of each good is given by a linear expenditure abound by regional labour income.

Top-down approach can be used to estimate the effects of region-specific demand shocks. However, as stated in CoPs (2010), there is no theory of regional variation in prices, and is unable of modelling region-specific supply effects e.g. local labour shortages, or efficiency increases in one region.

4.3.20. The rest of equations

The full version of TRAVELTHAI gives some more equations not mentioned in the stylized version. These groups of equations are normally for checking the consistency and facilitating the result analysis. For more details of explanation, see Dixon and Rimmer (2002) and CoPs (2010)

- **Equations for simulation result analyses**

i. Sales decomposition

The groups of sales decomposition disaggregate the percentage change in the total sales of each commodity into various categories of intermediate and final demand.

ii. Fan decomposition

This group of equations decompose the overall effects into the local market effect, which is an increase in local usage of a commodity, whether domestically-produced or imported; the export effect: an increase in exports of a commodity; and the domestic share effect: a shift in local usage of a commodity, from imported to domestically-produced.

iii. Expenditure side GDP decomposition

Equations in this group give the pattern of the change in real expenditure-side GDP on how much it is from any change in its components by breaking down changes in real GDP into the contributions of the expenditure-side aggregates (contGDPexp). The calculation approach behind are the same as that of the Sales decomposition. The contributions of exports and imports are combined into the variable contBOT (contributions of the balance of trade). Note that, by convention, this is a real contribution and it takes no account of changes in export or import prices.

iv. Income side GDP decomposition

Likewise, this group of equations portray the decomposition of the income side GDP regarding the primary factor usage, technological change and indirect taxes.

v. Industry sale shares

This tells the industry's output composition and the sales structure of those output commodities. As in CoPs (2010), if industry i produces several commodity c, and c are sold to different destinations, then share of a destination in industry output is the product of the share of c in i's output and the share of a destination in total sales of c.

- **Equations for checking and summarising the data**

i. Checking the data

To prevent errors and to detect errors, apart from often checking all required conditions for which the initial data must remain fulfilled. A few coefficients and formulas are generated and stored to the Summary file in order to help verify the required conditions which are:

• Value of output by each industry must equal to the total of production costs.
• Output of domestically produced commodities must equal to its total demands.
• Average value of the household expenditure elasticities, EPS, should be one.
• GDP on the expenditure side has to be equal to that on the income side.

DIFFIND, DIFFCOM, EPSTOT and DIFGDP are those to be computed on the file. The values should be near to zero (or one, for EPSTOT).

Assertion statements specifies the condition for the program, if the condition is not satisfied from the simulation, the error message will be presented.

ii. Summarizing the data

Data summaries are beneficial in terms of checking and explaining simulation results. The group of equations of various components of GDP from the expenditure side; GDP from the income side; and the components of total indirect taxes are presented.

iii. Import shares and short-run supply elasticities

As the higher the import share is for some commodities, there is a greater chance for the associated local producers to face fierce import competition. To compute the short-run supply elasticity is to help identify the effects of inelastic supply schedules for capital-intensive industries, of which normally contain high import shares.

iv. Storing data for other computations

To merge levels data with change results of the simulation results, aggregating the database could be prepared from the initial model database at the highest level of disaggregation that can be obtained by available Input-Output tables or TSA (in Thailand, I-O table has a format of 180 sectors and TSA has a format of 40 sectors). This large database can be aggregated into a smaller size of model for future use. Parameters, which cannot normally be added together, are normally weighted averages of the original parameters. To store such weights on a file for the parameter could be done by aggregation using the weight vector, CoPs (2010).

v. Equations for aggregations of simulation results

Simulation results for a set of sectors can be grouped at a more aggregated level than the 40 sectors of the core model. TRAVELTHAI provides the aggregation of the results of the 40 sectors into 20, 7, and two groups of 3 broad sectors.

4.4. Introduction to GEMPACK

This section dedicates to the overview of GEMPACK computer software, its tasks, and its operational processes. This is aimed to give some brief information of ‘how-to’ implement the model such as TRAVELTHAI for economic analysis via the software, more details on how to use the software, see CoPs (2010) and GEMPACK manuals.

In general, the software is used to deal with main 5 tasks: 1) writing and coding model’s theoretical framework of a system of equations; 2) arranging the database; 3) developing closure specification and simulations scenarios; 4) solving for solutions; 5) giving the facilitating feature for result interpretation.

GEMPACK (the General Equilibrium Modelling PACKage) is developed by the Centre of Policy Studies, Monash University. It consists of a number of programs to automate all important processes concerning general equilibrium modelling.

As a package of different programs designed to implement different modelling tasks, it composes of the main programs in the following list:

Table 4.5: Lists of programs in GEMPACK concerning its functional tasks

Program name	**Application Descriptions**
Programs for writing and coding the model	
TABmate	TABmate is a program for model-users to write, code, edit and debug text files (i.e. TABLO-language model), command files (which specify closures, shocks and solution method in simulations) and files for model condensation.
TABLO.EXE	This program converts TABLO input files into binary computer files for other programs, i.e. RunDynam, to conduct simulations. TABLO is run by TABmate, behind the scene.
Programs for arranging database	
Viewhar	This program is used for browsing and modifying the Header Array files of the database. Other associated programs for working with data include MODHAR, SEEHAR, and AGGHAR.
Programs for carrying out simulations	
TABLO-Generated Program	This Fortran-language program is written by TABLO. It can be compiled and linked to other programs using Fortran compiler to make an Executable image file (*.exe) which is used to run simulations. GEMSIM is another kind of program of this function for the practical uses without source-code.
Programs for viewing and processing simulation results	
Viewsol	ViewSOL is a program for browsing the simulation results in various ways. Variables can be viewed in series of period and several solutions can be compared. Results could be extracted to perform the analyses.
Analysge	AnalyseGE is aimed to facilitate modellers on analysing the results. Simulation results can be viewed in the form of a system of model equations in TABmate style. This is user-friendly and very convenient for the model users.
With Windows PCs	
RunDynam	RunDynam mainly carries out historical, forecasts and policy deviations with recursive dynamic models (with periods). It can also be used for comparative static models as well.
WinGEM	WinGEM provides a Windows-based application for modelling tasks with many of GEMPACK programs.

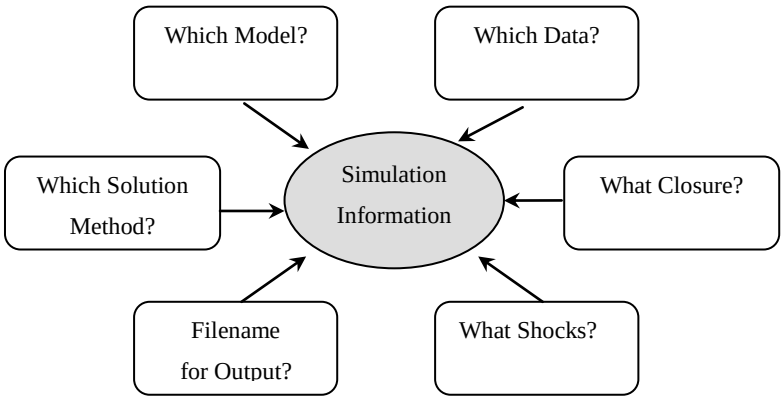
Source: adapted from CoPs (2010)

Those five tasks can be sequentially done in three main steps regarding the GEMPACK process to run simulations, which are represented in Figure 4.7.

In Step 1, it is mainly the model implementation of a TABLO input file (for example, TRAVELTHAI.tab), which is the specification of the system of equations of the model in TABLO language. The format looks like what it is in Appendix 4.2.

TRAVELTHAI.sti is simply a condensation file of the model. It omits or substitutes some variables in the model to condense the size for less computational loads. CoPs (2010) informs that condensation is optionally desirable to reduce running time or in case the model requires high computer memory to solve for the solutions. TAB and STI files are converted into a Fortran source file, which is the specific Fortran code. Fortran compiler is the program used to compile and link the TABLO-generated program to convert TRAVELTHAI.for into the executable image TRAVELTHAI.exe.

Figure 4.6. Information required to specify a simulation

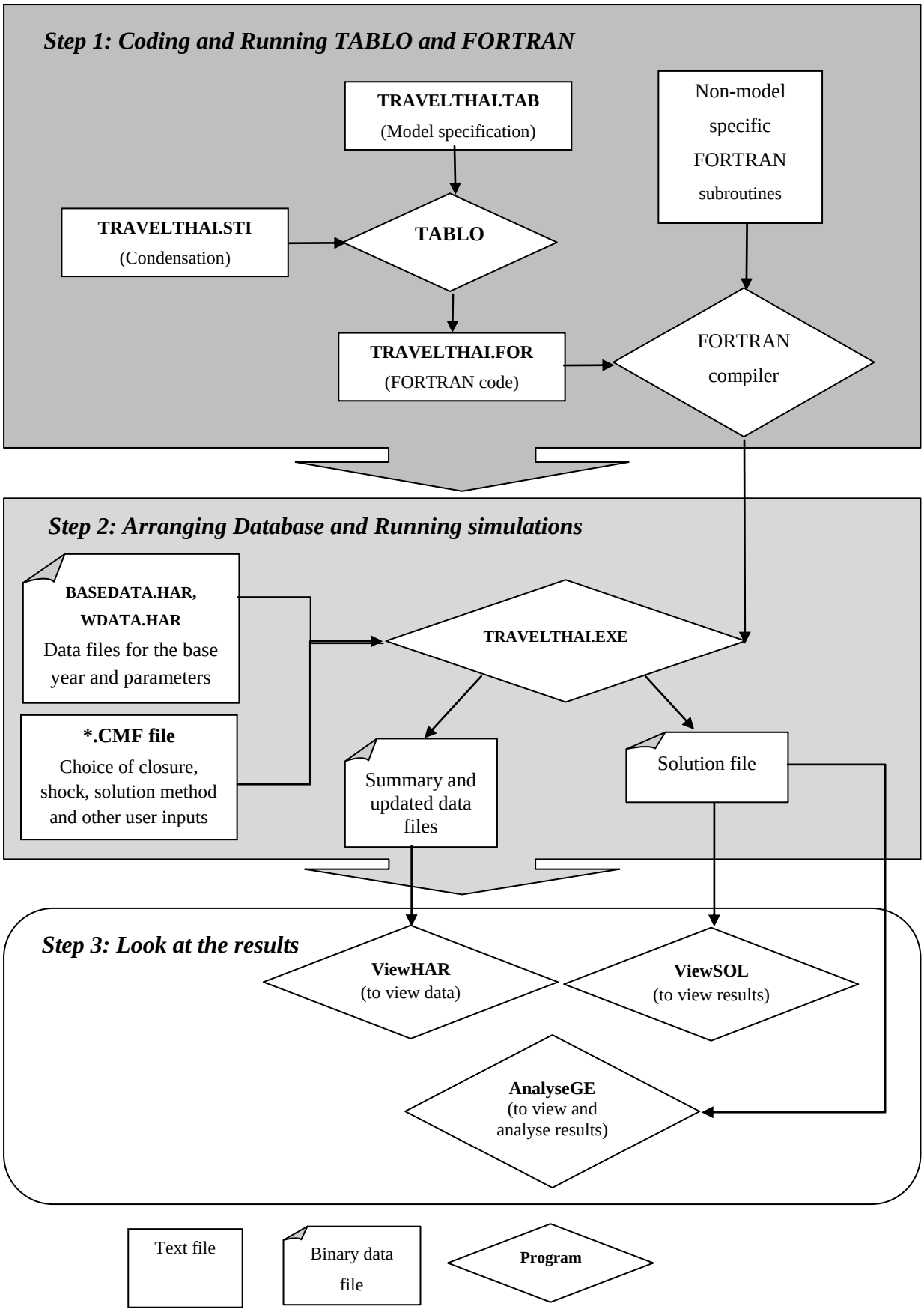


Source: CoPs (2010)

In Step 2, simulations are conducted using TRAVELTHAI.exe. Figure 4.6 shows the main factors to be pondered concerning the simulations. Data files with the core base data can be either Input-Output data or TSA data, parameters and additional data on national accounts which inform necessary characteristics of the economic structure at the initial equilibrium are the inputs at this step. Choices of closure, shocks and the solution methods are also to be considered. TRAVELTHAI.exe then computes the solution to the simulation and delivers Solution file, Summary file and updated data.

The simulation results can be browsed with ViewSOL or ViewHAR. AnalyseGE program is really helpful to analyze and interpret the results as it is in the form of model code.

Figure 4.7: Steps in the GEMPACK process (Adapted from CoPs (2010))



Chapter 5

Database

"It is a capital mistake to theorize before one has data……"
Sir Arthur Conan Doyle. A Scandal in Bohemia (1891)

This part mainly describes the characteristics of the core database of the model and how the core database has been developed. There are two sets of the data for the CGE model: the model coefficients and the parameters for the core database. The shares of the cost or the sales which are computed from the Input-Output Table or the Tourism Satellite Accounts (TSA) are the model coefficients. For the parameters, the elasticities e.g.elasticities of substitution and Armington elasticities are the common types of this kind. It is the elasticity that represents the behaviour of the economic agent in the model.

There are 8 sub-sections according to the objective of this part 1) describing the data file of the THORANI model, the standard comparative static version of TRAVELTHAI as the core database 2) explaining the characteristic of the Tourism Satellite Accounts for Thailand year 2000 published by Tourism Authority of Thailand, which is the main source of data to be developed for the THORANI data file for this study 3) describing the steps of the procedure for constructing the THORANI data file 4) discussing about the estimation of the parameters 5) stating a balance check 6) explaining the add-ons of the dynamic mechanism to develop the database for the TRAVELTHAI model 7) giving the details of indirect taxes 8) regional shares, and 9) concluding remarks on database.

5.1. The THORANI Data File

TRAVELTHAI is a dynamic CGE model, building on the basis of the generic version of the comparative static CGE model as MONASH was built upon ORANI for the Australian case. Likewise, this study follows the tradition to begin with by developing the database for the generic form of comparative static version of the CGE model of the Thai economy, which is called as 'THORANI' (as the name suggested, it is 'TH-Thai version of ORANI'). The version of ORANI here is

ORANI-G, which is the generic version of ORANI for a single- country comparative static model (See Horridge, 2003).

The THORANI data file is, thus, the extended version of ORANI-G data file of the Centre of Policy Studies (CoPs) with the particular specification of the Tourism and Tourism-related sectors of Thailand. The basic structure of THORANI coefficient data file is represented in Figure 5.1 with column heading shows the various demands of economic agents. There are 8 types of demanders: (1) domestic producers for i industries (2) investors for i industries (3) household for H groups, here assumes one household (4) exports (5) government demands (6) inventory demands (7) inbound tourist demands, and (8) domestic tourist demands. It could be easily seen that the major difference of the THORANI from the ORANI-G is the specific incorporation of inbound tourist demands and domestic tourist demands listed in (7) and (8).

Figure 5.1: Pattern of the THORANI Database (adapted from Horridge (2003), p.9)

		Absorption Matrix							
		1	2	3	4	5	6	7	8
		Producers	Investors	Household	Export	Government	Changes in Inventories	Inbound Tourism	Domestic Tourism
	Size	← I →	← I →	← H →	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →
Basic Flows	CxSxM	V1BAS	V2BAS	V3BAS	V4BAS	V5BAS	V6BAS	V7BAS	V8BAS
Margins	CxS	V1MAR	V2MAR	V3MAR	V4MAR	V5MAR	0	V7MAR	V8MAR
Indirect Taxes	CxS	V1TAX	V2TAX	V3TAX	V4TAX	V5TAX	0	V7TAX	V8TAX
Labour	O	V1LAB							
Capital	1	V1CAP							
Land	1	V1LND							
Other Costs	1	V1OCT							

C = Number of Commodities (40)
H = Number of Households (1)
I = Number of Industries (40)
M = Number of Margins (6)
S = Number of Sources (2)
O = Number of Occupations (1)

	MAKE	Import Duty
Size	← i →	← 1 →
C	MAKE	V0TAR

The structure of the purchase for source specific commodities made by each demander above is shown in the entries for each column. V1BAS represents the purchase of domestic producers upon commodities either domestically produced or imported from overseas to use as inputs for its output production. V2BAS are the inputs purchased for capital creation. V3BAS shows the household consumption.

V4BAS is the export where there are only domestically produced commodities. V5BAS represents the commodities the government purchases from locals and imports. V6BAS are the inputs purchased remaining for the inventory (Stocks in Figure 5.1). Commodities purchased by inbound tourists and domestic tourists are shown in V7BAS and V8BAS. Margins and commodity taxes are shown in the next two rows. Margins are the mark-ups required for transferring the commodities from the sources to the end-users. M in the Figure 5.1 means the commodities used as margins services for transferring all other commodities (in common e.g. Trade and Transport-related). Commodity taxes or Sales taxes are included when purchases. V1MAR to V8MAR represent the margins marked up upon the basic value of the commodities purchased by each demander whereas V1TAX to V8TAX show the commodity taxes each demander pays at purchase. No margins and taxes for Inventory. Domestic producers also need to hire and purchase 3 primary factors: Labour, Capital, Land for their output production. Other costs represent the incurred costs of holding inventories and miscellaneous production costs. V1LAB shows the payment for each occupation of labour (currently, assume one occupation). Rents for capital are V1CAP while rents for land are V1LND. V1OCT belongs to other costs, which includes production taxes (or subsidies). Another dimension view for the structure of the sale (or output distribution) of source specific commodities to each demander is shown in each row of Figure 5.1. V1BAS is the basic flow of commodity c from source s (domestically produced and imported) sold to industry or sector i to be functioned as an input to that industry's current production. Likewise, V2BAS is the basic flow of commodity c from source s sold to industry or sector i to be functioned as an input for capital creation in that industry. V3BAS is the basic flow of commodity c from source s sold to each household (currently, assume one household). V4BAS is the basic flow of commodity c from source s sold for exports. V5BAS and V6BAS are the basic flows of commodity c from source s sold to government and inventories. V7BAS and V8BAS are, thus, the basic flows of commodity c from source s sold to inbound tourists and domestic tourists, respectively. Imported flows of V8BAS, thus, mean outbound tourism of the domestic residents. All V1BAS to V8BAS are valued at the basic price[1] (excludes sales taxes, transport, and margin costs).

[1]For imports, basic price includes import duties, but excludes all other domestic sales taxes and margin costs.

V1MAR to V8MAR represent the value of domestically produced commodity m used as margins[2] to transfer each of the flows in V1BAS to V8BAS to each demander. For column-wise, V1MAR could be illustrated as the cost of margin service m on the flows of commodity c, both domestically produced and imported, incurred by industry i. For row-wise, V1MAR could then be understood as the sale of the margin service m on the flows of commodity c, both domestically produced and imported, to each industry i. For the sale of the margin service, it should be noted that for mark-up on a service on freight is different from the direct sale of the margin-related sector, for example the transportation of taxi charged. This is in a similar fashion for all other V2MAR to V8MAR.

Similarly for the next row, V1TAX to V8TAX show the value of commodity taxes (or sales taxes) imposed upon the delivery of domestic and imported commodities to each demander. For instance, V2TAX is then the commodity taxes (subsidy, if negative value) imposed on the sale of commodity c from source s to be used as inputs for capital creation in industry i. V3TAX to V8TAX, in a similar way, are the sales taxes obtained from household, exports, government, inventory, inbound tourists, and domestic tourists, respectively.

V1LAB, V1CAP and V1LND, row-wise, show the value of the return or payment each factor input obtained from each industry i. V1OCT also represent the amount of other net indirect taxes as miscellaneous payment that each industry i pay (as part of total cost of that industry).

Table 5.1: List of sets and associated dimensions

Set	Name	Dimension
COM	Set COM commodities	40
IND	SetIND industries	40
MAR	Set MAR margin commodities	6
SRC	Set SRC sources	2
OCC	Set OCC occupations	1
HH	Set HH Households	1

MAKE matrix in Figure 5.1 represent the value of output of each commodity by each industry. It is by then a notion that each industry produces only one commodity.

[2] It is the assumption that all margins services are in local.

For tariffs, it is levied upon the imported commodities, not by user. It is shown in matrix V0TAR. It is necessary that the accounting condition for the cost is equal to sale. For each domestic commodity, total sales must equal total production (row sums of the MAKE matrix). For each industry, total costs must be equal to the value of output (column sums of the MAKE matrix)

Table 5.2: List of coefficients and associated dimension

Coefficient	Name	Dimension
V1BAS	Intermediate basic	COM*SRC*IND
V2BAS	Investment basic	COM*SRC*IND
V3BAS	Household basic	COM*SRC*HH
V4BAS	Exports basic	COM
V5BAS	Government basic	COM*SRC
V6BAS	Inventory changes	COM*SRC
V7BAS	Inbound tourists basic	COM*SRC
V8BAS	Domestic tourists basic	COM*SRC
V1MAR	Intermediate margins	COM*SRC*IND*MAR
V2MAR	Investment margins	COM*SRC*IND*MAR
V3MAR	Household margins	COM*SRC*MAR*HH
V4MAR	Exports margins	COM*MAR
V5MAR	Government margins	COM*SRC*MAR
V7MAR	Inbound tourists margins	COM*SRC*MAR
V8MAR	Domestic tourists margins	COM*SRC*MAR
V1TAX	Intermediate taxes	COM*SRC*IND
V2TAX	Investment taxes	COM*SRC*IND
V3TAX	Household taxes	COM*SRC*HH
V4TAX	Exports taxes	COM
V5TAX	Government taxes	COM*SRC
V7TAX	Inbound tourists taxes	COM
V8TAX	Domestic tourists taxes	COM*SRC
V1CAP	Capital	IND
V1LAB	Labor	IND*OCC
V1LND	Land	IND
V1OCT	Other costs	IND
MAKE	Multiproduct Matrix	COM*IND
V0TAR	Tariff Revenue	COM

As mentioned before, apart from the coefficient data, another set of data that is necessary for the model is the parameter. Parameters in the form of elasticities determine each economic agent's behavior with its value. The parameters used in THORANI model are as follows.

SIGMALAB(i) means the constant elasticity of substitution (CES) between skill types in industry i, the current assumption is that there is no difference in types of labor, whereas SIGMA1PRIM(i) denotes the elasticity of substitution between

primary factors those are labor, capital and land for industry i, SIGMA1(c), SIGMA2(c), and SIGMA3(c) are the Armington elasticities which indicates the degree of substitutability between domestic and foreign sources of inputs or commodity (c) used in the production of output industry i, capital creation, and household consumption. SIGMAOUT(i) is the constant elasticity of transformation (CET) between outputs in industry i. SIGMA8 is the collective domestic tourism demand elasticity. Domestic residents can choose to consume either the bundle of domestic tourism commodity or outbound trip.

FRISCH(i) represents the linear expenditure system (LES) parameter in the household (h) where EPS(c,h) signifies the household expenditure elasticities of demand for commodity c of household h. At the moment, it is assumed that there is just one household type, so only EPS(c). EXP_ELAST(c) shows the elasticities of export demand for commodity (c), whereas EXP_ELAST_NT is the collective export demand elasticity for non-traditional export goods. IsIndivExp(c) determines the distinction between the individual export commodity and the collective export commodity. TOUR_ELAST is the collective tourism demand elasticity. Here, it is assumed that inbound tourists come to consume the bundle of tourism products. It follows similar pattern as the non-traditional export function, but the price faces by inbound tourist is the local price.

Table 5.3: List of Parameters and associated dimension

Parameter	Name	Dimension
SIGMA1LAB	Labor sigma	IND
SIGMA1PRIM	Primary factor sigma	IND
SIGMA1	Intermediate Armington	COM
SIGMA1OUT	Output sigma	IND
SIGMA2	Investment Armington	COM
SIGMA3	Households Armington	COM
SIGMA8	Domestic (National) Tourism Armington	SRC
FRISCH	Frisch parameter	HH
EPS	Household expenditure elasticity	COM*HH
EXP_ELAST	Individual export elasticities	COM
EXP_ELAST_NT	Collective export elasticity	1
IsIndivExp	Flag, >0.5 for individual export commodities, else collective	COM
TOUR_ELAST	Inbound tourist collective elasticity	1

5.2. The 2000 Tourism Satellite Accounts of Thailand (TSA of Thailand)

Constructing CGE model requires two main data sets for the database as stated earlier for the characteristics of the data file. In this sub-section, the accounting formation for the coefficients required by THORANI data file shown in the earlier section is discussed.

Unlike most of the CGE models of which using Input-Output Tables as their main databases, coefficients in the THORANI model are derived from the 2000 Tourism Satellite Accounts of Thailand published by the Tourism Authority of Thailand (TAT). This TSA has made a specification on tourism industries other than the general Input-Output formulation.

Table 5.4: List of the TSA industries by categories

No.	Direct tourism industries	No.	Tourism-connected industries
1	Accommodation	13	Growing of fruit & flowers
2	Second home ownership	14	Preserving of foods
3	Restaurant and similar	15	Manufacture of dairy products
4	Railway passenger transport services	16	Manufacture of bakery products
5	Road passenger transport services	17	Manufacture of coffee and tea
6	Waterway passenger transport services	18	Manufacture of beverages
7	Air passenger transport services	19	Manufacture of textiles
8	Transport supporting services	20	Manufacture of leather products
9	Transport equipment rental	21	Manufacture of wood products
10	Travel agencies and similar	22	Manufacture of paper and paper products
11	Cultural services	23	Publishing and printing
12	Sporting and other recreational services	24	Petroleum refinery
No.	Non-tourism industries	25	Manufacture of ceramic wares
33	Agriculture	26	Manufacture of glass products
34	Mining and quarrying	27	Manufacture of jewelry and related articles
35	Manufacturing	28	Communication
36	Electricity, gas and water supply	29	Financial intermediation
37	Construction	30	Real estate activities
38	Trade and repair of goods	31	Health
39	Transportation and warehousing services	32	Community and personal service activities
40	Services		

TSA of Thailand is based upon the conceptual framework of Tourism Satellite Account provided by World Tourism Organization (UNWTO) and the standardized Input-Output Analysis according to United Nations System of National Accounts, SNA 1993. TSA2000 provides the data for tourists (visitors with more than one

night stay), but not includes same-day visitor in the country. There are 2 main industry classifications for TSA: Tourism industry & Non-tourism industry. Within Tourism industry, there are also two sub-categories: Tourism characteristic industry & Tourism connected industry. Tourism characteristic industry is the group of industries those have the direct relationship with the tourists' expenditure. For Tourism connected industry, the related industries are those with their outputs as the main source of revenue gaining from the tourists' expenditure, although outputs in these industries are not primarily consumed by the tourists. For Non-tourism industry, the group is classified as the non-specific industries with their outputs are not the main source of revenue gaining from the tourists' expenditure. Table 5.4 informs the categorization.

Figure 5.2A shows the representation of the TSA Use table. Matrix A contains the information for the intermediate domestic use of inputs of those three groups of industries. Vectors B, C, D, E, F, G and H shows the final demand for the domestic outputs produced for Domestic tourists, Consumption of household (C), Government consumption (G), Investment (I), Exports (X), Special Exports, and Inbound tourists, respectively. Vectors I to M informs the negative value of import of those commodities. Vector I is the c.i.f value of imported commodities. Vectors J and K are the corresponding import duty and import taxes of those imported commodities. Vector L is the information on outbound tourists' expenditure and Vector M is the special imports. Vector N shows the margins regarding the service for transporting the commodities to the users. Vector O tells information about the wage cost whereas Vector P and Q inform the surplus and depreciation for the capital rental returns respectively. Matrix R shows the costs of indirect taxes incurred for output production.

All of those matrix and vectors from A to H represented in the Figure 5.2A could be titled as PUR(c,u) which means the purchaser's value of all the inputs (commodities) used for intermediate production and final demands. (c,u) are the dimension where c is the commodity (input) and u is the user (which includes industries and final demanders as they perform as users of the commodities). All the information in this part of the Table is at the purchaser's price, which simply includes basic values, taxes, and margin costs.

Input	Output	Domestic			Final Demand							Import					
	Sector	Tourism Industries	Tourism Connected	Non-tourism Industries	Domestic Tourists	C	G	I	X	Special Exports	Inbound Tourist	Import (c.i.f)	Import Duty	Import Tax	Outbound Tourists	Special Imports	Margins
Purchaser	TI																
	TC		A		B	C	D	E	F	G	H	I	J	K	L	M	N
	NI																
Value added	Wage		O		ZERO							ZERO					ZERO
	Surplus		P														
	Depreciation		Q														
	Indirect taxes		R														
Total	Cost	Sum of TI	Sum of TC	Sum of NI	Sum of DT	Sum of C	Sum of G	Sum of I	Sum of X	Sum of SX	Sum of IT	Sum of CIF	Sum of Duty	Sum of MTax	Sum of OT	Sum of SM	Sum of Mar

Input	Output	Domestic			Final Demand							Import					
	Sector	Tourism Industries	Tourism Connected	Non-tourism Industries	Domestic Tourists	C	G	I	X	Special Exports	Inbound Tourist	Import (c.i.f)	Import Duty	Import Tax	Outbound Tourists	Special Imports	Margins
Import	TI																
	TC		A		B	C	D	E	F	G	H	I	J	K	L	M	N
	NI																
Value added	Wage		O		ZERO							ZERO					ZERO
	Surplus		P														
	Depreciation		Q														
	Indirect taxes		R														
Total	Cost	Sum of TI	Sum of TC	Sum of NI	Sum of DT	Sum of C	Sum of G	Sum of I	Sum of X	Sum of SX	Sum of IT	Sum of CIF	Sum of Duty	Sum of MTax	Sum of OT	Sum of SM	Sum of Mar

Input	Output	Domestic			Final Demand							Import					
	Sector	Tourism Industries	Tourism Connected	Non-tourism Industries	Domestic Tourists	C	G	I	X	Special Exports	Inbound Tourist	Import (c.i.f)	Import Duty	Import Tax	Outbound Tourists	Special Imports	Margins
Producer	TI																
	TC		A		B	C	D	E	F	G	H	I	J	K	L	M	N
	NI																
Value added	Wage		O		ZERO							ZERO					ZERO
	Surplus		P														
	Depreciation		Q														
	Indirect taxes		R														
Total	Cost	Sum of TI	Sum of TC	Sum of NI	Sum of DT	Sum of C	Sum of G	Sum of I	Sum of X	Sum of SX	Sum of IT	Sum of CIF	Sum of Duty	Sum of MTax	Sum of OT	Sum of SM	Sum of Mar

Figure 5.2 A, B, and C : Components of Tourism Satellite Accounts in the Input-Output formulation

Figure 5.2B provides the information at producer's price (the value of commodity including sales taxes but excluding transport and other margin costs). The all margin matrix (distribution of margins) could then be calculated by subtracting PUR(c,u) with the PRO(c,u) which is the value at producer's price matrix with the same dimension as PUR(c,u) in Figure 5.2A. AMAR(c,u) could be titled for that all margins matrix obtained from the subtraction.

Import matrix is defined as IMPS(c,u). This matrix represents the data for import value with the dimension of (c,u). It is the import value of input used in domestic production and for the final demanders shown in Figure 5.2C. Note that this import value matrix is at the basic price where import duty is included. There are no re-exports for imported commodities as well as special exports and inbound tourists.

For vectors N to Q, these components are the compensation to employees, the returns to capital, and the indirect taxes included as value added for domestic production. These parts can be named as value added matrix VADD(v,i) with the dimension of (v,i) where v could be defined as the types of value added and i as the industry.

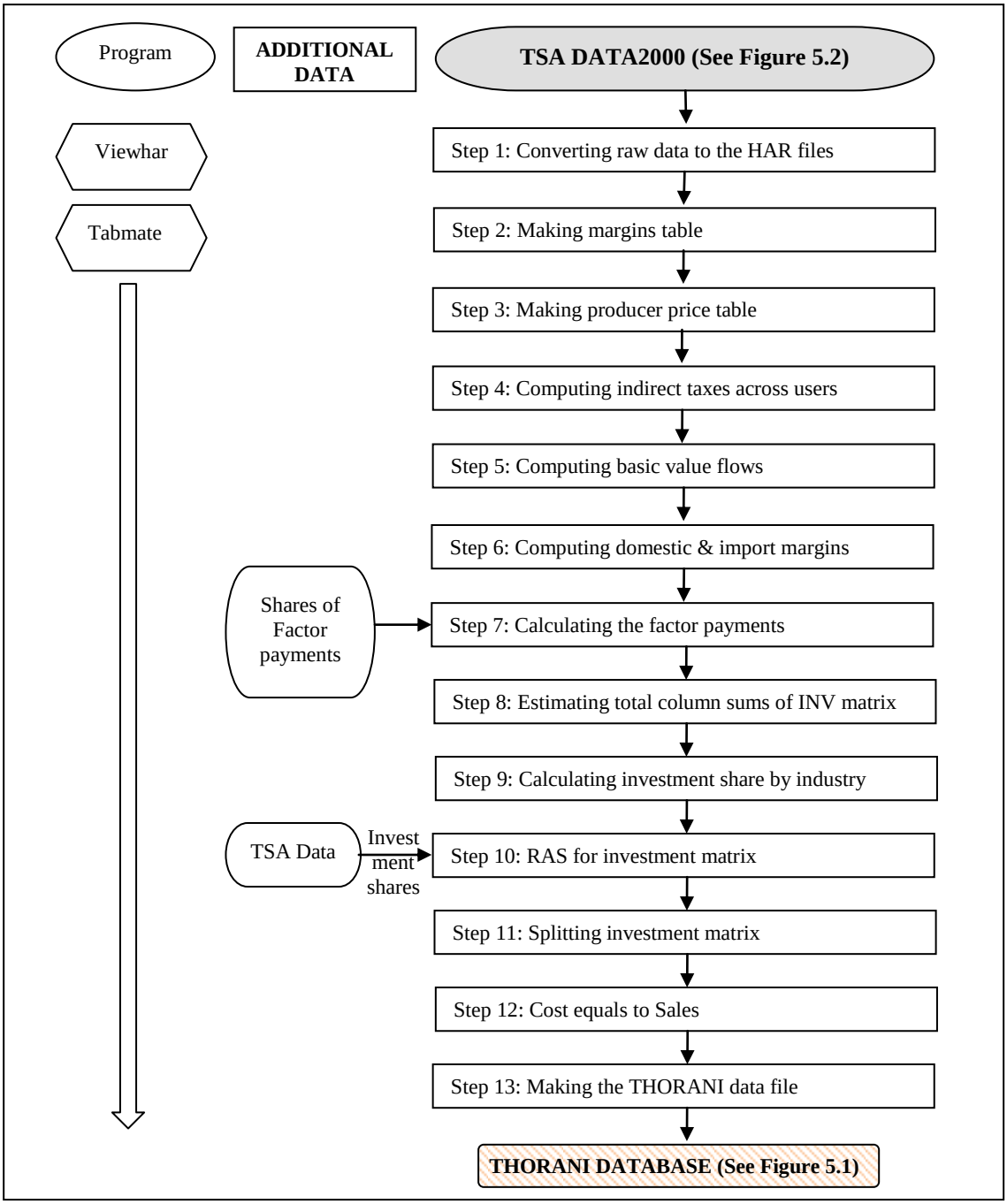
There is also another component in the TSA Table: negative import data in each of the Table. It tells the components of import as Vector I to M inform. The sum of these negative import values by commodities, titled as IMPDATA(c,q), would be equal to the import matrix IMPS(c,u) by accounting matter. These values of IMPDATA(c,q) are the same in each Table. It should be noted that the row sum of each commodity of Figure 5.2A would give the value of GDP at purchaser's price of each commodity regarding the expenditure equation by GDP definition (C+I+G+(X-M)).

TSA of the year 2000, as the main data source for the CGE model in this study, could commonly be thought of as out-dated data source comparing to the newer data of the Input-Output Table 2005 just released in 2011.It is worth-mentioned here that both sources have different classifications of the sectors and TSA2000 is the most updated TSA of Thailand as the project for the newer TSA is in the development process, to be published the next few years. The dynamic CGE model, however, could perform the database updating through historical simulation, which will be done in the baseline simulation of Chapter 6 and this proves the major advantage of dynamic CGE models.

5.3. The Construction of the THORANI Data File

In the first section, the pattern of THORANI data file is presented as the target of the core database. The subsequent section explains about the characteristics of the original main data source which is the Tourism Satellite Accounts year 2000. To reach the target of the first section, this section attempts to elaborate the how-to procedure for constructing the THORANI data file from TSA. There are 13 stages of the procedure.

Figure 5.3: Steps for constructing the THORANI Data File



It is important to remark from the beginning of the data file construction that the TSA data (or in some other common cases i.e. Input-Output Table) should be first verified and the four basic conditions, as following, should be held in the process (Tran, 2007).

- All other matrices, except those taxes and inventories (VTAXs and V6BAS), should not comprise of any negative numbers, or simply non-negativity.
- The value of output of each industry must equal the total of production costs.
- The market clearing condition, which means the value of output of domestically produced commodities (column sums of output by industry) must equal the total of the value of domestic output distribution by all demanders.
- By GDP identity, the total value added plus indirect taxes, which means GDP on the income side, must hold equal to the value of outputs at the market prices or GDP on the expenditure side.

Consultation with the authorities (this case, Tourism Authority of Thailand and NESDB who co-produced the TSA project) that publishes the data is necessary.

5.3.1. Converting raw data to the HAR files

The TSA data files in Excel format is converted into HAR files. With the GEMPACK utility program VIEWHAR (see GEMPACK Manuals for details), RAWDATA.HAR has been created from the TSA spread-sheet file. This single file contains the necessary number to construct the THORANI database from TSA. Note that the number in the HAR file and the spread-sheet would be the same regarding to the corresponding header of the file. The titles of the raw data in the HAR file are the same as illustrated earlier for the part of TSA data in the previous section 4.2. Those are PUR(c,u), AMAR(c,u), IMPS(c,u), VADD(v,i), and IMPDATA(c,q).

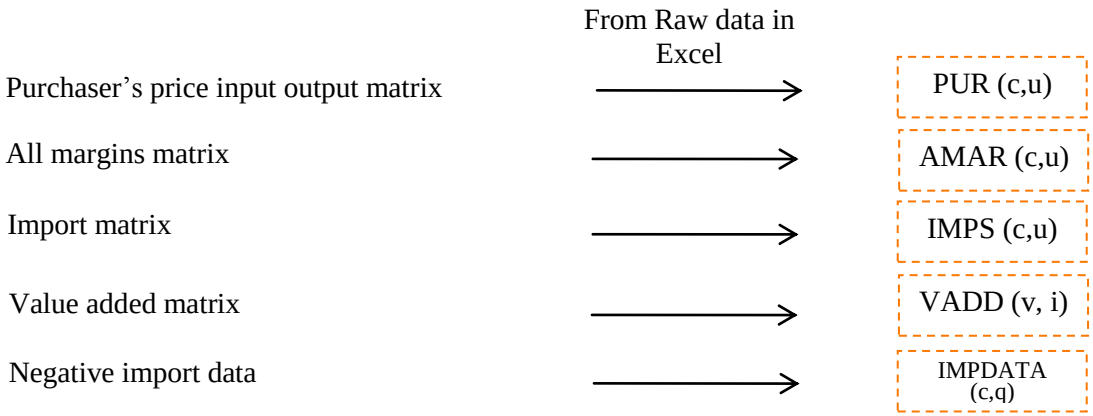


Figure 4.4: Database after stage 1

5.3.2. Making margins table

There are 6 sectors regarding as margins services sectors. Those are Railways passenger transport services, Waterway passenger transport services, Air passenger transport services, Transport supporting services, Trade and repair of goods, Transportation and warehousing services. MARGIN(c,u,m) could be produced from the original data of AMAR(c,u) , which is the all margins matrix, and the share of each margin, defined as TRANSMARSHR(m,u), in MARUSE(m,u) provided as a part in the table of AMAR(c,u), where m are those 6 sectors. The product of those two sources would give 6 margin commodities associated to each 40 commodities by 40 industries. TABMATE is the main editor program for managing the data.

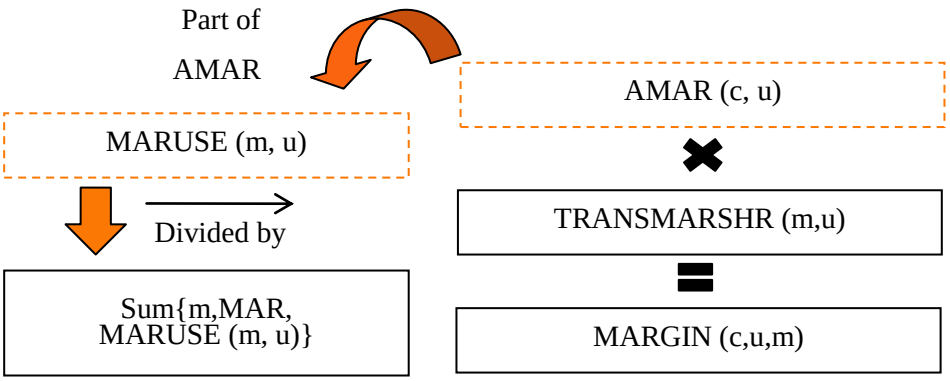


Figure 5.5: Database after stage 2

5.3.3. Making producer price table

From the original purchaser's price matrix or PUR(c,u), after subtracting the sum of all margins sum{m,MAR,MARGIN(c,u,m)}obtained earlier in the previous stage, this gives the producer's price matrix, ALLPROD(c,u). The matrix of domestic value at producer's price DOMPROD(c,u) is left after deducting all the import, IMPS(c,u).

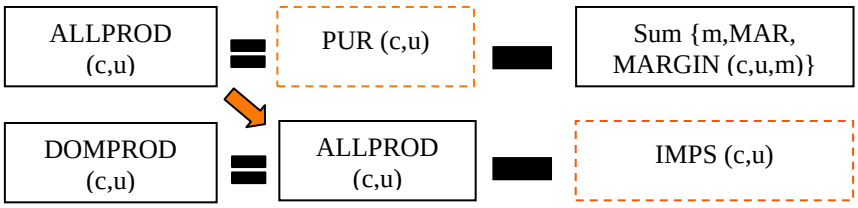


Figure 5.6: Database after stage 3

5.3.4. Computing indirect taxes across users

This sub-section describes the way to calculate the commodity taxes. There are two steps for the calculation. The first one is to compute the TAX(c,s,u) from the available information. VADD("indtaxes",i), which is the value of domestic indirect taxes by industry from TSA give the amount of domestic commodity taxes. Because of the one industry produces one commodity assumption, the amount of taxes paid by an industry is alike to that levied on a commodity produced by the corresponding industry. By this fact, VADD("indtaxes",i) = TAX_U(c,"dom"). That is the taxes by industry are equal to the taxes by commodity. Note that indirect taxes here are merely sales taxes, which imposes on basic the values of commodity flow. Other kind of indirect taxes are treated implicitly in the database.

The amount of imported commodity taxes comes from IMPDATA(c,"ImpTaxes"), which is shown in negative value in the original database, and it is by far by commodity. Thus, taxes for imported commodities are simply TAX_U(c,"imp").

TAXFACTOR, either domestic or import, are the weight for taxpayers. It is believed that, in general, the household pays higher taxes (as mainly final users) more than any other agents. The amount of taxes obtained from the household is thus higher, here triple, comparing to the others.

According to Figure 5.6, multiplying DOMPROD(c,u) to TAX_U(c, "dom") and the weight factor, TAXFACTOR(u, "dom"), the amount that is obtained then titled TAX(c,"dom",u). And, similarly, multiplying IMPS(c,u) with TAX_U(c,"imp") and TAXFACTOR(u,"imp"), this amount is named TAX(c,"imp",u). Both of TAX by two sources, then, could be written as TAX(c,s,u).

However, as the amounts of both sources of TAX_U are the value of the taxes, obtained by commodity, not the tax rate of which when multiplied to the value of domestic commodity, it would give the amount of commodity taxes.

In Step 2 of Figure 5.7, with the existing TAX(c,s,u), the new TAX (c,s,u) could be produced by multiplying to ratio between TAX_U (c,s) and the sum over u of

TAX(c,s,u). The ratio acts as the weight to make the TAX as the value of the commodity taxes. Thus, according to the pattern of THORANI outlined in the first section of 5.1, TAX could be filled in as in Figure 5.8.

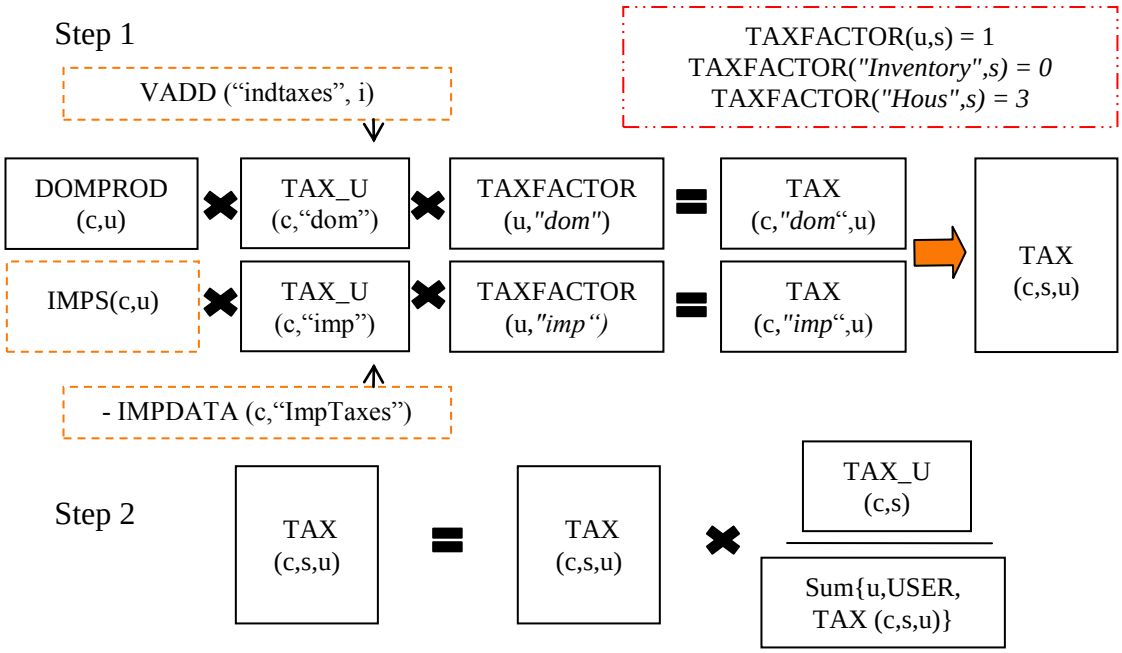


Figure 5.7: Database after stage 4

		Absorption Matrix							
		1	2	3	4	5	6	7	8
		Producers	Investors	Household	Export*	Gov	Stocks*	Inbound Tourism	Domestic Tourism
	Size	← I →	← 1 →	← H →	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →
Basic Flows	↑ C´S ↓								
Margins	↑ C´S´M ↓								
Taxes	↑ C´S ↓	TAX (c,s,i)	TAX (c,s, "Inv")	TAX (c,s,"Hous")	TAX (c,s,"Export")	TAX (c,s,"Gov")	0	TAX (c,s,"Inbtour")	TAX (c,s,"Domtour")
Labour	↑ O ↓								
Capital	↑ 1 ↓								
Land	↑ 1 ↓								
Other Costs	↑ 1 ↓								

C = Number of Commodities (40)

I = Number of Industries (40)

S = 2: Domestic, Imported,

O = Number of Occupation Types (assume one all occupation)

M = Number of Commodities used as Margins

H = Number of Household Types (assume one all household)

* Note: Export column is for domestic goods only.

Figure 5.8: Filling the THORANI form after stage 4

5.3.5. Computing basic value flows

The basic value flows, BAS(c,s,u) could be computed by subtracting the TAX(c,s,u) from the domestic value at producer's price, DOMPROD(c,u), and the import, IMPS(c,u) as shown in Figure 5.9. Figure 5.10 is the THORANI form after stage 5.

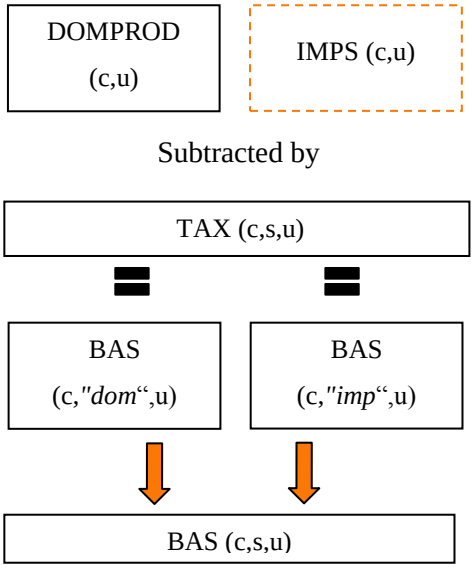


Figure 5.9: Database after stage 5

		Absorption Matrix							
		1	2	3	4	5	6	7	8
		Producers	Investors	Household	Export*	Gov	Stocks*	Inbound Tourism	Domestic Tourism
	Size	← I →	← 1 →	← H →	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →
Basic Flows	↑ C´S ↓	BAS (c,s,i)	BAS (c,s,"Inv")	BAS (c,s,"Hous")	BAS (c,s,"Export")	BAS (c,s,"Gov")	BAS (c,s,"Inventory")	BAS (c,s,"Inbtour")	BAS c,s,"domtour")
Margins	↑ C´S´M ↓								
Taxes	↑ C´S ↓	TAX (c,s,i)	TAX (c,s, "Inv")	TAX (c,s,"Hous")	TAX (c,s,"Export")	TAX (c,s,"Gov")	0	TAX (c,s,"Inbtour")	TAX (c,s,"Domtour")
Labour	↑ O ↓								
Capital	↑ 1 ↓								
Land	↑ 1 ↓								
Other Costs	↑ 1 ↓								

C = Number of Commodities (40)

I = Number of Industries (40)

S = 2: Domestic, Imported,

O = Number of Occupation Types (assume one all occupation)

M = Number of Commodities used as Margins

H = Number of Household Types (assume one all household)

* Note: Export column is for domestic goods only.

Figure 5.10: Filling the THORANI form after stage 5

5.3.6. Computing domestic & import margins

With the BAS(c,s,u) obtained in the previous sub-section, import share or IMPSHR(c,s,u) could be calculated by dividing the BAS(c,s,u) by the sum of BAS(c,s,u) over sources. This IMPSHR(c,s,u) can be used to compute the domestic and import margins by multiplying it to the MARGIN(c,u,m). This gives MARGN(c,s,u,m). Figure 5.11 shows two computing steps for margins by sources and Figure 5.12 shows after-stage-6 THORANI form.

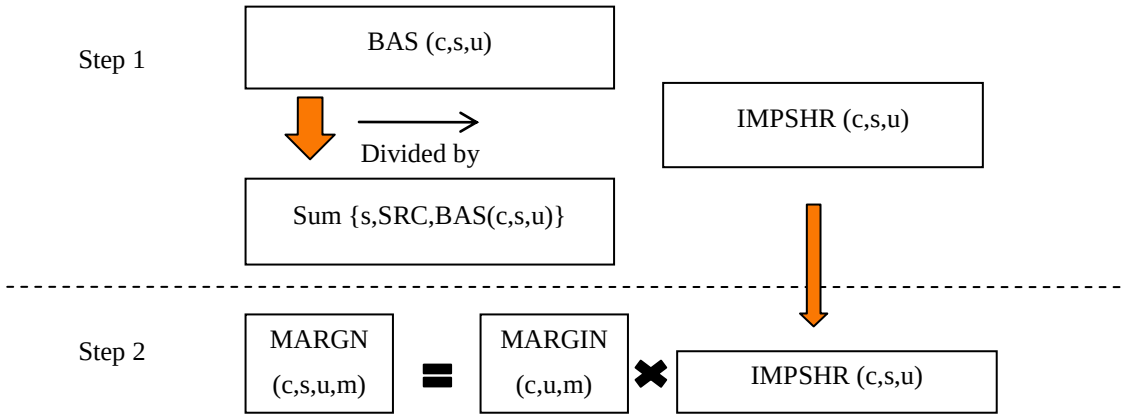


Figure 5.11: Database after stage 6

		Absorption Matrix							
		1	2	3	4	5	6	7	8
		Producers	Investors	Household	Export*	Gov	Stocks*	Inbound Tourism	Domestic Tourism
	Size	← I →	← 1 →	← H →	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →
Basic Flows	↑ C´S ↓	BAS (c,s,i)	BAS (c,s,"Inv")	BAS (c,s,"Hous")	BAS (c,s,"Export")	BAS (c,s,"Gov")	BAS (c,s,"Inventory")	BAS (c,s,"Inbtour")	BAS c,s,"domtour")
Margins	↑ C´S´M ↓	MARGN (c,s,i,m)	MARGN (c,s,m)	MARGN (c,s,"Hous",m)	MARGN (c,s,"Export",m)	MARGN (c,s,"Gov",m)	0	MARGN (c,s, "Inbtour",m)	MARGN (c,s, "Domtour",m)
Taxes	↑ C´S ↓	TAX (c,s,i)	TAX (c,s, "Inv")	TAX (c,s,"Hous")	TAX (c,s,"Export")	TAX (c,s,"Gov")	0	TAX (c,s,"Inbtour")	TAX (c,s,"Domtour")
Labour	↑ O ↓								
Capital	↑ 1 ↓								
Land	↑ 1 ↓								
Other Costs	↑ 1 ↓								

C = Number of Commodities (40)

I = Number of Industries (40)

S = 2: Domestic, Imported,

O = Number of Occupation Types (assume one all occupation)

M = Number of Commodities used as Margins

H = Number of Household Types (assume one all household)

* Note: Export column is for domestic goods only.

Figure 5.12: Filling the THORANI form after stage 6

5.3.7. Calculating the factor payments

In this model, production taxes are zero by assumption. Factor payments for labor could be brought from VADD (“Wages”,i) while factor payments to capital is the sum of depreciation and operating surplus, which are VADD(“Depreciation”,i) and VADD(“OperSurp”,i) respectively. 1/3 of factor payments to capital are set to be redistributed as factor payments for land for the industry with land specific factor. Here, only Agriculture is the land-user. In addition, import duty matrix is brought from the original data of IMPDATA(c,”Impduty”).

FACT(*"prodtax"*,i)	=	Net indirect taxes on MAR		LNDUSER (Agriculture)
FACT("*labour*",i)	=	VADD(*"Wages",i)*		
FACT(*"capital"*,i)	=	VADD(*"Depreciation",i)*	+	VADD(*"OperSurp",i)*
FACT(*"land",i)*	=	FACT(*"capital",i)*	×	0.33
FACT(*"capital"*,i)	=	FACT(*"capital",i)*	−	FACT(*"land",i)*
V0TAR(c)	=	- IMPDATA(c,*"Impduty")*		

Figure 5.13: Database after stage 7

		Absorption Matrix							
		1	2	3	4	5	6	7	8
		Producers	Investors	Household	Export*	Gov	Stocks*	Inbound Tourism	Domestic Tourism
	Size	← I →	← 1 →	← H →	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →
Basic Flows	↑ C´S ↓	BAS (c,s,i)	BAS (c,s,”Inv”)	BAS (c,s,”Hous”)	BAS (c,s,”Export”)	BAS (c,s,”Gov”)	BAS (c,s,”Inventory”)	BAS (c,s,”Inbtour”)	BAS c,s,”domtour”)
Margins	↑ C´S´M ↓	MARGN (c,s,i,m)	MARGN (c,s,m)	MARGN (c,s,”Hous”,m)	MARGN (c,s,”Export”,m)	MARGN (c,s,”Gov”,m)	0	MARGN (c,s, ”Inbtour”,m)	MARGN (c,s, ”Domtour”,m)
Taxes	↑ C´S ↓	TAX (c,s,i)	TAX (c,s, “Inv”)	TAX (c,s,”Hous”)	TAX (c,s,”Export”)	TAX (c,s,”Gov”)	0	TAX (c,s,”Inbtour”)	TAX (c,s,”Domtour”)
Labour	↑ O ↓	FACT ("labour",i)							
Capital	↑ 1 ↓	FACT ("capital",i)							
Land	↑ 1 ↓	FACT (*"land",i)*							
Other Costs	↑ 1 ↓	FACT ("prodtax",i)							

C = Number of Commodities (40)

I = Number of Industries (40)

S = 2: Domestic, Imported,

O = Number of Occupation Types (assume one all occupation)

M = Number of Commodities used as Margins

H = Number of Household Types (assume one all household)

Import Duty	
Size	← 1 →
↑ C ↓	- IMPDATA (c,*"Impduty")*

* Note: Export column is for domestic goods only.

Figure 5.14: Filling the THORANI form after stage 7

5.3.8. Estimating total column sums of INV matrix

It could be seen that there is only one investment column, which means overall industry's investment, not for each industry. THORANI database also adapts the idea of each industry's investment from ORANI-G model. That means it is about to create a dimension of investment column vector to be a matrix with c commodity by i industry.

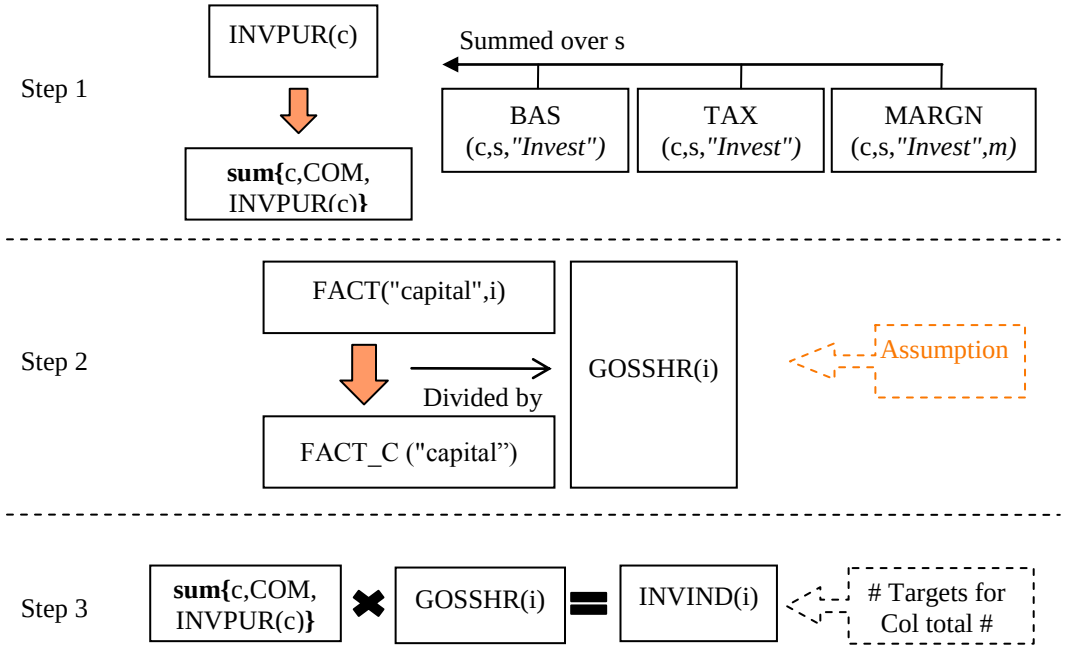


Figure 5.15: Database after stage 8

To add the dimension to the investment column, it is first to start with the investment column at the purchaser's price as Step 1 in Figure 5.15 shows. By summing up the basic value, the margins, and the commodity taxes related to investment, the investment column at purchaser's price is then available. Summing it up over all commodities, the total investment at purchaser's price is obtained. Step 2 is about the assumption that the investment by industry dimension follows the gross operating surplus shares, which can be computed from factor payments to capital by industry.

By multiplying the gross operating surplus shares to the total investment at purchaser's price, the investment by industry, INVIND(i), could be obtained as the targets for column totals for the matrix that will be created for investment shares by industry in the next stages.

5.3.9. Calculating investment share by industry

To allocate the investment commodities to the investing industries, the fact that each industry has its own source specific commodities for its capital creation, for example, only agriculture products are used as the capital for its own while construction is used for all industries, the usage of the investment commodities for capital creation needs to be done by judgment.

Of all 40 commodities, only 11 commodities could be regarded as investment commodities. These are Manutextiles, Manuleathers, Manuwoodprod, Manuceramicw, Manuglasspro, Manujewelry, Realestate, Agriculture, Miningquarry, Manufacturin, Construction (note that this is the short name for those sectors listed in Table 5.4). Within this group, only 6 commodities(Agriculture, Miningquarry, Manutextiles, Manuleathers, Manujewelry) are categorized as single-user commodities. Thus, there are 5 multi-user investment commodities.

By multi-user, it means that there are many users for that commodity for capital creation. The investment allocation (at purchaser's price) follows the gross operating surplus shares for those many users of that commodity. For single-user commodities, the investment is for that single user. This makes the INV(c,i), which is the matrix of 11x40 for the investment by commodity and by industry. INVPUR(c) represents as the targets for row totals for each investment commodity. Figure 5.16 shows the procedure for this stage.

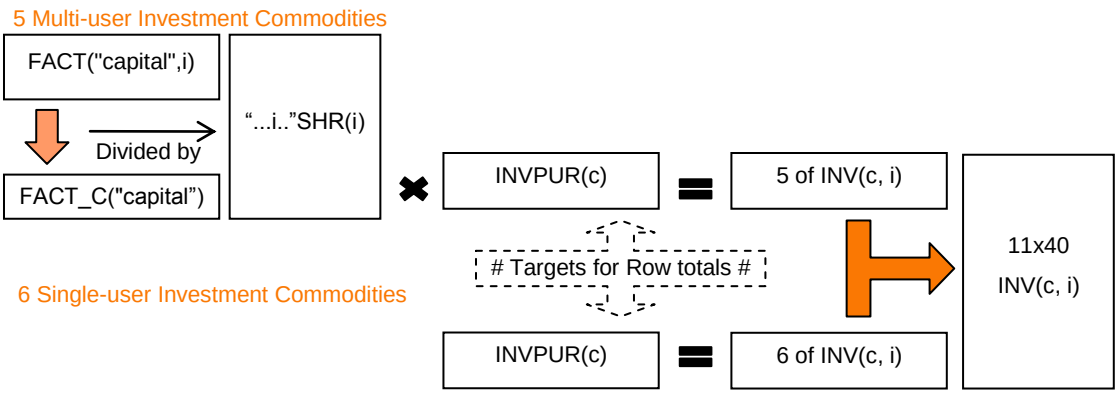


Figure 5.16: Database after stage 9

5.3.10. RAS for investment shares

The INV(c,i) that has been obtained, however, is needed to make some adjustments as the column sum (dimension by industry) and row sum (dimension by commodity) would have different values from the column targets and row targets. RAS (Row and Sum) method is applied to balance the new investment share matrix to fulfill the conditions above (for details of RAS algorithm for matrix balancing, see Schneider and Zenios (1989) and technical procedures of Gempack in Horridge (2010)).

From Figure 5.17, the row target is INVPUR(c), which is the vector of investment commodities at purchaser's price. It is understandable that the sum over i of INV(c,i) would be equal to the INVPUR(c) as INV(c,i) is calculated from INVPUR(c) as shown in Figure 5.16 of Stage 9. The column target INVIND(i), nonetheless, is not equal to the sum over c of INV(c,i). To RAS is to make the column sum of INV(c,i) equal to column target while the ratios of all elements to the sum are held with minimum errors as much as possible.

After RAS, the new matrix of INVR(c,i) is obtained. With INVR(c,i), the column sum and the row sum are all equal to the targets.

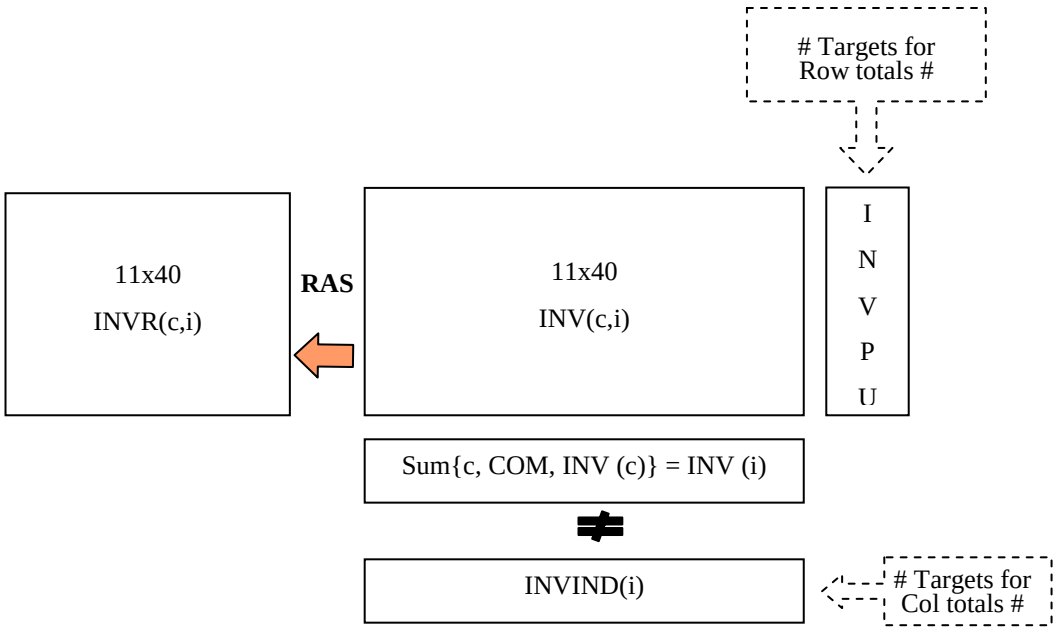


Figure 5.17: Database after stage 10

5.3.11. Splitting investment column

In Step 1 of Figure 5.18, the investment share by industry, INVSHR(i), is computed from INVR(c,i). Multiplying the INVSHR(i) to BAS(c,s,"inv"), TAX(c,s,"inv"), and MARGN(c,s,"inv",m), which are the basic values, the commodity taxes, and the margins for overall investment, this would give BASIS(c,s,i), TAXIS(c,s,i), and MARIS(c,s,i,m). The dimension by industry has been added up in Step 2.In Figure 5.19, the investment related matrices of basic values BASIS(c,s,i), commodity taxes TAXIS(c,s,i), and margins MARIS(c,s,i,m) are filled into the THORANI form instead of the existing investment column vector shown as "inv".

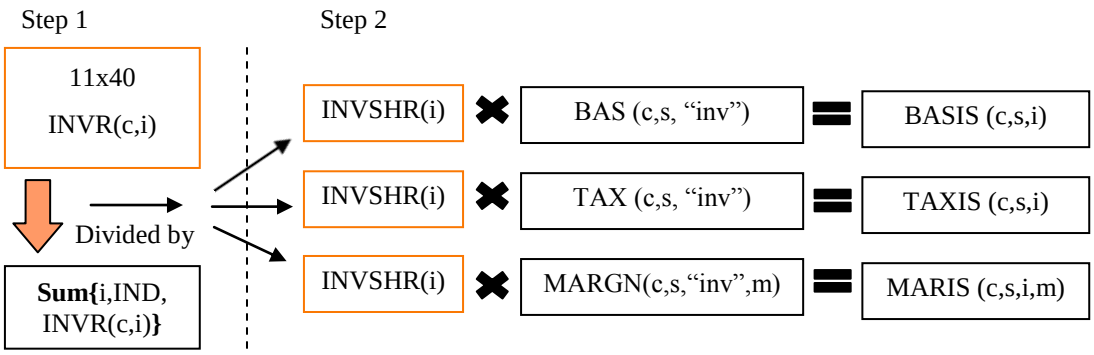


Figure 5.18: Database after stage 11

		Absorption Matrix							
		1	2	3	4	5	6	7	8
		Producers	Investors	Household	Export*	Gov	Stocks*	Inbound Tourism	Domestic Tourism
	Size	← I →	← I →	← H →	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →
Basic Flows	↑ C´S ↓	BAS (c,s,i)	BASIS (c,s,i)	BAS (c,s,"Hous")	BAS (c,s,"Export")	BAS (c,s,"Gov")	BAS (c,s,"Inventory")	BAS (c,s,"Inbtour")	BAS c,s,"domtour")
Margins	↑ C´S´M ↓	MARGN (c,s,i,m)	MARIS (c,s,i,m)	MARGN (c,s,"Hous",m)	MARGN (c,s,"Export",m)	MARGN (c,s,"Gov",m)	0	MARGN (c,s, "Inbtour",m)	MARGN (c,s, "Domtour",m)
Taxes	↑ C´S ↓	TAX (c,s,i)	TAXIS (c,s, i)	TAX (c,s,"Hous")	TAX (c,s,"Export")	TAX (c,s,"Gov")	0	TAX (c,s,"Inbtour")	TAX (c,s,"Domtour")
Labour	↑ O ↓	FACT ("labour",i)							
Capital	↑ 1 ↓	FACT ("capital",i)							
Land	↑ 1 ↓	FACT *("land",i)*							
Other Costs	↑ 1 ↓	FACT ("prodtax",i)							

C = Number of Commodities (40)

I = Number of Industries (40)

S = 2: Domestic, Imported,

O = Number of Occupation Types (assume one all occupation)

M = Number of Commodities used as Margins

H = Number of Household Types (assume one all household)

* Note: Export column is for domestic goods only.

Figure 5.19: Filling the THORANI form after Stage 11

5.3.12. Cost equals to Sales

After Stage 11, the final blank of the THORANI form left is the MAKE matrix. As the conditions stated regarding MAKE matrix in the first sub-section, for each domestic commodity, total sales must equal total production (row sums of the MAKE matrix) and for each industry, total costs must be equal to the value of output (column sums of the MAKE matrix). This stage concerns about the cost equals to sales.

Starts with the summation of the value at purchaser's price of BAS(c,s,u), TAX(c,s,u), and sum over m of the MARGN(c,s,u,m) in Step 1, the cost by industry can be calculated in Step 2 by adding up the factor cost of sum{f,FAC, FACT(f,i)} with the purchaser's value by industry obtained from Step 1. This is the sum of all costs seen in the column 1 of THORANI form for the producer part.See Figure 5.20.

Step 3 shows the sales of all domestically produced outputs (commodities) which could be computed from the sum over u of BAS(c,"dom",u). Another part of sales is the margins sales, which are mark-ups over the sales of commodities or sum{c,COM,sum{s,SRC,sum {u,USER,MARGN(c,s,u,m)}}} and, of course, the direct sales of the margins commodities. An example of mark-ups over the sales of commodities is freight service, whereas the direct sales are the taxi fare.

In Step 4, MAKE matrix of the outputs produced is equal to sales of all kind of commodities. Unique output for one industry makes the number of the industry equal to the number of the commodity. By that, the sum over commodities of MAKE is equal to the cost of each industry and the sum over industries of MAKE is equal to the sales of each commodity, shown in Step 5.

5.3.13. Making the THORANI database file

It could be easily seen that the THORANI database file is filled with all the data required. In Figure 5.20, all the processed data are set to be equal to the coefficients of the THORANI model, cell by cell and title by title. THORANI database coefficient file is completed for this stage.

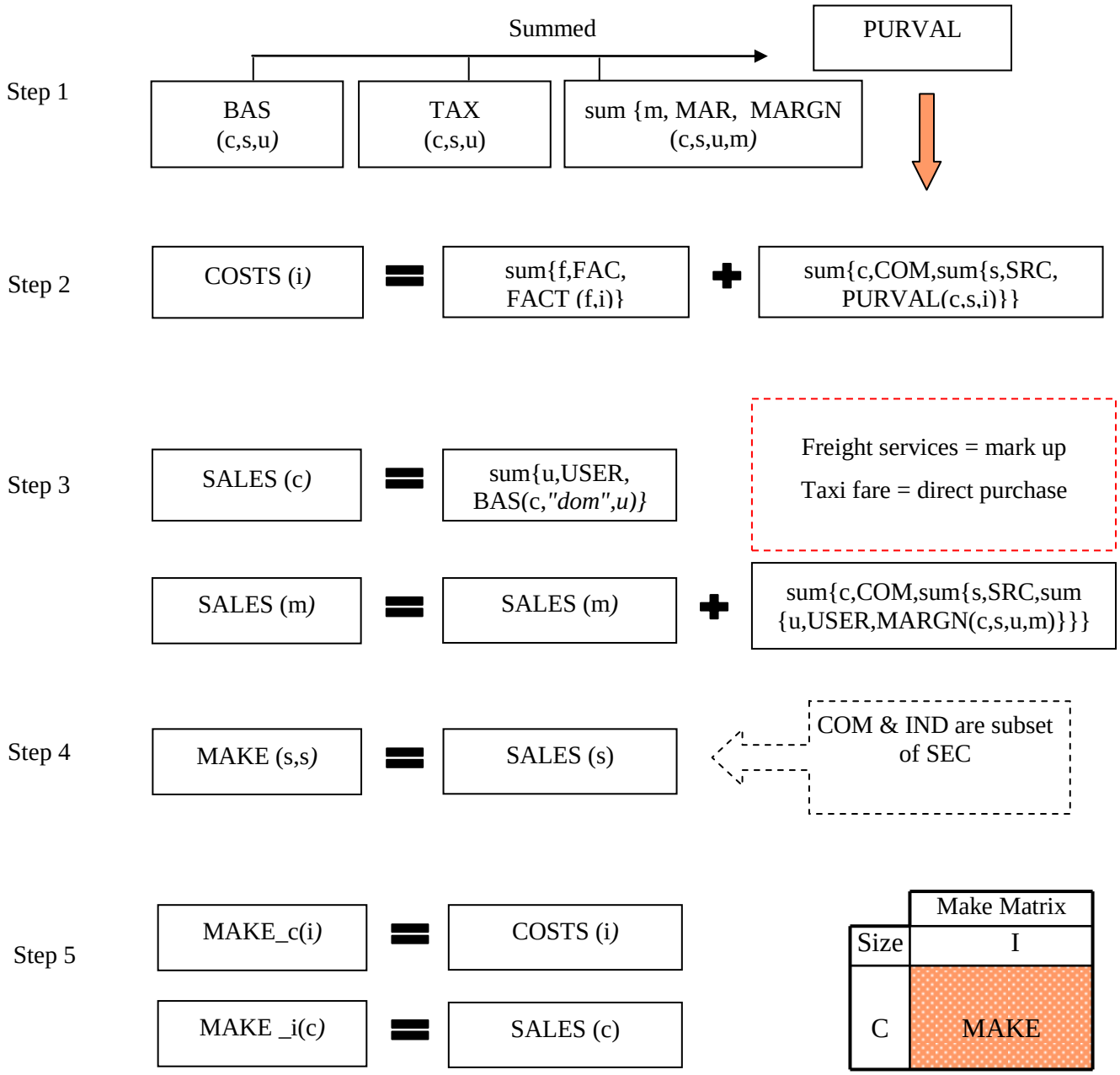


Figure 5.20: Filling the THORANI form and database after Stage 12

		Absorption Matrix							
		1	2	3	4	5	6	7	8
		Producers	Investors	Household	Export*	Gov	Stocks*	Inbound Tourism	Domestic Tourism
	Size	← I →	← I →	← H →	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →
Basic Flows	↑ C´S ↓	BAS (c,s,i)	BASIS (c,s,i)	BAS (c,s,"Hous")	BAS (c,s,"Export")	BAS (c,s,"Gov")	BAS (c,s,"Inventory")	BAS (c,s,"Inbtour")	BAS c,s,"domtour")
Margins	↑ C´S´M ↓	MARGN (c,s,i,m)	MARIS (c,s,i,m)	MARGN (c,s,"Hous",m)	MARGN (c,s,"Export",m)	MARGN (c,s,"Gov",m)	0	MARGN (c,s, "Inbtour",m)	MARGN (c,s, "Domtour",m)
Taxes	↑ C´S ↓	TAX (c,s,i)	TAXIS (c,s, i)	TAX (c,s,"Hous")	TAX (c,s,"Export")	TAX (c,s,"Gov")	0	TAX (c,s,"Inbtour")	TAX (c,s,"Domtour")
Labour	↑ O ↓	FACT ("labour",i)							
Capital	↑ 1 ↓	FACT ("capital",i)							
Land	↑ 1 ↓	FACT *("land",i)*							
Other Costs	↑ 1 ↓	FACT ("prodtax",i)							

C = Number of Commodities (40)

I = Number of Industries (40)

S = 2: Domestic, Imported,

O = Number of Occupation Types (assume one all occupation)

M = Number of Commodities used as Margins

H = Number of Household Types (assume one all household)

* Note: Export column is for domestic goods only.

	Make Matrix
Size	← I →
↑ C ↓	MAKE

	Import Duty
Size	← 1 →
↑ C ↓	- IMPDATA (c,*"Impduty"*)

=

		Absorption Matrix							
		1	2	3	4	5	6	7	8
		Producers	Investors	Household	Export*	Gov	Stocks*	Inbound Tourism	Domestic Tourism
	Size	← I →	← I →	← H →	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →
Basic Flows	↑ C´S ↓	V1BAS	V2BAS	V3BAS	V4BAS	V5BAS	V6BAS	V7BAS	V8BAS
Margins	↑ C´S´M ↓	V1MAR	V2MAR	V3MAR	V4MAR	V5MAR	0	V7MAR	V8MAR
Taxes	↑ C´S ↓	V1TAX	V2TAX	V3TAX	V4TAX	V5TAX	0	V7TAX	V8TAX
Labour	↑ O ↓	V1LAB							
Capital	↑ 1 ↓	V1CAP							
Land	↑ 1 ↓	V1LND							
Other Costs	↑ 1 ↓	V1OCT							

C = Number of Commodities (40)

I = Number of Industries (40)

S = 2: Domestic, Imported,

O = Number of Occupation Types (assume one all occupation)

M = Number of Commodities used as Margins

H = Number of Household Types (assume one all household)

* Note: Export column is for domestic goods only.

	Make Matrix
Size	← I →
↑ C ↓	MAKE

	Import Duty
Size	← 1 →
↑ C ↓	V0TAR

Figure 5.21: THORANI database file after stage 13

5.4. Dealing with Parameters

This sub-section deals with the parameters required by THORANI. Regarding to the list in Table 5.3, Table 5.5 informs the value of all parameters used in THORANI model. They are the values taken from the literature and assumption.

Regarding the elasticities of substitution between primary factors (labor, capital, and land), THORANI follows CAMGEM and Siksamat (1998) with the different values across industries. For the substitution between labors are priori set as 0.5 for all industries. This parameter will be altered when dealing with more types of labor in TRAVELTHAI. Armington elasticities are set as 2.0 for all cases, PARA has estimated with the values of 69 commodities centered around 1.0 – 2.0. Output sigma is set 0.5 for all industries.

Frisch parameter is a negative reciprocal of the share of supernumerary expenditure in total household expenditure (See details in Dixon, 1982). This study set it be -3.696399, a little lesser than GEMREG in Siksamat (1998). This study follows Wattanakuljaras (2006) for the values of EPS or Household Expenditure elasticities. Export demand elasticities are set as 4 for all commodities. Only Agriculture is set 0.1 for individual export commodity. Tourism elasticities are all set to be zero as they are regarded as collective in bundle and not with a market power.

Table 5.5: List of Parameters and associated values

Parameter	Name	Dimension	Value
SIGMA1LAB	Labor sigma	IND	0.5 for all i
SIGMA1PRIM	Primary factor sigma	IND	0.5 for all i
SIGMA1	Intermediate Armington	COM	2.0 for all c
SIGMA1OUT	Output sigma	IND	0.5 for all i
SIGMA2	Investment Armington	COM	2.0 for all c
SIGMA3	Households Armington	COM	2.0 for all c
SIGMA8	Domestic tourist collective elasticity	SRC	2.0
FRISCH	Frisch parameter	HH	-3.696399
EPS	Household expenditure elasticity	COM*HH	Literature
EXP_ELAST	Individual export elasticities	COM	4.0 for all c
EXP_ELAST_NT	Collective export elasticity	1	4.0
IsIndivExp	Flag, >0.5 for individual export commodities, else collective	COM	Agri = 0.1 Else = 0.0
TOUR_ELAST	Inbound tourist collective elasticity	1	4.0

5.5. A Balance Check for the THORANI Data File

The balance check is necessary to prevent any error occurring along the process of database construction. Cost equals to Sales condition must be satisfied every step since the beginning of the process. Output of the domestic production must be equal to the total of demands and the value of output by each industry must equal the total of production cost.

Assertion statements are inserted into the database arranging procedure to ensure the balance conditions are satisfied each step of the process.

It is noteworthy here that this study checked the THORANI data file and performed the homogeneity test with the comparative static THORANI model, which is theoretically based on ORANI-G model as the key condition before layering the dynamic mechanisms and adding some other special features to develop it as the TRAVELTHAI, which is the dynamic CGE model (See the test in Horridge, 2003).

5.6. Add-ons for Dynamic Mechanism

As shown in Chapter 4, the dynamic mechanism for CGE modeling normally deals with 5 more main features to convert the simple comparative static version into the dynamic version of TRAVELTHAI: 1) Investment and Capital accumulation 2) Treatment of foreign liabilities 3) Wage adjustment 4) Government Accounts and 5) Accounts with the rest of the world. This study incorporates these five main features by tradition, which fully described in MONASH (Dixon and Rimmer 2002), with the main difference for the foreign assets and liabilities, instead, the study follows MyAGE model (Giesecke and Tran, 2010) by making this feature to be Net foreign liabilities. The databases for those five add-ons are as following:

5.6.1. Database for Investment and Capital Accumulation

Investment and Capital accumulation in TRAVELTHAI represent recursive dynamic type. The level of the industry investment, depreciation and capital growth rates could be determined by the perpetual inventory formula cited in Dixon and Rimmer (2002):

$K_{j,1} = K_{j,0}(1 - D_j) + I_j$ or $K_{j,0} = \dfrac{I_j}{k_j + D_j}$ where

- $K_{j,1}$ and $K_{j,0}$ are the industry j's capital stock at the end and the beginning of the year;
- k_j is j's capital growth rate
- D_j is j's depreciation rate;
- I_j is the value of j's investment during the year.

Table 5.6: Capital Stock of Thailand in year 2000 (in Million Baht)

Sector	Gross Capital Stock	Net capital stock	Depreciation	Depreciation rate
Agriculture	1,633,227	64,868	1,046,766	0.062
Agriculture, Hunting and Forestry	1,306,582	51,894	837,413	0.062
Fishing	326,645	12,974	209,353	0.062
Non-Agriculture	21,086,679	824,937	15,615,173	0.053
Mining and Quarrying	319,720	15,285	229,649	0.067
Manufacturing	4,020,896	185,016	2,972,478	0.062
Electricity, Gas and Water Supply	1,585,682	39,771	1,253,577	0.032
Construction	752,394	38,880	595,383	0.065
Wholesale and Retail Trade; Repair of Motor Vehicles, Motorcycles and Personal and Household Goods	1,926,787	95,509	1,316,761	0.073
Hotels and Restaurants	1,112,143	61,130	713,628	0.086
Transport, Storage and Communications	3,828,136	161,273	2,996,994	0.054
Financial Intermediation	312,209	18,035	217,003	0.083
Real Estate, Renting and Business Activities	4,869,230	97,494	3,663,885	0.027
Public Admin. and Defence; Compulsory Social Security	380,634	17,360	289,641	0.060
Education	520,604	19,015	375,930	0.051
Health and Social Work	965,822	61,841	607,337	0.102
Other Community, Social and Personal Service Activities	492,422	14,328	382,907	0.037
Private Households with Employed Persons	-	-	-	-
Total	22,719,906	889,805	16,661,939	0.053

Source: National Economic and Social Development Board (NESDB) and Author's calculation.

The depreciation rates in Table 5.6 range from 3.2 per cent for electricity, gas and water supply to 10.2 per cent for Health and Social Work. Following MyAGE, the rates are adjusted so as to reduce the dispersion with the following formula:

$$D_{2,j} = D_{ave} \cdot \left(\frac{D_{1,j}}{D_{ave}} \right)^{\gamma}$$

where

• $D_{1,j}$ and $D_{2,j}$ are the depreciation rates of industry j's capital stock before and after adjustment;

• D_{ave} is an adopted economy-wide average depreciation rate of 5.5 per cent; and

• γ is the adjustment coefficient, adopted the value of $\gamma = 0.5$.

Table 5.7: Growth of Capital Stock of Thailand in year 2000

Sector	Depre.	Net K	K growth 1999-2010		
	Growth %	Growth %	Max %	Min %	Avr %
Agriculture	10.7	7.5	15.1	-3.8	6.8
Agriculture, Hunting and Forestry	10.7	7.5	15.1	-3.8	6.8
Fishing	10.7	7.5	15.1	-3.8	6.8
Non-Agriculture	9.1	5.5	10.6	-2.1	5.5
Mining and Quarrying	13.3	12.2	9.6	-7.1	6.7
Manufacturing	9.2	8.0	9.0	-5.7	6.2
Electricity, Gas and Water Supply	8.0	5.3	13.2	-5.0	7.6
Construction	13.7	12.9	8.0	-6.6	6.5
Wholesale and Retail Trade; Repair of Motor Vehicles, Motorcycles and Personal and Household	10.6	5.6	9.3	-6.0	4.2
Hotels and Restaurants	17.5	3.0	9.4	-5.7	3.6
Transport, Storage and Communications	6.0	7.7	11.9	-1.1	6.9
Financial Intermediation	9.8	6.2	9.4	-8.6	5.1
Real Estate, Renting and Business Activities	2.6	0.7	10.6	-4.3	3.9
Public Admin. and Defence; Compulsory Social Security	10.8	6.8	14.1	-0.5	5.6
Education	10.1	4.7	11.1	-0.4	4.0
Health and Social Work	16.6	9.2	8.4	-3.4	4.5
Other Community, Social and Personal Service Activities	1.0	3.9	11.4	-1.9	5.4
Private Households with Employed Persons	-	-	-	-	0.0
TOTAL	9.2	5.6	10.9	-2.2	5.6

Source: National Economic and Social Development Board (NESDB) and Author's calculation

From Table 5.7 of the growth of the net capital stock provided by NESDB, with the dispersion similar to depreciation above, this study applies the same method to calculate the trend growth rate of capital, using the adopted economy-wide average rate of growth of 5.5 per cent (as implied in Table 5.7) and the same value of adjustment coefficient of 0.5.

The difference between maximum and trend growth rates of capital is set to be 10 percentage points for all industries. The price of capital assets for all industries were normalised at 1 in the base year. The values for the CPI in 2000 and 2001, assuming a value of 1 in 1995, are 1.035 and 2.07 respectively. A real interest rate of 6.00% is adopted from World Development Indicators in 2000.

5.6.2. Database for Net Foreign Liabilities

Following MyAGE, TRAVELTHAI treats the Net Foreign Liabilities as one part for the dynamic mechanism. This study adopts the way on how to calculate and obtain the data from MyAGE. Note that the Balance of Payments is recorded in double entry accounting in flow concept. Hence, the negative term mean deficit (or, simply, money flows out) of such item and vice versa for the positive term of surplus.

Table 5.8: Net Foreign Liabilities of Capital Accounts in Balance of Payments

Items in Balance of Payments (in million Baht)	**1999**	**2000**	**2001**
Assets			
Direct Investment by Thai overseas	-12,916	795	-18,992
Equity	-82	-6,122	-15,927
Foreign credit, total	-65,576	-85,888	14,421
Foreign credit, government	*-5,762*	*-5,018*	*-1,389*
Foreign credit, private	*-59,814*	*-80,870*	*15,810*
Total Foreign assets	-144,150	-177103	-6,077
Liabilities			
FDI in Thailand	230,905	136,786	225,412
Equity	35,589	35,295	15,404
Foreign debt, total	-527,585	-465,763	-312,383
Government debt	*56,230*	*11,118*	*15,794*
Private debt	*-583,815*	*-476,881*	*-328,177*
Total Foreign liabilities	-788,676	-759,445	-383,950
NFL	-644,526	-582,342	-377,873
Change in Net Foreign Liabilities		62,184	204,469

Source: Bank of Thailand and Author's calculation

5.6.3. Government Accounts

The Government Accounts are mainly about its revenue and expenditure. The data are mainly supplied from Fiscal Policy Office and National Income Accounts. For the process on dealing with the allocation of various types of indirect taxes will be discussed in Section 5.7 in details. Table 5.9 reports the revenue and expenditure items those are important to TRAVELTHAI. Note that there is only one central government in TRAVELTHAI. For subsidies i.e. Tourists' vat refunds could be regarded as forgone earning. This study concerns them as incentive subsidization.

Table 5.9 Government account items in TRAVELTHAI, for 2000, in Million Baht.

Item	Value	Note
Revenue		
Personal income tax	94,894.56	Fiscal Policy Office
Corporate income tax	149,217.80	Fiscal Policy Office
Petroleum income tax	10,964.70	Fiscal Policy Office
Export duties	81.45	Fiscal Policy Office
Import duties	87,942.00	Tourism Satellite Accounts
Excise duties	164,458.35	Fiscal Policy Office
Value added tax	198,190.62	Fiscal Policy Office
Other taxes on commodities	63,979.65	Fiscal Policy Office
Business fees	15,458.71	Fiscal Policy Office
Transfers	8,501.00	National Income Accounts
Social Contributions	99,699.00	National Income Accounts
Other government revenues	140,653.16	Balancing item, comprising mainly of non-tax revenues, and other revenues.
Total revenue	**1,034,041.00**	
Operating Expenditure		
Consumption	593,566.00	Tourism Satellite Accounts
Interest payment	52,036.00	National Income Accounts
Adjustment to the change to pension entitlement	21,398.00	National Income Accounts
Benefits paid to households	76,873.00	National Income Accounts
Subsidies	74,741.15	Fiscal Policy Office/National Income Accounts/Author's calculations
Transfers	32,456.00	National Income Accounts
Other expenditure	39,519.85	Balancing item, comprising of development expenditure and operating expenditures.
Total operating expenditure	**890,590.00**	
Net saving	**37,477**	**National Income Accounts**
Consumption of Fixed Capital	**105,974**	**National Income Accounts**
Overall balance	**1,034,041.00**	

Note: Some statistical discrepancies are included into the other revenue and other expenditure items. This is mainly due to the different data sources and their mode of data collection. The control total is the National Income Accounts (Chain Value Measure: CVM) released in February 2012.

Government Investment by industry is calculated from the information obtained in the National Income Accounts. The shares of the public investment by sector obtained from the Fiscal Policy Office are applied to the public gross fixed capital formation.

Table 5.10: Gross Fixed Capital Formation of 1999 – 2001 in Million Baht.

	1999	2000	2001
Construction	**471,905**	**428,154**	**444,215**
Private	*126,980*	*146,138*	*163,934*
Public	*344,925*	*282,016*	*280,281*
Equipment	**505,695**	**665,657**	**757,360**
Private	*413,380*	*538,170*	*635,751*
Public	*92,315*	*127,487*	*121,609*
Gross fixed capital formation	**977,600**	**1,093,811**	**1,201,575**
Private	*540,360*	*684,308*	*799,685*
Public	*437,240*	*409,503*	*401,890*
Change in inventories	-11,334	35,878	33,784
Gross capital formation	**966,266**	**1,129,689**	**1,235,359**

Source: National Income Accounts

5.6.4. Database for Wage Adjustment and Tax Rate on Factor Incomes

As explained in MyAGE, the slope of the labor supply curve is determined to retain an adjustment period within which wages gradually move to make the aggregate employment return to its base case forecast level. Following MyAGE, that period is assumed to be about seven years, and the associate value is 0.5. Aggregate employment and CPI deflated wages indices were set at 1 for the base year.

The tax rates on factor incomes are average rates, calculated as the percentage of tax revenues over the relevant income categories. The data on revenues from labor and capital income taxes are provided by Fiscal Policy Office. This study assumes that the capital and land income tax rates are the same. Corporate income tax rates in Thailand are legally set as 30 per cent for all business with 10 per cent only for financial businesses. Labor income tax rate is calculated as the effective tax rate in term of ratio between total personal income tax revenue and aggregate labor income in TSA.

5.6.5. Accounts with the Rest of the World

Based on the Current Accounts in Balance of Payments of Table 5.11 and External income account of NIA, the data upon the rest of the world, including Tourism (in terms of receipts and expenditures) in the services accounts could be obtained. For Transfers, NIA gives the details as in Table 5.12.

Table 5.11 Current Accounts in Balance of Payments, for 1999-2001, in Million Baht

Items in Current Accounts	1999	2000	2001
Current account	469,988.00	371,512.00	226,340.00
a. Goods and services	568,882.00	403,380.00	309,141.00
1. Goods	349,918.00	217,442.00	110,951.00
Exports (f.o.b.)	2,150,049.00	2,730,943.00	2,802,530.00
Imports (f.o.b.)	-1,800,131.00	-2,513,501.00	-2,691,579.00
Of which: Non-monetary gold (f.o.b.)	-13,383.77	-24,092.08	-36,687.93
2. Services	218,964.00	185,938.00	198,190.00
Services receipts	553,259.00	556,341.00	578,220.00
(1) Transport	114,148.00	131,118.00	135,805.00
1.1 Freight	19,380.00	24,314.00	27,136.00
1.2 Passenger	90,389.00	99,001.00	102,301.00
1.3 Others	4,379.00	7,803.00	6,368.00
(2) Travel	265,670.00	299,536.00	313,999.00
(3) Government goods and services n.i.e.	3,548.00	3,310.00	4,110.00
(4) Others	169,893.00	122,377.00	124,306.00
4.1 Telecommunications, computer, and information services	5,419.00	5,419.00	4,847.00
4.2 Construction	8,947.00	9,280.00	13,119.00
4.3 Charges for the use of intellectual property n.i.e.	729.00	336.00	393.00
4.4 Insurance and pension services	2,132.00	3,248.00	3,896.00
4.5 Other business services 1/	152,666.00	104,094.00	102,051.00
Services payments	-334,295.00	-370,403.00	-380,030.00
(1) Transport	-38,920.00	-45,986.00	-61,139.00
1.1 Freight	-17,770.00	-19,263.00	-31,000.00
1.2 Passenger	-14,971.00	-17,929.00	-18,232.00
1.3 Others	-6,179.00	-8,794.00	-11,907.00
(2) Travel	-93,684.00	-111,424.00	-130,172.00
(3) Government goods and services n.i.e.	-4,488.00	-5,262.00	-5,988.00
(4) Others	-197,203.00	-207,731.00	-182,731.00
4.1 Telecommunications, computer, and information services	-1,087.00	-1,600.00	-6,467.00
4.2 Construction	-3,110.00	-4,220.00	-4,846.00
4.3 Charges for the use of intellectual property n.i.e.	-22,064.00	-28,308.00	-36,507.00
4.4 Insurance and pension services	-6,786.00	-7,085.00	-8,782.00
4.5 Other business services	-164,156.00	-166,518.00	-126,129.00
b. Primary income	-112,358.00	-55,275.00	-109,504.00
Primary Income receipts	116,993.00	169,929.00	173,767.00
(1) Compensation of employees	55,278.00	67,936.00	55,606.00
(2) Investment income	61,715.00	101,993.00	118,161.00
Of which: Reinvested earnings	0.00	0.00	3,732.00
Primary Income payments	-229,351.00	-225,204.00	-283,271.00
(1) Income on equity	-58,367.00	-61,320.00	-133,717.00
Of which: Reinvested earnings	0.00	0.00	-52,202.00
(2) Income on debt	-170,984.00	-163,884.00	-149,554.00
c. Secondary income	13,464.00	23,407.00	26,703.00
(1) General government	1,633.00	3,082.00	4,622.00
(2) Other sectors	11,831.00	20,325.00	22,081.00

Source: Bank of Thailand

Table 5.12: Transfers with the rest of the world, 1999-2001, from NIA

Items	1999	2000	2001	Items	1999	2000	2001
Public transfers to ROW	341	274	253	*Public transfers from ROW*	1,974	3,356	4,875
Private transfers to ROW	23,262	24,456	28,234	*Private transfers from ROW*	55,509	67,871	66,253

5.7. Dealing with Indirect Tax Matrices

Apart from building the database for the dynamic CGE model, this study intends to classify the data on indirect taxes with some arrangements for this issue in attention. By relaxing some assumptions and adding more available supplementary data, the model could be extended to deliver the additional dimension for some particular aspects. The intention to make it at this state is that it is simply far more comfortable to specifically deal with the certain size of the model and relevant database and test it to the certain extent and later on develop the additional part so as to provide more details and broader picture for model like TRAVELTHAI. The dimension of the matrix of indirect taxes, are added. Note that without this extension, the model is able to perform well with the dynamic framework developed earlier.

The earlier dynamic CGE data file developed is based upon the view over net indirect taxes as only one category of VTAX, which is the lump sum of its own. This category of indirect taxes is the net value of the indirect taxes of those related to the indirect taxes compiled in TSA data (or Input-Output Data) by Tourism Authority of Thailand and NESDB. Note that by definition of TSA and Input-Output Table of Thailand, this category of net indirect taxes is exclusive of tariff, which is explicitly categorized as Import duties in the TSA already (and named as V0TAR in the THORANI data file). It takes the additional data from the Fiscal Policy Office (FPO), Revenue Department (RD), Excise Department of the Ministry of Finance of Thailand and National Income Accounts (NIA) provided by NESDB to incorporate the various types of indirect taxes into the model and provide the certain details about the scheme of the indirect taxes of Thailand. There are two main kinds of the indirect taxes in this study: indirect taxes on products (commodities) and indirect taxes on production.

In this study, the commodity taxes (and subsidies) are categorized into eight types: 1) Tariff 2) Value Added Tax 3) VAT Refunds 4) Export duties 5) Excise Taxes 6) VAT refunds for tourists, 7) Commodity Subsidies and 8) Other commodity taxes, whereas there are three types of the production taxes: 1) Business and Special Business Taxes 2) Subsidies, and 3) Other production taxes. For Tariff, it is earlier categorized separately in the TSA data, thus this is just to inform it as one type of indirect taxes on products and show all categories of revenue from indirect taxes shown in Table 5.13.

Table 5.13: Indirect taxes and subsidies in 2000 (in Million Baht)

	TYPE OF INDIRECT TAXES/SUBSIDIES	SOURCE	VALUES
Commodity taxes			
1	Tariff (V0TAR)	TSA	87,942.00
2	Value added tax (VAT)	FPO/RD	198,190.62
3	VAT refunds (VATRef)	FPO/RD	50,738.57
4	VAT refunds for tourists (TourRef)	RD	148.84
5	Export duties (EXD)	FPO	81.45
6	Excise taxes (Excise)	FPO/Excise	164,458.35
7	Commodity Subsidies (CSub)	FPO/RD	19,368.04
8	Other commodities taxes (OthCTax)	FPO/NIA	63,979.65
	Tariff (V0TAR)	**TSA**	**87,942.00**
	Subtotal from 2 to 8		**496,965.52**
a	**Commodity Taxes less Subsidy (2-3-4+5+6-7+8)**		**356,454.62**
Production taxes			
9	Business and Special Business taxes (BusTax)	FPO	15,458.71
10	Subsidies (Sub)	NIA	4,486.00
11	Other production taxes (OthPTax)	FPO/NIA	11,274.29
	Subtotal from 9 to 11		**31,219.00**
b	**Production Taxes less Subsidy (9-10+11)**		**22,247.00**
c	**Total Subsidies (3+4+7+10)**		**74,741.15**
a+b	**Taxes less Subsidy without Tariff**		**378,701.62**
Control Total of Indirect taxes less subsidies		**TSA**	**489,215.97**
Gross Domestic Products		**TSA**	**5,413,880.86**
Indirect taxes less Subsidies (Chain Volume Measure: CVM)		**NIA**	**476,509.00**
Expenditure on Gross Domestic Products (CVM)		**NIA**	**4,973,708.00**
Statistical Discrepancies (CVM)		**NIA**	**86,311.00**
Gross Domestic Products (CVM)		**NIA**	**5,060,019.00**

Source: TSA, NIA, Fiscal Policy Office (FPO), Revenue Department (RD) and Author's calculation.
Note: Chain Volume Measure is the new methodology applied in NIA recently released in Feb 2012.

This study uses the top-down approach on calculating the indirect taxes. With the control total, which is the value of net indirect taxes exclusive of tariff in TSA, all of the indirect taxes are proportionately scaled to reach that value to avoid the data inconsistency, not disturbing the values of other matrices other than the indirect taxes. Data from Fiscal Policy Office (FPO), Revenue Department (RD), and National Income Accounts (NIA) are the main sources for splitting the indirect taxes into various types mentioned earlier. Note that this study regards all types of refunds as another form of incentive subsidization by the government, with VAT refunds for tourists as one relevant incentive concerning to the issue of this study.

This study applies RAS method to create the sub-matrices of those indirect taxes, with the control total as the constraints. The process of splitting VTAX could be referred to Section 5.3.10 and 5.3.11 about splitting investment column in this chapter.

a) **Commodity taxes:** Apart from the existing Tariff (V0TAR), the other types of commodity taxes are calculated as

- **Value added tax (VAT):**

The value added tax was introduced on January 1, 1992 and has been used for about 20 years till at present. It is imposed on the consumption and the burden is eventually borne by consumers. In general, the business entity that makes taxable supplies is required to collect the output tax of seven per cent of value added tax inclusive of surcharge tax for local government on the value of its supplies and secure of the input tax credit for its taxable inputs and the VAT payable is the amount of output tax deducted by the input tax (FPO, 2005). There are 10 major businesses exempted from VAT such as small entrepreneurs with an annual sales volume less than 1.2 million Baht (later changed to 1.8 million Baht, cited from the Revenue Department's website in March 2012 as the most updated information), unprocessed agricultural products and related goods, religious and cultural services, most government agencies, certain health care services, educational services, newspapers & magazines and text books.

This study assumes the amount of VAT obtained mostly distributed according to the basic value faced by all economic agents, including the government expenditure as the end users in many cases. Those exempted sectors are treated with the assumed effective rates for some certain sectors grouping within a big sector i.e. Agriculture, though some parts within the sector i.e. unprocessed agricultural products are literally and legally exempted. Together with some details of data for sectoral share calculation obtaining from Revenue department, this study sums the value of value added taxes by sectors classified by the ISIC code (International Standard of Industrial Classification: ISIC) provided by the Revenue department by mapping according to the grouping of TSA by definition. There are some missing values reported as unable to be categorized, which are treated by tracing back to all sectors with equal amount. Note that the compliance rates (the ratio of actual tax revenues to the expected tax revenues) may differ between commodities and users in reality. All the values are adjusted according to the total sum of that published by the Fiscal Policy Office. The calculation is mainly constrained by the net indirect taxes amount provided by the TSA data.

- **VAT refunds:**

It is assumed that VAT refunds are the amount that the Revenue department paid back to the business as the tax incentives or subsidies and in this study it is distributed proportionately according to the VAT with only intermediate industries, investors, and exporters are eligible to obtain the refunds. In reality, the VAT refunds normally categorized with exceptional criteria for the exporters or those who obtained the Board of Investment incentives. 100 per cent exporters would be treated as VAT-free and are eligible to ask for VAT refunds for the paid VAT amount based on those materials purchased (to produce for exports). Practically, it takes some time for the Revenue department to check and inspect the percentage of the export of the business entity and those with some percentage of exports would be treated as being eligible to get refunded partially. Note that there are many cases eligible but not apply for the refund. This is generally common as it is often regarded of the process of checking for such refund as time wasting for many small businesses if the refunded value is considered not worth the cost, although the applicable period to ask for refund is within 3 years.

- **VAT refunds for tourists:**

Value-added Tax refunds for tourists are categorized here as an incentive subsidy for the international tourists who visit Thailand. Those who carry a diplomatic passport and reside in Thailand are not eligible, including the airline crew members on duty.

Commodities are to be taken out of Thailand within 60 days from the date of purchase and the tourists need to depart Thailand by air carrier from an international airport. VAT Refund Application for Tourist form (P.P. 10) is necessary to get the refunds on the date of purchase with correct name and the passport number on the original tax invoice of the commodity attached herewith and shown the correct quantity. Value of goods purchased of less than 2,000 baht per day per store is not applicable. Total value of the goods claimed for refund is 5,000 baht at the minimum. Commodities are to be purchased from participating shops in the VAT refunds for tourists' scheme.

This study treats VAT refunds as the partial offset from VAT refunds and only inbound tourists of V7TAX are eligible. It is set and scaled to be proportionately distributed to all commodities.

- **Export duties:**

Only two groups of commodities, namely, raw hides and wood are listed in Part 3 of the Customs Tariff Decree B.E.2530 (1987) with the duty rate of value of 5 baht/kg for raw hide and duty rate of 40 per cent for wood and sawn wood. This study retains the value of export duties to the sector of manufacturing of wood products.

- **Excise taxes:**

Excise taxes are imposed on 20 commodities and services according to the Excise tax Act (1984) and its continuous amendment. They are subject to either the ad valorem or the specific tax rate, whichever is higher, then, is applicable. This study applies all the values of those taxes by 20 commodities obtained from Fiscal Policy Office mapping according to the definition by TSA commodity.

- **Commodity Subsidies:**

Some other commodity subsidies and tax refunds by the Revenue department are categorized in this item. This also includes some other revenue transfers from VAT to other authorities concerned as subsidies. The item is distributed proportionately in this study.

- **Other commodity taxes:**

Stamp duty is the main tax among this type of other commodity taxes. There are 28 classes of documents and transactions which are subject to Stamp duty at variety of rates ranging from 1 Baht to 100 Baht per 1,000 Baht of the value of transactions. This study proportionately distributes the value over each commodity.

b) Production taxes (and subsidies) :

- **Business and Special Business Taxes**

The tax is imposed on various business transactions e.g. banking or similar business, finance, credit foncier and securities business, insurance, pawn brokerage, dealers in immobile property and sales of securities in the Stock Exchange of Thailand (SET). This type of tax ranges between 2.5 – 3.0 per cent. This study lumps this tax up for the Financial Intermediation sector of TSA.

- **Subsidy**

The subsidy of production taxes is obtained from NIA and original TSA data and it is the sole value for the Railroad sector in TSA, which is considered to be the main sector with subsidization. While other sectors, the subsidies are distributed proportionately.

- **Other production taxes:**

Other production taxes are categorized as the residual of the other production taxes item in NIA after deducting the amount of business fee obtained from FPO shown separately as mentioned above. It includes all other production taxes, not categorized elsewhere. They are mainly related to the margin sector and other miscellaneous items. It is distributed proportionately.

5.8. Regional Shares

A top-down regional extension for 7 regions: Bangkok & vicinities, Central, Eastern, North Eastern, Northern, Western, and Southern, informed earlier in the first chapter has been applied for TRAVELTHAI. This enables to extrapolate the economy-wide effects of external shocks to the regional level. The economic impacts on the regions will be determined by the regional structures and the shares of the regions in the whole country's economic activities. Available data on gross regional and provincial products in the National Income Accounts from NESDB and additional data on employment by industry and by region are employed to calculate these shares.

- Regional shares in national output apply the data from regional shares in national outputs of all sectors.
- Regional shares in national investment use output shares as proxy for investment shares.
- Regional shares in national exports use regional output shares as a proxy for export shares.
- Regional shares in national government consumption use the regional shares in government consumption which are proportional to their population shares.
- Regional shares in national private consumption use regional share in national GDP.

- Regional shares in national changes in inventories use regional output shares as a proxy for shares in inventories.
- Regional shares in national inbounded tourists use regional output shares as a proxy for inbounded tourism shares.
- Regional shares in national domestic tourists use regional output shares as a proxy for domestic tourism shares.

5.9. Remarks on Database

Unlike the model chapter, the THORANI and, later, TRAVELTHAI databases are developed and recorded in this chapter, explaining the process step by step from the raw data of TSA to the final step of TRAVELTHAI database. It is very important to note that in the process of development the database were tested with the model at each stage as well. It took a great deal of time and efforts to check back and forth for the compatibility of the model and the database during the construction of both-interchangeably.

In this section, the remarks of the database construction are given with the intention of, in brief, to finalize the TRAVELTHAI database representation.

Figure 5.22 represents the full format of the TRAVELTHAI database after adding more dimensions and more parameters over THORANI. The dimension of the TRAVELTHAI database after splitting the VTAX and P1TAX to have more dimensions of indirect taxes and subsidies and additional regional extensions would become as shown in Table 5.14 and Table 5.15. Apart from the coefficients shown in the absorption matrix, there are 10 kinds of elasticities and 35 types of important parameters, including dynamic ones, in the full format of TRAVELTHAI.

Figure 5.22: TRAVELTHAI Database in Full Format

		Absorption Matrix							
		1	2	3	4	5	6	7	8
		Producers	Investors	Household	Export	Government	Changes in Inventories	Inbounded Tourism	Domestic Tourism
	Size	← I →	← I →	← H →	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →
Basic Flows	CxSxM	V1BAS	V2BAS	V3BAS	V4BAS	V5BAS	V6BAS	V7BAS	V8BAS
Margins	CxS	V1MAR	V2MAR	V3MAR	V4MAR	V5MAR	0	V7MAR	V8MAR
Commodity Taxes	CxSxT	V1TAX	V2TAX	V3TAX	V4TAX	V5TAX	0	V7TAX	V8TAX
Labour	O	V1LAB					Frisch		Flag Export
Capital	I	V1CAP				Size	← 1 →	Size	← 1 →
					Misc Parameters	H	FRISCH	C	ISINDIVEXP
Land	I	V1LND							
Production Taxes	P	V1PTX					Inbound Elasticity		Dom Tour Armington
						Size	← 1 →	Size	← 1 →
					Tourism Elasticities	I	Tour_Elas	S	SIGMA8
	MAKE	Import Duty							
Size	← i →	← 1 →							
C	MAKE	V0TAR					Primary Factor Sub	Output Substitution	OCC Substitution
						Size	← 1 →	← 1 →	← O →
					Elasticity	I	SIGMA1 PRIM	SIGMA1 OUT	SIGMA1 LAB
			Collective Export		Individual Export	Intermediate Armington	Investment Armington	Household Armington	Expenditure Price
		Size	← 1 →	Size	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →
	Elasticity	1	EXP_ELAST_NT	C	EXP_ELAST	SIGMA1	SIGMA2	SIGMA3	EPS
S = Number of Sources (2)									
T = Number of Commodity Taxes (5)						Initial income tax rate on L, T	Initial income tax rate on L, T, Base	Initial income tax rate on L, T-1	Initial income tax rate on L,T-1, Base
O = Number of Occupations (1)									
P = Number of Production Taxes (2)				Taxes	Size	← 1 →	← 1 →	← 1 →	← 1 →
C = Number of Commodities (40)				Dynamic Parameters	I	TAXL_R@1	TAXL_R@1_F	TAXL_R@2	TAXL_R@2_F
H = Number of Households (1)									
I = Number of Industries (40)									
M = Number of Margins (6)			Min/Trend IK ratio	Max/Trend IK ratio	K Supply Curve	Trend IK ratio	Capital stock	Lagged Investment	Depreciation
	K stock	Size	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →
	Dynamic Parameters	I	K_GR_MIN	K_GR_MAX	COEFF_SL	TREND_K	QCAPATT_B	QINV_BASE	DEP
			Dom Govt Debt, Initial	NFL Govt Start year, base	NFL Govt End year, base	NFL Priv Start year, base	NFL Priv End year, base	Interest rate foreign debt, public	Interest rate foreign debt, priv
	NFL	Size	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →
	Dynamic Parameters	I	DDEBT ISSUE_B	FDAT TG_B	FDAT TG_1_B	FDAT TP_B	FDAT TP_1_B	ROI FOREIGN_G	ROI FOREIGN_P
		Initial real pre-tax wage, T	Initial real pre-tax wage, T, Base	Initial real post-tax wage, T	Initial real post-tax wage, T, Base	Initial real pre-tax wage, T-1	Initial real pre-tax wage, T-1, Base	Initial real post-tax wage, T-1	Initial real post-taxwage, T-1, Base
Wage	Size	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →
Dynamic Parameters	I	RWAGE@1	RWAGE@1_F	RWAGE@1_PT	RWAGE@1_PT_F	RWAGE@2	RWAGE@2_F	RWAGE@2_PT	RWAGE@2_PT_F
		Slopes of K Supply Curve	Max K growth rate	Level CPI Base	Lagged Level of CPI Base	Adjusts Dum_year1	Slope of L Supply Curve	Pub sector deficit to GDP, Base	Pub sector debt to GDP, Base
Misc	Size	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →	← 1 →
Dynamic Parameters	1	SMURF	DIFF	LEV_CPI_B	LEV_CPI_L_B	ADJDUM YEAR1	LAB_SLOPE	R_DEF GDP_B	R_PSD GDP_B

Table 5.14: List of sets and associated dimension of TRAVELTHAI

Set	Name	Dimension
COM	Set COM commodities	40
CTAXS	Set CTAXS consumption taxes	7
IND	Set IND industries	40
MAR	Set MAR margin commodities	6
OCC	Set OCC occupations	1
PTAXS	Set PTAXS production taxes	3
SRC	Set SRC sources	2
REG	Set REG regions	7
HH	Set HH Households	1

Table 5.15: Dimension of the TRAVELTHAI Coefficient Database

Coefficient	Name	Dimension
V1BAS	Intermediate basic	COM*SRC*IND
V2BAS	Investment basic	COM*SRC*IND
V3BAS	Household basic	COM*SRC*HH
V4BAS	Exports basic	COM
V5BAS	Government basic	COM*SRC
V6BAS	Inventory changes	COM*SRC
V7BAS	Inbound tourists basic	COM*SRC
V8BAS	Domestic tourists basic	COM*SRC
V1MAR	Intermediate margins	COM*SRC*IND*MAR
V2MAR	Investment margins	COM*SRC*IND*MAR
V3MAR	Household margins	COM*SRC*MAR*HH
V4MAR	Exports margins	COM*MAR
V5MAR	Government margins	COM*SRC*MAR
V7MAR	Inbound tourists margins	COM*SRC*MAR
V8MAR	Domestic tourists margins	COM*SRC*MAR
V1TAX	Intermediate taxes	COM*SRC*IND*CTAXS
V2TAX	Investment taxes	COM*SRC*IND*CTAXS
V3TAX	Household taxes	COM*SRC*HH*CTAXS
V4TAX	Exports taxes	COM*CTAXS
V5TAX	Government taxes	COM*SRC*CTAXS
V7TAX	Inbound tourists taxes	COM*CTAXS
V8TAX	Domestic tourists taxes	COM*SRC*CTAXS
V1CAP	Capital	IND
V1LAB	Labor	IND*OCC
V1LND	Land	IND
V1PTX	Production Taxes	IND*PTAXS
MAKE	Multiproduct Matrix	COM*IND
V0TAR	Tariff Revenue	COM

Chapter 6

Historical Simulations

"Finally, historical simulations produce as a by-product detailed and interpretable estimates of changes in household preferences and industry technologies. The by-product has become such a central input to decomposition and forecast simulations that it now overshadows up-to-date input-output tables as the major output of historical simulations…"

Dixon and Rimmer (2002)

Computable General Equilibrium models have almost exclusively been used as economic tools to analyse a wide range of issues under consideration in various aspects. As one of the conventional main objectives for which 'TRAVELTHAI' is developed, the historical simulation is performed as a benchmark for 'what if' analyses upon Tourism, which is the model application for this study. It is aimed to understand how the economy evolves through a certain period and develop the baseline. In this chapter, the first section introduces an overview of the simulation types. The Back-of-the-Envelope Model as the analytical key is shown in Section 6.2. Section 6.3 deals with the closure for the historical simulation. Section 6.4 discusses the historical baseline simulation.

6.1. Introduction

6.1.1. Types of dynamic simulations

Concerning on the matter of 'time', a comprehensive analytical framework like a CGE model can be used to conduct two types of simulations: comparative-static simulations and dynamic simulations.

It could be said that comparative-static simulations can calculate the effects of various economic shocks on macroeconomic variables e.g. GDP, household consumption, investment, or exports and imports, comparing to what they would have been without these economic shocks. Hence, it means that two different equilibrium states of the economy, before and after a change by the economic shocks, are compared for this

kind of simulation, regardless whether short run or long run. It does not involve the path from one equilibrium state to another. Since the effects of the shocks are independent of such path, it would implicitly means that such what-if analyses do not take into account of foreseeable changes along the realistic baseline time-path, though in reality, the results also depend on the baseline forecast (CoPs, 2010).

Dynamic CGE models, on the other hand, carry out each variable periodically over time explicitly e.g. annually or quarterly. In contrast to the comparative static simulations, they are able to give a realistic baseline forecast, which could reasonably reflect and give analyses of any policy changes. From the explanations by Dixon and Rimmer (2002) and CoPs (2010), there are four types of dynamic simulations:

I) *Historical simulation*: This simulation is aimed to update the initial solution with the initial database of the particular year, normally the year of the latest input-output data, to the latest year for which the observed value of macroeconomic data from statistical compilations are obtainable. The observed values of these variables e.g. consumption, investment, government expenditure, etc. given to the model can be used to calculate for the estimates of unknown technology and preference variables that are well-matched with the statistics provided. The model can, thus, create up-to-date input-output tables for years beyond the latest input-output table obtained, of which is routinely published every 5 years for the case of Thailand.

II) *Forecast simulation*: is called the business-as-usual (BAU) baseline. This scenario will employ prospected forecasts of the economy and project the changes forward to the future regardless of policy shocks. Those macroeconomic variables e.g. population growth rates, GDP growth or employment growth are normally available as public forecasts (e.g. from economic outlook), and technology and taste trends could be computed from the historical simulations. The simulations could deliver forecasts for other variables which are consistent with predictions about the economic structure e.g. labor market variables, industry capital stocks, etc.

III) *Policy simulation*: the purpose of this type of simulations is to compute the effects of changes in policies or some related relevant shocks to the economy. The policy effects are represented by comparing the simulation paths with the paths in the forecasting simulation as deviation from the forecasted baseline.

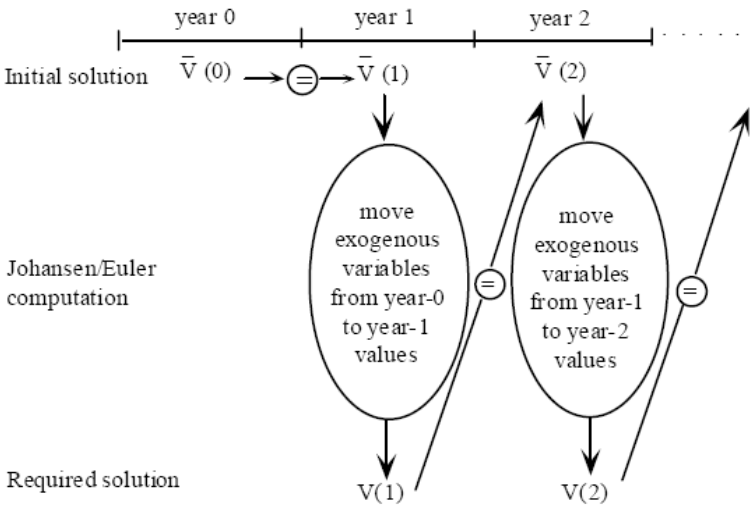
IV) *Decomposition simulation*: this is aimed to evaluate the contribution of each of the changes in the exogenous variables to changes in the endogenous variables. It could be done with historical, forecasting or policy simulations.

6.1.2. Nature of dynamic simulation

Dixon and Rimmer (2002) explained that the changing values of m endogenous variables from the initial solution came from the changing values in the (n–m) exogenous variables from one period to the next where the number of variables n is normally more than m. With period t as initial solution, the solution for year t+1 comes from the change of the exogenous variables (n-m) from their initial (year t) values to their determined values in year t+1. Sequential computations are linked between one year and the next by the quantities of opening capital stocks in the year t+1 are the quantities of closing stocks in the year t computation.

From Figure 6.1, the initial solution from a given database is at year 0. Without changes in exogenous variables from year 0 values, it is also an initial solution for year 1. Moving exogenous variables from year 0 values to the determined values, this generates the solution for year 1. This also establishes the initial solution for year 2.

Figure 6.1: A sequence of solutions using the final solution for the year t-1 as the initial solution for year t



Source: Dixon and Rimmer (2002: 129)

6.2. Back-of-the-envelope Model (BOTE)

In order to deal with a complex CGE model like TRAVELTHAI, BOTE (back-of-the-envelope) model, a stylized analytical key representation for such complex model, is used to help explain the main mechanisms of the simulation setting and the shocks for different types of simulations and their associated closures.

Following CoPs (2010), Table 6.1 presents BOTE under two closures: standard and historical/forecast. It is assumed that there are one domestically produced good, used domestically and exported, and one imported good in BOTE. The equations of BOTE are shown, under the condition sets of two closures:

(E1) informs constant price GDP (Y) with (7) and (8) as inbound and domestic (national) tourism.

(E2) explains an economy-wide constant return to scale output function, relating Y to labor, capital, land and productivity (L, K, Lnd, A).

(E3) links consumption (C+G) to GNP via an average propensity to consume (APC).

(E4) defines Γ, the ratio of real private (C) to real public (G) consumption.

(E5) sets real GNP as real GDP multiplied by a positive function of the terms of trade (TOT) less interest payments on foreign liabilities (NFL·R, where NFL is real net foreign liabilities and R is the interest rate).

(E6) explains about import volumes (M). Imports are related to these 4 variables: agent's activity (Y); import/domestic preferences (T); tariffs (TM); and the domestic/import price ratio (the terms of trade, TOT, as a proxy). Import demand responds to changes in household preference and industry technology variables as well, shown in (E6) by A_C. Changes in these variables affect imports by moving demand towards or away from commodities for which imports engage a significant share of the domestic market.

(E7) relates the foreign currency export price (PX) to export volumes (X), export taxes (TX), and a shift in foreign demands (V). Commodity exports are inversely related to foreign currency prices via constant elasticity demand functions.

(E8) defines the aggregate investment/capital ratio (Ψ). It represents the reflection of

business confidence, set exogenous.

(E9) relates the profit maximising K/L ratio to the post-tax rate of return (ROR), the capital tax rate (T_K), technical change (A), capital input taxes (T_I), and the terms of trade (TOT). Constant return to scale is assumed. Thus marginal product functions are homogeneous of degree zero and can be expressed as functions of the ratio K/L and A. Cost-neutral labor/capital bias in technical change is represented by Ξ.

(E10) relates real consumer wage (W) to K/L ratio, technology, and terms of trade.

(E11) shows the change in NFL to the accumulated savings/investment imbalance over the simulation period

(E12) treats the terms of trade as the ratio of foreign currency export prices to import prices (P_M).

(E13) shows the relationship of inbound tourists' demand in the form as (E7)

(E14) relates domestic (national) tourism to consumption.

Table 6.1: The BOTE model and its standard short-run and long-run closures

	A. Standard short run closure	**B. Standard long run closure**
(E1)	$Y=C + I + G + X - M + 7 + 8$	$Y=C + I + G + X - M + 7 + 8$
(E2)	$Y=\mathbf{A}.F_1(\mathbf{K}, L, \mathbf{Lnd})$	$Y=\mathbf{A}.F_1(K, \mathbf{L}, \mathbf{Lnd})$
(E3)	$C + G + 8 = \mathbf{APC}.GNP$	$C + G + 8 = \mathbf{APC}.GNP$
(E4)	$C / G = \boldsymbol{\Gamma}$	$C / G = \boldsymbol{\Gamma}$
(E5)	$GNP=Y.F_2(TOT) - NFL.\mathbf{R}$	$GNP=Y.F_2(TOT) - NFL.\mathbf{R}$
(E6)	$M=F_3(Y, TOT, \mathbf{T_M}, \mathbf{T}, \mathbf{A_C})$	$M=F_3(Y, TOT, \mathbf{T_M}, \mathbf{T}, \mathbf{A_C})$
(E7)	$P_X=F_4(X, \mathbf{T_X}, \mathbf{V})$	$P_X=F_4(X, \mathbf{T_X}, \mathbf{V})$
(E8)	$I = F(ROR)$ and $\Psi= I / \mathbf{K}$	$\boldsymbol{\Psi}= I / K$
(E9)	$\mathbf{K}/L=F_5(ROR, \mathbf{T_K}, \mathbf{T_I}, \mathbf{A}, TOT, \boldsymbol{\Xi})$	$K/\mathbf{L}=F_5(\mathbf{ROR}, \mathbf{T_K}, \mathbf{T_I}, \mathbf{A}, TOT, \boldsymbol{\Xi})$
(E10)	$\mathbf{W}=F_6(\mathbf{K}/L, \mathbf{A}, TOT)$	$W=F_6(K/\mathbf{L}, \mathbf{A}, TOT)$
(E11)	$NFL=F_7(K, \mathbf{APC}, GNP)$	$NFL=F_7(K, \mathbf{APC}, GNP)$
(E12)	$TOT=P_X / \mathbf{P_M}$	$TOT=P_X / \mathbf{P_M}$
(E13)	$P_7=F_7(7, \mathbf{T_7}, \mathbf{V})$	$P_7=F_7(7, \mathbf{T_7}, \mathbf{V})$
(E14)	$8 / C = \theta$	$8 / C = \theta$

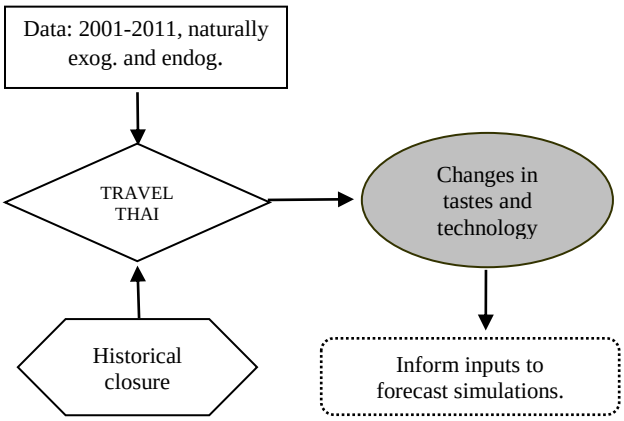
Bold denotes exogenous. Remaining variables are endogenous.

Note: P_X *and* P_M *are foreign-currency export and import prices respectively.*

6.3. Closures of the Baseline Simulation

One major effort of this thesis is to report the calibration of historical data of the period 2000-2011 into the TRAVELTHAI model to develop the baseline simulation as an important benchmark for further analyses. To develop the baseline, it is not a prerequisite to develop full historical simulation and updating realistic database annually. Instead, this study employs the average method by calculating the average of historical macroeconomic data and makes them as inputs for historical simulation of the period of attention. The final results would be the same as calculating and updating all annual historical simulation and make an average for baseline. The information obtained from baseline simulation would be beneficial for the baseline forecasts and policy simulations later on.

Figure 6.2: Steps for baseline simulations



Source: adapted from Dixon and Rimmer (2002)

Macroeconomic data and industry data are prerequisite for performing the historical simulation for developing baseline. As the number of equations in CGE model is commonly smaller than the number of variables, the number of variables that the model can be solved would be chosen to be equal to the number of equations in the model. Those excessive variables specified for the model would be exogenized as a model closure listed as variables to be determined exogenously whereas the rest of other variables are to be endogenously determined by the model's equation system. The key process is to make the set of historical closures of the model by operating the reverse fashion of the usual standard policy simulation of a CGE model, for which quantities and prices of production outputs and inputs, consumption, and international trade are typically treated as endogenous. These variables, in turn, would be set as exogenous in the historical closures and the model is informed of the observed values

(historically) of the changes in those macroeconomic variables in order to calculate for the corresponding technical and preference change variables (treated as endogenous) for the historical simulation. This kind of historical simulation technique was originally introduced in Dixon and Rimmer (2002) for their MONASH dynamic CGE model of Australia. See Figure 6.2 for representation.

Table 6.2. Status summary of some variables under the historical closure

Variables exogenous in historical closure (for data inputs)	**Corresponding variables which are endogenous in historical closure (targets)**
• Real Consumption	• *Shifts in household preferences*
• Import volumes	• *Import/domestic preference shifts*
• Export volumes	• *Shifts in export demand schedules*
• Real Investment	• *General capital growth shifter*
• Capital accumulation shifters	• *Ratio of investment to capital, shift*
• Real Government Consumption	• *Shifts in government preferences*
• Real inbound tourism	• *Shifts in Inbound tourists' demand schedules*
• Nominal exchange rate	• *Consumer price index*
• GDP price index	• *all factor augmenting technical change*
Other variables which are exogenous in historical closure	
• Number of households and population	
• c.i.f. import prices in foreign currency	
• Shifts in domestic (national) tourists' demand schedule	
• Tariff rates, real interest rates	
• Land use by industry	
Other Variables which are endogenous in historical closure	
• Demand for source-specific commodity inputs by industry, for current production	
• Demand for source-specific commodity inputs by industry, for capital creation	
• Prices of source-specific commodity inputs by industry, for current production	
• Prices of source-specific commodity inputs by industry, for capital creation	
• Demand for margin *m* by agent *k* to facilitate purchase of commodity *c* from source *s*	
• Demand for national tourists including both domestic and outbound types	

Source: Adapted from Dixon and Rimmer (2002) and Tran and Giesieke (2006)

In order to perform a historical or a baseline forecast simulation, it is, henceforth, to force the model to incorporate the observed structural changes of the macroeconomic variables like output, consumption, investment, international trade, or tourism and endogenously solve for the associated behavior or preference variables. With the aid from the BOTE model presented earlier as in Table 6.1. The structural closure to conduct the baseline simulation is listed step-by-step as following

• Step 1: exogenise real private consumption growth (x3tot) and endogenise corresponding consumer preference variable (f3tot);

• Step 2: exogenise real investment growth (x2tot) and endogenise variables that allow the corresponding capital supply curves to shift (d_f_eeqror);
• Step 3: exogenise real government consumption growth (x5tot) and endogenise the corresponding government demand preference variable (f5tot);
• Step 4: exogenise real growth of exports (x4tot) and endogenise variables that allow the corresponding export demand curves to shift (feq_gen);
• Step 5: exogenise real growth of imports and endogenise corresponding variables describing user preference in favor of (or against) imports (twistsrc_c);
• Step 6: exogenise real growth of inbound tourists' receipt (x7_tour) and endogenise the corresponding inbound tourists' preference shifter (f7q_tour);
• Step 7: exogenise GDP deflator (p0gdpexp) and endogenise corresponding all factor augmenting technical change variables (a1primgen).

6.4. Data Sources and Data Consistency

In developing the baseline simulations to obtain the baseline time-path, the macroeconomic data are required as explained earlier. This section informs the list of the sources of data used for this sake, including the data management to maintain the data consistency for overall simulations.

Concerning the macroeconomic data used for baseline simulation of TRAVELTHAI, this study employs:

1. National Income Accounts of Thailand by National Economic and Social Development Board (NESDB)
2. Input-Output Table of Thailand by NESDB
3. World Bank: World Development Indicators for data on income and expenditure side GDP in both constant and current prices in local currency or US Dollar; population and working age population
4. Labor Force Surveys of Thailand from National Statistics Office of Thailand
5. Balance of Payments from Bank of Thailand
6. Tourism Satellite Accounts from Tourism Authority of Thailand
7. Capital Accounts of Thailand

It is also aimed to make a coherent picture from the data obtained as data from various sources may not inform the same story. Hence, it is very useful to cross verify data

from those multiple sources. In doing so, this study follows the strategy for incorporating the seemingly contradictory information provided in Mai, et. al. (2010). The practice to make the coherence of the macroeconomic data is, first, to set the hierarchy of the information obtained. Normally, Gross Domestic Products or GDP is the most important information to be considered as the first priority. It is a suggestion that for the study developing a baseline for trade analysis, the trade information would be of more important than other components. This study focuses on tourism, thus, the trade information would be of minor ranking, comparing to tourism. Hence, GDP would mostly be set as given and adjust the other components, correspondingly.

With the different sources or even the same source of data, the data inconsistency does possibly present and is often difficult to neglect. After priority ranking and choosing, the calculation for the coherence of overall data becomes a subsequence. The tuning for GDP and GDP components to be coherent could be clearly accustomed by considering Table 6.3. The growth rates of GDP components should be consistent with the GDP identity, however, things are not as they seem.

National Income Accounts of Thailand (NIA) is the data source for the real growth rates of the GDP components using Chain-Value measures. The multiplication of the level forms of each real GDP component with its own respective growth rate gives the implied change of each component. All in total summed up should be the change of the overall real GDP according to the GDP identity. The calculation has shown that the real GDP growth itself multiplied with its own level accordingly give the result not equal to the amount summing up by each component and, thus, the GDP identity fails to hold.

The technical way suggested in Mai et. al. (2010) to deal with the data inconsistency is to scale the growth rates of GDP components proportionately until they become consistent with the real GDP growth rate. Thus, it means that the GDP growth is considered as more reliable than the growth rates of its components and the growth pattern of the GDP components is still preserved.

In this thesis, all GDP components are scaled and adjust proportionately to the GDP growth. Therefore, the information of the growth rates of GDP components still are coherent with overall pattern in terms of the GDP identity.

6.5. Baseline Simulation

Table 6.3 shows the historical macroeconomic data of Thai economy during 2001-2011 with three averages: decade average, first half of the decade average (2001-2006) and second half of the decade average (2007-2011). This study intends to develop the baseline from these three averages in three scenarios.

Why three scenarios? The reason for delivering three baselines upon decade average, the first half and the second half of the previous decade is that, from the Table, It could be seen that Thai economy had experienced the fluctuation of real GDP growth, growing for the beginning of the decade with the sharp oscillating slow-down in the recent years. The Thai economy has evolved moderately in the first half, only the unfortunate event of tsunami on the southern region that affected Tourism on the day after Christmas day of 2004, which took effects in the early 2005, and the occasional SARS and bird flu during 2003-2005. The second half of the decade has been in frequent trepidation of external shocks ranging from political crises, starting from 2006 military coup with consequences of turmoil from 2007, world economic recession, and natural disasters of the flood. The worst flood in 70 years was in the last quarter of 2011, which dropped the economic growth to -9 per cent in only one quarter. Political turmoil is concerned as economic hindrance whereas flooding became unexpected catastrophic incident, although overall economic potential has been fair. Decade average could later give a picture of the future events as it has a basis on the average growth of all preference and technological changes ever happened through the period, but this may not be fully reflective as the Thai economy of the previous decade was with high oscillation disturbed from various external shocks. This study regards these matters to discern the facts by giving two more scenarios of the first half and the second half of the decade for the abovementioned reasons. They could also be regarded as optimism and pessimism scenarios according to those two half decades rather than only the information of the decade average one.

In order to incorporate such macroeconomic growth into the model, nevertheless, the data inconsistency problem is needed to be fixed since the sum of all level terms of macroeconomic components (C+I+G+X-M+7+8) of GDP after multiplying to its own growth would not be equal to the level terms of GDP after multiplying to the GDP growth. Thus, overall adjustment has been carried out to sustain the GDP identity.

Table 6.3: Historical Macroeconomic Data 2001 – 2011 (real terms)

GDP and Macro % growth	% GDP	% C	% I	% G	% X	% M	% Tour Growth	% GDP Deflator	% Employ Growth
2001	3.45	5.91	1.83	2.63	-0.02	1.47	3.01	2.07	2.59
2002	6.19	6.30	6.19	3.40	5.89	6.22	7.32	0.82	2.98
2003	7.18	7.32	12.64	5.21	9.13	11.10	-7.42	1.33	2.36
2004	6.32	7.49	15.86	3.92	14.63	20.30	20.28	3.13	2.62
2005	4.18	4.21	14.28	8.04	7.73	16.15	-10.81	4.49	1.52
2006	4.94	2.84	2.61	2.28	10.79	2.96	25.18	5.24	1.21
2007	5.45	1.18	1.75	8.54	8.90	4.19	10.59	3.45	1.58
2008	1.65	2.88	2.34	4.97	6.24	11.39	-3.53	3.93	2.12
2009	-1.12	-1.36	-9.33	9.00	-12.29	-20.93	-9.22	1.95	1.86
2010p	7.53	5.21	10.22	7.40	14.50	22.56	12.00	3.66	0.88
2011p	0.10	1.30	3.30	1.40	9.50	13.60	12.86	4.2	1.12
Dec Avg	4.17	3.93	5.61	5.16	6.82	8.09	5.48	3.11	1.90
Avg 01-06	5.37	5.68	8.90	4.25	8.03	9.70	6.26	2.85	2.22
Avg 07-11	2.72	1.84	1.66	6.26	5.37	6.16	4.54	3.44	1.51

Source: National Income Accounts, Bank of Thailand, Ministry of Tourism and Sports and Author's calculation.

Table 6.4: Adjusted average of macro inputs for baseline Simulation and GDP result

GDP and Macro % growth	***% GDP***	% C	% I	% G	% X	% M	% Tour Growth	% GDP Deflator	% Employ Growth
Dec Avg	*4.69*	4.36	5.99	6.60	8.06	9.51	6.52	3.11	1.90
Avg 01-06	*5.56*	5.68	8.91	4.25	8.03	9.71	6.27	2.85	2.22
Avg 07-11	*3.65*	2.77	2.49	9.42	8.08	9.27	6.83	3.44	1.51

Source: Simulation result and author's calculation

Note: GDP is endogenous for baseline. Assume same rate of population growth of 0.73 over the period

After the data inconsistency is solved, the baseline simulation is performed according to the historical closure. Table 6.4 shows the adjusted macroeconomic data inputs of during 2001-2011 for baseline simulation using first half and second half averages. This study applies the growth of all these macroeconomic variables into the model to develop the baseline simulation starting from the snapshot of the economy provided by the TSA for the year 2000, except only GDP which is left as an endogenous variable serving as a targeting term. GDP is set endogenous, but its main macro components are all exogenous. GDP is then determined by those main macro components (through (E1) Y=C+I+G+X+7-M+8 where 7 is inbound tourism and 8 is domestic tourism as shown in Table 6.1). All the shifters associated could then be estimated from historical simulation. For example, using BOTE, through (E2), Y is determined from its components and K (predetermined by the known I or investment

in the database) and Lnd are also exogenous. Employment growths (L) are exogenously observed, then the technological term or A could be traced. In this sense, the preferences and technological terms could be traced. (For more step-by-step information, see p.35 in Mai (2010)). The expected results are the information on the preferences and the technological terms based on the average of the first half and second half of the decade, including GDP, which is already shown in Table 6.4.

It is worth to note that it is assumed that domestic tourism has the same real growth rate as the real consumption as it is also assumed in the model that domestic (national) tourism bundles proportionately follows the growth of real aggregate consumption while the inbound tourism's real growth is calculated from the travel receipts item in the Balance of Payments using the consumer price index (calculating from Tourism-related price indexes) as the deflator.

Table 6.5: Some associated preferences, structural and technological terms

Year	Shifts in house hold pref.	General capital growth shifter	Shifts in govern ment demand	Shifts in export demand schedules	Import/ domestic preference shifts	Shifts in Inbound tourists' demand	All factor augment ing tech change
2001	-0.9897	0.0029	4.1960	16.0847	7.2556	19.0240	-2.8965
2002	-0.7879	0.0047	4.2140	18.6625	5.7946	18.8721	-2.8573
2003	-1.0095	0.0034	4.2340	17.3616	6.4772	18.0700	-2.8324
2004	-0.9283	0.0041	4.2590	18.3064	6.1817	18.8594	-2.7349
2005	-1.0761	0.0031	4.2860	17.6125	6.6583	18.2718	-2.6420
2006	-1.0379	0.0034	4.3170	18.2625	6.5839	18.7916	-2.5203
2007	-2.8911	0.0047	9.7200	28.7192	13.6564	37.2849	-0.5593
2008	-3.3242	0.0028	9.4880	29.0202	12.6860	29.6805	-1.0176
2009	-3.3772	0.0045	9.4150	29.7671	12.2915	34.9730	-1.2913
2010	-3.6260	0.0041	9.3030	29.5056	12.2516	32.7267	-1.5315
2011	-3.7884	0.0049	9.1810	29.7837	12.0531	34.1390	-1.7629
Dec Avg	-2.0760	0.0039	6.6012	23.0078	9.2627	25.5175	-2.0587
Avg 01-06	-0.9716	0.0036	4.2510	17.7150	6.4919	18.6482	-2.7472
Avg 07-11	-3.4014	0.0042	9.4214	29.3592	12.5877	33.7608	-1.2325

Source: Simulation results

Note: For any augmenting technological changes, negative term means improvement. This derives from the fact that the production function is defined as Y=(1/A)*(K,L) where A is the technical (or technological) change term.

Table 6.5 shows the simulation results of some associated preferences, structural and technological terms in attention. These behavioural and structural terms will be used to project the economy forward in the forecast simulations in the next chapter, also in

three scenarios of decade average, average of first half and average of second half of the decade. It is also important to note that the preference and technological terms in this baseline simulation are based on the averages of the historical macroeconomic data. Hence, the function of the updated input-output table of this baseline simulation is interpreted as the updated average of that half decade, not similar to the conventional historical simulation, for which the historical baseline normally comes from the average of annual updating. The sum of annual updated input-output tables of that half decade is hypothetically similar to the sum of the updated average of the same half decade. All in all, it is the final product of the baseline simulation that is the main attention in order to obtain the inputs for developing the baseline forecasts, which is the trend average of the preference and technological terms. The main difference is the method to make an average before or after.

Discussion of Structural Shifts

This part discusses the main findings from the historical simulation, as shown by the results of Table 6.5, in which all available shocks have been applied.

- Household Preferences

Column 1 in Table 6.5 reports overall changes in household preferences revealed by the historical simulation. Shifts of household preference show contraction on the decade average. The 2.076 per cent decrease in household taste means that at any given pries and income, consumption per household would be 2.076 per cent lower on average than the base year. It is lower for the second half comparing to the first half of the decade (-3.401 per cent comparing to -0.971 per cent). This signifies the shrinkage of the consumption trend supporting the fact that there have been frequent economic instabilities and negative external factors in the latter half of the decade.

Table 6.6 reports taste changes by commodity-wise, Thai consumers mainly favoured *Accommodation, Construction, Trade and repair of goods, Transport equipment rental, Agriculture, Manufacture of wood products, Services, Travel Agencies and similar,* and *Restaurant*. Tastes change away from *Manufacture of glass products, Mining and quarrying, Air passenger transport services, Publishing and Printing,* and *Manufacture of ceramic wares.* Other commodities are of insignificant changes.

Table 6.6: Some sectoral structural changes in the economy, 2001-2011 (%)

Sectors		Household tastes	I/K ratios
No.	**Dimension**	**COM**	**IND**
1	Accommodation	1.35	4.67
2	Second home ownership	0.35	-1.57
3	Restaurant and similar	0.93	0.19
4	Railway passenger transport services	-0.06	3.79
5	Road passenger transport services	0.46	2.25
6	Waterway passenger transport services	0.55	3.40
7	Air passenger transport services	-1.01	4.81
8	Transport supporting services	-0.49	3.12
9	Transport equipment rental	1.33	1.66
10	Travel agencies and similar	1.00	1.68
11	Cultural services	-0.43	5.34
12	Sporting and other recreational services	-0.25	2.99
13	Growing of fruit & flowers	0.78	0.71
14	Preserving of foods	-0.25	4.91
15	Manufacture of dairy products	-0.10	-4.76
16	Manufacture of bakery products	0.71	0.60
17	Manufacture of coffee and tea	-0.20	-0.21
18	Manufacture of beverages	0.75	-1.64
19	Manufacture of textiles	0.51	2.13
20	Manufacture of leather products	0.59	2.83
21	Manufacture of wood products	1.13	4.40
22	Manufacture of paper and paper products	0.14	3.16
23	Publishing and printing	-0.99	4.04
24	Petroleum refinery	0.10	3.09
25	Manufacture of ceramic wares	-0.76	5.28
26	Manufacture of glass products	-1.23	3.72
27	Manufacture of jewelry and related articles	0.10	3.79
28	Communication	-0.49	1.97
29	Financial intermediation	-0.29	2.89
30	Real estate activities	0.45	-1.67
31	Health	0.15	3.24
32	Community and personal service activities	0.04	4.64
33	Agriculture	1.16	-0.88
34	Mining and quarrying	-1.08	-0.22
35	Manufacturing	0.24	3.86
36	Electricity, gas and water supply	0.80	1.07
37	Construction	1.35	6.70
38	Trade and repair of goods	1.33	2.41
39	Transportation and warehousing services	-0.16	4.61
40	Services	1.09	5.92
	Average	**0.24**	**2.47**

Note: Simulation results

The results are worth to be discussed for the consumption behaviours. Although the taste change was found favoured of necessity matter e.g. *Construction*, *Agriculture*, *Trade and repair of goods*, and *Transport equipment rental*, some commodities or

activities are worth to observe e.g. *Accommodation, Services,* and *Travel Agencies and similar*. This also maybe the case that Thai people have their shifts of consumption patterns towards tourism and services. This may also mean the preference towards the ready to use or ready-made goods or activities e.g. *Restaurant, Services,* and *Travel Agencies and similar*.

- General capital growth shifter and sectoral I/K ratios

Column 2 of Table 6.5 shows general capital growth shifter (a change variable, not percentage change) shows insignificant impact but higher in the second half of the decade. This shifter is mainly endogenised to accommodate the historical simulation, for which the growth of the aggregate investment is known and being exogenous shocks. The uniform shift of investment to capital (I/K) ratio is set exogenous, while industry shifts, or the ratios of investment to capital by industry, are endogenous.

Changes in sectoral investment to capital ratios are reported in Table 6.6. Of all 40 sectors, only 7 sectors have the decreased ratios. The sound investment climate of the Thai economy encouraged by government policies e.g. investment promotions by the Board of Investment attracted both foreign and domestic investments. Although with political instabilities through the period, the strong macroeconomic fundamental still induced investor confidence. The highest change of ratios are *Construction,* followed by *Services, Cultural services, Manufacture of ceramic wares, Preserving of foods, Air passenger transport services*, *Accommodation, Community and personal service activities*, and *Transportation and warehousing services*. These high changes reflect the investor confidence, especially in *Construction* and *Services,* which means the geared development towards the services sector over the period. Services sector grows gradually and has become the highest share in GDP supply side (53 per cent; Agriculture of 9 per cent and Industry of 38 per cent in 2011). I/K ratios dropped for *Manufacture of dairy products, Real estate activities, Manufacture of beverages, Second home ownership, Agriculture, Mining and quarrying,* and *Manufacture of coffee and tea*. The property market, e.g. real estate, experienced a big slump from the 1997 financial crisis, hence, a legally and financially cautious investment in a decade afterwards. Nonetheless, the average investment-capital ratio during the period increased 2.47 percent reflecting the improved investment climate in the economy.

- Overall shift term for government demand

Column 3, Table 6.5 reports the value of government shifter from historical simulation regarding changes in government preferences. The shifts could partly derive from any change in the pattern of budget allocation and fiscal implementation in terms of effectiveness and efficiency. Growth of this shifter may also have arisen as a result of the public administration reforms during the decade that Thailand has experienced. To begin with, the 1997 Constitution was enacted and defined decentralization as one of the national agenda and the 1999 Decentralization Act also provided the structure for decentralization measures. Meanwhile, the World Bank has been actively supporting the public administrative reform efforts for good governance shortly after the onset of the 1997 economic crisis. Subsequently, Thailand International Public Sector Standard Management System and Outcomes was adopted for public sector reform. Since then, there have been many reforms, of which widely aimed to simplify administrative processes and to enhance the public administrative system, including the use of information technologies and improvement in tax collection. Public administration was noticeably redefined, particularly in the Thaksin government (2001-2006) during the first half of the decade, although decentralization was not a big topic in his agenda (Dufhues et.al. (2011)). Thaksin's strategy of enhancing the powers of the unelected provincial governors like corporate Chief Executive Officers (CEO), with full management authority and the final say on all branches of local government including budgets, personnel and various assignments was apparently centralizing while Thailand was decentralizing (Dufhues et.al. (2011)). In terms of public administration, there were promotions of local economic development, investment, employment, trade, and tourism. Rural communities have been empowered in decision-making and policy formulation. People have the right to access information on local management practices, take part in procurement processes, and impeach local representatives and executives. This opened the door for political participation of the rural electorate on the national level. Thaksin's policy to strengthen his political base with the rural population was, consequently, perceived as a threat to the traditional bureaucrats' interests (Dufhues et.al. (2011)). Nonetheless, the practice did continue, after the 2006 coup with the supports of the 2007 constitution, with greater accountability fostered by requiring local government to report annually to the public regarding budget, expenditures, and performance, for which was considered deepening local political

participation and strengthening local authorities and democratic representation at the community level (Charas and Weist 2010). In addition, the more frequent political instabilities in the latter half of the decade partly proved to be another factor of the increase of overall government demand shifter. This also goes along with the results, especially on the second half period (9.421 per cent), for the role on boosting the economy, pacifying the disputes, and remedying the loss.

- Shifts in export demand schedules

Column 4, Table 6.5 shows shifts in export demand schedules for commodities regarding changes in foreigners' preferences for Thai commodities. The positive shifts of export demands could come from a cut in tariffs and other barriers in foreign countries, a decline in the exports prices relative to those of other countries, or an increase in foreign income or in foreigners' preference for Thai export. This includes the changing trade environment. Trade reforms, which reduced trade barriers for exports, such as WTO Agreements, ASEAN Free Trade Area or Bilateral Trade Agreements are also the factors affecting the shift.

After the recovery from financial crisis, Thailand has immensely depended on the growing exports to Asia, EU, and the United States. The rise in export, particularly electronics, including integrated circuits and hard disk drives, and automobiles industries, had improved the trade balance. With over one million cars produced annually since 2005, Thailand has become automobile-exporting country, though mainly from Japanese companies. In 2010, Thailand accounted for over 1.6 million units of vehicle production, or 2.1 percent of global vehicle production, and was ranked the 12th largest producer in the world (Natsuda and Thoburn (2011)). Foreign investors, like Japanese, have contributed to the export shifts by bringing in know-how and technical supports, which lessened the production costs, and giving better access to the more diversified international markets. Trade flows have been increased gradually as well as the surge of foreign capitals with foreign ownership. Furthermore, Thailand has become a member in many trade negotiations and regional integrations. The trade reforms are apparent during the decade. Thailand is a member of the World Trade Organization (WTO), AFTA, and many bilateral trade agreements with other countries. This also supports the 23 per cent increase of the decade average historical simulation and proves to be main engine for the economic growth during the period.

- User preference in favour of (or against) imports

Column 5 in Table 6.5 shows user preference shifts between imported goods and domestically-produced goods. The import/domestic preference shifts was 9.2627 per cent for the decade average, meaning that at any given ratio of import/domestic purchasers' prices and demand, Thailand increased the import/domestic ratio in their demand for imports by 9.2627 per cent over the period. This means that Thailand preferred import goods and services over time. This is also consistent with the rise in import growth, which may reflect the fact that in that period many industries were performed as the assembly industries. Domestic production, especially foreign-owned, tended to purchase more imported goods from foreign suppliers, as raw materials or factors of production, in order to produce outputs. Automobile and Electronics, for example, have been the major export-oriented industries in Thailand, however, they import a great deal of raw materials, capital goods, and know-how technologies either from lower-cost production base in China, allied affiliates in Asian countries, or the parent companies in Japan. For Automobile, Japanese producers have been playing an important role, accounting for 80-90 per cent in production, domestic sales and export activities in Thailand. This also is also in line to the fact that Thailand still has not tried to create its own automotive producers, depending rather on automobile multinational assemblers in collaboration with local capital as joint ventures (Natsuda and Thoburn (2011).

- Shifts of inbound tourists' demand

Column 7, Table 6.5 reports the shifts of inbound tourists' demand. The shifts of inbound tourists' demands could compare to those of export demands. Any cut or amendment of barriers to entry (or travel) for foreigners, a decline or a rise in the travel or tourism-related prices relative to those of other countries, or an increase or decrease in foreign income or in foreigners' preference, which is sensitive, for Thai tourism are associated with this shift. This includes the changing travel atmosphere. The greater average percentage of 33.76 per cent of the shifts of inbound tourists' demand in the second half of the decade (comparing to 18.65 per cent of the first-half) could imply the fact that the frequent instabilities and those setbacks have shown no tendency to deter away the decision-to-come of the inbound tourists, in general.

As having elaborated in Chapter 3, Tourism industry has been distinctively fast-growing and become significant in the Thai economy, accounting about six per cent share of GDP on average during the decade (7.3 per cent share of GDP in 2012). Thailand has been one of the top tourist destinations of the world, with about 1.7 per cent market share of the world in 2010. Bangkok was also identified as the most visited city in the world by the 2013 Global Destination Cities Index. 2001 was the year that Thailand welcomed 10 million visitors in one year, and 2011 was the year that Thailand welcomed 19 million annual visitors, which was almost double and partly supports the almost twice-the-size of the value of the shifters obtained from the historical simulation throughout the decade. Moreover, in 2013, Thailand was the 10th most visited country in the World Tourism Organization (UNWTO) rankings with 26.5 million visitors. This signifies the high popularity from the growing foreigners' preference on Thai tourism. Furthermore, the fact that Thailand has been regarded as one of the major travel destinations with the best value for money in the world, this also supports over-time increasing value of the shifters in term of budget-wise, not only from the cheaper price. In addition, Thai governments have well-recognized the popularity of Thai tourism and released cycles of promotional campaigns for better travel atmosphere, especially after any crisis to achieve fast economic recovery, thorough over the decade (2000-2010). The promotion proved not only inducing the foreign tourists to visit the country, but enhancing the image and theme in proper time.

- All-factor-augmenting technical change

The adoption of new technologies or new how-to of doing business could enhance the all-factor-augmenting technical change, reported in column 8, Table 6.5. This could also be as a result of changes in the economic environment which encourage the more efficient use of resources. Note that a negative value of technical change means technical improvement, because this means fewer inputs are required to produce the similar level of output. There have been primary factor technological improvements each year as shown in the result. Average primary-factor-saving technological change for a decade average, was -2.587 per cent, which means that for a given level of output, the economy used 2.587 per cent less of primary factor inputs. While the technology of the average of first half is higher at 2.7472 per cent less of primary factor inputs and average of second half of the decade is lower at 1.2325 per cent less of primary factor inputs.

The results from the historical simulation have been in corresponding to the main goals of the country's technological development. Thailand has been promoting and supporting scientific and technological development in many areas, emphasizing the integration of research and technological development that is in line with national development policies and strategies for Thailand's sustainable development. This includes technological and management know-how transfer attached with the foreign investment, particularly export-oriented industries e.g. automobile or electronics, as discussed earlier. Using the GERD to GDP ratio as the scientific and technological competitiveness index (GERD: Gross Domestic Expenditure on Research and Development), applied by International Institute for Management Development (IMD) and World Economic Forum (WEF), GERD/GDP ratio contracted from 0.26 in 2003 to 0.24 in 2005 and 0.21 in 2007, later on grew to 0.24 in 2009 and 0.37 in 2011. This partly supports the results of the consecutive lag of the lower technological inputs as R&D expenditure on the effectiveness of the outcome of technical change of the historical simulation as shown in the increasing trend from 2007 – 2011 reported in column 8 of Table 6.5. Nevertheless, GERD to GDP ratio of 0.37 of 2011, although with a growing trend, is still low comparing to other countries e.g. 4.04 of Korea (the highest in the sample reported by IMD). To support this, the Eighth National Research Policy and Strategy (2012-2016) has been laid out by the Office of National Research Council of Thailand (NRCT) to carry on the country's technological development in five major areas: 1) Empowerment through social capital and good governance 2) Empowerment through economic capital 3) Empowerment through natural resources and environment capital 4) Empowerment through science and technology, and finally 5) Unity and efficiency of knowledge management. The anticipated outcomes from implementation of the policy are the progress of the technological development with participation of the government, private and civil sectors in conjunction with local community with special focus on the expansion of existing knowledge and wisdom. It is expected that there will be an increase in research findings that can be utilized for economic, social and public benefits necessary for the promotion of various aspects of public welfare and potentials (NRCT (2011)).

Chapter 7

Forecast Simulations

"Forecast simulations are not an attempt to attribute causes to future events. They simply give our "most likely picture" of future events…."

Dixon and Rimmer (2009)

The forecast simulations are one of the critical applications for 'TRAVELTHAI'. They show the baseline forecasts projected in certain scenarios and give a point of reference for policy simulations. The first section introduces an overview of the simulation and its general process. Baseline forecasts are represented in Section 7.2.

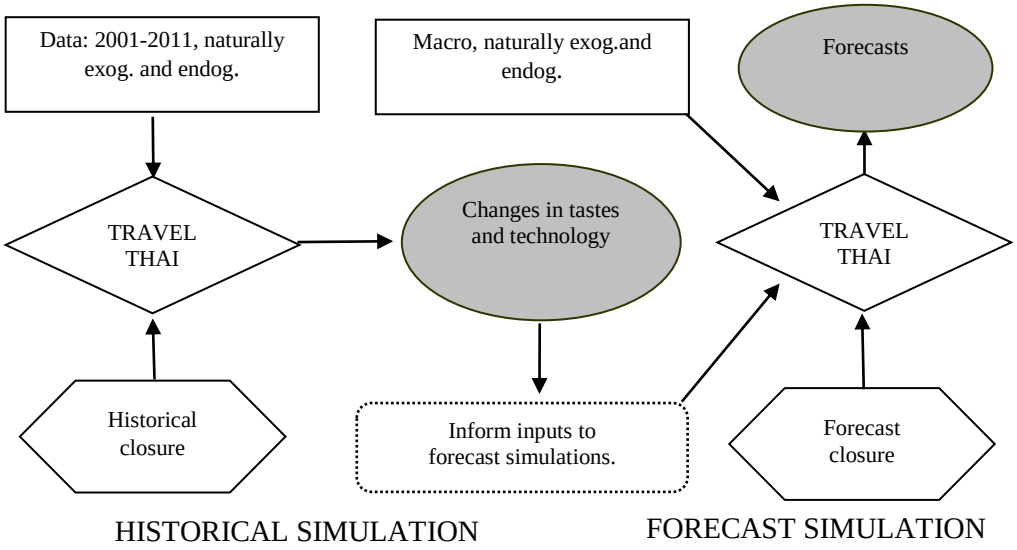
7.1. Introduction

Forecast simulation is aimed to give the projected baseline forecast of the economy upon the basis of the historical simulation as shown in the previous chapter. In this chapter, the forecast simulations are carried out in three main simulations concerning on the economic condition based on the historical macroeconomic data of the previous decade (2001-2011) and the historical baseline simulation: projection on the decade average baseline (2001-2011); projection on the first half baseline (2001-2006) and projection on the second half baseline (2007-2010 and 2011 as the most recent year).

Figure 7.1 reports steps on how to move from historical simulations to forecast simulations. Information on the changes in tastes, preferences and technological including structural terms obtained from historical simulation are regarded as inputs for the forecast simulations. Together with the macro estimates e.g. population growth and forecast closure, the model could perform for the forecast simulations.

Table 7.1 shows the list of forecast closures for forecast simulation. From the values of structural variables like shifts variables and preferences from historical simulation, the assumptions for baseline forecasts could be drawn accordingly, this study assumes the preference and structural terms follow three different trends, which can be formulated into three different scenarios as above-mentioned.

Figure 7.1: Steps from historical simulations to forecast simulations



Source: adapted from Dixon and Rimmer (2002)

Table 7.1: Status of some variables under the historical and forecast closures

Variables exogenous in historical closure, but endogenous in forecast closure	**Corresponding variables which are endogenous in historical closure, but exogenous in forecast closure**
• Real Consumption	• *Shifts in household preferences*
• Import volumes	• *Import/domestic preference shifts*
• Export volumes	• *Shifts in export demand schedules*
• Real Investment	• *General capital growth shifter*
• Capital accumulation shifters	• *Ratio of investment to capital, shift*
• Real Government Consumption	• *Shifts in government preferences*
• Real inbound tourism	• *Shifts in Inbound tourists' demand schedules*
• Nominal exchange rate	• *Consumer price index*
• GDP price index	• *all factor augmenting technical change*
Variables which are exogenous in both historical and forecasting closure	
• Number of households and population	
• c.i.f. import prices in foreign currency	
• Shifts in domestic (national) tourists' demand schedule	
• Tariff rates, real interest rates	
• Land use by industry	
Variables which are endogenous in both historical and forecasting closure	
• Demand for source-specific commodity inputs by industry, for current production	
• Demand for source-specific commodity inputs by industry, for capital creation	
• Prices of source-specific commodity inputs by industry, for current production	
• Prices of source-specific commodity inputs by industry, for capital creation	
• Demand for margin *m* by agent *k* to facilitate purchase of commodity *c* from source *s*	
• Demand for national tourists including both domestic and outbound types	

Source: Adapted from Dixon and Rimmer (2002) and Tran and Giesieke (2006)

7.2. Baseline Forecasts

Three scenarios of the baseline forecasts from 2012-2020 are delivered in this section, as literally called decade average, first half, and second half projections. Basing on the assumption of the historical trend still prevails. The decade average is derived from the average of the percentage growth variables of preference and structural terms in the period 2001 – 2011 in the historical simulation. The first half projection bases the simulation upon the average growth of those preference terms in the period 2001-2006, which is regarded as the period with more moderate economic condition upon the assumption that the Thai economy is going to be on the recovery path for a moderate growth. The second half projection involves the average growth of those preference terms in the period 2007-2011, when there have been a continuous political turbulence and the ongoing effects of the flood, as having been publicly predicted for the next few years and pointed out as one major awareness.

Table 7.2: Historical and forecast simulation: macroeconomic indicators, per cent

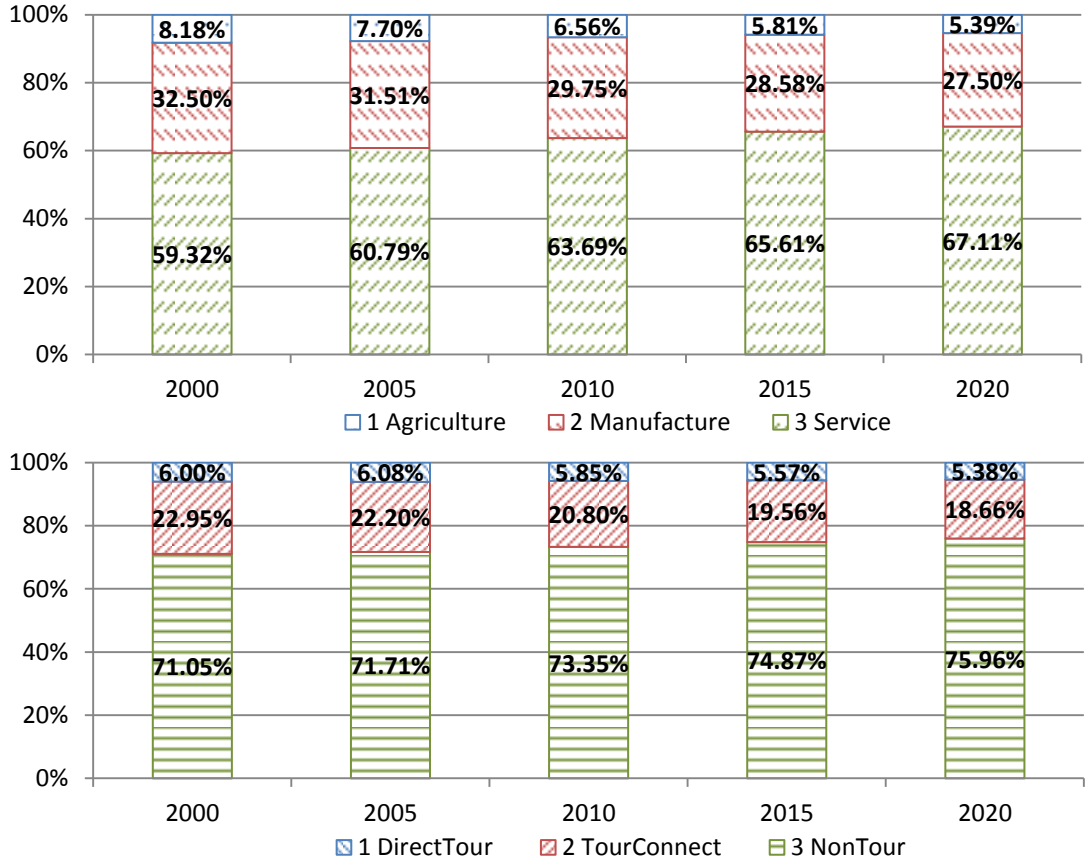
Row	Simulation	History	Decade Average Forecast	First half Forecast	Second half Forecast
	Average annual growth	(2001-2011)	(2012-2020)	(2012-2020)	(2012-2020)
1	Real GDP	4.69	5.85	7.16	3.99
2	Real aggregate consumption	4.36	6.11	7.81	3.75
3	Real aggregate investment	5.99	6.72	6.97	5.90
4	Real aggregate government spending	6.60	6.60	4.25	9.42
5	Real exports	8.06	6.75	8.72	3.36
6	Real imports	9.51	8.12	9.08	6.43
7	Real inbound tourism	6.52	5.60	7.41	2.39
8	Real domestic tourism	2.87	4.55	6.94	1.37
9	Real outbound tourism	6.47	8.31	9.02	7.14
10	Aggregate employment	1.90	1.51	1.51	1.51
11	Aggregate capital stock	3.57	6.44	6.94	5.30
12	Real wage	6.08	10.33	10.36	10.01
13	Price deflator for GDP	3.11	3.73	3.41	4.07
14	All Primary factor augmented tech change	-2.06	-2.04	-2.67	-1.29

Source: Simulation results

Table 7.2 compares the average annual growth of the historical and three forecast simulations. It is simple to notice that decade average is just the average of the first half (optimism) and second half (pessimism) of the decades. Real GDP in the decade average forecast is slightly higher than the history. The main engines come from the higher real aggregate consumption and real aggregate investment whereas it was the trading counterpart of export and import for the history.

The inbound tourism still plays important role following the historical trend, although with a little lower percentage in the case of decade average forecast. The first half of the decade forecast shows an optimistic trend, with the greater percentage of the averages of all types of Tourism while the second half of the decade forecast delivers an insignificant amount of the lowest average annual growth for Tourism, comparing to other GDP components. This supports the pessimistic assumption of frequent disturbances from Tourism setbacks.

Figure 7.2: Historical and forecast simulation: group sectoral shares in GDP, per cent



Source: Simulation results
Note: Decade average forecasts for 2015 and 2020.

Figure 7.2 presents the main group sectoral shares in GDP. There are two types; one is according to Input-Output categorization with Agriculture, Manufacture and Service; the other is according to TSA categorization for Tourism with Direct-Tourism, Tourism-connected and Non-tourism industries. It could be seen that the economic structure evolves with the declining share of Agriculture, Manufacture at the gaining share of the Service and it is also in a similar trend for the rising of Non-Tourism sector at the expense of Direct-Tourism and Tourism-connected.

Baseline forecasts in this chapter are thematically focused on Tourism-related factors and GDP. Forecasts on number of visitors concerning Tourism activities and GDP are presented in comparisons for those scenarios. Note that in forecasting, the population growth has been assigned with the values calculated from the projection of population from 2000-2030 provided by National Statistics Office (The study uses only 2012-2020). The growth rises to 2015, then with the slower rate to 2020. The implication on this is that there is a rising trend of the population, which would later imply the higher labor force and employment. The effect of the increase in population normally is the decrease in real GDP per capita despite the increase in real GDP through employment. And, when GDP increases, it means imports to rise and, consequently, worsening the terms of trade. The capital to labor ratio is to decrease as well as real wage falls. GDP would increase less than the increase in employment, considering the pattern of the effect from the population growth.

Table 7.3: Population growth assigned for forecast closures

Year	Forecasted Population ('000)	Pop Growth (%)
2012	67,912	0.466
2013	68,251	0.499
2014	68,610	0.526
2015	68,980	0.539
2016	69,222	0.351
2017	69,455	0.337
2018	69,679	0.323
2019	69,893	0.307
2020	70,100	0.296

Source: National Statistical Office (in thousand persons)

Figure 7.3 informs three baseline forecasts for GDP growth. It is easy to understand about the economic fluctuation of the previous decade from the period 2001-2011 that is also shown in the figure. The decade average is like the mean for those optimism and pessimism scenarios. The growth ranges from 5.4 – 7.9 per cent to 2.8 – 6.6 per cent. Growth rate declines overtime concerning the price mechanisms.

Figure 7.4 represents three baseline forecasts on the number of inbound visitors. The number of the inbound visitors is expected to grow based on the historical trend from historical simulation. It ranges from 20 – 20.71 million persons in 2012 to 23.6 - 36.35 million persons in 2020.

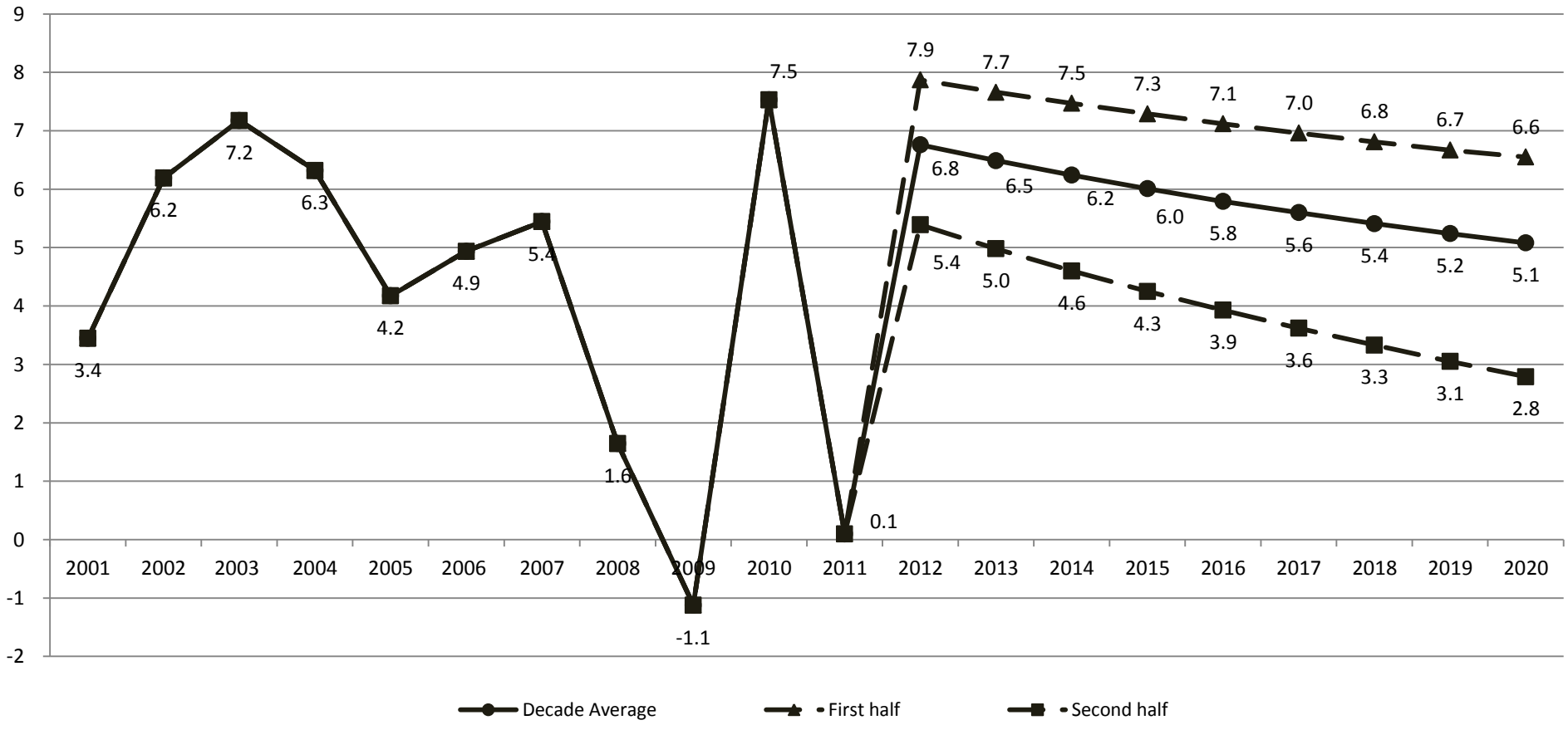
Three baseline forecasts on the number of domestic visitors (person per trip) and the number of outbound visitors are shown in Figure 7.5 and 7.6, respectively. Domestic visitors are expected to grow from 126.8 – 132.8 million trips in 2012 to 139.3 – 225.5 million trips. Outbound visitors are projected to grow from 7.7 – 7.8 million persons in 2012 to 13.2 – 15.46 million persons in 2020.

Figure 7.7 and 7.8 show the respective forecasted amounts of Travel receipts and Travel expenses of the three projections. Travel receipts range from 857 – 888.6 billion baht in 2012 to 1,222.5 to 1,902.4 billion baht in 2020 while Travel expenses range from 180.4 – 188.9 billion baht in 2012 to 233.4 - 375.5 billion baht in 2020. This also constitutes the effects on Travel balance in Figure 7.10 which ranges from 676.6 – 699.6 billion baht in 2012 to 989.1 – 1,526.8 billion baht in 2020.

Figure 7.9 delivers three baseline forecasts the number of domestic tourism revenue. The amount grows from 431.1 – 451.4 billion baht in 2012 to 557.6 – 897.2 billion baht in 2020.

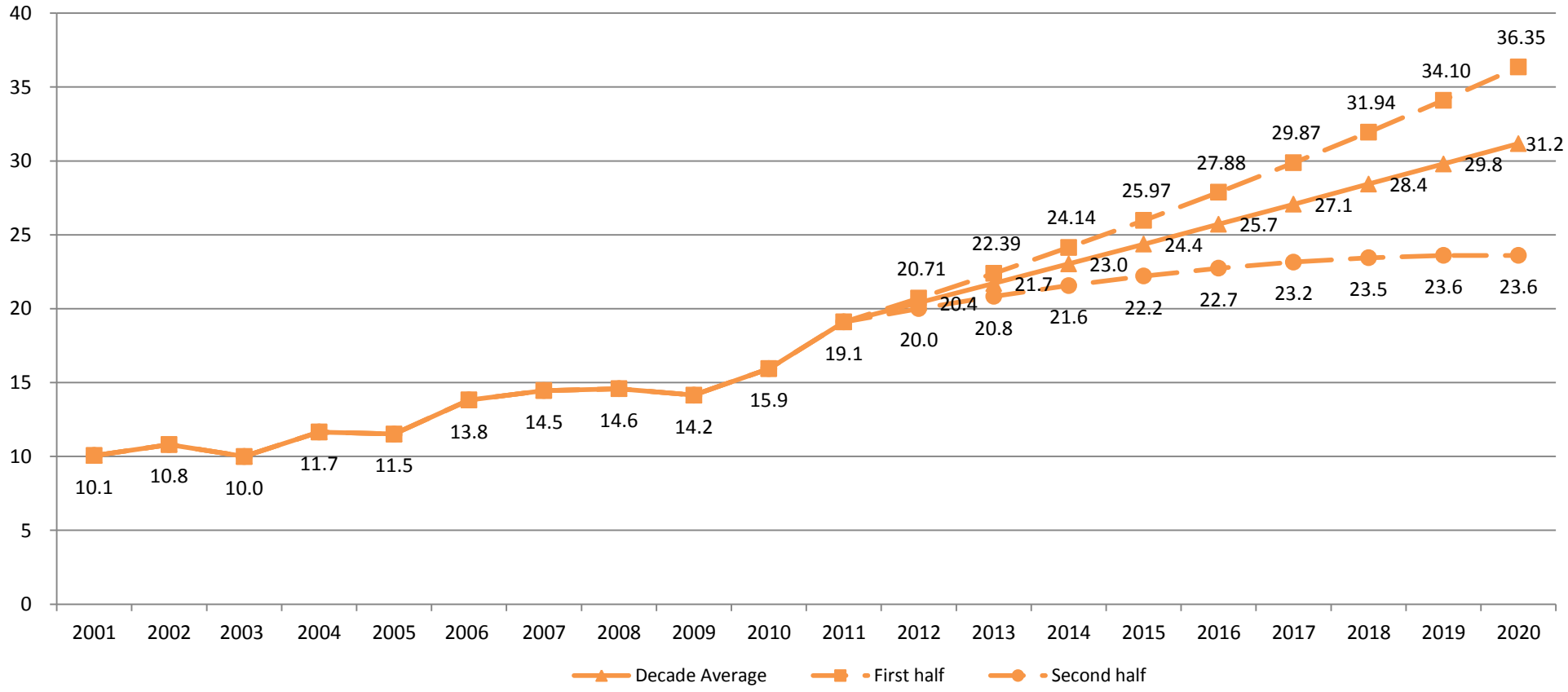
All the baseline forecasts are simulated on the basis of the historical trend from the average preference and shift terms of 2001-2011 and its first half and second half.

Figure 7.3: Three Forecasts on GDP growth (2012-2020)



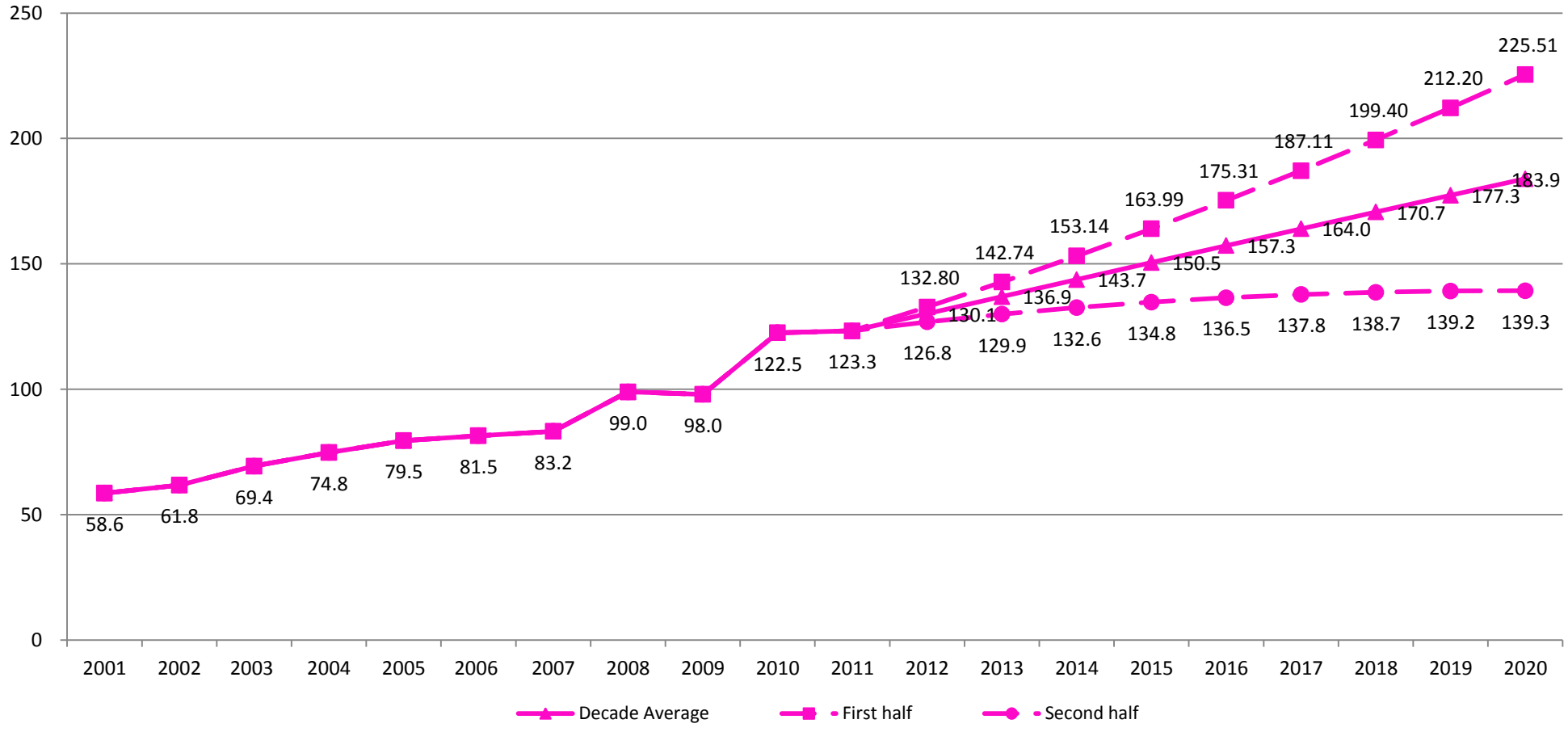
Source: Simulation results

Figure 7.4: Three forecasts on the number of inbound visitors (million)



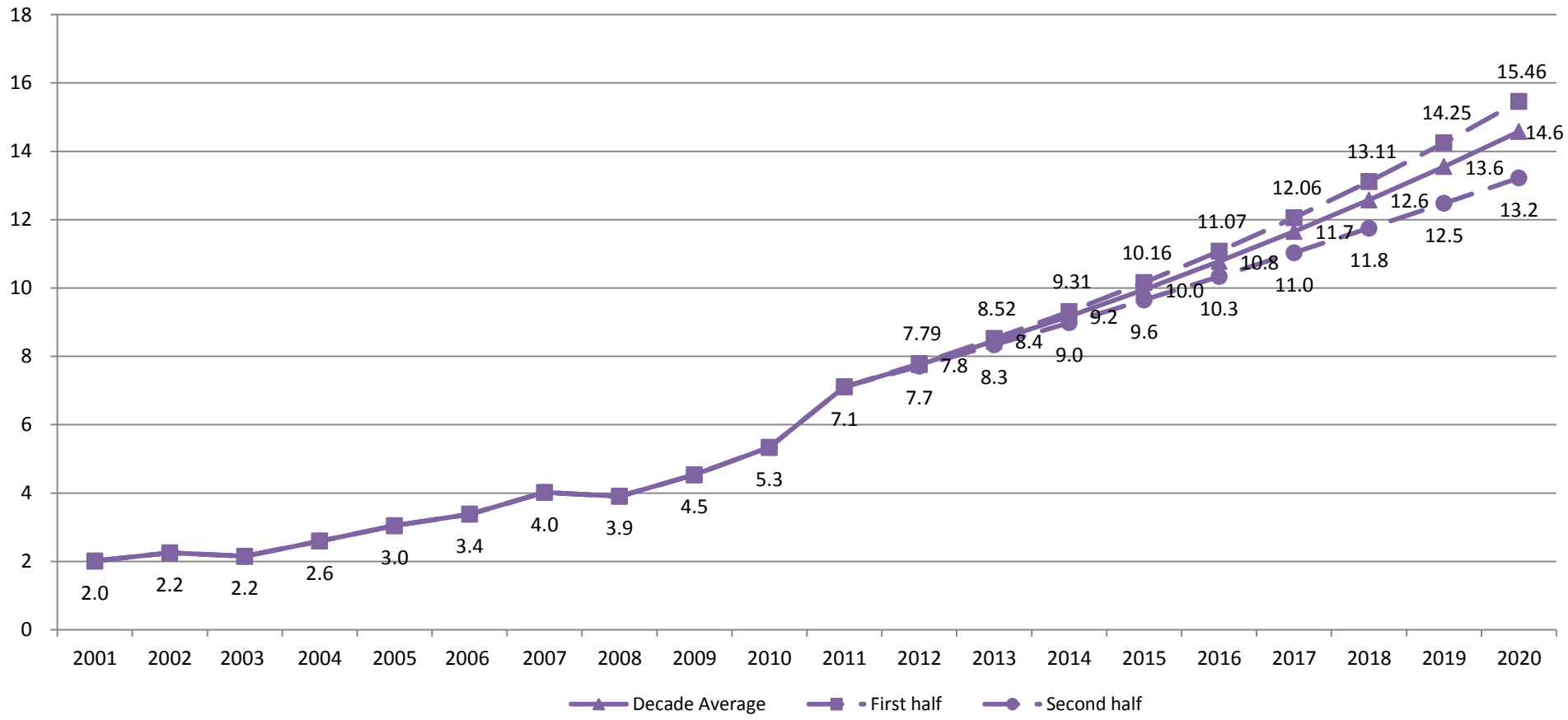
Source: Simulation results

Figure 7.5: Three forecasts on the number of domestic visitors (million trips)



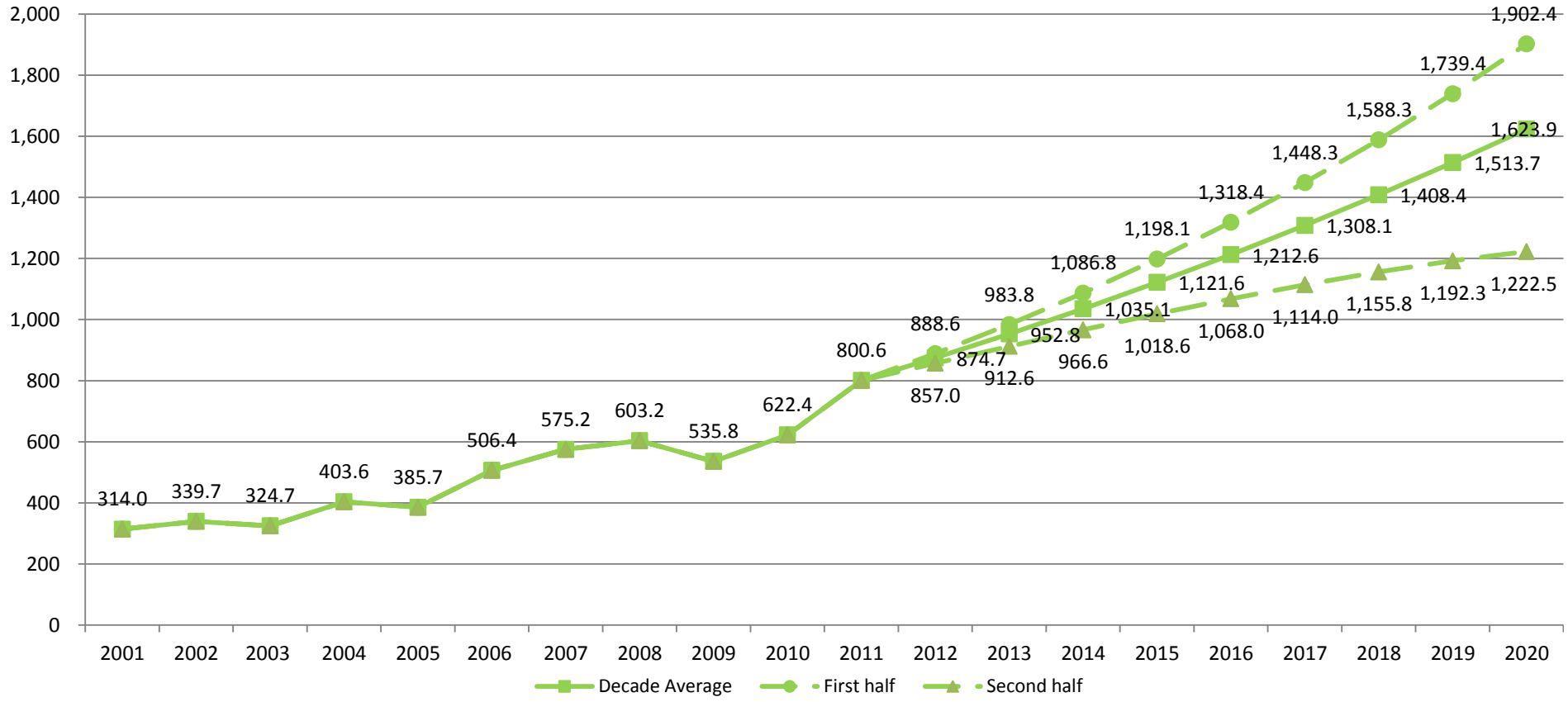
Source: Simulation results

Figure 7.6: Three forecasts on the number of outbound visitors (million)



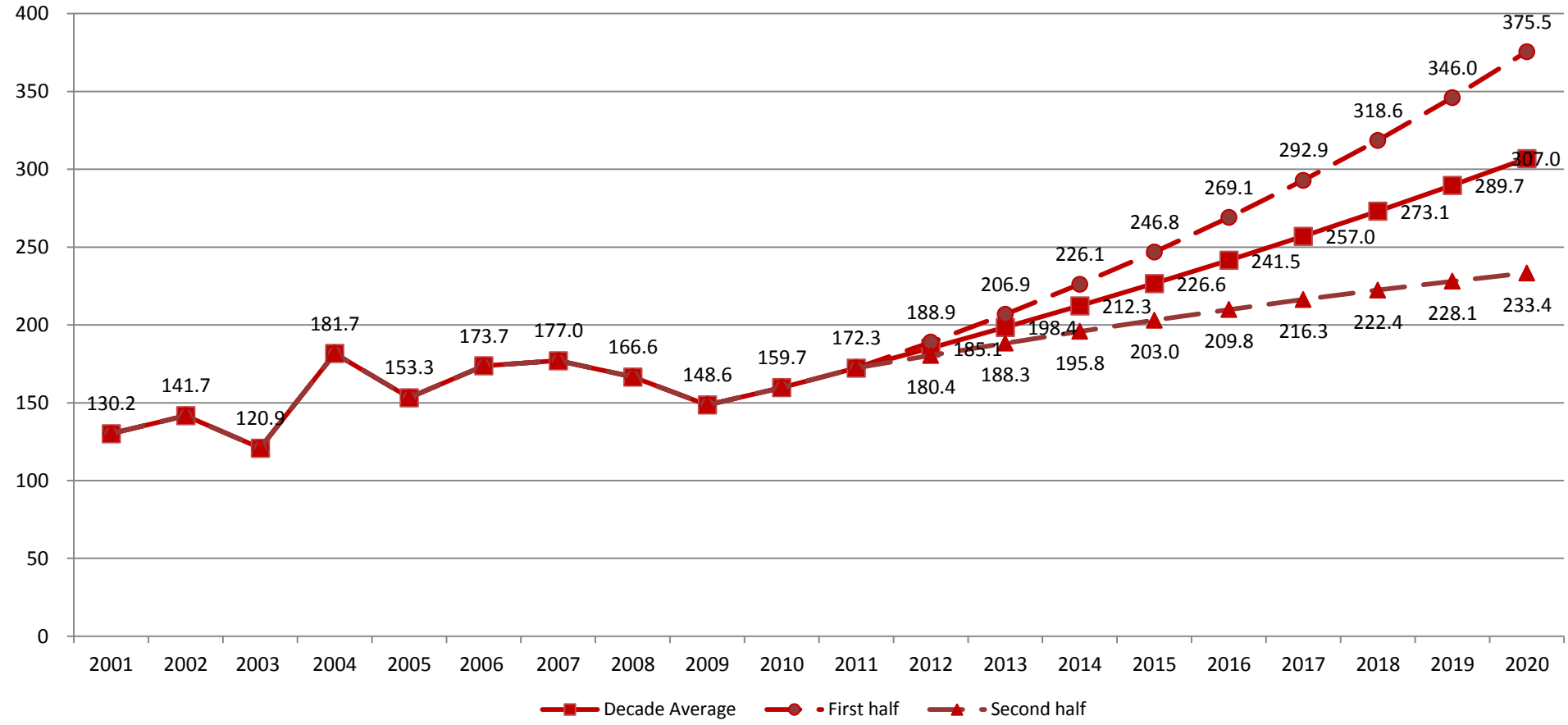
Source: Simulation results

Figure 7.7: Three forecasts on Travel receipts (Billion Baht)



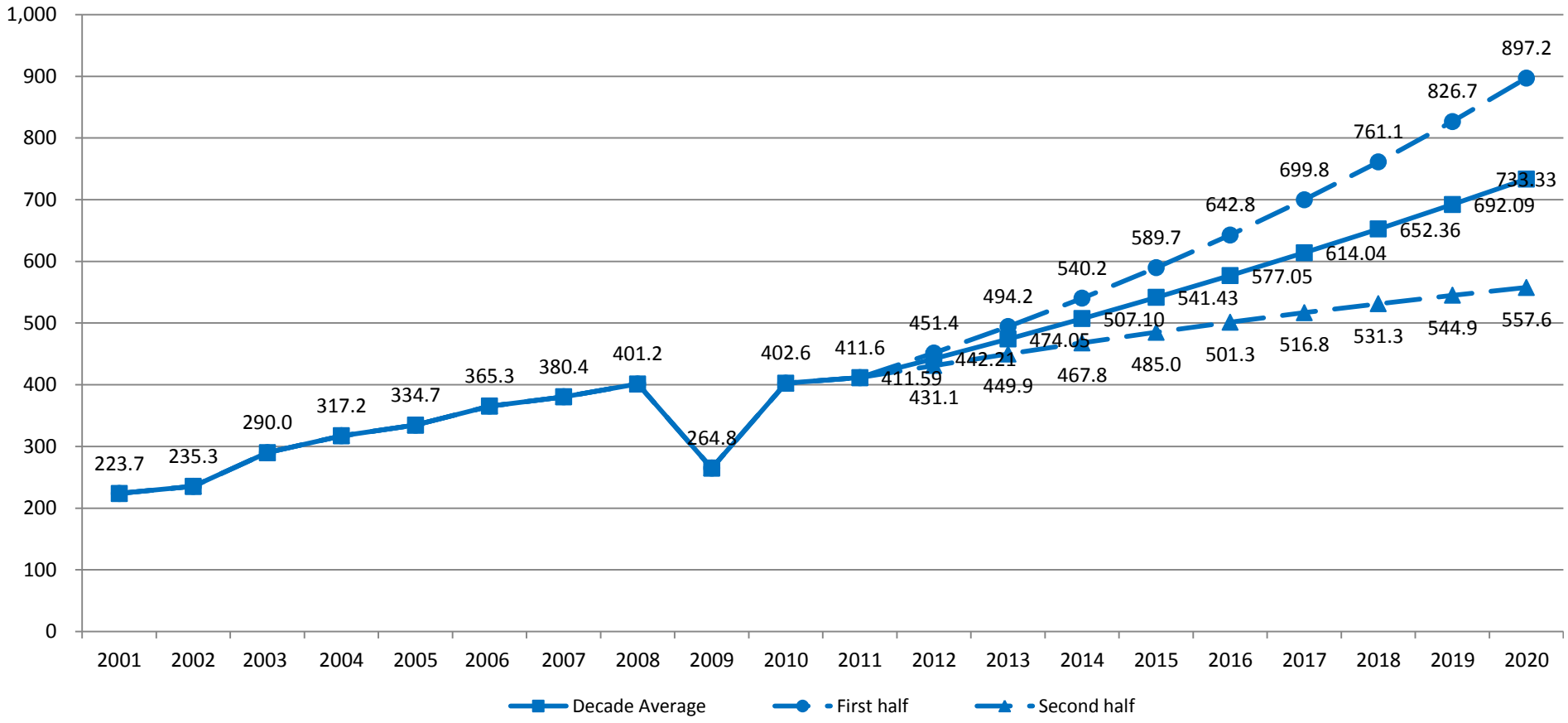
Source: Simulation results

Figure 7.8: Three forecasts on Travel expenses (Billion Baht)



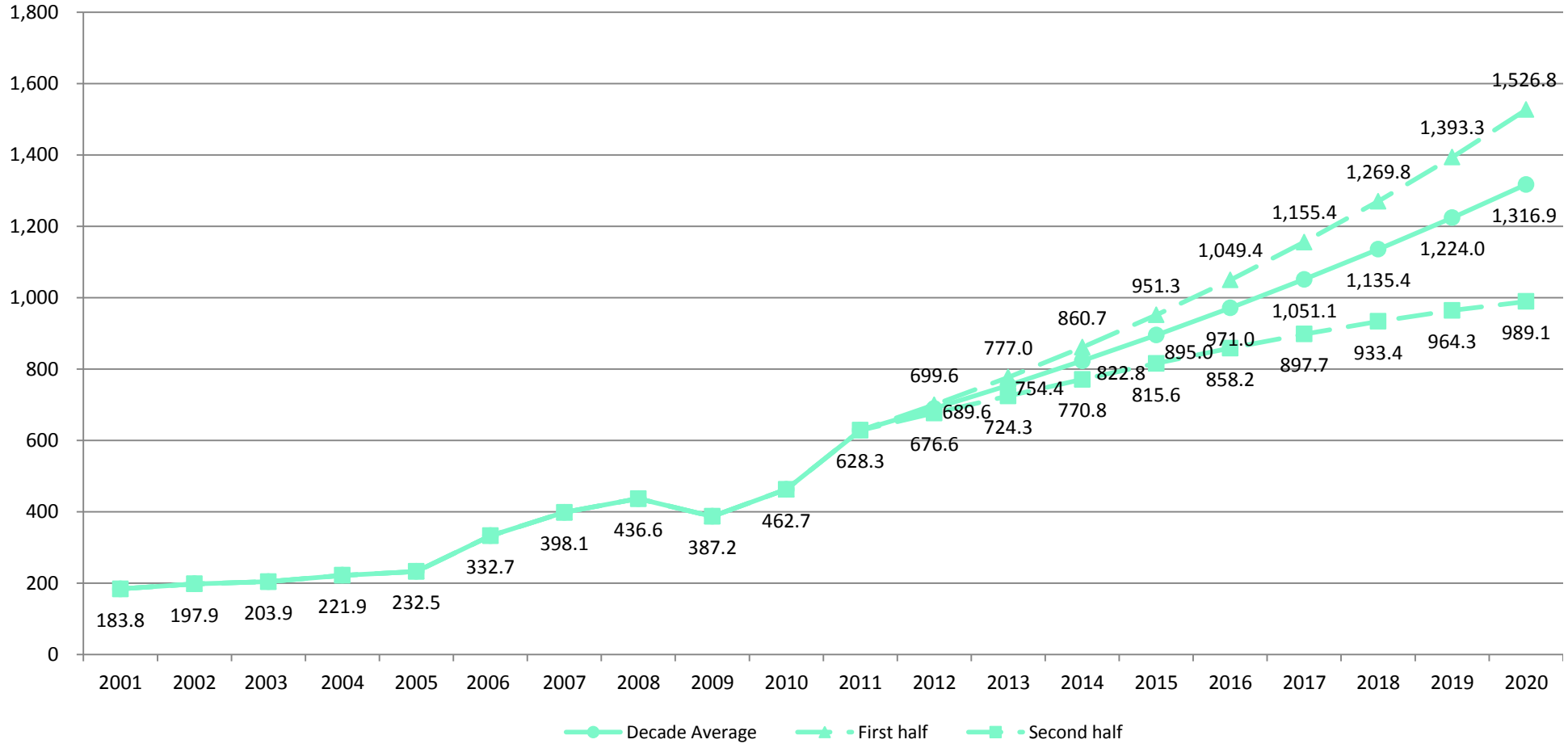
Source: Simulation results

Figure 7.9: Three forecasts on domestic tourism revenue (Billion Baht)



Source: Simulation results

Figure 7.10: Three forecasts on Balance of Travel: 2012-2020



Source: Simulation results

Chapter 8

Policy Simulations: Tourism Setback

"…Attributing causation is the role of policy simulations in which potential future events are explained in terms of changes in naturally exogenous variables, particularly policy variables…"

Dixon and Rimmer (2009)

As one of the objectives for which 'TRAVELTHAI' is aimed to contribute, the policy simulations are highlighted to make a guideline for further research in this chapter. The first section explains the external shocks of Tourism setback in this study. Section 8.2 delivers the results of the external shocks. Section 8.3 ends with the conclusion.

8.1. External shock

This study aims to apply the external shock into TRAVELTHAI model to measure the effects of the Tourism setback. To implement the shock into the model, the first task is to estimate the size of the external shock. The external shocks are difficult to estimate concerning reality. This is because there are many related factors e.g. the case of flood in which the affected areas are vast and the degree of severity is different. The closer approximation would be based on the previous alike incidents. The external shock for this study is based on *what the potential future event will be for the Tourism industry if the recent flood like 2011 is likely to happen again*.

In this section, the magnitudes of the external shock of the 2011 flood are estimated for its impacts on Tourism. Following Giesieke et.al (2010), the external shock of this type is applicable to be formulated into two categories: demand-side behavioral effects and supply-side resource loss effects. These two main types could be seen as the foregone earning of Tourism revenues from behavioral effects and the damage costs of resource losses from the concerning 2011 flood. Four sub-sections are given accordingly: overview of the 2011 flood, shocks from behavioral effects, shocks from resource loss effects and summary of the external shock and underlying assumptions.

8.1.1. Overview of 2011 flood

The 2011 flood in Thailand has been regarded as one of the most expensive natural disasters. The World Bank has estimated 1,425 billion baht or around US$ 45.7 billion economic damages and losses due to flooding, as of 1 December 2011 (World Bank, 2011). Most of the costs was in the manufacturing industry (1,007 billion baht or US$ 32 billion) and 90 per cent were borne by private owners, including seven major industrial estates, which were submerged by as much 3 meters (10 feet). This consequently disrupted the manufacturing supply chains in many productions and caused global shortage in supplies of many intermediate materials, which could last over 2012. Tourism sector was also suffered damages and losses of 95 billion baht or over US$ 3 billion due to the forgone of tourism revenues for around six months (World Bank (2011) and the Economist (2012)). Emergency Operation Center for Flood, Storm and Landslide announced that 65 of the total 77 provinces were declared flood disaster zones, and over 20,000 square kilometers of farmland was damaged (this approximately equals to 7,700 square miles). There were a total of 815 deaths (with 3 missing) and 13.6 million people were affected. Flooding persisted in some areas until 16 January 2012. The flood has been pronounced as "the worst flooding yet in terms of the amount of water and people affected." (AFP, 2011)

The situation of 2011 flood happened through the year with March as the start of the unexpected early rainy season and the effects were continuously varied in different regions, with the severe flood occurred mainly in the southern region for this period. Rainfall in March over the area of northern Thailand was an extraordinary 344% above the mean (Meteorological Department, 2011). Since then, there were five major tropical storms and they were continuous ranging from Haima (June), Nock-Ten (July), Nesat and Haitang (September – October) to Nalgae (October). The severity of the flood began at the end of July started from the mountainous areas in the Northern region and then continuously widespread to the provinces of Northern and Central regions of Thailand along the Chao Phraya river basins. Normally, the water flows along the main rivers and many smaller water canals until it reaches the Gulf of Thailand (for the Northeastern region, it was the case along Chee and Mun rivers to reach Mae Khong river as the main channel), but in year 2011, the system of water channels could not accommodate the unexpected high volume of water from the series of storms. Drainage control systems, irrigation canals and flood detention basins were

inadequate to prevent flood damage. It was also the case that eleven of the country's 26 major dams in the lower Northern region and Central region were unable to store the excessive water in their reservoirs since they were at their full capacity. Hence, they soon had to release the water out with the increasing discharge rates to compensate for incoming flow, which worsened the situation with more flood (The Nation, 2011a).

The situation heightened around the end of September when the flood nearly came to the provinces nearby Bangkok. In the province of Nakhonsawan, the broken sandbag barrier and the collapsed dykes resulted in rapid flooding into the city. The entire municipal area was under a flood level of at least one meter. The worst flooded areas were with the water levels of four meters. Patients had to be evacuated from the hospitals by boats. Electricity and life support systems were disrupted (The Nation, 2011b). Broken floodgates later made the water from Chao Phraya River flowing into wide areas of paddy fields in the provinces of Singburi, Angthong and Ayutthaya. These provinces served as the major water retention for Bangkok. The situation in Ayutthaya was worsened in October as the water entered the city, submerging the whole province including Ayutthaya Historical Site, the World Heritage, and forcing evacuations. Not so long, barriers protecting industrial estates collapsed in the provinces of Ayutthaya, Pathumthani and Nonthaburi, resulting in flooding of major factories and supply chains wreckage, including many suburban residential areas not far from Bangkok. The war-alike situation became worsened as the barrier protecting the water-supply canals was broken resulting in a defeat as the floodwaters contaminated the water-supply for the cities. Although it was later controlled and announced that water-supply was still safe, this frightened people concerning the worsening situation of the flood.

It was November that the situation for Bangkok became high-alerted. Neighborhoods of Bangkok became inundated. Western side of Bangkok became submerged including some districts in the northern side. Governor of Bangkok announced the evacuations for 13 districts as of November 9. This included the Donmuang airport and the nearby areas. The number of the forcing-evacuation districts increased to 17 districts by November 17. As of November 19, there were 36 out of total 50 districts affected from the flood (Matichon, 2011) while downtown Bangkok was saved from

the flood by the end of November, although it still took more than a few months for the flood situation to be relieved.

At the end of the year, Thailand also saw seasonal flash-flooding in the Southern region, although not extreme and dramatic as experienced by the Central region. Many areas of the southern-most provinces of Suratthani, Trang, Patthaloung, Pattani, Songkhla, Yala, and Narathiwas had been announced as disaster zones. The level of the flood was as high as 2-5 meters. The worst were Pattani and Patthaloung where the whole provinces were announced as the emergency zone. Figure 8.1 shows the spatial size of the flood and its concentration in the map of Thailand and the high-lighted effects of the flood as of October 31, 2011 in the news. There are more geographical depictions in Appendix 8.1.

Figure 8.1: Understand the size of the flood and its effects in 5 minutes (Oct 31, 2011)

Source: www.lfpress.com (data on flooded area as of Oct 31; released Nov 2, 2011)

8.1.2. Behavioral effects

Behavioral effects from the floods in this context mean the possible change in the behavior of the visitors or tourists as a consequence of the flood. This study regards this as the demand-sided external shocks in TRAVELTHAI. In this sub-section, reviews of the important estimations concerning the deterring of inbound tourists and national tourists (domestic/outbound) from traveling in /out of Thailand are provided.

The flood in 2001 has caused the country and its Tourism a catastrophe. Ministry of Tourism and Sports estimated the effects as a disappearance of 0.7 million visitor arrivals and this meant to be about 19 billion baht of revenue foregone in the last quarter. 175 attractions in 21 provinces were damaged with the costs of 560 million baht at least. This also gave a decline of six million persons per trip of domestic tourists or around 13 billion baht. Hotel accommodations were shut down 674 out of 6,321 places or about 10 per cent. It was also estimated that the sales for restaurants and related activities in the affected area were dropped 40 per cent or about 1.5 billion baht (Bkkbiznews, 2011).

Tourism Authority of Thailand priori evaluated the flood situation of quarter 4 in 2011 in 2 scenarios. First, the number of domestic tourists dropped about three million person/trips, losing about 7.621 billion baht. The number of foreign visitors declined about 0.2 million persons, losing about 8.5 billion baht. Second, domestic market lost 1.09 million person/trips with foregone earning of 1.01 billion baht. Foreign market dropped 0.07 million persons with foregone earning of 2.7 billion baht. However, this second scenario was stated impossible later by TAT (Prachachat, 2011).

Tourism Council of Thailand also estimated that the target of visitor arrivals was missed about one million persons from the flood and the forgone revenue was around 50 billion baht with the decrease of domestic tourists of 20 per cent or about 50,000 persons per day, which approximated 20-billion-baht forgone earning. The Council had proposed the alleviation measures of transforming the 15,000-baht travel expenses to be a discount of personal income tax and some certain tourist visa exemptions.

For the case of the recent flooding situation in Thailand, the Kasikorn research center had estimated the last quarter effect in 2011 as shown in Table 8.1.

Table 8.1: Scenarios on the Tourists Forecast of Flooding Incidence of 2011

Scenario	Inbound Tourists (mill pp.) Quarter 4	Inbound Tourists (mill pp.) All year	Revenue (Million Baht)	Note
Before flood forecast	4.9	19.29	730,000	
After flood forecast				
1) Flood subsided within November (0.1 million tourists decline in October)	4.55	18.94	715,000	Able to accommodate tourists in December. Decline of 0.25 million tourists.
2) Flood extended to December (0.1 million tourists decline in October)	4.3	18.69	705,000	Unable to accommodate within December. Decline of 0.5 million tourists.

Source: Kasikorn Research Center (released Oct, 2011)

The estimation of the impact on Tourism of both scenarios was on condition that the main international airport (Suvannabhumi airport) was operable and the beaches in the Southern region and Eastern region were not affected. The official announcements on the ways to deal with the flood were effective and able to ensure the tourists.

In 2012, Ministry of Tourism and Sports has targeted the number of international visitors at 19.5 million persons with the revenue of 766 billion baht. For the domestic tourists, the target has been set at 107 million persons per trip with the associated tourism revenue of 442 billion baht. In order to achieve the predetermined targets, the 2.8-billion-baht budget has been allocated with another ongoing proposed amount of 5-billion-baht soft loans for recovering the industry and promoting its private sector (MOTS, 2011).

8.1.3. Resource loss effects

Economic damages and losses due to flooding have been estimated by the World Bank as stated in the overview of the 2011 flood in the above sub-section 8.1.1. Nevertheless, resource loss effects which are concerned to be the supply-sided external shock in TRAVELTHAI are listed in three aspects: the labor productivity changes, the capital damages and losses, and the losses in agricultural areas.

- Labor productivity changes

It is difficult to estimate the changes of labor productivity from flooding. NESDB has

announced that the employment in the fourth quarter of 2011 rose 0.9 per cent despite the flood. Unemployment rate was low while GDP of this quarter dropped nine per cent. Unemployment was a bit increased in November but it declined especially in December. The employment was not as low as expected because the economy still has not reflected the impacts immediately. The reasons given by NESDB were (1) Construction, retail trade and wholesale trade still hired more workers in October when the flood was high-alerted. (2) It took time for business owners to reconcile or make the lay-off contracts while some others tried to reserve the workers even though the productions were pause by the flood. This was also due to the specific skills of the workers, which were not easy to get replaced. (3) Instead of lowering employment, it partly turned out to be a decline in working hours. It showed that there was an implicit unemployment as the workers still be hired (or, still with the contract) but unproductive and this amounted to about 780,584 persons. (4) Seasonal work force was higher but still not included as unemployed. It was the case that there were the helps in terms of unemployment alleviation from the government of which in turn allowed the workers to still obtain the earning although with the lower rate.

In 2012, NESDB made a notice on the issue of employment. There is a high possibility of higher unemployment on the first half of the year after the three-month unemployment alleviation project ends.

Table 8.2: Employment in 2011 and Q1 of 2012 (whole country in thousands persons)

Year	Month	Labour Force	Employed	Unemployed	Seasonal	Unemployment rate
2011	Jan	38,060.0	37,422.5	373.9	263.6	1.0
	Feb	38,076.3	37,553.6	267.7	255.0	0.7
	Mar	38,432.9	37,809.6	276.4	346.9	0.7
	Apr	37,929.8	37,370.3	284.7	274.8	0.8
	May	38,362.0	37,819.3	203.6	339.2	0.5
	Jun	39,126.0	38,886.3	162.7	77.0	0.4
	Jul	39,769.3	39,547.6	205.9	15.8	0.5
	Aug	39,761.3	39,437.7	270.4	53.2	0.7
	Sep	39,233.2	38,864.8	295.3	73.2	0.8
	Oct	38,816.9	38,298.5	219.2	299.2	0.6
	Nov	39,452.7	38,978.7	322.0	152.1	0.8
	Dec	39,784.9	39,493.7	171.7	119.6	0.4
2012	Jan	38,619.2	37,926.9	314.5	377.8	0.8
	Feb	38,798.1	38,057.7	256.3	484.2	0.7
	Mar	38,955.1	38,195.1	284.7	475.4	0.7

Source: NSO and NESDB

Table 8.2 informs the employment from NESDB and NSO in 2011. Unemployment rates were generally low with less than one per cent through 2011. It swung a little bit during the severe flood period (Aug – Dec) and later on a bit increasing to around 0.7 to 0.8 per cent per month in the first quarter of 2012.

The Small and Medium Enterprises Development Bank of Thailand (SMEs Bank) has also estimated that the flood affected 557,637 SMEs with the direct and indirect losses of 71.156 billion baht per month approximately. Of this amount of SMEs, 102,892 businesses are production sector, 264,572 businesses are in the trade and repair sector while 163,976 businesses belong to services sector. This affects the employment of 2,325,644 people.

Labor productivity is typically defined as the average real output per hour of work (inflation-adjusted). It is simply the average quantity of output produced by a given quantity of labor input (Charnsarn, 2011). Bank of Thailand has provided the quarterly labor productivity index as in Table 8.3, which shows a decline relative to 2010 in Q4.

Table 8.3: Labour Productivity Index per employed persons by sectors (2010-11)

Labour Productivity Index per employed persons	**2010**				**2011**			
	Q1	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Agriculture	129.6	104.8	77.8	130.1	136.5	105.1	76.4	132.4
Agriculture, Hunting and Forestry	123.9	103.3	74.7	125.3	132.5	104.9	74.1	128.7
Fishing	157.2	115.6	145.7	194.1	187.5	121.6	113.0	176.6
Non-Agriculture	119.1	114.6	121.8	126.5	122.7	119.1	125.2	111.2
Mining Quarrying and Others	132.9	158.4	194.0	123.0	105.3	127.1	130.5	130.5
Manufacturing	152.8	150.7	155.2	161.8	158.5	153.8	158.7	126.9
Electricity,Gas and Water Supply	133.1	165.2	158.9	126.7	76.9	78.9	90.3	81.1
Construction	78.0	78.4	119.4	94.0	74.1	77.5	108.2	86.2
Wholesale and Retail Trade, Repair	103.2	92.5	96.4	98.9	108.6	100.8	102.7	98.7
Hotels and Restaurants	101.3	92.8	106.4	122.8	121.6	113.7	114.7	123.4
Transport, storage & Communication	122.9	111.1	129.7	141.1	137.5	134.5	147.3	141.7
Financial Intermediation	169.4	173.0	182.2	169.5	173.6	181.7	200.4	174.4
Real Estate, Renting and Business	92.3	92.9	89.5	99.2	87.3	81.9	86.0	86.3
Public Administration and Defence; Compulsory Social Security	98.8	85.6	80.1	86.4	85.9	81.0	83.9	75.6
Education	111.7	109.1	107.6	111.4	105.6	107.9	109.6	102.3
Health and Social Work	87.3	84.6	89.4	92.8	71.6	63.0	68.9	75.8
Other Community, Social & Personal Service Activities	107.6	116.5	129.2	139.4	154.6	147.9	145.6	135.1
Private Household w/ Employed Person	126.1	116.0	124.6	112.4	117.6	109.6	121.6	109.8
Total	131.4	123.7	120.1	128.8	134.8	125.4	122.6	116.2

Source: BOT

- Capital damages and losses

It seemed that the 2011 flood slowly crawled during the flooding period. It actually hit hard when it happened and in many cases it came as flash-flooded. Water came through the small and tiny leakages on the house floors or on the walls of the building and the fact that it was difficult to prevent as it was quite impossible to find those small leakages on the surfaces. Thus, in just a few hours, the level of the water could rise up to at least one foot. Many buildings, houses, and infrastructures including the machines, which are considered to be a factor of production in terms of capital, were damaged by the water.

Ratanavong (2012) estimated the damages and losses using Damage and Loss Assessment (DaLA) methodology. The spatial definitions were applied to the affected area and broken down by geo-political divisions. Damage is defined as the immediate effects, which include destruction of physical assets occurring at time of natural event (this case, flooding) and measured in physical units and at replacement value. Losses, in turn, are defined as medium term effects which include the changes in economic flows occurring for a relative longer period and expressed in the current values. Total effects are the sum of damages and losses. The data for damages and losses obtained from initial desk assessment and appraisal surveys. It was also suggested that the highest priority in six months after the flood is to expedite the rapid and full recovery of all services, particularly, industrial estates. The risk reduction measures and improvement on resiliency in preparation for any possible events of disaster should be restored, including network redundancies to avoid any failure. Table 8.4 shows information on the damages and losses by Ratanavong, ESCAP.

The total effects are arranged in two categories: disaster effects by DaLA method and the public/private ownership. There are four main sectors: infrastructure, production, social, and cross-cutting. Manufacturing of the production sector in the Table 8.4 is the most affected. Main interests for this study are Tourism and Cultural heritages. They were estimated with damages and losses for 94,807 million baht and 7,505 million baht, respectively. And, as being stated earlier in the overview, the private owners were borne with the cost of around 1,284,066 million baht of the total 1,425,543 million baht or about 90 per cent.

Table 8.4: Information on damages and losses by group of sectors (million baht)

Sector	Disaster effects			Ownership		
	Damages	Losses	Total	Public	Private	Total
Infrastructure						
Water resources management	8,715	-	8,715	8,715	-	8,715
Transport	23,538	6,938	30,476	30,326	150	30,476
Telecommunication	1,290	2,558	3,848	1,597	2,251	3,848
Electricity	3,186	5,716	8,902	5,385	3,517	8,902
Water supply and sanitation	3,497	1,984	5,481	5,481	-	5,481
Production						
Agriculture, Livestock and Fishery	5,666	34,715	40,381	-	40,381	40,381
Manufacturing	513,881	493,258	1,007,139	-	1,007,139	1,007,139
Tourism	5,134	89,673	94,807	403	94,405	94,808
Finance & Banking	-	115,276	115,276	74,076	41,200	115,276
Social						
Health	1,684	2,133	3,817	1,627	2,190	3,817
Education	13,051	1,798	14,849	10,614	4,235	14,849
Housing	45,908	37,889	83,797	-	83,797	83,797
Cultural Heritage	4,429	3,076	7,505	3,041	4,463	7,504
Cross cutting						
Environment	375	176	551	212	339	551
Total	630,354	795,191	1,425,545	141,477	1,284,066	1,425,543

Source: Ratanavong, ESCAP (2012)

Table 8.5 tells the regional output and value added per month of the flooded areas before flooding. The regional information on this table is calculated and summed up from the output and value added per month by affected provinces and districts before the flood happened. It should also be reminded that the flooding would affect these areas differently concerning the level of severity and flood exposure. It also depends on how the businesses reacted to the situation at hand. Hence, the productivity during the period of flooding would be different accordingly. This study uses the information on this table together with the estimation of the losses assessed by Ratanavong (2012) for calculating the size of the external shock on capital damages.

- Losses in agricultural areas

Table 8.6 tells the summary of the estimation of the agricultural areas being flooded calculated from the details of provincial flooded area. There were 48 provinces with the areas being flooded more than seven days. The total affected areas were

approximately 13,738,829 – 13,752,745 rai (1 rai is 1,600 square meters) of the agricultural areas of more than seven days being flooded (Note on the prior estimation by the Office of Natural Calamity and Agricultural Risk Prevention using the satellite RADARSAT-1, Landsat-5, SPOT-2, SPOT-4 and ALOS from GISTDA from March - December 2012 needs actual surveys supported. At this stage, it still contains errors but considered the best option for external shock estimation as it has wide ranges of details). The total affected agricultural areas of being flooded (including less than seven days being flooded) were 24,293,229 rai of 66 provinces. The flooded agricultural areas estimated for Bangkok was a bit higher than the agricultural areas surveyed by the Land Development Department. This study assumes away all the agricultural areas in Bangkok were fully flooded for the sake of water retention areas.

Although the survival rates of any kind of the crops being flooded more than seven days are varied and this depends on many factors i.e. the seriousness of the flood, the managerial skills of the farmers, the strengths of the crops themselves, the affected areas, etc., it is assumed that the flood perished away the operability of the land as the factor of production for agricultural sector for the areas being flooded more than seven days. The flood lasted in some areas until the mid of January 2012, with the serious situation for around six non-consecutive months (March, July – December 2011) in different regions. This makes the total of about 9.05 per cent of agricultural areas being flooded more than seven days for the whole country.

It is also assumed that the seasonal crops could not be fully planted effectively for those flooded areas during the flooding period. Rice or Paddy, as the major crop of Thailand, normally has two main seasons: normal season (May – October and cultivated until February) and off-season (January – April). It was also the announced by MOAC that the 2011 rice production for normal season was declined, but higher for the off-season as it was in total 31 million metric tons (comprised of normal-season 20 million metric tons and off-season 11 million metric tons) for 2011-2012 production (Daily news, 2012).

Table 8.7 and Table 8.8 give some supplementary details for the previous overall damages from flood and subsidization of the whole country provided by the Department of Disaster Prevention and Mitigation from 1989 - 2010.

Table 8.5: Information on the cost and value added (per month) before flooding

No.	Region	Districts Affected	Tambon Affected	No.HH Affected	Pop Affected	Number of Businesses affected, classified by size				Affected Cost/month	Affected Value Added/month
						Total	1-5 pp	6-10 pp	>11 pp		
1	Northern	62	386	904,437	3,930,869	100,731	94,287	3,767	2,747	11,906,783	2,810,141
2	Northeastern	77	614	1,225,810	4,155,475	167,685	160,704	3,778	3,203	14,138,831	5,627,118
3	Central	82	776	2,119,603	6,207,602	173,162	156,501	8,410	8,241	131,773,848	41,061,548
4	Bangkok	37	130	6,307,701	2,143,618	209,152	171,886	18,436	18,830	295,193,585	63,661,027
5	Eastern	26	185	529,065	1,679,136	36,142	32,449	1,357	1,336	26,915,240	7,678,360
6	Western	9	64	134,354	492,783	11,163	10,202	553	408	2,405,330	543,287
7	Southern	25	145	342,192	1,231,295	32,013	30,378	947	658	9,472,190	2,985,970

Source: NSO.

Note: 1. NSO presented the before-flooding data of the flooded area from their own censuses, the 2010 Population census and 2011 Business and Industry Census.

2. In some areas, the cost and value added per month during flooded would be affected partially, while the fully flooded areas mean all cost and value added were gone.

Table 8.6: Regional agricultural area and percentage of flooded agricultural area (in Rai).

No.	Region	Province	Area (Rai)	Agricultural area (2002)			Agricultural area (2010, *2011)			% growth 2010/2002	2011 Flooded Agri Area	% Flooded of Agri area
				Total	Paddy field	Others	Total	Paddy field	Others			
1	Northern	17	106,027,680	33,384,323	16,240,841	17,143,482	33,391,176	16,181,087	17,210,089	0.02	1,954,887	5.85
2	Northeastern	20	105,533,963	65,480,967	43,789,244	21,691,723	64,992,799	43,264,728	21,728,071	-0.75	1,053,042	1.62
3	Central	8	11,713,521	8,114,616	4,653,079	3,461,537	7,921,650	4,349,753	3,571,897	-2.38	6,651,262	83.96
4	Bangkok*	1	978,263	397,849	170,997	226,852	255,892	139,897	115,995	-35.68	*258,328*	*100.9*
5	Eastern	9	23,441,621	12,884,213	3,121,324	9,762,889	12,063,737	2,731,533	9,332,204	-6.37	1,543,035	12.79
6	Western	8	28,804,848	10,594,137	2,974,962	7,619,175	10,641,892	2,998,812	7,643,080	0.45	2,278,277	21.41
7	Southern	14	44,196,992	22,041,765	2,417,242	19,624,523	22,733,111	2,001,273	20,731,838	3.14	13,914	0.06
Total			320,696,888	152,897,870	73,367,689	79,530,181	152,000,257	71,667,083	80,333,174	-0.59	13,752,745	9.05

Source: Ministry of Agriculture and Co-operatives. * Bangkok use 2011 agricultural area data from Land Development Department

Note: 1. Agricultural area based on the land use data source provided by Office of Agricultural Economics (Ortrosi 1:4,000) 2002 and Agricultural Statistics year book 2010

2. Flooded agricultural areas are assessed by the Office of Natural Calamity and Agricultural Risk Prevention using RADARSAT-1, Landsat-5, SPOT-2, SPOT-4 and ALOS from GISTDA (Geo-Informatics and Space Technology Development Agency) from March – December 2012. Need actual surveys supported.

Table 8.7: Damages from Flooding 1989 – 2010, whole country.

Year	Damage																	
	Quality of Life				Assets								Infrastructure					
	Affected Persons	House hold	Death in persons	Injuries	Whole House	Partial	Build ing	Hotel/Flat (No.)	Facto ries	Fish/ Shrimp Farm	Animal Farm (unit of animal)	Agri Area (Rai)	Road	Bridge	Dam/ Dyke (places)	Temple/ School/ Govt	Pipe drain (places)	Damage costs (Baht)
1989	2,461,500	461,001	602	5,495	867	16,018	462	42	32	112,650	65,890	10,145,658	10,475	698	2,236	2,043	1,123	11,739,595,265
1990	2,131,765	489,236	50	19	765	11,233	210	38	11	26,580	41,250	2,256,000	9,258	546	1,126	1,023	1,182	6,652,227,121
1991	1,976,150	412,398	43	26	6,224	18,562	215	52	18	24,500	22,035	9,875,023	8,124	1,023	1,452	1,365	1,240	4,562,305,420
1992	3,650,710	699,123	16		2,011	14,033	228	28	20	35,620	16,850	14,298,000	12,017	989	1,025	1,285	1,475	5,240,583,940
1993		411,201	47	254	1,698	9,982	189	16	19	42,560	72,564	16,024,259	9,865	1,236	1,136	1,463	1,365	2,181,606,542
1994	2,450,002	572,017	46	12	2,037	14,001	256	28	24	33,250	32,659	14,000,259	10,236	875	1,452	1,758	1,450	5,058,883,356
1995	5,953,344	1,569,53	442	11	987	18,327	685	86	67	124,560	365,240	3,792,364	8,875	698	3,265	3,025	3,745	6,123,517,926
1996	8,377,481	1,859,27	158	21	264	20,278	365	23	21	45,678	65,890	21,014,456	6,598	1,254	2,245	2,013	2,236	7,160,677,015
1997	4,069,006	787,839	98	427	991	14,445	224	27	18	32,560	36,520	12,269,013	12,147	865	2,034	1,986	2,013	3,824,223,866
1998	1,649,752	343,717	8	3	1,022	11,201	220	22	20	20,154	22,036	466,074	10,257	1,024	1,856	1,754	2,014	1,706,035,444
1999	4,560,517	1,016,50	53	30	967	10,272	236	27	17	32,658	20,356	3,038,167	11,374	937	1,745	1,635	1,742	1,381,638,279
2000	6,739,652	2,002,97	120		12,650	33,724	478	38	36	91,520	76,258	10,340,584	17,952	1,441	2,785	2,245	2,041	10,032,935,112
2001	3,454,265	919,699	244	68	315	13,239	226	17	10	36,589	102,365	29,133,765	7,901	1,231	1,653	1,853	1,985	3,666,285,247
2002	5,127,652	1,373,94	216		1,135	130,136	120	12	8	103,533	2,955,577	10,435,115	13,294	730	1,613	2,465	707	13,385,316,549
2003	1,882,017	485,436	44	10	18	10,311	246	11	2	22,339	301,343	1,595,557	5,071	393	183	174	282	2,050,262,243
2004	2,324,441	619,797	28	3	297	5,536	114	11	17	12,884	71,889	3,298,733	4,173	379	638	827	594	850,659,584
2005	2,874,673	763,847	75		275	5,697	68	15	46	13,664	222,600	1,701,450	5,697	667	2,462	2,123	1,482	5,982,283,276
2006	6,050,674	1,673,82	446	1,462	1,583	69,887	793	63	113	122,123	245,375	6,560,541	12,969	1,129	2,492	2,485	1,978	9,627,418,620
2007	2,326,179	571,566	36	17	26	3,860	84	2	8	13,866	19,146	1,617,284	7,202	388	1,643	895	3,020	1,687,865,982
2008	7,921,127	2,031,94	119	16	170	18,694		11	4	87,413	263,509	6,590,655	18,389	908	1,407	1,062	1,833	7,601,796,302
2009	8,881,758	2,308,96	53	22	176	11,235	4	2	7	43,186	147,762	2,958,523	18,661	1,092	2,005	371	2,500	5,252,613,976
2010	13,485,963	3,917,33	266	1,665	21,172	256,472	312	7	76	76,180	1,493,838	10,909,561	25,986	1,536	2,788	3,020	391	16,338,772,341

Source: Department of Disaster Prevention and Mitigation. Note: 1 Rai is 1,600 square meters.

Table 8.8: Areas Affected from Flooding and Subsidization 1989-2010

Year	No. of Flood	Area affected					Subsidization			
		Pro vince	Dis trict	Sub-district	Tam bon	Village	Boat (unit)	Water pump (machine)	Consumer products	Advanced budget
1989	9	52	365	30	1,450	9,871	1,125	960	1,250,485	
1990	12	58	540	36	1,865	10,162	1,025	758	865,200	
1991	14	66	496	32	2,061	10,654	853	902	752,300	
1992	10	66	531	40	2,217	12,101	698	580	825,600	
1993	9	42	441	24	1,664	8,960	744	685	563,500	
1994	11	74	620	45	2,119	9,170	982	846	556,002	
1995	8	73	650	48	2,160	11,175	1,685	1,453	1,650,352	
1996	10	74	610	25	2,411	12,615	936	882	1,256,352	
1997	7	64	486	32	1,860	10,610	730	685	568,520	
1998	12	65	522	28	2,215	12,117	865	711	256,350	
1999	9	69	472	30	1,450	6,219	688	720	320,520	
2000	12	62	653	42	2,325	13,029	1,230	962	241,523	
2001	14	60	628	61	2,760	10,996	820	869	139,000	26,384,263
2002	5	72	636	70	3,820	18,510	837	1,250	1,173,081	472,827,669
2003	17	66	349	24	1,331	5,281	487	765	277,681	853,860,799
2004	12	59	337	31	1,856	9,964	563	457	556,461	1,063,265,356
2005	12	63	541	24	2,342	10,326	1,175	1,077	645,600	1,111,404,929
2006	6	58	520	44	3,432	22,771	1,511	2,768	1,150,960	3,346,597,800
2007	13	54	394		2,130	12,848	383	1,340	663,189	4,289,736,260
2008	6	65	719		4,813	38,448	667	1,014	799,500	5,471,365,273
2009	5	64	683		4,344	33,847	339	100	587,873	4,452,673,765
2010	7	74	823		5,887	48,488	1,603	4,051	1,795,647	1,628,458,367

Source: Department of Disaster Prevention and Mitigation.
Note: 1 Rai is 1,600 square meters. Tambon is a collection of villages in a form of administration.

8.1.4. Summary of the external shock

This chapter employs the above-mentioned information to estimate the external shock and the policy shock for policy simulation. Table 8.9 summarizes external shock given to TRAVELTHAI. This study maintains the scope for the effects of the flood as ‘setbacks’ on Tourism as the amalgam of industries according to the objective of the study (not overall effects of the flood, but focus only the estimable Tourism-related effects in 2011 according to the main objective of the study about developing dynamic CGE model for Tourism industry). For further study on the flooding and water management, the more appropriate CGE modeling by region is the TERM-styled model (TERM- The Enormous Regional Model) e.g. TERM-H2O by Centre of Policy Studies for Australian case (see details in the Economic modeling of water by Wittwer (2012)). This type of regional CGE modeling requires a great deal of database as the model is disaggregated into many regions and it is the bottom-up approach, which means the model is developed from regional economies, not from the top-down, which is out of the scope for the objective of TRAVELTHAI at this stage. It is also

the fact that the core database for the case of Thailand (Input-Output Table or TSA) is still national type. There is no regional Input-Output table for Thailand. At present, the most advanced disaggregated regional model for Thailand is the hybrid type of GEMREG by Siksamat (1998) as reviewed in Chapter 2. Some others are mostly top-down approach, including TRAVELTHAI, of which the model is developed with the regional extension, but considered not the main aim for the thesis and the regional analysis is recommended for future research.

Table 8.9: Summary of the effects of flood as Tourism setback for external shock

External Shock				**Notes and Assumptions**
Demand side: Behavioural shocks				
Variable	**Inbound Tour**	**Dom Tour**		
Size in percentage	-5%	-15%		Flood lowered demands both domestic and inbound tourism but lower for inbound
Supply side: Resource loss shocks				
Sector	**Labour**	**Capital**	**Land**	Flood damaged factors of production
1:Accommodation	0.14	-0.30	-	Mixed effects as locals moved out of houses to stay in high-rise accommodation or out to unaffected
2: 2nd home	0.00	-0.30	-	Same as Sector 1
3: Restaurant	0.32	-0.30	-	MOTS estimation
4: Railway	-0.23	-0.30	-	Partly operable
5: Road	-1.29	-0.30	-	Inoperable in many affected areas, became canals
6: Waterway	-0.19	-0.30	-	Routing changed and partly turned to charity help
7: Air service	-0.96	-0.30	-	Don Muang Airport was inoperable. Domestic route moved to Suvannabhumi International
8: Transport Serv.	-0.24	-0.30	-	Supporting services changed; turned to charity help
9: Transport Equip	-0.03	-0.30	-	Mixed effects as waterway-related devices in demand
10: Travel Agent	-0.16	-0.30	-	Inoperable for locals of affected area; some operated outside
11: Cultural Serv.	-0.08	-0.30	-	Inoperable for locals of affected area; some operated outside
12: Sporting Serv.	-0.02	-0.30	-	Inoperable for locals of affected area; some operated outside
13-18: TC	Varied	-1.36	-	Assumes partial effects on Tourism out of total
19-27: TC	Varied	-1.36	-	Assumes partial effects on Tourism out of total
28-32: TC	Varied	-1.75 to 0.0	-	Assumes partial effects on Tourism out of total
33-40: NT	Varied	-2.08 to -0.89	-9.05*	Indirect shocks from Non-Tourism to Tourism

Source: Author's calculations and assumptions. Sizes of the shocks are concerned with regional shares.

Note: Sector 1 – 12 are Direct-Tourism sectors (DT). Sector 13-32 are Tourism-connected industries (TC). Sector 33-40 are Non- Tourism sectors (NT). The name list is in Table 4.4 of Chapter 4

* for land, only Sector 33 of NT was given the shock for agricultural land of -9.05 per cent

The external shock with its sub-totals in Table 8.9 are based on the fact that the 2011 flood mainly affected the Central region and Bangkok, with some parts in Northern, Northeastern, Western, Southern, and Eastern regions, as shown in Figure 8.1. The flood happened through 2011 but varied in locations and its severity. Appendix 8.1 shows the information on the regional effects of the flood with spatial graphical presentations of those locations. It is worth to note that although the flood is normally regarded of the characteristic of the sharp short-run effects (also appropriate with the cases like epidemic, see Monash-health model in literature of Chapter 2), which is more sensible to make an application with the quarterly CGE modeling, this study regards that the annual model is applicable for this case due to the fact that it happened through the year and was vast affecting all regions of the country as shown in Figure 8.1 and in Appendix 8.1. The effects of 2011 flood have been high and the catastrophic impacts have taken a long period including recovering time (of which the prior 2010 flood was with high, frequent, and vast devastating impacts and also took long period, see details in Table 8.6, 8.7, and 8.8). Thus, it is possible to apply the case with the annual model. It is certainly interesting to use the quarterly model for the future research in hope for comparison.

For the magnitudes of those sub-totals of external shock summarized in Table 8.9, for the behavioral effects, this study bases on the information obtained and reviewed earlier from MOTS and TAT. Inbound visitor arrivals were expected to experience a sharp decline of five per cent while the national visitors (domestic residents including outbound tourists) were assumed with the overall decrease of fifteen per cent in contrast to the information estimated by TAT that the number of domestic tourists dropped about three million person/trips, losing about 7.621 billion baht for Quarter 4 of 2011 and that of about 20 per cent by Tourism Council reviewed in section 8.1.2. Although modeled with the national model, it is also worth to mention that, for the main flooded area, in 2009, the size of the regional GDP of Bangkok and Central region from total GDP are 42 and 7.6 per cent, respectively, which made about a half of GDP of the country. From Table 3.16 of Chapter 3, the distribution of the inbound visitors to each region in 2007, which is concerned as the normal year concerning tourism flows, also shows the shares of 37.33 and 1.54 per cent in total inbound visitors for Bangkok and Central region. It is about the same size for the domestic visitors to Bangkok and Central region (33.7 and 5.06 per cent). Note here that the

shares of the inbound visitors were also high in Southern region and Eastern region (famous for beaches as main attractions), which were 32.84 and 17.72 per cent.

The calculation of the sizes of the sub-total shocks for resource loss effects are based on the information obtained from Labor Force Survey, Business and Industrial Census and Population Census of National Statistical Office (NSO), the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), Land Development Department, and Ministry of Agriculture and Co-operatives (MOAC) reviewed in earlier sub-sections. It is very important to note that the calculation bases on some predictions and inferences referred to those sources since the information on the resource loss effects is scarce and mostly with predictions, especially the damages and losses from the recent 2011 flood. It is the fact that in some areas the flood was severe with high level of water that all businesses in those areas were inoperable (even difficult to access) while in some cases the damages happened but with some degree of business operability. It was also the case that the flooded and non-flooded areas were divided into two from only one road or high pavement as a border of division within one political district. Hence, the flooded areas became the swamps full of water while the businesses in the non-flooded areas were almost fully operable just across the road. This study concerns this fact but need to assume some percentages of operability because of no certain data available. The sizes of the shocks could be altered for the future research when there is appropriate data availability.

Calculation for the losses in labor productivity is based on an overall decline of 9.6 per cent for 2011 given by BOT, but concerning the reasons by NESDB, the figures vary by industries, also with some increases. It turned out that the labor productivity dropped greatly in Sector Electricity, Gas & Water supply and Health & Social works. For the capital damages and losses, the estimation from ESCAP is used to calculate the percentage decreases in capital from the earlier year. For losses, this study needs to assume the degree of severity according to the data availability of flooding level.

It is very important to note here that the external shocks used in this example are only the estimation. The actual ones have not been known and very difficult to clarify. This is the attempt to provide the simulation example for the model this thesis aims to construct and the example, here, is the supplementary guideline for further analysis.

8.2. Effects of the flood as the setback to Tourism

The thematic explanation of this part is to inform the 'summary' of the effects of the sub-totals of external shock in terms of behavioral effects and resource loss comparing to the baseline forecast of the second half of the decade as a benchmark. The second half of the decade is thought of not only because of the close-prior period, but also because of the pessimism that the effects further continue. Only thirty important macroeconomic variables are reported in Table 8.10.

Behavioral effects concerning the impacts of flooding on Tourism are mainly those two informed in sub-section 8.1.2. For resource loss effects, there are three to be evaluated as told in sub-section 8.1.3. The magnitudes of the shocks come from Table 8.9, including the losses of agricultural land informed separately. The external shock is simulated with five sub-sections of this section 8.2. They are presented thematically in macro and sectoral results, focusing on Tourism industry.

Macro perturbed results are represented in Table 8.10 in six columns corresponding to five sub-totals of external shock and one column of the total effects. Each sub-total shows the effects of the shock in 2012, which is the year of the shock, separately. The focus is thus on the deviations from the baseline of the policy simulations (this case, they are five sub-total shocks). These deviations are included in the columns of Table 8.11. Sectoral results are shown in Table 8.12 in the same style as the macro results with the differences of step-wise results shown in Table 8.13. There are eighteen sectoral variables reported in the three macro-sectors styles of conventional grouping (Agriculture, Manufacturing, Services) and Tourism-related grouping (Direct-Tourism, Tourism-connected, Non-Tourism industries).

Several figures upon the important endogenous variables concerning macro-economy and Tourism, showing the movements of the percentage that each external shock causes a deviation from the baseline, are placed in each sub-section accordingly. Note that the sum of perturbed results and deviations gives ex-ante baseline forecasts.

In the analysis of results, sometimes data which are not reported in this thesis would also be informed e.g. the shares separately calculated from the database, or the information on other outside references.

Table 8.10: Macro perturbed solution with the sub-totals of external shock (2012).

	Column	Demand-side (Behavioural effects)		Supply-side (Resource-loss effects)			%
Row	External Shocks	Shift in inbound tourists' demand	Decline in national tourists' demand	Losses in Agricultural Land	Labour productivity change	Capital Damages	Annual Total
	Endogenous Variables	(1)	(2)	(3)	(4)	(5)	(6)
1	Real GDP	0.015	-0.004	-0.112	-2.620	3.530	2.651
2	Real aggregate consumption	-0.156	1.236	0.088	-4.326	-0.733	1.787
3	Real aggregate investment	0.374	-0.001	-0.230	-6.350	-0.120	0.663
4	Real government spending	0.000	0.000	0.000	0.000	0.000	6.860
5	Real exports	-0.881	-0.224	-0.106	-1.688	7.479	5.327
6	Real imports	0.081	-0.199	0.128	-2.872	2.748	5.217
7	Real inbound tourism	10.239	-0.001	0.330	1.792	10.546	4.410
8	Real domestic tourism*	0.000	-9.914	0.000	0.000	0.000	-9.914
9	Real outbound tourism	1.392	-10.918	-0.034	-1.177	-2.291	-7.775
10	Travel receipts	12.690	-0.265	0.287	3.711	11.430	6.072
11	Travel expenses	0.692	-10.945	-0.041	0.064	0.128	-10.731
12	Domestic tourism revenue	0.692	-10.945	-0.041	0.064	0.128	-10.731
13	Aggregate employment	0.000	0.000	0.000	0.000	0.000	1.512
14	Real wage	0.268	-0.099	-0.309	8.323	6.888	18.751
15	Real devaluation	-0.958	-0.185	0.108	0.184	3.998	-7.663
16	Terms of trade	0.221	0.056	0.026	0.423	-1.872	5.506
17	*Change* in balance of trade	-67.946	-30.769	-11.876	106.198	331.861	424.590
18	*Change* in balance of travel	79.977	22.249	1.935	23.691	73.116	62.476
19	Real GNP	0.156	-0.073	-0.186	-0.677	2.763	7.335
20	Propensity to consume to GNP	0.388	-9.522	0.212	-3.367	-3.118	-15.502
21	GDP Price index	0.139	-0.071	-0.074	2.168	-0.699	4.902
22	Aggregate investment price index	-0.094	-0.001	-0.267	-1.744	-2.494	-2.241
23	Exports price index	-0.635	-0.206	0.065	2.754	1.594	2.385
24	Imports price index	-0.838	-0.257	0.038	2.291	3.381	-3.012
25	Inbound tourist price index	2.372	-0.261	-0.043	1.886	0.821	1.615
26	Outbound tourism price index	-0.701	-0.162	-0.008	1.258	2.451	-3.122
27	Domestic tourism price index	0.715	-1.098	-0.043	0.066	0.132	-0.876
28	Average capital rental	0.159	-0.019	-0.382	-5.606	-6.095	-5.527
29	Average land rental	-1.798	-0.281	17.371	-4.872	15.954	20.657
30	Exchange rate	-0.838	-0.257	0.038	2.291	3.381	-3.012

Source: Simulation results; Consumer price index is numeraire. * is external shock
Note: See Appendix 8.2 for more results of 40 sectoral outputs and 40 commodity prices

Table 8.11: Deviations from Baseline with the sub-totals of external shock (2012)

	Column	Demand-side (Behavioural effects)		Supply-side (Resource-loss effects)			%
Row	External Shocks	Shift in inbound tourists' demand	Decline in domestic tourists' demand	Losses in Agricultural Land	Labour productivity change	Capital Damages	Annual Total
	Endogenous Variables	(1)	(2)	(3)	(4)	(5)	(6)
1	Real GDP	-0.003	-0.006	-0.106	-2.467	-0.783	-3.374
2	Real aggregate consumption	0.040	1.921	0.085	-4.168	0.362	-1.939
3	Real aggregate investment	-0.089	-0.001	-0.214	-5.912	-0.019	-6.281
4	Real government spending	0.000	0.000	0.000	0.000	0.000	0.000
5	Real exports	0.202	-0.334	-0.097	-1.547	-1.814	-3.528
6	Real imports	-0.018	-0.296	0.117	-2.634	-0.637	-3.507
7	Real inbound tourism	-2.298	-0.004	0.310	1.682	-1.860	-2.007
8	Real domestic tourism*	0.000	-15.000	0.000	0.000	0.000	-15.000
9	Real outbound tourism	-0.408	-15.891	-0.031	-1.062	0.934	-16.725
10	Travel receipts	-2.864	-0.403	0.266	3.431	-2.672	-1.918
11	Travel expenses	-0.213	-16.487	-0.039	0.060	-0.058	-16.609
12	Domestic tourism revenue	-0.213	-16.487	-0.039	0.060	-0.058	-16.609
13	Aggregate employment	0.000	0.000	0.000	0.000	0.000	0.000
14	Real wage	-0.057	-0.142	-0.274	7.385	-1.719	5.377
15	Real devaluation	0.262	-0.324	0.116	0.197	-1.384	-0.976
16	Terms of trade	-0.049	0.087	0.025	0.404	0.440	0.908
17	*Change* in balance of trade	16.447	-49.830	-11.876	106.198	-95.727	-29.120
18	*Change* in balance of travel	-19.392	35.822	1.935	23.691	-18.420	25.587
19	Real GNP	-0.039	-0.110	-0.170	-0.620	-0.733	-1.666
20	Propensity to consume to GNP	-0.124	-15.029	0.208	-3.303	1.249	-17.087
21	GDP Price index	-0.035	-0.113	-0.072	2.106	-0.021	1.910
22	Aggregate investment price index	0.008	-0.003	-0.269	-1.756	0.603	-1.549
23	Exports price index	0.155	-0.335	0.064	2.740	-0.858	1.887
24	Imports price index	0.214	-0.436	0.039	2.385	-1.354	0.975
25	Inbound tourist price index	-0.596	-0.419	-0.043	1.858	-0.856	0.081
26	Outbound tourism price index	0.178	-0.274	-0.008	1.303	-0.936	0.345
27	Domestic tourism price index	-0.187	-1.768	-0.043	0.065	-0.055	-1.882
28	Average capital rental	-0.047	-0.032	-0.384	-5.645	1.371	-4.859
29	Average land rental	0.343	-0.409	15.466	-4.338	-3.720	7.424
30	Exchange rate	0.214	-0.436	0.039	2.385	-1.354	0.975

Source: Simulation results, Consumer price index is numeraire. * is external shock
Note: See Appendix 8.2 for more results of 40 sectoral outputs and 40 commodity prices

Table 8.12: Sectoral perturbed solution with the sub-totals of external shock (2012)

	Column	Demand-side (Behavioural effects)		Supply-side (Resource-loss effects)			%
Row	External Shocks	Shift in inbound tourists' demand	Decline in domestic tourists' demand	Losses in Agricultural Land	Labour productivity change	Capital Damages	Annual Total
	Endogenous Variables	(1)	(2)	(3)	(4)	(5)	(6)
1	Direct-tourism industries – Output	1.658	-0.132	0.066	-1.806	4.424	2.359
2	Tourism-connected industries – Output	-0.035	-0.123	0.015	-2.276	4.269	2.665
3	Non-tourism industries – Output	-0.124	0.051	-0.180	-2.772	3.271	2.656
4	Agricultural sector – Output	-0.299	-0.089	-1.787	-1.168	3.825	0.304
5	Manufacturing sector – Output	-0.325	-0.058	-0.013	-2.749	5.364	2.784
6	Services sector – Output	0.202	0.043	-0.018	-2.673	2.573	2.792
7	Direct-tourism industries – Labor	4.073	-0.321	0.163	-4.129	1.694	-6.042
8	Tourism-connected industries – Labor	-0.095	-0.331	0.042	-3.102	1.324	-3.230
9	Non-tourism industries – Labor	-0.323	0.123	-0.026	1.247	-0.526	3.524
10	Agricultural sector – Labor	-0.979	-0.292	0.803	-6.107	4.018	-7.059
11	Manufacturing sector – Labor	-0.909	-0.163	-0.035	1.682	3.305	2.074
12	Services sector – Labor	0.494	0.097	-0.043	-0.331	-1.831	1.883
13	Direct-tourism industries – Capital	0.000	0.000	0.000	0.000	6.243	6.243
14	Tourism-connected industries – Capital	0.000	0.000	0.000	0.000	6.000	6.000
15	Non-tourism industries – Capital	0.000	0.000	0.000	0.000	6.061	6.061
16	Agricultural sector – Capital	0.000	0.000	0.000	0.000	5.448	5.448
17	Manufacturing sector – Capital	0.000	0.000	0.000	0.000	6.682	6.682
18	Services sector - Capital	0.000	0.000	0.000	0.000	5.743	5.743

Source: Simulation results

Table 8.13: Deviations from Baseline of Sectoral results with the sub-totals of external shock (2012)

	Column	Demand-side (Behavioural effects)		Supply-side (Resource-loss effects)			%
Row	External Shocks	Shift in inbound tourists' demand	Decline in national tourists' demand	Losses in Agricultural Land	Labour productivity change	Capital Damages	Annual Total
	Endogenous Variables	(1)	(2)	(3)	(4)	(5)	(6)
1	Direct-tourism industries – Output	-0.359	-0.201	0.063	-1.713	-0.673	-2.898
2	Tourism-connected industries – Output	0.013	-0.186	0.015	-2.144	-1.008	-3.307
3	Non-tourism industries – Output	0.028	0.077	-0.169	-2.608	-0.727	-3.418
4	Agricultural sector – Output	0.074	-0.140	-1.718	-1.123	-0.670	-3.564
5	Manufacturing sector – Output	0.076	-0.089	-0.012	-2.572	-1.252	-3.833
6	Services sector – Output	-0.045	0.066	-0.017	-2.520	-0.569	-3.097
7	Direct-tourism industries – Labor	-1.067	-0.520	0.162	-4.109	-1.157	-6.495
8	Tourism-connected industries – Labor	0.040	-0.531	0.041	-3.072	-0.718	-4.176
9	Non-tourism industries – Labor	0.078	0.195	-0.025	1.225	0.302	1.743
10	Agricultural sector – Labor	0.273	-0.482	0.807	-6.137	-1.224	-6.607
11	Manufacturing sector – Labor	0.226	-0.263	-0.034	1.659	-0.988	0.691
12	Services sector – Labor	-0.124	0.156	-0.042	-0.326	0.545	0.156
13	Direct-tourism industries – Capital	0.000	0.000	0.000	0.000	-0.304	-0.304
14	Tourism-connected industries – Capital	0.000	0.000	0.000	0.000	-1.090	-1.090
15	Non-tourism industries – Capital	0.000	0.000	0.000	0.000	-1.282	-1.282
16	Agricultural sector – Capital	0.000	0.000	0.000	0.000	-0.558	-0.558
17	Manufacturing sector – Capital	0.000	0.000	0.000	0.000	-1.323	-1.323
18	Services sector - Capital	0.000	0.000	0.000	0.000	-1.150	-1.150

Source: Simulation results

8.2.1. A shift in inbound tourists' demand (Column 1)

The simulation of the five per cent decline in the inbound tourists' demand shifter (f7q_tour) as one impact in the total shock of flooding in 2012 is conducted in the counter-factual approach, which means the results are estimated relative to the baseline (here, the second half of the decade baseline forecast estimated in the previous chapter). This behavioral effect caused by the flood is the estimation from the fact that the flood deterred the decision to visit of the inbound visitors.

- Closures and parameter settings

The closures in this simulation are adapted from the policy closures discussed in Dixon and Rimmer (2002). The exogenous variables are technical changes and shifters terms with the main external shock of f7q_tour of a negative five per cent introduced. In this policy closure, the short-run determination of investment is turned on and the rates of return are endogenized. Consumer price index is a numeraire.

Table 8.14: Status of some variables under the policy and forecast closures

Variables exogenous in forecast closure, but endogenous in policy closure	**Corresponding variables which are endogenous in forecast closure, but exogenous in policy closure**
• Industry shift, ratio of I/K	• *Industry specific K growth shifter, yr-to-yr*
• Expected rate of return	• *Shifters in K accumulation equation for year t-1*
• Consumption to GDP ratio	• *National propensity to consume out of GNDI*
• Real wage	• *Shifter, sticky wage post-tax*
• Capital accumulation shifters	• *Ratio of investment to capital, shift*
• Change in private NFL	• *Shifts in private foreign debts*
• Change in public NFL	• *Shifts in public foreign debts*
• Change in domestic public debt	• *Shifts in domestic public debts*
• Change in inventories demand	• *Shifts in inventories demand*

Source: Adapted from Dixon and Rimmer (2002) and Tran and Giesieke (2006)

- Macro Simulation results

The sub-total results in the first column of Table 8.11 show that the negative shift of the inbound visitors' demand of five per cent causes the decline of 0.003 per cent of real GDP relative to the baseline. Using Back of the Envelope (BOTE) analysis (Table 6.1 in Chapter 6), through (E13), which describes the inbound visitor's demand

function of this schematic mini-model of TRAVELTHAI suggests that the external shock of the preference shift of inbound visitors' demand means its quantity as being shown with a fall of 2.298 per cent of the real inbound visitors' demand and its price in (E13) would change accordingly. The model informs that the associated price (P_7 in mini-model or p7tot in TRAVELTHAI) declines 0.596 per cent from such a downward shift of demand from the sub-total shock. This effect here drives down the travel receipts (or the revenue from inbound visitors) 2.864 per cent. This would, in turn, affect (E1) or the GDP equation (as (7) or travel receipts are one component with its share about 5.4 per cent of GDP). A drop in Y or GDP growth is expected as a consequence, but how about other components? The slight decline of real GDP of about 0.003 per cent suggests that there must be some kinds of offset in the components of GDP. And, this needs to justify the underlying mechanism.

Lower demand for goods, in general, would, in turn, deter the producers to produce less and, of course, lower their demands for factors of production. Likewise, this kind of channel gets through with the composition of the factors of production subject to incurring cost. Through (E2), it shows the output function relating output to factors of production, sectoral outputs, especially those related to Tourism, get affected. Table 8.13 shows the impacts of such demand shift. The output of those sectors categorized as direct-tourism industries declines by 0.359 per cent responding to the lower demand of inbound visitors. With capital being set exogenous for this sub-total simulation, labors are hired less in direct-tourism industries by 1.067 per cent. They tend to move to other industries as shown 0.04 per cent for tourism-connected industries and 0.078 per cent for non-tourism industries. The output growths in those two industries are then higher by 0.013 per cent and 0.028 per cent, respectively.

Such changes in the compositions of factors of production go along with its price. Overall wage declines about 0.057 per cent. This can be inferred that the negative demand shift effect on the Tourism-related industries outweighs others. Labors are released from Tourism-related industries to other sectors. This can be explained through the marginal product of labor, which is tied down by real wage. Result also shows that real wage drops 0.057 per cent as consumer price index (p3tot) is a numeraire. This would relate to (E10) which shows the relationship of real consumer wage to K/L ratio, technology and terms of trade. With the fixed aggregate

employment (allowing inter-sectoral movement), no change in technology, and exogenous capital (as another sub-total shock), the decline in real wage would also mean the terms of trade deterioration. The result confirms with a drop in terms of trade of 0.049 per cent. That means the relative prices (in local currency) between export and import in (E12) becomes lower from the shift in inbound visitors' demand. P_M rises by 0.214 per cent. Thus, export price or P_X would increase but relatively less. The result reveals an increase in P_X (or p4tot) by 0.155 per cent.

Furthermore, when considering the exchange rate (phi), which is defined as local currency over foreign currency, it also shows a depreciation of 0.214 per cent relative to the baseline. This means that 0.214 per cent more of local currency is needed for the same one single unit of foreign currency as that before the shock. The explanation could be drawn from the first round of the shock of the negative shift of inbound visitors' demand, for which generally means lower demand for local currency or Baht (to obtain less local currency for travelling). The second round is about the price mechanism regarding international trade. More demand for export and less demand for import as mentioned above altogether would mean lower demand for local currency and/or higher demand for foreign currency. The relatively cheaper price of local currency, in turn, is also a boost for exports and discouraging for imports.

The change in export price or P_X (foreign currency) would affect the export portion through (E7), which relates the export price to export volumes, related taxes, exchange rate (implicitly in mini-model, explicitly in TRAVELTHAI), and a shift in foreign demands. As commodity exports are inversely related to foreign currency price, it is expected that an increase in export price would provide a decrease in exports (move along the demand curve). Results inform that the real exports increase by 0.202 per cent. This comes from the fact that the effect of the depreciation of the exchange rate mandates the increase in local currency export prices in general. Thus, this explains why exports rise despite the increase in export prices in local currency, since the foreign currency export price becomes cheaper through exchange rate depreciation.

Regarding imports, (E6) relates imports with preferences, tariffs, terms of trade, and the activity level. The activity levels are known as mentioned above in Y (output

production), while terms of trade decline with the fixed technical change and tariff neutrality in this scenario. Results tell that imports in Tourism-related industries drop more than the increase in others. Thus, the real imports decline by 0.018 per cent following the activity level accordingly.

Another macro indicator relating to international trade is the real devaluation. In this realm, the real devaluation means the depreciation of the real exchange rate where the real exchange rate, in general, means the purchasing power of a currency relative to another at the current exchange rates and prices. Thus, the real exchange rate is the exchange rate times the relative prices of a market basket of goods in the two countries or the assumed boundaries. In TRAVELTHAI, the real devaluation is defined as the ratio of the import c.i.f. price over the GDP price index. In this sense, it is the comparison between the foreign price and local price. With the aforementioned rise in import c.i.f. price, real devaluation would depend on another remaining component which is the GDP price index, of which is defined as the weighted price of all related prices to GDP. With consumer price index (p3tot) is the numeraire for the model together with fixed government related prices (p5tot) and a negligible effect on inventory price (p6tot), only those related to investment (p2tot_i) and domestic tourism (p8totd) remain to be justified as export price (p4tot) and price for inbound tourism (p7tot) are known as mentioned above.

Domestic tourism (8) is normally expected to be affected from the change in exchange rate and local prices. However, in this simulation, the domestic tourism is set exogenous to be the external shock for negative effect of flooding as having investigated and estimated its magnitude externally of about 15 per cent in Table 8.9. This makes the null effects for this sub-total of the shift in inbound visitors' demand. Nevertheless, the depreciation of exchange rate generally makes it cheaper to travel domestically and costly for outbound tourism. This is confirmed by the increase in price for outbound tourism (p8toto) by 0.178 per cent whereas the price for domestic tourism (p8totd) declines by 0.187 per cent in the result. Outbound tourism (x8toto) declines according to its higher price by 0.408 per cent. This decrease in price for domestic tourism (p8totd) marks an add-on negative effect on GDP price index together with those declines of prices for export (p4tot) and inbound tourism (p7tot).

The change in terms of trade would also further affect the courses of mechanism. With (E9) which tells the relationship between capital-labor ratio, rates of return, and terms of trade, the profit maximizing condition tells that producers would choose to adapt the composition of factors of production to the returns they face and the costs incurred. With the unchanged aggregate capital-labor ratio, the decline in terms of trade would also means the decrease in rates of return or ROR, with the fixed technical change and tax neutrality. The result informs the decline in the rate of return by 0.047 per cent. This, in turn, affects the investment function in (E8), which relates the aggregate investment portion to the rates of return. With the exogenous industry shift, result tells that the aggregate investment drops by 0.089 per cent, following the decline in rates of return. This confirms that the investors would supply the capital at a lower level. This makes a final effect of a slight increase of 0.008 per cent in the general price of investment (p2tot_i).

The GDP price index is, thus, declined by 0.035 per cent. Mostly, due to the decline in prices other than the slight increase of the price of investment. With the rise in import price, this confirms the real devaluation of 0.262 per cent.

For real consumption, to demonstrate in details, starting from BOTE equation (Table 6.1), equation (E3) links total final consumption C+G+8 to GNP via a propensity to consume (or apc_gnp in TRAVELTHAI) out of real GNP. Thus, the rise/fall of real GNP leads to the increase/decrease in private and public real consumption and domestic tourism (as a part of overall consumption). The same style of equation (E3) is also applied for GNDI (or Gross National Disposable Income which is defined as GNP plus both private and public transfers from foreigners in TRAVELTHAI, but not specifically shown in BOTE). From Table 8.14, apc_gndi or national propensity to consume out of GNDI is set as exogenous in the policy closure (swap with f3tot or the ratio of consumption to GDP). G is set exogenous and apc_gnp is then endogenous. Thus, for (E3), apc_gnp is a ratio of C+8 to GNP. In percentage change form, the results show that GNP is declined by 0.039 per cent and apc_gnp drops by 0.124 per cent. Domestic tourism shows a decline of 0.213 per cent. It is expected that consumption should be positive to balance the equation and the result shows that the private consumption grows 0.040 per cent, which makes a balance. For the equation (E4), which defines Γ, the ratio of real private (C) to real public (G) consumption.

Since G is fixed (zero growth) in this simulation, this ratio also shows a decline of 0.039 per cent, about the same percentage as the increase in real private consumption.

This negative shift of inbound visitors' demand also represents the lower growth of real GDP from the contribution of inbound tourists' demand from the baseline of about 0.019 per cent to the perturbed solution of 0.015 per cent (shown in the first column of Table 8.10), which 'partly' constitutes the overall annual GDP growth to only 2.652 per cent, lower from the baseline of about 3.373 per cent (as shown in the last column of annual total in Table 8.11 deviations from baseline).

8.2.2. A cut in the number of domestic tourists (column 2)

A cut of fifteen per cent of the domestic tourists (x8totd) is another sub-simulation of the total shock of flooding in 2012. This behavioral effect stemmed from the fact that the flood obstructed people from traveling.

- Closures and parameter settings

The closures in this simulation are similar to section 8.2.1. The exogenous variables are technical changes and shifters terms with the main external shock of x8totd for a negative fifteen per cent introduced. In this policy closure, the short-run determination of investment is turned on and the rates of return are endogenized. Consumer price index is a numeraire. The closures are shown to be the same as Table 8.14 with the main swap of policy closure that is different from the forecast closure in that domestic tourism (x8totd) becomes exogenous and its shift term (f8tot) becomes endogenous.

- Macro Simulation results

The sub-total results in the second column of Table 8.11 indicate that the fifteen per cent cut of the number of domestic tourist causes a drop of 0.006 per cent of real GDP relative to the baseline. Through (E14) in the Back of the Envelope (BOTE) analysis (Table 6.1 in Chapter 6), which describes the domestic tourists' demand function as a ratio to the consumption (f8tot), implies that the exogenous shock of the cut in the number of the domestic tourists of 15 per cent would change the ratio accordingly. In TRAVELTHAI, people would decide to travel (or consume travel-related products)

domestically or outbound (in import sense as opposing to the export sense of inbound tourists) as a bundle (x8tot_s). This change in domestic tourism would also change the composition of the bundle, but this needs to take into account of the related relative prices. First guess on consumption is that, theoretically, consumers would consume products other than domestic/outbound tourism to accommodate the overall consumption bundles, while realistically the reasons for higher consumption would partly be either for storage during flooding period or for damage restoration from flooding. The associated price (P_8 in mini-model or p8totd in TRAVELTHAI) declines 1.768 per cent from such a downward shift of demand from the sub-total shock. P8toto or the price for outbound tourism also drops by 0.274 per cent, where the number of outbound tourist falls by 15.891 per cent. The domestic tourism revenue and the outbound travel expenses all decline by 16.487 per cent accordingly due to its composition as a bundle.

Similar to what explained in 8.2.1, for the supply side, lower demand for domestic tourism and outbound tourism would lower the related demands for outputs and factors of production. Through (E2), those outputs and factors of production related to tourism would be produced and demanded less in respond to the lower demand. Table 8.13 reports that outputs of those direct-tourism industries decline by 0.201 per cent and outputs of those tourism-connected industries fall by 0.186 per cent responding to the lower demand of domestic tourists. Labors are hired less in direct-tourism industries by 0.520 per cent and in tourism-connected industries by 0.531 per cent as they migrate to non-tourism industries with the increase by 0.195 per cent. The output growth in the non-tourism industries therefore rises by 0.077 per cent.

Such lower demand for labor implies that nominal wage and real wage tend to fall and the model says they fall by 0.142 per cent (since consumer price index (p3tot) is a numeraire). With (E10), the drop in real wage would depend on K/L ratio and terms of trade providing that technology, and capital are exogenous. The result shows that there is a rise in terms of trade of 0.087 per cent. This indicates that the relative price (in local currency) between export and import in (E12) becomes higher. As P_M decreases by 0.436 per cent, thus, export price or P_X would decrease but relatively less. The result shows a fall in P_X (or p4tot) by 0.335 per cent. Therefore, it means that K/L ratio has to decline more than the rise in terms of trade to have a drop in real wage.

With externally determined capital, the percentage rise in labor hired in non-tourism industries should outweigh the percentage fall of labor hired in other industries, providing that the shares of labor hired in non-tourism industries are much higher. This would confirm such a drop in real wage.

The exchange rate (phi), which is defined as local currency over foreign currency, shows an appreciation of 0.436 per cent relative to the baseline. This means that 0.436 per cent less of local currency is required for the same single unit of foreign currency as that ex ante. As such, demand for expensive Baht is lower relatively. The higher price of local currency would encourage imports and discourage exports respectively.

Export demand function through (E7) states that commodity exports are inversely related to foreign currency price. Real exports decrease by 0.334 per cent. The effect of the appreciation of the exchange rate dominates the fall in local currency export prices. Therefore, exports drop despite the decrease in export prices in local currency, because the foreign currency export price becomes relatively expensive through exchange rate appreciation.

(E6) represents import function. With the aforementioned activity levels, the rise in terms of trade, the fixed technical change and tariff neutrality, the decline of imports by 0.296 per cent comes mainly from the higher decreasing income effects of activity level than the increasing relative price effects of the terms of trade (price of imports decline more than price of exports). The lower demand of domestic tourism leads to lower demands for imports in many industries, especially tourism-related industries, despite the small gain for imports from the exchange rate appreciation. This is because only the exchange rate matters as world price is given by small country assumption.

There is a real appreciation of the real exchange rate, which means the higher purchasing power of local currency relative to the foreign currency. As defined in the model, with real appreciation and a fall in import price of 0.436 per cent, the GDP price index would decrease in a smaller magnitude than the decline in import price. GDP price index drops by 0.113 per cent. This makes a real appreciation of 0.324 per cent (or, in other words, it is -0.324 percent of real devaluation shown in Table 8.11).

Inbound tourism (7) is declined by 0.004 per cent with the associated tourism receipts decline by 0.403 per cent. The market mechanism makes the supply shocks for tourism-related industries and the appreciation makes it expensive for inbound tourism. This sub-total effect shows that price for inbound tourism (p7tot) declines by 0.419 per cent. This decrease also pushes negative effect on the GDP price index.

For (E9), with the fixed technical change and tax neutrality, the result shows that there are a fall in the rental rate (p1cap_i) by 0.032 per cent and a slight decrease of 0.008 per cent in the general price of investment (p2tot_i). Aggregate investment decreases by 0.001 per cent, following the fall in the rate of return as the rental rate declines more than the cost of investment.

Consumption in (E3), where G is set exogenous, depends on APC and GNP. With (E5), GNP depends on the terms of trade and output, ignoring negligible effects of NFL. The rise in terms of trade gives the positive effect on GNP. The results show a growth in GNP by 0.086 per cent and a rise in APC by 0.027 per cent. Consumption, hence, increases by 1.921 per cent and is the only GDP composition that contributes the positive effect on GDP growth, relative to the baseline.

8.2.3. Losses in Agricultural land (column 3)

Losses of agricultural land represent the losses of factor of production in terms of the agricultural area being flooded. The shock of -9.05 per cent for the resource loss effect from flooding is analyzed in this sub-section. Note that this is the supply side effect since the factor of production becomes economically dysfunction from flooding.

- Closures and parameter settings

Similar to 8.2.1, the closures for this sub-simulation are set with the exogenous variables of technical changes and shifters terms. Table 8.14 summarizes the closure. No swap is needed as the x1lnd (or land as factor of production) is set exogenous in both forecast and policy closure. The relevant external shock on x1lnd of -9.05 per cent is given as having been externally estimated in the Section 8.1.

- Macro Simulation results

The third column of Table 8.11 shows that the losses of agricultural land (or x1lnd) of 9.05 per cent leave a fall of 0.106 per cent of real GDP relative to the baseline. Using Back of the Envelope (BOTE) analysis of Table 6.1, x1lnd directly relates to (E2), which represents the production function using three kinds of factors of production including agricultural land (x1lnd). This means that the losses in area of agricultural land would affect the output production. In TRAVELTHAI, only the agricultural sector uses land as the factor of production. This change in the percentage of agricultural land losses would alter the composition of the factors of production used to produce the agricultural output. This would need to consider about the related relative prices of factors of production. The agricultural output production becomes lower accordingly by 1.718 per cent as shown in Table 8.13 and the associated agricultural output price rises by 4.006 per cent from such a leftward shift of supply resulting from the sub-total shock of land losses. The sector hires more labor by 0.807 per cent, with the fixed capital for this sub simulation. This could infer that producers try to produce agricultural products by using labor as a substituted production factor for the losses of agricultural land, although not fully substituted. Such migration of labor implies that wage and real wage tend to play some pivotal roles and the model says that they fall by 0.274 per cent (consumer price index (p3tot) is a numeraire). This comes from the fact that the ratio of marginal product of land to marginal product of labor rises from the losses of agricultural land due to flooding also leads to the cheaper wage comparing to rental price of land relatively. In the representation of (E10), instead of K or capital which is fixed and no change in technology for this sub-simulation, the ratio of land to labor can be viewed in analogy where terms of trade could be either positive or negative, but its magnitude would be less than that of the drop in the ratio of land to labor, which makes the wage falls by 0.274 per cent.

Table 8.13 also reports that outputs of the manufacturing sectors decline by 0.012 per cent and outputs of those services sectors fall by 0.017 per cent. This is due to the labor migration to agricultural sector. In turn, while the outputs of direct tourism industries increase by 0.063 per cent and also tourism-connected industries by 0.015 per cent, the output of non-tourism industries decrease by 0.169 per cent. This decline in output of non-tourism industries confirms the losses of agricultural land as the

agricultural industries are concerned as one major industry within non-tourism industries. Labors are hired more in direct-tourism industries by 0.162 per cent and in tourism-connected industries by 0.041 per cent as they migrate from non-tourism industries which show a decrease by 0.025 per cent. This supports the increases in outputs of those tourism-related industries.

The model tells an increase in terms of trade of 0.025 per cent. That means the relative prices (in local currency) between export and import in (E12) becomes higher from the losses of agricultural land. P_M rises by 0.039 per cent from the rise of exchange rate (phi) of the similar amount (given the exogenous foreign import price of small country assumption). Thus, export price or P_X would increase but relatively more. The result shows an increase in P_X (or p4tot) by 0.064 per cent.

As mentioned, the exchange rate (phi) also shows a depreciation of 0.039 per cent, or that is about 0.039 per cent more of local currency for the same single unit of foreign currency is required relative to the baseline. The rise in export price of local currency would inversely affect demand for exports through (E7). A drop in exports by 0.097 per cent comes from the effect of the depreciation of the exchange rate of 0.039 per cent and the increase in local currency export prices by 0.064 per cent. For imports, (E6) shows that, with unchanged technical change and tariff neutrality, the rise in terms of trade would lead to the cheaper imports, although with the lower production of many industries especially agricultural sector, for which could mean lower demand for related imported materials. The real imports increase by 0.117 per cent according to the relatively higher terms of trade effect.

Real devaluation, which is defined as the ratio of the import c.i.f. price to the GDP price index in the model, would depend only on the GDP price index as the import price is known. The model tells that GDP price index decreases by 0.072 per cent, mostly, from the declines in the prices of investment and the average output prices (of course, except agricultural products). With the given import c.i.f. price, this confirms the real devaluation of 0.116 per cent relative to the baseline.

It is expected that the change in exchange rate and also the local prices would affect all inbound, outbound, and domestic tourism. Nonetheless, in this sub-simulation, the domestic tourism (x8totd) is set as the external shock for negative effect of flooding as

shown in the prior section. And, as aforementioned, the depreciation of exchange rate typically causes outbound tourism more expensive and cheaper for inbound and domestic tourism, relatively. As such, the results basically reveal that all tourism-related prices fall, with the price for outbound tourism (p8toto) drops by a smaller amount of 0.008 per cent, while the price for domestic tourism (p8totd) and the price for inbound tourism (p7tot) decline relatively more by the same magnitude of 0.043 per cent. Outbound tourism (x8toto) declines according to its higher price by 0.031 per cent while inbound tourism (x7tot) increases by 0.310 per cent. Tourism receipts become higher by 0.266 per cent, whereas both tourism expenses and domestic tourism revenue are lower with the same amount of 0.039 per cent. In all, there is a change in the balance of travel, of which increases by 1.935 billion baht.

The aggregate investment drops by 0.214 per cent with a decrease of 0.269 per cent of the general price of investment (p2tot_i). There is a leftward shift in investment demand according to the losses in agricultural land as the flooding would deter the investors from investing. From (E3), consumption depends on GNP and APC where G is exogenous. Through (E5) where all other factors assumed negligible change, GNP depends on the terms of trade and output. An increase in terms of trade means cheaper imports but costly for exports. APC also increases by 0.012 per cent. Thus, this suggests a higher consumption (and also imports as ever mentioned) through (E3).

The losses of agricultural land show the lower growth of real GDP by 0.106 per cent relative to the baseline which constitutes the perturbed solution of -0.112 per cent (shown in the third column of Table 8.10).

8.2.4. Labor Productivity Changes (column 4)

The flood situation also changes labor productivity. Table 8.9 informs the summary of the labor productivity changes in 2011, of which the flood mostly happened in the latter half of the year, though began and recognized as serious in March and continued with the series of serious storms from late May. Note that it is difficult to estimate the exact magnitude of the change of labor productivity from the pure effect of flooding. Moreover, the flood actually did not cover the whole year period thorough, and also not affect every province of the country (mostly in the central region). Therefore, it is assumed that, for this ‘national (and top-down)’ and ‘annual’ type of model, the flood

affects the labor productivity of 2011 for the whole period and the country as a whole; and the model subsequently perceives the effect as such. There are various magnitudes of the external shock ranging from -35 per cent to almost five per cent for the labor productivity change for each sector. The effect is analyzed in this sub-section. Note that, similar to the prior section, this is the supply side effect since the factor of production, here labor, is affected from flooding.

- Closures and parameter settings

Similar to those above sub-sections, the closures are set with the exogenous variables of technical changes and shifters terms. Table 8.14 summarizes the closure. No swap is required since the b1lab_o (or productivity of labor as a factor of production) is set exogenous in both forecast and policy closure. The magnitudes of the external shock on b1lab_o are given as being externally estimated in Section 8.1. Among most of the sectors with declining labor productivity, there are only eight sectors which gain higher percentage of labor productivity for the year; those direct tourism sectors are accommodation (0.14%), second-home owner (0.0003%), restaurant (0.32%); those tourism-connected ones are communication (0.04%), financial intermediaries (3.3%); and those non-tourism sectors are agriculture (2.61%), mining (4.46%), and transport & storage (0.34%). Those sectors with the notably declining rate of labor productivity are electricity, gas & water (-35%), manufacturing (-15.4%), health (-13%), real estate (-10%), and services (-8.3%).

- Macro Simulation results

The fourth column of Table 8.11 exhibits that the various labor productivity changes (or b1lab_o) leave a drop of 2.467 per cent of real GDP relative to the baseline. Again, with the Back of the Envelope (BOTE) analysis of Table 6.1, the shock on b1lab_o would introduce into the production function of (E2), via labor as one factor of production. The labor productivity changes would consequently affect the sectoral output productions and the related relative prices of factors of production. Such various diverse shocks would give the impacts differently. Note that in terms of labor cost structure, the labor cost share in services sector is the highest comparing to other sectors (about 28 per cent of the total), while manufacturing sector has about fifteen per cent and trade & repair takes about fourteen per cent. Sectors with high labor cost

comparing to other input costs (e.g. rents) are Rail passenger services (92%), Cultural services (70%), Services (79%), and Health (63%).

From Table 8.13, the results show that the decline in labor productivity subsequently makes manufacturing production drop by 2.572 per cent, which makes its price rise by 4.789 per cent, despite more labors are hired by 1.659 per cent. From the furious competition on labor by other sectors, labors are hired less by 6.137 per cent in Agricultural sector, which is considered to be in line with the higher labor productivity of that smaller amount of labors. Agricultural production, thus, decreases by 1.123 per cent which makes its price increases by 0.200 per cent from the leftward supply shift. For the group of services, the change in labor productivity leaves a fall in the group's output production by 2.520 per cent. In general, the prices for this group of sectors rise, with the increase by 13.511 per cent only in the services sector (sector 40). Labors for the group of aggregated services sector (including tourism-related industries) are released by 0.326 per cent, but for the services sector only (sector 40), the labors are hired more by 6.403 per cent. This seemingly paradoxical outcome is, thus, needed to be examined.

Wage (and, real wage) shows its crucial roles. The model informs that it rises by 7.385 per cent (with consumer price index (p3tot) as a numeraire), signifying the higher demand for labor in general. From (E10), the change in wage depends on the labor productivity changes (in terms of A), the ratio of capital to labor, and the terms of trade. With the change in labor productivity, the ratio of marginal product of capital to marginal product of labor would be altered accordingly. In general, the relatively higher wage comes from the fact that, with the increase in labor productivity in the sector like agricultural sector, the producers tend to hire less labor at the same level of output production, whereas, for the sectors with the decline in labor productivity like manufacturing sector, the producers tend to hire more labor to compensate that decline at the same production level. However, this also depends on the labor cost share of that sector and, hence, the significance of the ratio of capital to labor. The results show that employments in those aforementioned sectors with the notably high magnitude of declining labor productivity increase at the relatively higher rate, even crowding out the employment in those sectors with the low rate of declining labor productivity. The employments become higher in electricity, gas & water (20.806%), manufacturing (5.984%), health (5.877%), and services (6.403%). Except real estate, for which there

is a decline in employment (-1.658%) despite the relatively high declining rate in labor productivity. This is because its labor share was only 11 per cent of total factor inputs used and its share is only 0.7 per cent of total labor bill. With the exogenous total employment (but allowing the sectoral mobility), the compensation for the drop of labor productivity results in the higher employment in those in-need sectors and higher wage rate adjusted. The cost push effect from the higher wage rate let the other sectors release labors, despite of low rates of declining labor productivity, and produce less amount of outputs subsequently. Overall, although total employment unchanged, the sectoral output productions decrease according to change in labor productivity and the following changes in sectoral employment.

Another factor in (E10), terms of trade, which could be either positive or negative in the equation, also shows an increase by 0.404 per cent supporting the wage rise. Moreover, the relatively higher ratio of export price to import price in (E12) also alter the output production concerning the price changes. P_M increases by 2.385 per cent due to the rise of exchange rate (from a small country assumption). The result reports an increase in P_X (or p4tot) by 2.740 per cent.

Depreciation of 2.385 per cent relative to the baseline means requiring 2.385 per cent more of local currency for the same single unit of foreign currency comparing to the baseline rate. Through (E7), the increase of export price in local currency leads to a decrease in exports by 1.547 per cent. And, (E6) shows that, apart from the activity level (or output production; Y), the increase in terms of trade leads to the cheaper imports, assumed the unchanged technical change and neutral tariff. Imports decrease by 2.634 per cent according to the relatively higher decline in output production effect (as reported above from lower employment and productivity, hence lower output production and lower demand for imported raw materials) comparing to the lower rise of the price effect from the terms of trade. However, in some high-declining labor-productivity sectors whose productions notably decrease, the imports for these products increase accordingly e.g. electricity, gas & water (16.5%), services (12.6%).

Furthermore, the model informs that GDP price index increases by 2.106 per cent, mostly, from the increase of the prices due to the decline of output production. With the given import c.i.f. price, this confirms the real devaluation of 0.197 per cent relative to the baseline.

The change in exchange rate and local prices affect all tourism-related matters. The externally estimated domestic tourism (x8totd) is set exogenous. Depreciation of 2.385 per cent would deter outbound tourism and encourage inbound and domestic tourism subsequently. Accordingly, outbound tourism (x8toto) declines by 1.062 per cent whereas inbound tourism (x7tot) increases by 1.682 per cent. The results show, nevertheless, that all tourism-related prices rise, with the price for outbound tourism (p8toto) increases by 1.303 per cent, whereas the price for domestic tourism (p8totd) and the price for inbound tourism (p7tot) increase 0.065 per cent and relatively more by 1.858 per cent, respectively. The drops in the supply of outputs of direct tourism industries by 1.713 per cent and tourism-connected industries by 2.144 per cent lead to the overall tourism-related price increases. However, the effect on exchange rate depreciation still benefits the inbound tourism despite the local tourism-related prices rise, which, in turn, makes tourism receipts become higher by 3.431 per cent. Tourism expenses and domestic tourism revenue increase the same amount of 0.060 per cent. Balance of travel shows the increase by 23.691 billion baht.

The lower labor productivity, in general, leads to a lower investment demand. As the capital earns the value of its marginal product and it is the ratio of its rental price to the price (cost) of capital, which is rate of return (ROR). The wage rises reflecting the increasing ratio of capital to labor in (E10) and through (E9), where this ratio of capital to labor relates to the rate of return and terms of trade, ignoring related taxes and fixed technical change. This, in turn, relates to the investment in (E8). In sum, aggregate investment declines by 5.912 per cent altogether with a drop in the general price of investment (p2tot_i) by 1.756 per cent and a decrease in rental price (p1cap_i) by 5.645 per cent, for which reflecting a lower rate of return. In the case of consumption, it is determined by GNP and APC from (E3) where G is set exogenous. GNP is also determined by the terms of trade and output, ignoring the negligible NFL and interest rate, in (E5). An increase in terms of trade would lead to cheaper imports, but discouraging exports, which partly supports a rise in GNP. Nevertheless, APC declines by 4.248 per cent and GNP decreases according to the higher effect of decline in output production. This leads to relatively less consumption by 4.168 per cent, of which also partly responding to the increase in general prices.

8.2.5. Capital Damages (column 5)

Capital damages are concerned as resource loss effects, which is the supply side. The sectoral shocks range from -0.305 to -2.08 per cent are performed in this sub-section since the capital, as factor of production, becomes damaged from flooding.

- Closures and parameter settings

Table 8.14 summarizes the closure. Capital as factor of production is set exogenous in policy closure swapping with the shifters in capital accumulation equation for year t-1. The external shocks on capital are introduced as having been externally estimated in the Section 8.1. Those sectors with the considerable capital damage are transport & storage (-2.08%), community & personal services (-1.75%).

- Macro Simulation results

Capital damage causes a drop in real GDP by 0.783 per cent more relative to the baseline. With the BOTE analysis in Table 6.1, capital relates to equation (E2), which represents the production function counting capital as one of factors of production and this means the related relative prices of factors of production are needed to be considered. The agricultural output production decreases by 0.670 per cent, while manufacturing sector produces less by 1.252 per cent. Services sector also performs less amount of output production by 0.569 per cent (as shown in Table 8.13). This is as expected for the capital damages from flooding since there are smaller amount of capitals, as a factor of production, to use for producing outputs. Their associated output prices drop as well; agricultural product by 2.455 per cent, manufacturing product by 1.222 per cent, and services (sector 40) by 1.073 per cent. However, in some sectors, they increase e.g. transport & storage by 0.590 percent, trade & repair by 2.858 percent, real estate by 1.040 per cent. Both the group of agricultural sector and manufacturing sector employ less labor by 1.224 per cent and 0.718 per cent respectively, while services sector hire more by 0.545 per cent.

Wage (and real wage since cpi is set as a numeraire) falls by 1.719 per cent. The drop in wage comes from a decline in the ratio of capital to labor due to capital damages through (E10). This also means the rise of the ratio of marginal product of capital to marginal product of labor, for which leads to the cheaper wage. From (E10), another

factor, which is terms of trade, could be either positive or negative, but its size would be less than that of the fall in the ratio of capital to labor, hence, the fall in wage. From the model, it reveals that there is an increase in terms of trade of 0.440 per cent. It shows that P_M declines by 1.354 per cent through exchange rate appreciation (given small country assumption). Therefore, export price or P_X would decrease but relatively less. The result reveals a decline in P_X (or p4tot) by 0.858 per cent.

There is an exchange rate appreciation by 1.354 per cent. Through (E7), a drop in exports by 1.814 per cent comes from the effect of the appreciation of the exchange rate of and the increase in local currency export prices. From (E6), ignoring technical change and tariff, the increase in terms of trade means cheaper imports. The model informs that real imports decrease by 0.637 per cent because of the relatively higher effect of exchange rate appreciation over terms of trade. Balance of trade becomes deteriorated by -95.727 billion baht.

There is a real appreciation from the capital damages, which means the growth of import c.i.f. price is less than the growth of GDP price index. The model tells that GDP price index decreases by 0.021 per cent. With the given import c.i.f. price, this confirms the real appreciation of 1.384 per cent relative to the baseline.

All inbound, outbound, and domestic tourism changes accordingly. Apart from the domestic tourism (x8totd) which is set as the external shock, the appreciation of exchange rate makes outbound tourism cheaper and relatively more expensive for inbound and domestic tourism. All tourism-related prices drop, with the price for outbound tourism (p8toto) falls by a bigger amount of 0.936 per cent, while the price for domestic tourism (p8totd) and the price for inbound tourism (p7tot) decrease relatively less by 0.055 per cent and 0.856 per cent. Outbound tourism (x8toto) rises responding to its lower price by 0.934 per cent while inbound tourism (x7tot) decreases by 1.860 per cent, mainly from the exchange rate. Tourism receipts are lower by 2.672 per cent, while tourism expenses and domestic tourism revenue are lower by 0.058 per cent similarly. Balance of travel decreases by 18.42 billion baht.

The outputs of direct tourism industries decrease by 0.673 per cent and also tourism-connected industries by 1.008 per cent, the outputs of non-tourism industries decrease by 0.727 per cent. Labors are hired more in non-tourism industries by 0.302 per cent

and less in tourism-connected industries and direct-tourism industries by 0.718 per cent and 1.157 per cent, respectively. This shows that capital damages affect tourism-connected industries the most and the decline in wage supports a labor migration from tourism-related industries to non-tourism industries.

The aggregate investment drops by 0.019 per cent with an increase of 0.603 per cent of the general price of investment (p2tot_i) and an increase in rental price (p1cap_i) by 1.371 per cent, for which showing a higher rate of return as the increase in rental price is higher than the price (cost) of investment. Higher rate of return stems from a drop in capital from damages resulting from flooding. There is an increase in consumption by 0.362 per cent. An increase in terms of trade would lead to cheaper imports, but discouraging exports as mentioned before. This partly means as more GNP from relatively lower import price through (E5). Changes in GNP and capital stocks (which relates to the investment) determine changes in NFL and changes in interest payments on them via (E11), with a given average propensity. The damages of capital from flooding would mean lower capital for labors to work with. This would create the effects on (E11) directly through the lower amount of capital and indirectly through (E2), respectively. NFL is lower through (E11) and, in turn, together with the lower GDP via (E2) would reflect a drop in GNP in (E5). This would further influence a decline in NFL through a drop in GNP. Nevertheless, through (E5), the drop in NFL in the first direct round would also induce the higher GNP. The total effect could be ambiguous. Nonetheless, the result shows that GNP declines by 0.733 per cent.

Capital damages deteriorate the real GDP by 0.783 per cent relative to the baseline which constitutes the perturbed solution of 3.530 per cent (shown in the fifth column of Table 8.10). Each part of the real GDP reveals the deterioration by capital damages.

8.2.6 Annual Total (column 6)

The annual total is the sum of all behavioral and resource loss effects of those sub-total shocks represented in the first to the fifth column with explanations on each effect in those five sub-sections above. As each effect from flooding gives different impacts, the annual total would show total impacts of all effects on the economy.

As shown in Table 8.11, the deviations from baseline from each effect give different

magnitudes both positive and negative. The annual total effects of all deviations are therefore shown with the final column. For Table 8.10, it shows the macro perturbed solution as the after effect, comparing to the magnitude of the effect as the deviations in Table 8.11. Note that the value of the magnitude summed up of sub-total does not necessarily mean the exact addition of the value of each sub-total, but rather the sum of the effects of the total shocks. The macro-perturbed solution in Table 8.10 would report the solution, of which deviates from the baseline forecast (mainly, the second half average). This section would focus only the annual totals of the deviations and the macro-perturbed solution.

For the deviations, the result in Table 8.11 shows that the annual GDP, after the flooding, would decline by 3.374 per cent relative to the baseline. This has made the macro-perturbed solution to be at 2.651 per cent in Table 8.10. Each composition of GDP also reveals the deterioration. Aggregate consumption declines by 1.939 per cent while aggregate investment is the most affected by flooding, with a drop of 6.281 per cent. This gives aggregate consumption and aggregate investment increases by 1.787 per cent, 0.663 per cent for the macro perturbed solution, respectively. The model set government spending to be exogenous. The macro perturbed solution for government spending is, thus, the same as the growth of baseline forecast at 6.86 per cent. For the deviations, decreases in both exports and imports are shown by 3.528 per cent and 3.507 per cent, respectively. This deteriorates trade balance by 29.12 billion baht more relative to the baseline. From the decreases in the deviations, the macro perturbed solution tells that exports and imports only grow at 5.327 and 5.217 per cent, respectively, of which generates only 424.590 billion baht after the declines in policy simulation. Inbound tourism declines by 2.007 per cent, with the externally estimated (as one of the shocks) domestic tourism of -15 per cent, while outbound tourism also drops about 16.725 per cent as the model views both the domestic tourism and outbound tourism (or imported side) as a bundle for national tourists. Tourism receipts (export side) weaken by 1.918 per cent, while tourism expenses (import side) worsen by 16.609 per cent. This yields a travel surplus by 25.587 billion baht, mainly from a large drop of the outbound tourism although with a weaker inbound tourism as well. Domestic tourism revenue also declines by 16.609 per cent from the estimated decline of fifteen per cent in the domestic tourism. For macro-perturbed solution, the inbound tourism shows a rise to only 4.410 per cent after a little fall from policy shocks.

Domestic tourism also drops by 9.914 per cent from the deviation of fifteen-percentage external shock from the flood. This is also the case for the declining outbound tourism of 7.775 per cent from the deviation of 16.725 per cent of the policy shock. This makes the tourism receipts grow only 6.072 per cent. With the drop in both tourism expenses by 10.731 per cent after the policy deviation of 16.609 per cent, the macro perturbed solution suggests the travel surplus of 62.746 billion baht.

Aggregate employment is set exogenous with real wage as the market mechanism of the model and consumer price index is set as a numeraire. The deviations reports that real wage increases by 5.377 per cent, mainly from the labor productivity change. The rise in real wage also reflects the increase in the capital to labor ratio and the increase in marginal product to labor relative to marginal product to capital. This means that the effects on the productivity of labor overrule the capital damages in terms of real wage and labor market. This produces the rise of real wage in the macro-perturbed solution to 18.751 per cent. Furthermore, the real appreciation of 0.976 per cent relatively encourages imports and discourages exports in the deviation result. This also makes the real appreciation of 7.663 per cent in the macro-perturbed solution. Overall supply-side shocks on the factors of production also lead to the contraction of exports. It then causes an improvement in the terms of trade by 0.908 per cent, which also adds a rise in the terms of trade of 5.506 per cent in the macro perturbed solution. This, in turn, for the deviation, increases the GDP price index (or GDP deflator) by 1.910 per cent relative to other domestic price indices e.g. investment price and raises the GDP price index to 4.902 per cent in the macro perturbed solution.

Table 8.13 reports the deviations from baseline forecast that the outputs of all sectors decline: outputs of the agricultural sector drop by 3.564 per cent, outputs of the manufacturing sector decline by 3.833 per cent, and outputs of those services sectors fall by 3.097 per cent. For tourism-related outputs, outputs of direct tourism industries decrease by 2.898 per cent, outputs of tourism-connected industries decline by 3.307 per cent, and outputs of non-tourism industries fall by 3.418 per cent. These declines in output production confirm that the losses or damages of factor of production are concerned as the major cause. Table 8.12 reports the sectoral perturbed solution resulting from the policy shock (deviations). The increasing growth in sectoral outputs becomes lower from the deviations shown in Table 8.13, as a result of the flood. For

employment, it shows a decrease by 6.607 per cent for agricultural sector, while increase by 0.691 per cent and 0.156 per cent for manufacturing and services sectors, respectively. This is in line with the macro-perturbed solution in Table 8.12 where labor drops in agricultural sector by -7.059 per cent, while increases in manufacturing and services sectors by 2.074 and 1.883 per cent, respectively. For deviations, labors are hired more in non-tourism industries by 1.743 per cent and less in tourism-connected industries by 4.176 per cent and direct tourism industries by 6.495 per cent as they migrate to non-tourism industries. For the macro-perturbed solution in Table 8.12, labors follow the pattern resulting from the deviations shown in Table 8.13. It could be said that in terms of employment, the direct tourism industries and agricultural sector are worse off from the flooding. For capital, the effect of the annual total comes solely from the sub-total effect of the capital damages. Results from the deviation in Table 8.13 show that agricultural sector has its capital damaged from flood by 0.558 per cent. Manufacturing and services sector have their capital damaged by 1.323 per cent and by 1.150 per cent. For tourism-related industries, capital is damaged by 1.282 per cent for non-tourism industries, by 1.090 per cent for tourism-connected industries, and by 0.304 per cent for direct tourism industries. The macro-perturbed solution in Table 8.12 reports the lower growth resulting from the deviation in Table 8.13 above, mostly due to the capital damage shock.

It can be straightforwardly seen that the flood damages the economy and the resource-loss effects on the supply side show its domination regarding output production. For the tourism-related matters, the behavioral effects on demand side, especially the drop in the domestic tourism as externally estimated, creates the worsening impacts on the tourism-related economy, although not at the high rates on the overall real GDP.

8.2.7 After-effect Forecast Growths to 2020

This sub-section informs the after-effect forecast growths (cumulative difference) relative to base case forecast from 2012 to 2020, as shown in Figure 8.2-8.6. A few swaps are performed to specify the long run simulation rather than year-to-year basis: full employment and constant ratio of investment to capital. Hence, the aggregate employment and the ratio of investment-capital are set exogenous. Both behavioral and resource-loss effects of flooding reduce real GDP and its components overtime as shown in Figure 8.2 for its demand side of the economy. It shows that the effect is

more intense overtime. In 2020, the real GDP is reduced by 4.039 per cent relative to the baseline, comparing to about 3.351 per cent in 2012. This stems from the much lower consumption (-7.385 per cent) in 2020. The fall in investment is relatively the same throughout the period after the policy shock, due to the long run specification of constant ratio of investment to capital. Other components are also shown to be negative and ranged around the same magnitude as of 2012 whereas only the effect on inbound tourism improve overtime as in 2020 the effect becomes lower (1.862 per cent decrease instead of more negative effect earlier).

With a small economy, the deviation for exports is negative but improved through time. Without any shock on foreign demand for exports on this scenario, the improvement in export volumes is accompanied by the fall in foreign currency prices. For imports, assume that any changes in local demand have no effect on foreign currency prices, the over-time slight deterioration in terms of trade, or a smaller ratio of the price of exports to the price of imports as shown in Figure 8.8, would mean a further decline in consumption relative to the GDP, as the relative price of imports (of which, partly for consumption) slightly increases. Hence, it eventually improves the trade balance, of which confirmed by the continuing depreciation of exchange rate. This is also the case for the gain in the balance of travel, where, as aforementioned, the improvement in inbound tourism exists while the outbound tourism slightly declines as confirmed in the travel receipts and expenses shown in Figure 8.4. It is because the gdp price index (the local price) rises at a higher rate than the foreign currency import price, which makes a slight real appreciation over time.

Figure 8.5 shows real wage and the change in sectoral employment. The long run specification let aggregate employment be exogenous (at full employment). Real wage rises as there is a competition for limited labors. There is a quick rise by 5.852 per cent relative to the baseline before steadying with an increase by 6.443 per cent in 2020. For the three major-sector grouping, services sector hires higher amount of labors, of which mainly migrates from the agricultural sector, while manufacturing sector hires a slightly less amount of labor in the short run, but continue to release labors less in the long run. For tourism-related grouping, labor migrates to the non-tourism industries from direct tourism industries and tourism-connected industries. Direct tourism industries suffer more than tourism-connected industries in terms of labor reduction and the releases of labor grow more through the period.

All sectors produce less output, accordingly. In the short run, manufacturing outputs are reduced the most, but as releasing less labor, the declining rate is slightly slow in the long run although still produces the outputs less. This is opposite for the agricultural outputs, where the production declines the most in the long run. This is all in line with the employment and labor migration through the period.

Figure 8.2: % Deviations from Base case Forecasts of Real GDP and its composition

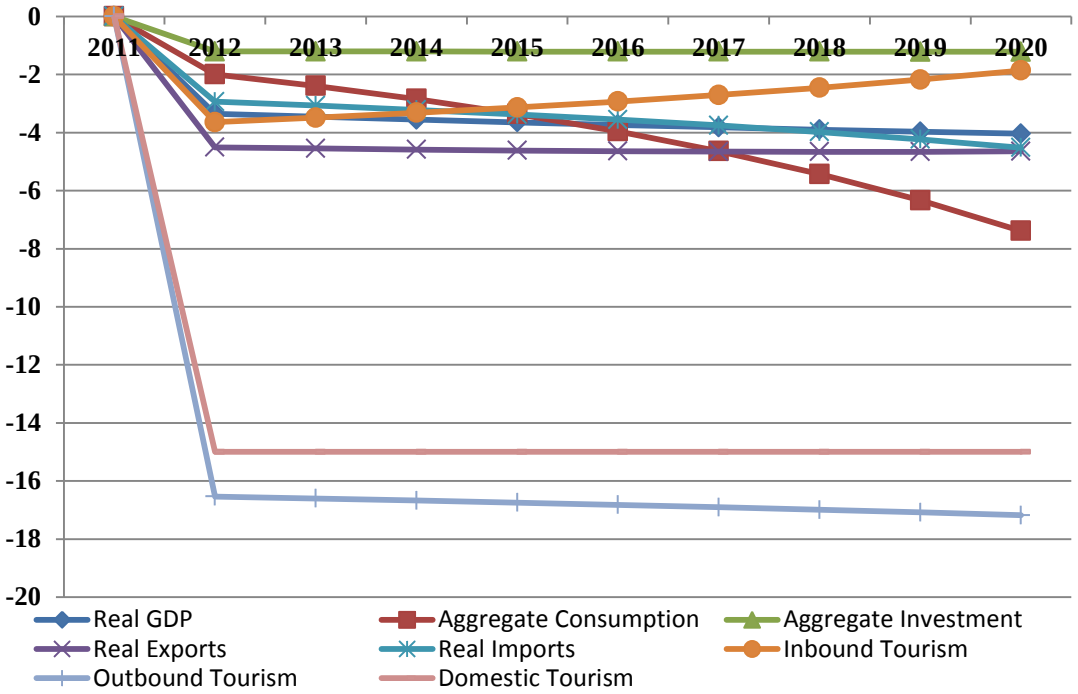


Figure 8.3 % Deviations from Base case Forecasts of Terms of Trade and Real Exchange Rate (Real Devaluation/Real Appreciation)

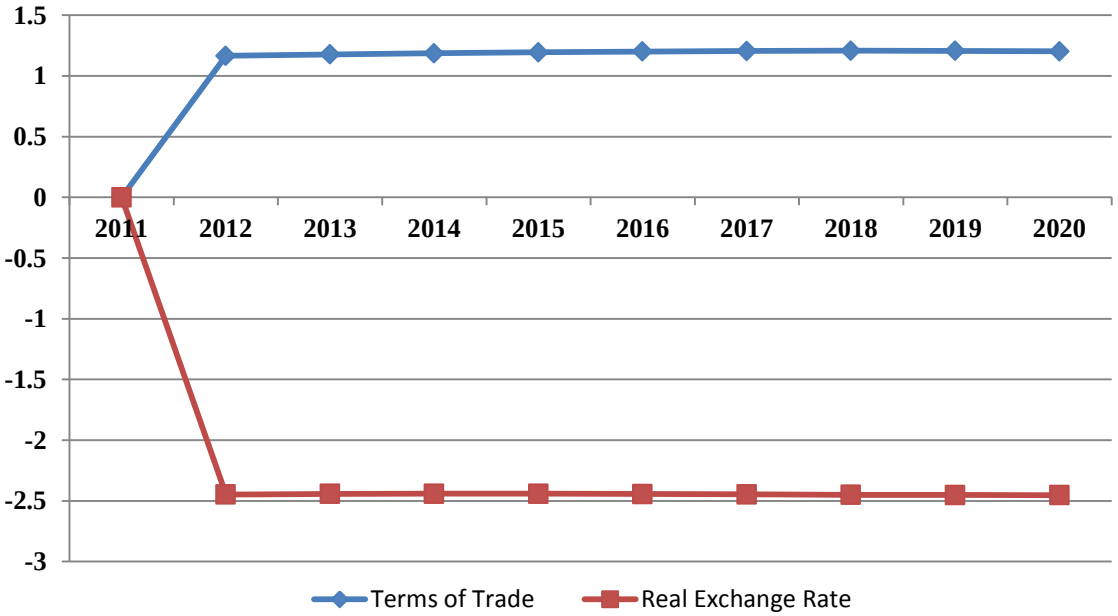


Figure 8.4: % Deviations from Base case Forecasts of Travel Receipts & Expenses and Domestic Tourism Revenue

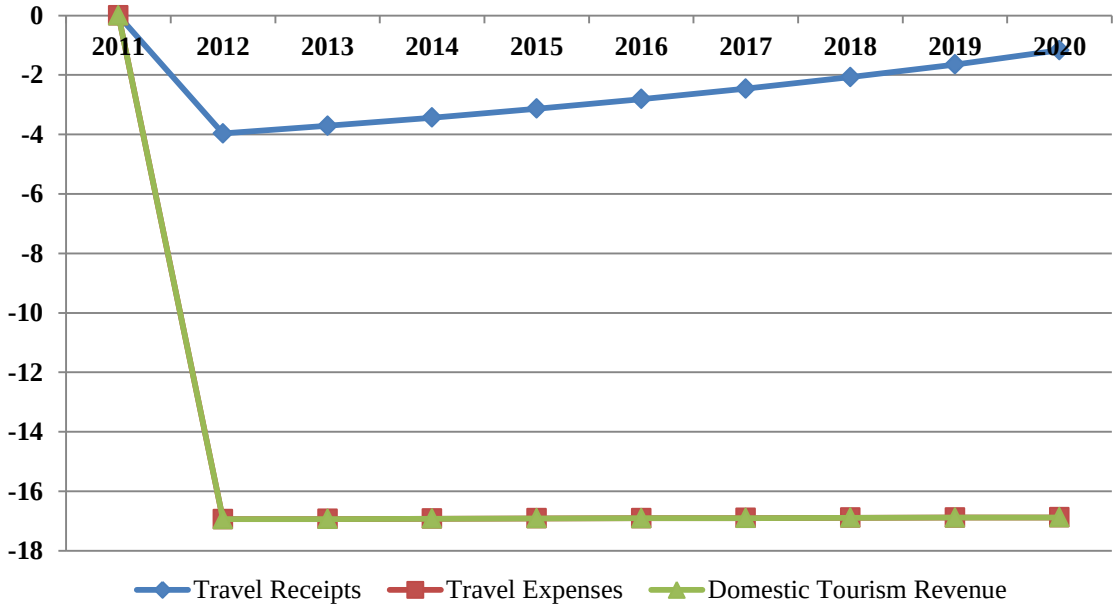


Figure 8.5: % Deviations from Base case Forecasts of Real wage and Employment

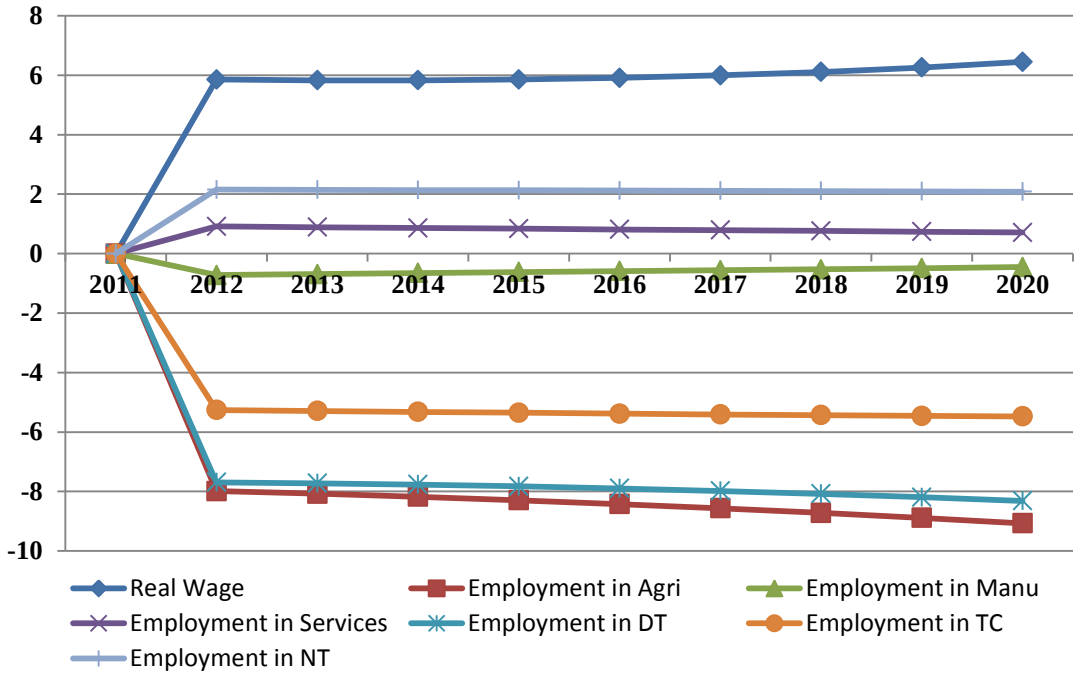
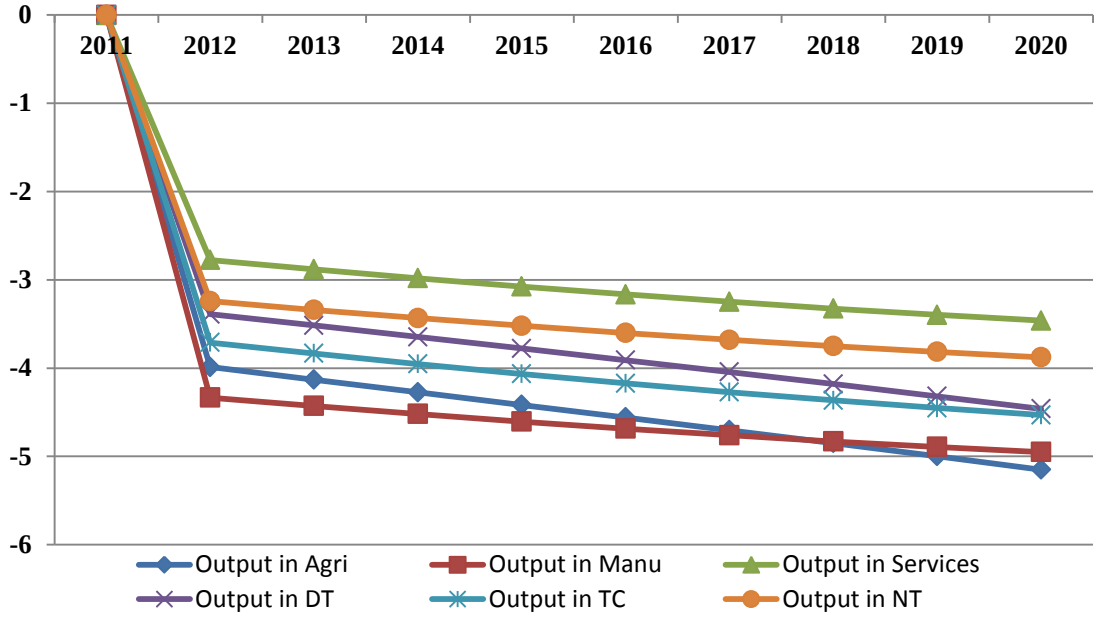


Figure 8.6: % Deviations from Base case Forecasts of Outputs (2011-2020)



8.3 Policy Simulation

Tax Cut for Inbound Tourism

The controversial issue of how to soothe the flood-affected businesses is the same as choosing the vote for politicians. In this study, the policy simulation is aimed to examine the effect of a uniform half-percentage cut of the power of tax for inbound tourism as an inducement for the inbound tourists to still travel in the country in spite of the flooding. This is only a trial case in terms of tax-incentive proposal to see its impact on the macro-economy and whether to pursue it for real.

- Closures and parameter settings

Closures in this simulation remain the same to those reported in Table 8.14, of which summarizes major differences of the policy closures and forecast closures. Exogenous variables are technical changes and shifters terms with the main external shock of f7tax_c of a half percentage introduced in addition to those sub-shocks in section 8.2.1-8.2.5. Consumer price index is still a numeraire. This policy simulation would be presented in comparison to the effects from flooding in terms of 'flooding without any tax incentive' and 'flooding with tax incentive for inbound tourism' focusing on only the deviations. Table 8.15 and 8.16 show the deviations from baseline of macro and sectoral results of flood both with and without tax incentive for inbound tourism.

- Macro Simulation results

The tax cut simulation shows that a half percentage cut causes the increase of 0.005 per cent of real GDP relative to the baseline. From BOTE analysis, the shock is introduced through the price in (E13), which is the inbound visitor's demand function. It suggests that the external shock of the tax incentive would generally decrease the related tax, which is t_7, and thus makes the associated prices (P_7) in (E13) decline. The model reports that p7tot (general price of P_7) declines by 1.778 per cent. This would increase inbound visitors' demand as shown by the rise of 5.220 per cent of the real inbound visitors' demand accordingly. The increase in x7tot or real inbound tourism makes the travel receipts (or the revenue from inbound visitors) increase by 3.415 per cent. This would partly affect the GDP equation for its increase of 0.005 per cent.

Through (E2), in response to the higher demand, it shows that the sectoral output and related factors of production, especially tourism-related ones, are affected. Table 8.16 reports that outputs of direct-tourism industries increase by 0.863 per cent responding to the higher inbound tourism demand. The compositions of factors of production follow the output production. Real wage increases by 0.134 per cent. With exogenous capital, labors are hired more in direct-tourism industries by 2.237 per cent, whereas less for other industries as shown 0.055 per cent for tourism-connected industries and 0.174 per cent for non-tourism industries. Output growths in those two industries are lower by 0.019 per cent and 0.064 per cent, respectively.

The higher wage rate would relate to (E10). With the fixed aggregate employment but allowing inter-sectoral movement, no change in technology, and exogenous capital, it would mean the gain in terms of trade, of which increases by 0.115 per cent. As P_M falls by 0.473 per cent, export price or P_X would decrease but relatively less for that gain in terms of trade. The result shows a decrease in P_X (or p4tot) by 0.342 per cent.

The exchange rate shows an appreciation of 0.473 per cent relative to the baseline. This means 0.473 per cent less of local currency is required for one single unit of foreign currency relative to that before tax cut. Higher demand for inbound tourism means higher demand for local currency for travelling. Appreciation also means relatively less demand for export and more demand for import.

For export demand function (E7), it is expected that a decrease in export price would increase exports volumes accordingly. Results, however, reveal that real exports drop by 0.441 per cent. This means the appreciation of the exchange rate mandates the decrease in local currency export prices. Hence, this explains the reason why real exports fall despite a decrease in export price in local currency. Foreign currency export price becomes more expensive through exchange rate appreciation.

Table 8.15: Deviations from Baseline of macro results with tax incentive (2012)

	Column	With tax incentive		Without	Difference
Row	External Shocks	Tax Cut	Annual Total	Annual Total	(w) – (w/o)
	Endogenous Variables	(t)	(w)	(w/o)	Δ
1	Real GDP	0.005	-3.368	-3.374	0.006
2	Real aggregate consumption	-0.085	-2.025	-1.939	-0.086
3	Real aggregate investment	0.194	-6.089	-6.281	0.192
4	Real government spending	0.000	0.000	0.000	0.000
5	Real exports	-0.441	-3.980	-3.528	-0.452
6	Real imports	0.040	-3.467	-3.507	0.040
7	Real inbound tourism	5.220	3.386	-2.007	5.393
8	Real domestic tourism*	0.000	-15.000	-15.000	0.000
9	Real outbound tourism	0.690	-16.058	-16.725	0.667
10	Travel receipts	3.415	1.642	-1.918	3.560
11	Travel expenses	0.357	-16.266	-16.609	0.343
12	Domestic tourism revenue	0.357	-16.266	-16.609	0.343
13	Aggregate employment	0.000	0.000	0.000	0.000
14	Real wage	0.134	5.516	5.377	0.139
15	Real devaluation	-0.384	-1.340	-0.976	-0.364
16	Terms of trade	0.115	1.027	0.908	0.119
17	*Change* in balance of trade	-36.969	-67.495	-29.120	-38.375
18	*Change* in balance of travel	22.889	49.542	25.587	23.955
19	Real GNP	-0.083	-1.755	-1.666	-0.089
20	Propensity to consume to GNP	0.370	-16.735	-17.087	0.352
21	GDP Price index	-0.090	1.814	1.910	-0.096
22	Aggregate investment price index	-0.047	-1.607	-1.549	-0.058
23	Exports price index	-0.342	1.549	1.887	-0.338
24	Imports price index	-0.473	0.512	0.975	-0.463
25	Inbound tourist price index	-1.778	-1.725	0.081	-1.806
26	Outbound tourism price index	-0.393	-0.041	0.345	-0.386
27	Domestic tourism price index	0.392	-1.491	-0.1882	-1.303
28	Average capital rental	0.095	-4.772	-4.859	0.087
29	Average land rental	-0.874	6.496	7.424	-0.928
30	Exchange rate	-0.473	0.512	0.975	-0.463

Source: Simulation results

For (E6), the rise in terms of trade and activity level (with fixed technical change and tariff neutrality) would relatively induce more imports. The real imports increase by 0.040 per cent accordingly.

Table 8.16: Deviations from Baseline of sectoral results with tax incentive (2012)

	Column	With tax incentive		Without	Difference
Row	External Shocks	Tax Cut	Annual Total	Annual Total	(w) – (w/o)
	Endogenous Variables	(t)	(w)	(w/o)	Δ
1	Direct-tourism industries – Output	0.863	-1.994	-2.898	0.904
2	Tourism-connected industries – Output	-0.019	-3.325	-3.307	-0.018
3	Non-tourism industries – Output	-0.064	-3.483	-3.418	-0.065
4	Agricultural sector – Output	-0.185	-3.722	-3.564	-0.158
5	Manufacturing sector – Output	-0.167	-4.004	-3.833	-0.171
6	Services sector – Output	0.104	-2.988	-3.097	0.109
7	Direct-tourism industries – Labor	2.237	-4.278	-6.495	2.217
8	Tourism-connected industries – Labor	-0.055	-4.221	-4.176	-0.045
9	Non-tourism industries – Labor	-0.174	1.567	1.743	-0.176
10	Agricultural sector – Labor	-0.538	-7.125	-6.607	-0.518
11	Manufacturing sector – Labor	-0.490	0.206	0.691	-0.485
12	Services sector – Labor	0.266	0.418	0.156	0.262
13	Direct-tourism industries – Capital	0.000	-0.295	-0.304	0.009
14	Tourism-connected industries – Capital	0.000	-1.092	-1.090	-0.002
15	Non-tourism industries – Capital	0.000	-1.284	-1.282	-0.002
16	Agricultural sector – Capital	0.000	-0.558	-0.558	0.000
17	Manufacturing sector – Capital	0.000	-1.325	-1.323	-0.002
18	Services sector - Capital	0.000	-1.149	-1.150	0.001

Source: Simulation results, See more on sectoral outputs & commodity prices in Appendix 8.3

Like the case of imports, the appreciation of exchange rate generally makes it cheaper for outbound tourism. There is a decrease in price for outbound tourism by 0.393 per cent whereas the price for domestic tourism increases by 0.392 per cent in the result. Outbound tourism rises by 0.690 per cent accordingly (domestic tourism is determined externally as being estimated).

There is a real appreciation of 0.384 per cent from the tax cut, which means the growth of import c.i.f. price is less than the growth of GDP price index. It is known that GDP price index decreases by 0.090 per cent in the result. Given import c.i.f. price, this confirms the real appreciation of 0.384 per cent relative to the baseline.

Labor migration, from other industries to the direct tourism industries as mentioned earlier, reflecting the rising ratio of capital to labor in (E10), of which the wage increases. And, through (E9), this rising ratio of capital to labor reflects the increasing rate of return and terms of trade, where other terms are exogenous. This relates the aggregate investment in (E8), for which aggregate investment increases by 0.194 per cent reflecting a higher rate of return. ROR is shown higher from a fall in the general

price of investment (p2tot_i) by 0.047 per cent and a rise in rental price (p1cap_i) by 0.095 per cent. By this, from (E1), the effect from the increases in investment and inbound tourism from tax cut should outweigh the effect from the trade deficit and the expected decline in consumption, since GDP slightly increases (supported by (E2)). Through (E4), the ratio of real private (C) to real public (G) consumption, also shows a rise of 0.086 per cent, about the same percentage as the decrease in real private consumption by 0.085 per cent shown in the results. From (E3), apc_gnp is a ratio of C+G+8 to GNP, where G and 8 are exogenous, thus C is determined by apc_gnp and GNP. This is in line with the drop in GNP by 0.083 per cent as reported in Table 8.15.

- Tax incidence

The tax cut as an incentive to boost inbound tourism creates a positive effect on real GDP. As shown in Table 8.14, the annual total with tax incentive (w) reveals some boons and banes over the annual total without tax incentive (w/o). The difference of the two scenarios is compared as in last column, named difference or (w)-(w/o). Note that the effects of tax cut sub simulation are not equal to the difference of both annual totals since there are some interactions of what is called ‘general equilibrium’. Each agent would respond differently with the existence of tax cut and without any tax cut.

The incentive of a tax cut of a half percentage creates some positive effects on GDP and its composition of GDP. The annual total with tax incentive (w) is better off by 0.006 per cent more concerning the GDP than that without tax incentive (w/o). Annual total for real GDP decreases by 3.368 per cent comparing to the decline by 3.374 per cent of that without tax cut. The effects on GDP composition are also slightly different comparing between the tax cut sub simulation and the difference of (w)-(w/o) but they are all in the same direction. Real consumption and real exports are worse off from the tax cut with the decrease by 0.086 per cent and 0.452 per cent, respectively.

The tax cut as an incentive for inbound tourism creates a larger impact on inbound tourism as expected. For the tax cut scenario, the effect on real inbound tourism is an increase by 3.386 per cent, of which contributes to make an increase of real inbound tourism in the annual total with tax cut by 5.220 per cent, whereas it is a decrease in the annual total without tax cut by 2.007 per cent. This gives the difference of a plus

about 7.227 per cent. Travel receipts increase accordingly by 3.415 per cent from the tax cut, of which contributes to the increase in annual total of 1.642 per cent, comparing to the decrease by 1.918 per cent in the annual total without the tax cut. The difference of (w)-(w/o) is thus about 3.560 per cent. This furnishes the balance of travel to be 49.542 billion baht in the annual total with the tax cut comparing to the surplus of 25.587 billion baht of that without the tax cut.

Other variables are slightly different in comparison. Real wage increases a bit more from the tax incentive as well as the terms of trade and real appreciation. When considering the sectoral impacts, the tax cut generates more outputs in the direct tourism industries as expected. Although the increasing outputs of 0.904 per cent more are not enough to make a positive outcome for the annual total (w), the decline in the reduction of output production from 2.898 per cent in the annual total without tax cut (w/o) to 1.994 per cent is a better off. This is in line with the greater amount of labor hired in the sector by 2.217 per cent in comparison between the two annual totals. For other two industries, they are worse off as their own labors migrate to the direct tourism industries. In the difference (w)-(w/o) column of Table 8.15, it shows 0.045 and 0.176 per cent falls in sectoral employment for tourism-connected industries and non-tourism industries, respectively. Their output productions follow the falls in sectoral employment with a drop by 0.018 per cent for tourism-connected industries and by 0.065 per cent for non-tourism industries. Capital in direct tourism industries decreases by 0.295 per cent for annual total with tax cut accordingly. Other tourism-related industries experience the declines by 1.092 and 1.284 per cent, respectively. The difference (w)-(w/o) is positive by 0.009 per cent for direct tourism industries whereas similar amounts of 0.002 per cent fall for other tourism-related industries.

For macro-sectoral wise, the tax cut gives a plus of 0.104 per cent more to the output production of services sector, of which marks a decrease in annual total with tax cut of 2.988 per cent comparing to that of 3.097 per cent in annual total without tax cut. This makes the difference of 0.109 per cent between the two. Agricultural sector and Manufacturing sector experience the declines in their output production by 0.185 per cent and 0.167 per cent from the tax cut. This makes the annual total (w) with the further declines by 3.722 and 4.004 per cent for both sectors, respectively. Hence, comparing with the annual total without tax cut (w/o), there are the further differences

by -0.158 per cent and -0.171 per cent for both sectors. This goes along with the labor migration since labor moves to services sector by 0.266 per cent from agricultural sector (-0.490 per cent) and manufacturing sector (-0.538 per cent) because of tax cut. Annual total (w) marks a drop in employment of 7.125 per cent in agricultural sector whereas the increases in employment of manufacturing and services sector by 0.206 per cent and 0.418 per cent, respectively. Comparing to the annual total without tax, the simulation with tax incentive makes further declines by 0.518 and 0.485 per cent for agricultural and manufacturing sectors while a rise by 0.262 per cent for services. For sectoral capital, there are about the same deviations for both annual totals.

- After effect forecast growth to 2020

For the after-effect tax cut forecast growths of the deviations relative to base case forecast from 2012 to 2020, the results show just a slight difference in most of the variables from the without tax cut scenario. Only real inbound tourism and tourism receipts have the drastic changes when comparing between the two scenarios as showing in Figure 8.7. For real inbound tourism, the after-flood growth is negative for without tax cut scenario in the short run and later on recover to be less negative in the long run (the same as in Figure 8.2). With the tax cut, the deviation from base case forecast is positive and growing further in the long run. Tourism receipts also show a quite similar growing pattern, only with a slight drop in the short run. Nonetheless, the effect on the deviation over real GDP is very tiny and it reveals the same trend for both tax cut and without tax cut. From Figure 8.8-8.9, outputs and employments of direct tourism industries with tax cut decline less than that of without tax cut, although with the same declining trend. For tourism-connected industries, the reductions are about the same and with the similar trend. For the case of non-tourism industries, there are further output and employment reductions with tax cut comparing to the without tax cut scenario. Hence, the tax cut incentive could be presented as an alleviation program to soothe the situation like tourism setback, in this case the flood. Tourism-related industries are better off, but at some expenses of other industries for this long run scenario with full employment specification. A mix of incentives e.g. investment measures, or transfers could be further pursued to examine all inclusive effects other than tourism-focused. This would be beneficial for macroeconomic policy planners.

Figure 8.7: % Deviations from Base case Forecasts of Real GDP, Real inbound tourism, and Tourism receipts comparing between tax cut and without tax cut

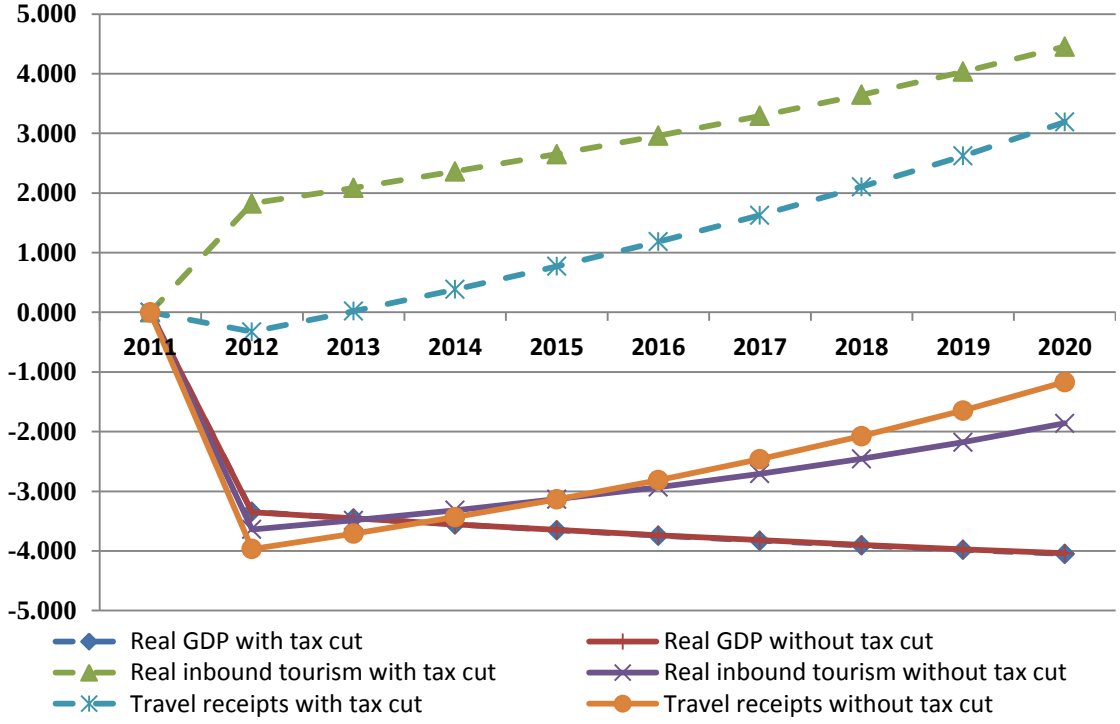


Figure 8.8: % Deviations from Base case Forecasts of Outputs comparing between tax cut and without tax cut

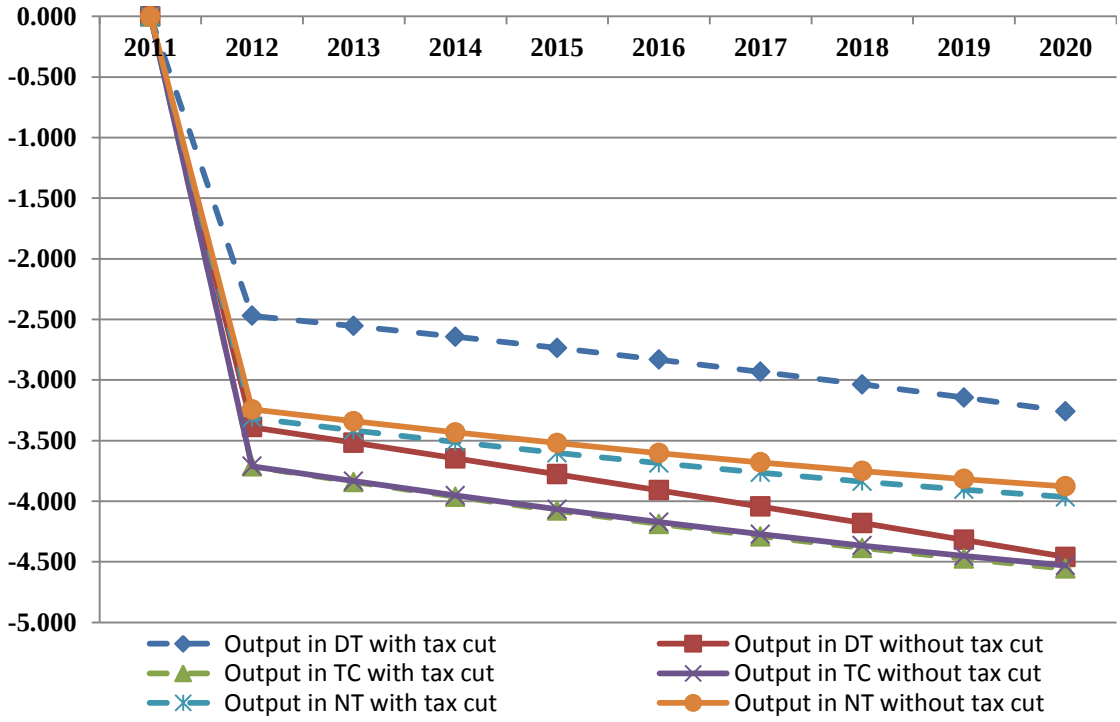
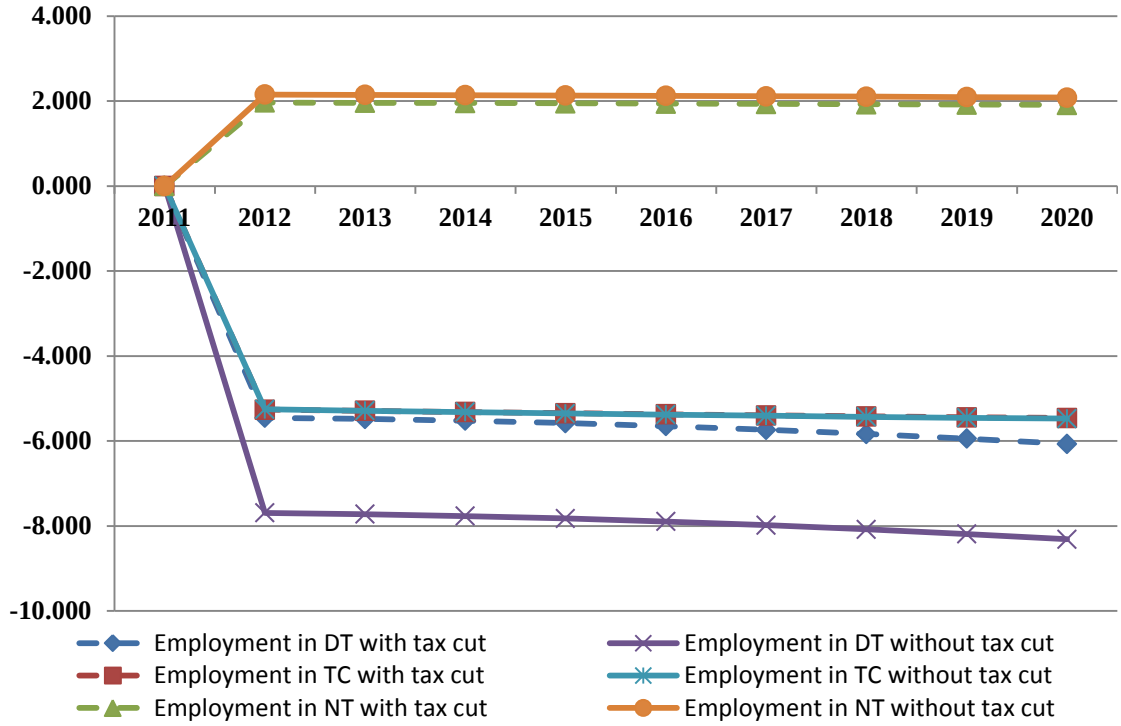


Figure 8.9: % Deviations from Base case Forecasts of Sectoral employments comparing between tax cut and without tax cut



Chapter 9

Summary and Future Research

"The journey of a thousand miles begins with a single step."

Lao Zi. Chapter 64 in Tao Te Ching (6th century BC; in debates)

9.1. Overview

In this thesis, TRAVELTHAI, a dynamic computable general equilibrium (CGE) model for the Thai economy, has been constructed with an application to the Tourism industry for the analysis of its economic impacts over the period 2001-2020.

In Chapter 1, the objectives and the main contributions of the thesis and are presented. It informs that examining the impacts of the Tourism setbacks on the Thai Tourism could be immensely improved by a dynamic CGE model, especially with wide-ranged abilities of historical and forecasting, including policy analyses. TRAVELTHAI, a medium-scale CGE model, serves as an analytical tool that offers many other attributes apart from what many existing CGE models of Thailand provide. It is based on MyAGE and McHuge/CHINAGEM, the successors of MONASH model for Australian economy, one of the prominent CGE models with three-decade development effort by Centre of Policy Studies (Dixon and Rimmer 2002).

Chapter 2, it contains the definition of Tourism and related issues, an overview of the Tourism Satellite Accounts (TSAs), and an overview of historical development of CGE modeling and literature reviews of the CGE models in Thailand, the dynamic CGE models and existing studies on Tourism-related CGE models.

Chapter 3 delivers the brief background of the Thai economic development. It also gives the information on how important the Tourism industry is in Thailand and its role in the world among other countries. The geographical reference of Thai Tourism, Tourism resources, and climate for Tourism are concisely explained. The chapter, in addition, applies the SWOT analysis to the industry concerning its competitiveness and provides the agenda and alleviation scheme that the authorities e.g. Department of Tourism and Tourism Authority of Thailand are taking control.

In Chapter 4, the theoretical structure of TRAVELTHAI is described in details. TRAVELTHAI has its mixed framework following MyAGE for Malaysia (CoPs, 2010) and McHuge, or later on ChinaGEM for China (Mai, et.al. 2010). It specifies production technologies and consumption preferences, plus a detailed description of prices, and recursive dynamic mechanism for capital and net financial liabilities, together with a wage-adjustment process. These capture the important features of the Thai economy, to which the model has been carefully calibrated in the subsequent chapter. TRAVELTHAI, hence, could capacitate giving responses to a wide-scale of questions on the Thai economy, not conform to only the analysis of Tourism setbacks, either in the past, or to forecasting the future.

Chapter 5 first describes the steps of making the core database for the comparative static version of CGE model, THORANI, in the style of ORANI-G, a general all-suite-purpose model template under Centre of Policy Studies (CoPs). Later on, the dynamic mechanism is added, together with the supplementary data, to create the overall database of TRAVELTHAI. The chapter mainly documents the sources of data and how to arrange the data in the form used in the model.

How to develop the base line simulation of the economy over the period 2001-2010 is explained in Chapter 6. The observed changes in macroeconomic variables calculated in this chapter serve as inputs into the historical simulation. The historical simulation computes changes to structural variables i.e. preferences over the period. This gives the realistic baseline for the forecasts and also delivers the updated information of the economic slices through time from the model.

Forecasting and policy simulations are presented in Chapter 7 and 8, respectively. The calibration and projection for the future is explained and the deviations because of policy shocks are thus described as the result of the study. The study projects forward from 2011 to the period of 2020. Scenarios of the policy simulations are mainly the general tax cut for inbound tourism, in the form of lower cost to pay.

The next section summarizes the model's specification and the results of the study.

9.2. TRAVELTHAI and Baseline Simulation

Unlike other previous studies, TRAVELTHAI developed in this study takes into account Tourism industry in specific, and hence estimate the contribution of tourism to the Thai economy over the period of 2001-2020. It is one of the very first models in Thailand to incorporate the dynamic sense into such topic. With Tourism Satellite Accounts of Thailand as its main data source, the model covers 40 sectors categorized by tourism-relationship: direct-tourism industries, tourism-connected industries, non-tourism industries. TRAVELTHAI also incorporates three kinds of tourism: inbound, outbound, and domestic tourisms and serves as a tool for any related applications.

This thesis provides five main contributions: (1) the construction of a dynamic CGE model for the Thai economy with the special specification on tourism; (2) the database development for the model; (3) the baseline simulation from the model for the decade 2001-2011; (4) the simulations of forecast and policy scenarios for the decade of 2012-2020; and (5) extension on regional disaggregation via top-down approach. Note that for the extension, it is included in the model for future study only.

TRAVELTHAI was constructed with theoretical framework based on that of MyAGE, a Monash-style Applied General Equilibrium model for Malaysia (CoPs, 2010) and McHUGE (later on CHINAGEM by Mai et.al, 2010) for China. It also includes the fiscal policy scheme with types of income taxes including indirect taxes and subsidies. This enables the model to deliver the fiscal aspects concerning tourism.

The purpose of the baseline simulations is to develop the realistic baseline time-path as an important benchmark for further analyses. This is to understand how the Thai inbound tourism evolved with the economy in 2000-2010 and also uncover changes in technologies and preferences in the economy during that period, and estimate their contributions to the economy's performance over the period. In this thesis, the historically observed macroeconomic data from 2001-2011 (as a decade including 2011) are employed from many data sources e.g. National Income Accounts of Thailand, Input-Output Table, Balance of Payments, Tourism Satellite Accounts, etc. Then, after the process of making data consistency, the model is performed to obtain some important changes of the tastes and preferences for the historical baseline. This set of information is used for the forecast simulation.

9.3. Main Findings from Forecasting and Policy Simulations

- **Forecasting Simulation**

Forecast simulations are generally the projections for the plausible picture of the economy into the future period, of which it is over the period of 2012 – 2020 in this study, based on the historical trend of the preference and structural terms obtaining from the historical simulation over the period of 2001 - 2011. With the changes in structural terms like tastes and preferences from the historical simulation, the projections on the base case forecasts are performed using the average growth. There are three scenarios for the forecast simulations, which make three baseline forecasts: decade average (2001-2011), first half of the decade average (2001-2006: optimism), and second half of the decade average (2007-2011: pessimism). Such averages signify the averages of the preference terms used for projections taken from each part of the historical decade. This is aimed to get the comparison for forecast selection to be used for the policy simulation. Note that optimism means the optimistic view on the forecast projection as the average is of the first half of decade when there was only a few major disturbances in the economy e.g. tsunami whereas the pessimism is the projection using the average of the second half of the decade with more setbacks e.g. protest, riot, flooding, etc. Decade average is an average of the two. Base case forecasts show that GDP Growth ranges from 5.4-7.9 per cent to 2.8-6.6 per cent. Growth rate falls overtime regarding price mechanisms. The number of inbound visitors is expected to grow based on the historical trend from historical simulation. It ranges from 20–20.71 million persons in 2012 to 23.6-36.35 million persons in 2020.

This thesis reviewed the story of 2011 flood as the major tourism setback. The World Bank has estimated 1,425 billion baht or around US$ 45.7 billion economic damages and losses due to flooding, as of 1 December 2011. The flood happened through the year. It started in March with unexpected early rainy season in the southern region. Since then, there were five major tropical storms and they were continuous ranging from Haima (June), Nock-Ten (July), Nesat and Haitang (September – October) to Nalgae (October). It could be seen that the flood in 2011 had emerged in many areas of many provinces. Overall, the severity was serious, especially in the central region. There were varieties of effects in the flooding period of almost a year, although the economic impacts were actually more than one year and different in each area.

- **Simulation on Tourism Setback: Floods**

Following Giesieke et.al (2010), the application on the flood is formulated into two categories: demand-side behavioral effects and supply-side resource loss effects. These two main types could be seen as the foregone earning of tourism revenues from behavioral effects (a shift in inbound tourism demand and a drop in domestic tourism) and the damage costs of resource losses from the concerning 2011-2012 flood (losses in agricultural land, changes in labor productivity, and capital damages). These five external shocks are externally estimated for their magnitudes from various sources.

Using the second half of the decade average as a benchmark for the policy simulation, five sub-simulations are performed according to the external shocks. This summary focuses on tourism-related matters only. In the short run, the shift in inbound tourism causes a decline of 0.003 per cent of real GDP, with a fall of 2.298 per cent of the real inbound visitors' demand, relative to the baseline. Travel receipts declines by 2.864 per cent. Outbound tourism declines according to its higher price by 0.408 per cent. On the supply side, the outputs of direct-tourism industries decline by 0.359 per cent responding to the lower demand of inbound visitors. Labors are hired less in direct-tourism industries by 1.067 per cent. They tend to move to other industries as shown 0.04 per cent for tourism-connected industries and 0.078 per cent for non-tourism industries. Output growths in those industries are higher by 0.013 and 0.028 per cent, respectively. The shock deteriorates balance of travel by 19.392 billion baht.

The cut in domestic tourism by fifteen per cent causes a drop of 0.006 per cent of real GDP relative to the baseline. Inbound tourism is affected by 0.004 per cent with the tourism receipts decline by 0.403 per cent. The number of outbound tourist declines by 15.891 per cent. Domestic tourism revenue and outbound travel expenses all decline by -16.487 per cent due to its composition as a bundle. The drop in outbound tourism benefits balance of travel by 35.822 billion baht. Outputs of direct-tourism industries decline by 0.201 per cent and outputs of tourism-connected industries fall by 0.186 per cent responding the lower demand of domestic tourists. Labors are hired less in direct-tourism industries by-0.520 per cent and in tourism-connected industries by 0.531 per cent as they migrate to non-tourism industries with the increase by 0.195 per cent. Output growth in non-tourism industries therefore rises by 0.077 per cent.

The losses of agricultural land by 9.05 per cent leave a fall of 0.106 per cent of real GDP relative to the baseline. Outputs of direct tourism industries increase by 0.063 per cent and also tourism-connected industries by 0.015 per cent, while outputs of non-tourism industries decrease by 0.169 per cent. Labors are hired more in direct-tourism industries by 0.162 per cent and in tourism-connected industries by 0.041 per cent as they migrate from non-tourism industries which show a fall by 0.025 per cent. Outbound tourism declines by 0.031 per cent, whereas inbound tourism increases by 0.310 per cent. Tourism receipts become higher by 0.266 per cent, while both tourism expenses and domestic tourism revenue are lower with the same amount of 0.039 per cent. There is a change in balance of travel, of which increases by 1.935 billion baht.

Labor productivity changes leave a drop of 2.467 per cent of real GDP relative to the baseline. There are the decreases in the supply of outputs of direct tourism industries by 1.713 per cent and tourism-connected industries by 2.144 per cent, of which lead to the overall tourism-related price increases. Outbound tourism declines by 1.062 per cent whereas inbound tourism increases by 1.682 per cent. The effect on exchange rate depreciation benefits the inbound tourism despite the local tourism-related prices rise, which, in turn, makes tourism receipts become higher by 3.431 per cent. Tourism expenses and domestic tourism revenue increase the same amount of 0.060 per cent. Balance of travel shows an increase by 23.691 billion baht.

Capital damage causes a drop in real GDP by 0.783 per cent more relative to the baseline. Appreciation makes outbound tourism cheaper and relatively costly for inbound and domestic tourism. Outbound tourism rises responding to its lower price by 0.934 per cent while inbound tourism decreases by 1.860 per cent, mainly from the exchange rate. Tourism receipts are lower by 2.672 per cent, while tourism expenses and domestic tourism revenue are lower by 0.058 per cent similarly. Balance of travel decreases by -18.42 billion baht. Outputs of direct tourism industries decrease by 0.673 per cent and also tourism-connected industries by -1.008 per cent, outputs of non-tourism industries decrease by 0.727 per cent. Labors are hired more in non-tourism industries by 0.302 per cent and less in tourism-connected and direct-tourism industries by 0.718 per cent and 1.157 per cent, respectively. Tourism-connected industries affected the most and the fall in wage supports a labor migration from tourism-related industries to non-tourism industries.

The annual total is the sum of all behavioral and resource loss effects. As each effect from flooding gives different impacts, the annual total would show total impacts of all effects on the economy. There is a fall by 3.374 per cent in real GDP relative to the baseline and all GDP compositions deteriorate. Aggregate consumption falls by 1.939 per cent whereas aggregate investment shows a drop of 6.281 per cent. Government spending is exogenous. There are decreases in both exports and imports by 3.528 and 3.507 per cent, respectively. This deteriorates trade balance by 29.12 billion baht more relative to the baseline. Inbound tourism declines by 2.007 per cent, together with the externally estimated domestic tourism of 15 per cent, while outbound tourism also drops by 16.725 per cent from the assumption of viewing both domestic tourism and outbound tourism (or imported side) as a bundle for national tourists. Travel receipts (export side) weaken by 1.918 per cent, while travel expenses (import side) worsen by 16.609 per cent. This yields a rise towards travel surplus by 25.587 billion baht, mainly from a larger fall of the outbound tourism despite a weaker inbound tourism. Domestic tourism revenue also declines by 16.609 per cent. Labors are hired in non-tourism industries by 1.743 per cent more and less in tourism-connected industries by 4.176 per cent and direct tourism industries by 6.495 per cent as they migrate to non-tourism industries. For tourism-related industries, outputs drop by 3.418 per cent for non-tourism industries, by 3.307 per cent for tourism-connected industries, and by 2.898 per cent for direct tourism industries. It can be straightforwardly seen that the flood damages the economy and the resource-loss effects on the supply side show its domination regarding output production.

The after-effect forecast growths in terms of deviations relative to base case forecast from 2012 to 2020 shows that both behavioral and resource-loss effects of flooding reduce real GDP and its components overtime. Real wage rises as there is a scarce in labor by assumption. Labor migrates to the non-tourism industries from direct tourism industries and tourism-connected industries. Direct tourism industries suffer more than tourism-connected industries in terms of labor reduction and the releases of labor grow more through the period. All sectors produce less output, accordingly. The over-time slight deterioration in terms of trade improves the balance of travel, where the improvement in inbound tourism exists while the outbound tourism slightly declines as confirmed in the travel receipts and expenses.

- **Policy Simulation: Tax cut on Inbound Tourism**

This policy simulation is an example for further model applications on other issues. In the frail period of tourism setback like flooding, the authorities are in search of policy measures to soothe the flood-affected businesses and the economy. This kind of policy simulation would help justify for further policy recommendations.

This simulation is aimed to examine the effect of a uniform half-percentage cut of the power of the tax as an inducement for the inbound tourists to travel in the country despite the flooding. A half percentage tax cut causes the increase of 0.005 per cent of real GDP relative to the baseline. The tax cut makes its associated prices fall by 1.778 per cent. Inbound visitors' demand increases by 3.386 per cent accordingly. The increase makes the travel receipts rise by 3.415 per cent. On the other hand, outbound tourism rises by 0.690 per cent, which makes travel expenses increase by 0.357 per cent. For the supply, outputs of direct-tourism industries increase by 0.863 per cent responding to the higher inbound tourism demand. Real wage increases by 0.134 per cent. With exogenous capital, labors are hired more in direct-tourism industries by 2.237 per cent, whereas less for other industries as shown 0.055 per cent for tourism-connected industries and 0.174 per cent for non-tourism industries. Output growths in those two industries are lower by 0.019 per cent and 0.064 per cent, respectively.

The annual total with tax incentive is better off by 0.006 per cent more for the GDP than that without tax incentive. Annual total for real GDP decreases by 3.368 per cent comparing to the decline by 3.374 per cent of that without tax cut. The tax cut as an incentive for inbound tourism creates a larger impact on inbound tourism as expected. For the tax cut scenario, the effect on real inbound tourism is an increase by 3.386 per cent, of which contributes to make an increase of real inbound tourism in the annual total with tax cut by 5.220 per cent, whereas it is a decrease in the annual total without tax cut by 2.007 per cent. This gives the difference of 7.227 per cent. Travel receipts increase accordingly by 3.415 per cent from the tax cut, of which contributes to the increase in annual total of 1.642 per cent, comparing to the decrease by 1.918 per cent in the annual total without the tax cut. The difference is thus about 3.560 per cent. This furnishes the balance of travel to be 49.542 billion baht in the annual total with the tax cut comparing to the gain of 25.587 billion baht of that without the tax cut.

Tax cut generates more outputs in the direct tourism industries as expected. Although the increasing outputs of 0.904 per cent more are not enough to make a positive outcome for the annual total, the fall in the reduction of output production from 2.898 per cent in the annual total without tax cut to 1.994 per cent is a better off. This is in line with the greater amount of labor hired in the sector by 2.217 per cent in comparison between the two annual totals. For other two industries, they are worse off as their own labors migrate to the direct tourism industries. In the difference, it shows 0.045 and 0.176 per cent falls in sectoral employment for tourism-connected industries and non-tourism industries, respectively. Their output productions follow the falls in sectoral employment with a drop by 0.018 per cent for tourism-connected industries and by 0.065 per cent for non-tourism industries.

For the after effect tax cut forecast growth to 2020, only real inbound tourism and tourism receipts have the considerable changes comparing to without tax cut. For real inbound tourism, the after-flood growth is negative for without tax cut scenario in the short run and recover to be positive in the long run. With the tax cut, the deviation from base case forecast is positive and growing further in the long run. Tourism receipts show similar pattern. Nonetheless, the effect on the deviation over real GDP is very tiny and it reveals the same trend for both tax cut and without tax cut. Outputs and employments of direct tourism industries with tax cut decline less than that of without tax cut, though with similar declining trend. For tourism-connected industries, the reductions are about the same with the similar trend. For non-tourism industries, there are further output and employment reductions comparing to the without tax cut.

As controversial as it is, the tax cut incentive could be presented as an alleviation program to soothe the situation like tourism setback, in this case the flood. As the results show, tourism-related industries, especially direct-tourism, are better off, but at some expenses of other industries for this kind of scenario. Political-wise, a mix of incentives e.g. investment measures, tax refunds, or some transfers could be further pursued to examine all inclusive effects other than the tourism-focused. To investigate the impacts of the package of the policy measures before making any decision is proved to be the major benefit of this kind of computable general equilibrium model applications. Such what-if analysis in many scenarios for policy planning is helpful to understand the trade-off among economic agents and to minimize any incurring costs.

9.4. Potential Applications, Limitations and Recommendations

This section gives the comments on the potential applications of the model created and the simulations developed. It also provides the lists of its limitations and recommendations for future research.

9.4.1. Potential Applications of TRAVELTHAI

Like other predecessors of dynamic CGE models i.e. MONASH and MyAGE, TRAVELTHAI, which is a medium-scale general-purpose dynamic model, is capable of applying to a wide range of economic analyses which includes tax policy reforms, trade liberalization, investment and fiscal policies, and the effects of natural disasters such as floods or health issues like pandemics. The model could also be added for various extensions to provide other aspects of dimension for a variety of economic analyses i.e. categorization of households by income or issues of labor's education.

As having shown in the macroeconomic data from chapter 5 and later on in chapter 6, the projection on historical simulation for developing baseline forecasts could be done for scenarios. It depends on the observed macroeconomic data and the model users for the concerns upon the economic situation. A slump of the economy, as oppose to the boom, may give the projection of the baseline differently. This mainly bases upon the observed values and the opinions upon realistic sense. Scenarios for the baseline forecast, hence, could be projected for comparisons.

Forecasting and policy simulation based on the findings from the historical simulation could deliver various scenarios upon baseline projections. The shocks on projections about changes to the economy regarding to structural variables or policy variables or socio-economic variables, of which i.e. preference, tariff rates, or population growth, respectively, could be obtained from the macroeconomic forecasting authorities on future trends of those variables and the values of the shocks can be modified to provide the possible scenarios. With the base case for the analysis of any policy, the scenarios of economic targets like to project the economic growth or to keep the inflation within appropriate bands could be used to evaluate for sensible and realistic results, which is very beneficial for the strategic planning of economic agencies.

9.4.2. Limitations and Recommendations for Future Research

This section lists the limitations of this study and guidelines the further development with regard to the theoretical framework, the database, and future applications.

Theoretical Framework

TRAVELTHAI has some certain flexibility concerning its variety of closures. Its structure captures many features of the Thai economy. Nonetheless, it could be extended into some tourism-related areas such as economic efficiency, environmental costs upon Tourism, welfare effects or income distribution concerning Tourism, different effects from different types of tourists by country of origin or by income or by gender, and bottom-up approach for regional applications.

By economic efficiency, it could be conventionally extended to provide the emphasis upon the distortions created by governments (and reduced by decreasing government involvement towards the state of laissez faire) and the distortions created by markets (and, yes, could be reduced by increasing government involvement) upon Tourism-related issues. Such quantitative analysis that CGE model could provide would be appropriate to measure the level of involvement of the government upon the specific issues in the field of Tourism.

Tourism is often seen as one of the major causes of environmental degradation by the environmentalists. Environmental costs could be valued and made the evaluation upon the means to provide the appropriate compensation by the relevant authorities. This is also in line with the cultural effects as Tourism spurs over time, since to accommodate the tourists, the local environment also is dynamically disturbed both environmentally and culturally. Local people also change lifestyles to gain income from Tourism.

One main question often raised upon the issue of Tourism is about the welfare effects or income distribution that Tourism is able to deliver. Tourism is often expected to be the means to mitigate the problems of urban-rural migration with its own unique characteristic in that the tourists need to travel to the destination. It then is thought of as income generator for the local people.

Different types of tourists by country of origin, by gender, by age, by education, and by income would also give different effects. It is so much apparent that a university graduated male business owner aged 40 from the developed country with higher income would prefer traveling in the different lifestyles from the female student as a 20-year-old backpacker from another developing country with budgeted income. Preference upon lifestyle, culture, and tourist attractions plays an important key role. Traveling as a group of family or in tour group would be so much different from a single solo backpacker. Disaggregation of the groups of tourists would deliver the in depth analysis for the strategic planning division of the relevant authorities, however, this depends much on the details of data for the model's database development.

Bottom-up approach for regional disaggregation would be very beneficial for the Thai economy and the country like Thailand. As explained and suggested in chapter 2, Thailand has regional differences not only the location but also climates and its distinguished tourism resources. The effects on Tourism from tsunami over the coasts of southern region would be different from the floods in central region. The TERM or MMRF models, which are also developed by the Centre of policy studies (CoPs) would be the interesting framework for regional effects. Nonetheless, this kind of approach requires a great deal of data details.

Tourism is often concerned as labor intensive, thus other model improvements could be performed e.g. more details in the labor market by separating labor not only by occupation, but also by education, by gender, or by the place of residency. As mention earlier, household dimensions could be extended by disaggregating them based on income level or place of residency. This could provide a more in-depth analysis upon the question of Tourism's benefits and costs upon household level. Distinction between different trade partners would also allow the analysis of such questions as the effects of a bilateral trade agreement with one of the trade partners.

As to the trade agreement, multi-sector multi-region multi-country framework is also an ideal framework for overall impact of Tourism assessment. The well-known model focusing upon the international trade of Global Trade Analysis Project (GTAP) by Purdue University is another good example to put forward the international tourism issue, which nowadays becomes increasingly significant, to be similarly recognized.

Database

It took much so effort creating a detailed database for TRAVELTHAI. Starting from the THORANI's core database, the latest TSA of Thailand is of the year 2000. The year of starting this study was 2008. The latest Input-Output Table by that time was 2000 with the different classification of the sectors. During this study, the newer Input-Output Table 2005 had been released in the early 2011, which is the normal lag. With this kind of data lag, it is not possible to obtain the up-to-date data. Nevertheless, with the advantage of the dynamic CGE model that is enable the model user to update the database file through the model using the historical simulation, this gives the room to the study to update the database to the most up-to-date status, which is the year 2011 or the last year. Calibrating the historical simulation also delivers the time path of how the economy evolves, which is concerned as beneficial for the analysis.

Nonetheless, many assumptions have to be employed in order to manipulate the TSA and some additional information on capital stock and labor market since TSA does not contain information about the allocation of taxes and margins, including investment by industry. The allocation could have been more precise if there is the available data with the appropriate format. It was also problematic for the data on some other variables i.e. capital stock, capital stock growth rate and the rates of return on capital stock because the published data are not in the same disaggregated level as in TSA. The available data are inconsistent with each other and it is necessary to scale to have the same basis, like that having been explained in Chapter 5. Database for the model could, henceforth, be improved when there are the available and appropriate data.

It is more than an ideal to have specific econometric estimates for all the parameters of this study. Most parameters are adopted from the previous literature. In some cases, especially tourism-related elasticities, it is impossible to find. All parameters, however, may not be of much significant as most of the economic variables happened to be observed in the history, which gives a stronghold to reflect the picturesque structure of the Thai economy. Nonetheless, sensitivity analyses of many simulations to give some variations in some important elasticities prove to make a sensible backup. It could be the case that the results are, perhaps, sensitive to the elasticity values, and thus gives rise to a need to obtain more consistent estimates.

Applications

Six major applications were conducted for this study, a historical baseline simulation, three baseline forecasting projections with scenarios, and two policy simulations, one on flood with five sub-total shocks and one upon the tourism-related fiscal policy.

Historical simulation is based upon the observed macroeconomic data, for which the data consistency issue has been documented in chapter 5. Difference on scaling method could mean different results in the simulation developing a historical baseline.

Forecasting projections depends much on the economic reasoning behind. For the fact that the looks upon the expectation over the economy are varied, it is a subjective matter, however, even on a basis of the observed economic history. This study designs three of the baseline forecasting according to the possibility to at least suffice the odds. Applications on the likelihood of the benchmark could be later altered upon the other alternative bases. For the external shocks, data on changes on the economic variables, specifically tourism-related ones, over the period were not available. Tourism shocks from the setbacks were given in terms of assumption to suffice with the scenarios. Of course, they could be varied either upon the degree of the percentage shocks or the experiment composition to deliver a variety of possible simulations as to reflect the reality is ideal for all experiments.

The best possible estimates based on the sensible assumptions may not be the case for the simulation results as there could be some missing connections between variables or misspecifications of equations that may arise. Furthermore, interpreting simulation results should be aware of the theoretical relationships, the database and parameters, as well as the values of the shocks imposed on the simulations.

Applications on the policy shocks also could be seen the same way. It is the deviation from the baseline projection that the policy may cause and this have to look for the reference point.

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ILO - see International Labour Organization

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World Bank –see The World Bank

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APPENDICES

Appendix 4.1 **Derivation of input demand functions from the CES production function (adapted from Tran (2010))**

To choose intermediate inputs from domestic and imported sources, the problem is:

To choose the level of $X_{c,s,i}^{(1)}$ to minimise $\sum_{s \in SRC} X_{c,s,i}^{(1)} P_{c,s,i}^{(1)}$ (A4.1. 1)

subject to $$X_{c,i}^{(1)} = \left[\sum_{s \in SRC} \delta_{c,s,i}^{(1)} \left(\frac{X_{c,s,i}^{(1)}}{A_{c,s,i}^{(1)}} \right)^{-\rho_c^{(1)}} \right]^{-1/\rho_c^{(1)}} \quad \text{(A4.1. 2)}$$

where

- $X_{c,i}^{(1)}$ is the quantity of composite commodity *c* used in industry *i*;
- $X_{c,s,i}^{(1)}$ and $P_{c,s,i}^{(1)}$ are quantities and purchasers' prices of commodity *c* from source *s* used in industry *i*;
- $\delta_{c,s,i}^{(1)}$ is a positive parameter;
- $\rho_c^{(1)}$ is a parameter whose value is greater than -1 but not equal to zero, assumed to be specific to commodity *c*, but the same for all industries; and
- $A_{c,s,i}^{(1)}$ is input-(c,s)-augmenting technology in *i*. It is convenient to assume that the value of $A_{c,s,i}^{(1)}$ is defined so that $\sum_{c \in COM} \delta_{c,s,i}^{(1)} = 1$.

Note that the qualifiers *i*, *c* and (1) (which mean industry, commodity, and current production) can be omitted because this problem is to choose between alternative sources *s* for *the same* commodity *c* to use in industry *i*. Denoting:

$$X = X_{(c,i)}^{(1)}, \quad X_s = \frac{X_{c,s,i}^{(1)}}{A_{c,s,i}^{(1)}}, \quad P_s = P_{c,s,i}^{(1)} A_{c,s,i}^{(1)}, \quad \rho = \rho_c^{(1)} \quad \text{(A4.1. 3)}$$

Then, it becomes:

Minimise $\sum_{s \in SRC} P_s X_s$ subject to (A4.1.4)

$$X = \left(\sum_{s \in SRC} \delta_s X_s^{-\rho} \right)^{-1/\rho} \quad \text{(A4.1.5)}$$

The Lagragian function for this constraint optimisation problem is:

$$L = \sum_{s \in SRC} P_s X_s - \lambda (X - \left(\sum_{s \in SRC} \delta_s X_s^{-\rho} \right)^{-1/\rho} \qquad \text{(A4.1.6)}$$

First-order conditions:

$$P_s = \lambda \frac{X \delta_s X_s^{-(1+\rho)}}{\sum_{k \in SRC} \delta_k X_k^{-\rho}} \text{ and (A4.1.4)} \qquad \text{(A4.1.7)}$$

Hence

$$\frac{P_s}{P_k} = \frac{\delta_s X_s^{-(1+\rho)}}{\delta_k X_k^{-(1+\rho)}} \Rightarrow X_s = \left(\frac{P_s \delta_k}{P_k \delta_s} \right)^{-\frac{1}{1+\rho}} X_k \qquad \text{(A4.1.8)}$$

Substituting (A4.1.8) into the production function gives:

$$X = \left(\delta_s \left(\frac{P_s \delta_k}{P_k \delta_s} \right)^{\frac{\rho}{1+\rho}} X_k^{-\rho} + \delta_k X_k^{-\rho} \right) \qquad \text{(A4.1.9)}$$

After some manipulations,

(A4.1.9**)** becomes

$$X = X_k \left(\frac{\delta_k}{P_k} \right)^{-\frac{1}{1+\rho}} \left(\delta_s^{\frac{1}{1+\rho}} P_s^{\frac{\rho}{1+\rho}} + \delta_k^{\frac{1}{1+\rho}} P_k^{\frac{\rho}{1+\rho}} \right)^{-\frac{1}{\rho}} \qquad \text{(A4.1.10)}$$

And the input demand function for X_k can be derived as:

$$X_k = X \left(\frac{\delta_k}{P_k} \right)^{-\frac{1}{1+\rho}} \left(\delta_s^{\frac{1}{1+\rho}} P_s^{\frac{\rho}{1+\rho}} + \delta_k^{\frac{1}{1+\rho}} P_k^{\frac{\rho}{1+\rho}} \right)^{-\frac{1}{\rho}} \qquad \text{(A4.1.11)}$$

In percentage-change form:

$$x_k = x - (\frac{1}{1+\rho}) p_k + \frac{1}{\rho} \sum_{s \in SRC} \frac{\delta_s^{\frac{1}{1+\rho}} P_s^{\frac{\rho}{1+\rho}}}{\sum_{t \in SRC} \delta_t^{\frac{1}{1+\rho}} P_t^{\frac{\rho}{1+\rho}}} p_s \qquad \text{(A4.1.12)}$$

Define $\sigma = \frac{1}{1+\rho}$; $S_s = \frac{\delta_s^{\frac{1}{1+\rho}} P_s^{\frac{\rho}{1+\rho}}}{\sum_{t \in SRC} \delta_t^{\frac{1}{1+\rho}} P_t^{\frac{\rho}{1+\rho}}}$, then (A4.1.12) can be rewritten as:

$$x_k = x - \sigma(p_k - \sum_{s \in SRC} S_s p_s) \qquad \text{(A4.1.13)}$$

σ is the elasticity of substitution between two sources, and S_s is cost share of commodity c from source s in total costs of the composite commodity c.

Therefore, $\sum_{s \in SRC} S_s p_s$ is the cost-weighed average price of the composite input c.

Equation
(A4.1.13) is the percentage change form of the input demand function resulting from the problem with simplified notations. The relationship between variables in the simplified form and those in the original form can be derived in percentage change form from (A4.1.1) as

$$x = x_{c,i}^{(1)}; \quad x_s = x_{cs,i}^{(1)} - a_{c,s,i}^{(1)}; \quad p_s = p_{c,s,i}^{(1)} + a_{c,s,i}^{(1)} \qquad \text{(A4.1.14)}$$

Substituting

(A4.1.14) into

(A4.1.13) and rearranging we have:

$$x_{c,s,i}^{(1)} = x_{c,i}^{(1)} - \sigma_c^{(1)}(p_{c,s,i}^{(1)} - \sum_{t \in SRC} S_{c,t,i}^{(1)} p_{c,t,i}^{(1)}) + a_{c,s,i}^{(1)} - \sigma_c^{(1)}(a_{c,s,i}^{(1)} - \sum_{t \in SRC} S_{c,t,i}^{(1)} a_{c,t,i}^{(1)}) \qquad \text{(A4.1.15)}$$

Proof that S_s is a cost share*:*

Multiplying both sides of (A4.1.8) by P_s gives:

$$X_s P_s = X P_s \left(\frac{\delta_s}{P_s}\right)^{\frac{1}{1+\rho}} \left(\sum_{t \in SRC} \delta_t^{\frac{1}{1+\rho}} P_t^{\frac{\rho}{1+\rho}}\right)^{\frac{1}{\rho}} = X \delta_s^{\frac{1}{1+\rho}} P_s^{\frac{\rho}{1+\rho}} \left(\sum_{t \in SRC} \delta_t^{\frac{1}{1+\rho}} P_t^{\frac{\rho}{1+\rho}}\right)^{\frac{1}{\rho}}$$

$$\Rightarrow \sum_{s \in SRC} X_s P_s = X(\sum_{s \in SRC} \delta_s^{\frac{1}{1+\rho}} P_s^{\frac{\rho}{1+\rho}}) \left(\sum_t \delta_t^{\frac{1}{1+\rho}} P_t^{\frac{\rho}{1+\rho}}\right)^{\frac{1}{\rho}}$$

$$\Rightarrow \frac{X_s P_s}{\sum_{t \in SRC} X_t P_t} = \frac{\delta_s^{\frac{1}{1+\rho}} P_s^{\frac{\rho}{1+\rho}}}{\sum_{t \in SRC} \delta_t^{\frac{1}{1+\rho}} P_t^{\frac{\rho}{1+\rho}}} = S_s$$

Appendix 4.2 Derivation of elasticities from the household optimisation problem with Klein-Rubin utility function (from Tran (2010))

A representative household is set to choose $X_c^{(3)}$, c∈COM, to maximise a Klein-Rubin utility function:

$$U = \prod_{c \in COM} \left(\frac{X_c^{(3)}}{A_c^{(3)} Q} - \frac{X_{sub,c}^{(3)}}{A_{sub,c}^{(3)} Q} \right)^{\Delta_c} \quad \text{subject to} \quad \sum_{c \in COM} \frac{X_c^{(3)}}{Q} P_c^{(3)} = \frac{V_{tot}^{(3)}}{Q} \tag{A4.2.1}$$

where $X_c^{(3)}$ and $P_c^{(3)}$ are quantities consumed and prices paid by the average household of the composite good c;

Q is the number of households in the economy;

$A_c^{(3)}$ are positive coefficients introduced to allow for changes in tastes;

$V_{tot}^{(3)}$ is the aggregate household budget;

$X_{sub,c}^{(3)}$ is the subsistence quantities of commodity *c* below which consumption cannot fall;

$A_{sub,c}^{(3)}$ are positive coefficients introduced to allow for changes in tastes toward subsistence part of commodity *c*; and

Δ_c is the positive parameter which is less than one, and they sum over c to one.

Using the simplified notations:

$$X_c = \frac{X_c^{(3)}}{A_c^{(3)} Q}; \quad P_c = P_c^{(3)} A_c^{(3)}; \quad Y = \frac{V_{tot}^{(3)}}{Q}; \quad \gamma_c = \frac{X_{sub,c}^{(3)}}{A_{sub,c}^{(3)} Q} \tag{A4.2.2}$$

and monotonically transforming the utility function, the household's problem can be rewritten as: choose X_c to maximise

$$U^* = \sum_{c \in COM} \Delta_c \ln\left(X_c - \gamma_c\right) \text{ subject to } \sum_{c \in COM} X_c P_c = Y \tag{A4.2.3}$$

The Lagragian function of this constrained optimisation problem is:

$$L = \sum_{c \in COM} \Delta_c \ln\left(X_c - \gamma_c\right) - \lambda (Y - \sum_{c \in COM} X_c P_c) \tag{A4.2.4}$$

First-order conditions:

$$\frac{\Delta_c}{X_c - \gamma_c} = \lambda P_c \Rightarrow \Delta_c = \lambda (P_c X_c - P_c \gamma_c) \tag{A4.2.5}$$

and $Y = \sum_{c \in COM} P_c X_c$ (A4.2.6)

Summing (A4.2.5) over *c* gives

$$\sum_{c \in COM} \Delta_c = \lambda \sum_{c \in COM} (P_c X_c - P_c \gamma_c) = 1 \Rightarrow \lambda = \frac{1}{\sum_{c \in COM} (P_c X_c - P_c \gamma_c)}; \quad \text{(A4.2.7)}$$

Substituting (A4.2.7) into (A4.2.5) and taking (A4.2.6) into account gives:

$$P_c X_c = P_c \gamma_c + \Delta_c (Y - \sum_{k \in COM} P_k \gamma_k); \quad \text{(A4.2.8)}$$

where (A4.2.8) is a Linear Expenditure System, where the total household expenditure $P_c X_c$ on good *c* is a linear function of income and prices. It consists of the subsistence expenditure $P_c \gamma_c$ and supernumerary expenditure $\Delta_c (Y - \sum_k P_k \gamma_k)$ on good *c*. The term $Y - \sum_k P_k \gamma_k$ represents the total 'un-committed', or 'supernumerary' purchasing power remaining after purchasing the minimum, 'subsistence' bundle of goods, and Δ_c is the share of good *c* in total supernumerary expenditure. In the section below, Δ_c is proved to be marginal budget shares as well.

Derivation of expenditure elasticity of demand for i

From (A4.2.8) we have for $\forall c \in COM$:

$$X_c = \frac{\gamma_c}{P_c} + \frac{\Delta_c}{P_c} (Y - \sum_{k \in COM} P_k \gamma_k); \quad \text{(A4.2.9)}$$

$$\Rightarrow \frac{\partial X_c}{\partial Y} = \frac{\Delta_c}{P_c} \quad \text{(A4.2.10)}$$

Derivation of expenditure elasticities

$$E_c = \frac{\partial X_c}{\partial Y} \frac{Y}{X_c} = \frac{\Delta_c}{P_c} \frac{Y}{X_c} = \frac{\Delta_c}{S_c} \quad \text{(A4.2.11)}$$

where $S_c = \frac{P_c X_c}{Y}$ is the average share of good i in total household expenditure.

From (A4.2.11) we have:

$$\Delta_c = E_c S_c = \frac{\partial X_c}{\partial Y} \frac{Y}{X_c} * \frac{P_c X_c}{Y} = \frac{\partial X_c P_c}{\partial Y} \tag{A4.2.12}$$

That is, Δ_c's are marginal budget shares of commodity *c* in household total expenditure.

Derivation of price elasticities

Taking derivatives of X_c in (A4.2.9) relative to price P_k, where *k* can be either the own price of *c* or the price of other goods $k \in$COM gives:

$$\frac{\partial X_c}{\partial P_k} = -KD_{c,k} \frac{\Delta_c}{P_c^2}(Y - \sum_{t \in COM} P_t \gamma_t) - \frac{\Delta_c}{P_c} \gamma_c \tag{A4.2.13}$$

where $KD_{c,k}$ is defined as:

$$\begin{Bmatrix} KD_{c,k} = 1 \ \ if \ \ c = k \\ KD_{c,k} = 0 \ \ if \ \ c \neq k \end{Bmatrix}$$

This leads to the formulas of own- and cross-price elasticity of demand:

$$\eta_{ck} = \frac{\partial X_c}{\partial P_k} \frac{P_k}{X_c} = -KD_{c,k} \frac{\Delta_c}{P_c} \frac{Y}{X_c} \frac{(Y - \sum_t P_t \gamma_t)}{Y} - \frac{\Delta_c}{P_c} \frac{P_k}{X_c} \frac{\gamma_k Y}{Y} \tag{A4.2.14}$$

Denoting $F = -\frac{Y}{(Y - \sum_{t \in COM} P_t \gamma_t)}$ and recognising that $P_k \gamma_k = P_k X_k - \Delta_k (Y - \sum_t P_t \gamma_t)$

and $E_c = \frac{\Delta_c}{S_c}$, we have for $\forall c, k \in COM$:

$$\eta_{ck} = KD_{c,k} \frac{\Delta_c}{S_c} \frac{1}{F} - \frac{\Delta_c}{S_c}(S_c + \Delta_k \frac{1}{F}) = KD_{c,k} \frac{E_c}{F} - E_c(S_k + \frac{\Delta_k}{F}) \tag{A4.2.15}$$

The parameter F is called the Frisch parameter, which is the inverse of the share of supernumerary expenditure in total household expenditure.

Appendix 5.1 Shares of value added components for 40 sectors (%)

Column	(1)	(2)	(3)	(4)	(5)
Sector	Labour	Capital	Land	Production tax	Total
1 Accommodatio	43.1	56.7	0.0	0.2	100.0
2 Sechomeowner	39.8	60.2	0.0	0.0	100.0
3 Restaurant	27.2	72.6	0.0	0.2	100.0
4 Railpassserv	90.8	9.0	0.0	0.2	100.0
5 Roadpassserv	36.3	63.2	0.0	0.5	100.0
6 Waterpasserv	26.4	73.1	0.0	0.5	100.0
7 Airpassserv	49.5	50.1	0.0	0.4	100.0
8 Transsupserv	29.4	70.5	0.0	0.1	100.0
9 Transeqprent	20.4	79.6	0.0	0.0	100.0
10 Travelagenci	26.2	73.7	0.0	0.1	100.0
11 Culturalserv	70.1	29.9	0.0	0.0	100.0
12 Sportrecreat	25.0	74.8	0.0	0.2	100.0
13 fruitflowers	14.9	85.1	0.0	0.1	100.0
14 Preservfoods	30.3	69.6	0.0	0.1	100.0
15 Manudairypro	42.0	57.8	0.0	0.2	100.0
16 Manubakerpro	32.0	67.7	0.0	0.2	100.0
17 Manucoffetea	35.1	64.8	0.0	0.1	100.0
18 Manubeverage	26.3	73.4	0.0	0.3	100.0
19 Manutextiles	35.2	64.7	0.0	0.2	100.0
20 Manuleathers	34.0	65.9	0.0	0.1	100.0
21 Manuwoodprod	33.9	65.9	0.0	0.1	100.0
22 Manupaperpro	13.1	86.6	0.0	0.3	100.0
23 Publishprint	25.7	74.0	0.0	0.3	100.0
24 Petroleumref	13.7	83.6	0.0	2.7	100.0
25 Manuceramicw	31.6	68.1	0.0	0.2	100.0
26 Manuglasspro	30.1	69.4	0.0	0.5	100.0
27 Manujewelry	40.6	59.1	0.0	0.3	100.0
28 Communicatio	31.3	68.7	0.0	0.0	100.0
29 Financialint	36.8	63.1	0.0	0.1	100.0
30 Realestate	9.5	90.5	0.0	0.0	100.0
31 Health	60.9	39.0	0.0	0.1	100.0
32 Commperserv	44.4	55.3	0.0	0.3	100.0
33 Agriculture	27.3	48.6	24.0	0.1	100.0
34 Miningquarry	27.9	48.2	23.8	0.1	100.0
35 Manufacturin	29.9	69.7	0.0	0.4	100.0
36 Elecgaswater	37.6	62.1	0.0	0.3	100.0
37 Construction	34.8	64.9	0.0	0.3	100.0
38 Traderepair	18.5	81.5	0.0	0.0	100.0
39 Transportsto	40.9	58.4	0.0	0.6	100.0
40 Services	79.6	20.4	0.0	0.0	100.0
Average	33.2	64.4	2.2	0.2	100.0

Appendix 5.2 Margin rates on composite commodities (%)

(Calculated as the ratio between margins and basic values of commodities)

Column	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Margin rates on composite commodities used in							
Sectors	Intermediate inputs	Investment	Private consumption	Export	Public consumption	Stocks	Inbound Tourism	Domestic Tourism
1 Accommodatio	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 Sechomeowner	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 Restaurant	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 Railpassserv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 Roadpassserv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 Waterpasserv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7 Airpassserv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8 Transsupserv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9 Transeqprent	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10 Travelagenci	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11 Culturalserv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12 Sportrecreat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13 fruitflowers	0.21	0.00	0.84	0.90	3.64	0.00	3.03	0.78
14 Preservfoods	0.07	0.00	0.30	0.04	0.01	0.00	0.21	0.29
15 Manudairypro	0.07	0.00	0.43	0.25	0.02	0.00	0.38	0.26
16 Manubakerpro	0.08	0.00	0.15	0.08	0.00	0.00	0.59	0.14
17 Manucoffetea	0.06	0.00	1.08	0.28	0.00	0.00	0.62	0.85
18 Manubeverage	0.14	0.00	0.21	0.21	0.00	0.00	0.25	0.07
19 Manutextiles	0.15	0.44	0.23	0.07	0.50	0.00	0.13	0.20
20 Manuleathers	0.09	0.00	0.28	0.05	0.00	0.00	0.33	0.21
21 Manuwoodprod	0.26	0.40	0.43	0.13	0.06	0.00	0.09	0.45
22 Manupaperpro	0.25	0.00	1.00	0.14	0.28	0.00	0.06	1.00
23 Publishprint	0.29	0.00	0.25	0.16	0.02	0.00	0.18	0.22
24 Petroleumref	0.16	0.00	0.28	0.19	0.48	0.00	0.57	0.20
25 Manuceramicw	1.64	0.04	1.19	0.15	0.00	0.00	0.02	1.17
26 Manuglasspro	0.22	0.16	1.38	0.13	0.00	0.00	0.00	1.42
27 Manujewelry	0.27	0.03	0.35	0.00	0.00	0.00	1.41	0.32
28 Communicatio	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29 Financialint	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30 Realestate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31 Health	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 Commperserv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33 Agriculture	0.13	0.06	1.04	0.21	0.13	0.00	0.00	0.00
34 Miningquarry	0.05	0.12	0.16	0.03	0.00	0.00	0.00	0.00
35 Manufacturin	0.15	0.31	0.57	0.08	0.20	0.00	0.25	0.14
36 Elecgaswater	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00
37 Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38 Traderepair	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39 Transportsto	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weighted average	0.12	0.19	0.26	0.07	0.02	0.00	0.12	0.08

Appendix 5.3 Industry cost shares (%)

Column	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Shares of primary factors				**Shares of input components**									
Sectors	**Lab**	**Cap**	**Lnd**	**Total**	**IntDom**	**IntImp**	**Margin**	**ComTax**	**Lab**	**Cap**	**Lnd**	**ProdTax**	**OCT**	**Total**
1 Accommodatio	43.2	56.8	0.0	100	45.7	8.0	5.0	1.3	17.2	22.7	0.0	0.1	0.0	100
2 Sechomeowner	39.8	60.2	0.0	100	23.3	0.0	0.0	0.5	30.3	45.9	0.0	0.0	0.0	100
3 Restaurant	27.3	72.7	0.0	100	45.8	5.5	10.5	1.2	10.1	26.8	0.0	0.1	0.0	100
4 Railpassserv	91.0	9.0	0.0	100	38.8	10.3	2.9	3.1	99.5	9.9	0.0	0.2	-64.6	100
5 Roadpassserv	36.5	63.5	0.0	100	58.8	1.0	5.4	2.7	11.7	20.3	0.0	0.2	0.0	100
6 Waterpasserv	26.5	73.5	0.0	100	44.6	3.4	2.7	3.9	11.8	32.7	0.0	0.2	0.7	100
7 Airpassserv	49.7	50.3	0.0	100	59.9	4.5	1.8	2.0	15.2	15.4	0.0	0.1	1.1	100
8 Transsupserv	29.4	70.6	0.0	100	40.7	2.5	1.3	1.3	15.6	37.5	0.0	0.1	0.9	100
9 Transeqprent	20.4	79.6	0.0	100	17.2	0.1	0.8	0.6	16.6	64.7	0.0	0.0	0.0	100
10 Travelagenci	26.3	73.7	0.0	100	40.1	0.2	1.6	0.9	15.0	42.1	0.0	0.1	0.0	100
11 Culturalserv	70.1	29.9	0.0	100	17.8	4.7	1.6	0.4	53.0	22.6	0.0	0.0	0.0	100
12 Sportrecreat	25.1	74.9	0.0	100	45.9	9.3	3.8	1.6	9.9	29.5	0.0	0.1	0.0	100
13 fruitflowers	14.9	85.1	0.0	100	19.7	7.8	5.9	0.6	9.8	56.1	0.0	0.0	0.0	100
14 Preservfoods	30.3	69.7	0.0	100	55.7	10.4	11.2	0.5	6.7	15.5	0.0	0.0	0.0	100
15 Manudairypro	42.1	57.9	0.0	100	48.6	16.7	4.7	0.8	12.2	16.9	0.0	0.0	0.0	100
16 Manubakerpro	32.1	67.9	0.0	100	52.8	13.4	5.9	1.1	8.6	18.2	0.0	0.1	0.0	100
17 Manucoffetea	35.1	64.9	0.0	100	63.8	5.0	1.3	0.5	10.3	19.1	0.0	0.0	0.0	100
18 Manubeverage	26.4	73.6	0.0	100	36.8	18.9	6.7	1.8	9.4	26.3	0.0	0.1	0.0	100
19 Manutextiles	35.2	64.8	0.0	100	49.3	11.7	7.4	0.9	10.8	19.9	0.0	0.1	0.0	100
20 Manuleathers	34.0	66.0	0.0	100	30.3	14.5	10.3	0.8	15.0	29.0	0.0	0.0	0.0	100

Appendix 5.3 Industry cost shares (%) (continued)

Column	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Shares of primary factors				**Shares of input components**									
Sectors	**Lab**	**Cap**	**Lnd**	**Total**	**IntDom**	**IntImp**	**Margin**	**ComTax**	**Lab**	**Cap**	**Lnd**	**ProdTax**	**OCT**	**Total**
21 Manuwoodprod	34.0	66.0	0.0	100	24.1	19.3	9.6	0.9	15.6	30.4	0.0	0.1	0.0	100
22 Manupaperpro	13.2	86.8	0.0	100	14.3	32.9	13.4	1.8	4.9	32.5	0.0	0.1	0.0	100
23 Publishprint	25.8	74.2	0.0	100	30.3	32.4	8.9	1.5	6.9	19.8	0.0	0.1	0.0	100
24 Petroleumref	14.1	85.9	0.0	100	9.0	74.1	0.1	5.3	1.6	9.6	0.0	0.3	0.0	100
25 Manuceramicw	31.7	68.3	0.0	100	32.3	17.3	5.4	1.8	13.6	29.4	0.0	0.1	0.0	100
26 Manuglasspro	30.2	69.8	0.0	100	28.4	37.3	7.2	2.2	7.5	17.3	0.0	0.1	0.0	100
27 Manujewelry	40.7	59.3	0.0	100	23.8	36.8	13.9	1.1	9.9	14.4	0.0	0.1	0.0	100
28 Communicatio	31.3	68.7	0.0	100	28.5	0.1	0.1	0.5	22.2	48.7	0.0	0.0	0.0	100
29 Financialint	36.9	63.1	0.0	100	21.4	0.5	2.5	0.4	27.7	47.5	0.0	0.0	0.0	100
30 Realestate	9.5	90.5	0.0	100	10.9	0.1	0.2	0.3	8.4	80.1	0.0	0.0	0.0	100
31 Health	61.0	39.0	0.0	100	23.7	14.3	7.7	0.8	32.6	20.8	0.0	0.0	0.0	100
32 Commperserv	44.5	55.5	0.0	100	46.0	16.5	6.0	1.3	13.4	16.6	0.0	0.1	0.0	100
33 Agriculture	27.4	48.7	24.0	100	26.7	4.8	6.0	0.9	16.8	29.9	14.7	0.1	0.0	100
34 Miningquarry	27.9	48.3	23.8	100	29.9	0.7	1.1	1.2	18.7	32.3	15.9	0.1	0.0	100
35 Manufacturin	30.0	70.0	0.0	100	30.1	36.4	7.6	1.5	7.3	17.1	0.0	0.1	0.0	100
36 Elecgaswater	37.7	62.3	0.0	100	45.8	1.1	1.1	2.9	18.5	30.5	0.0	0.2	0.0	100
37 Construction	34.9	65.1	0.0	100	38.8	16.2	13.7	1.3	10.4	19.4	0.0	0.1	0.0	100
38 Traderepair	18.5	81.5	0.0	100	19.6	2.6	1.7	0.5	13.0	57.5	0.0	0.0	5.1	100
39 Transportsto	41.2	58.8	0.0	100	58.4	2.2	3.9	3.4	12.7	18.2	0.0	0.2	1.0	100
40 Services	79.6	86.2	0.0	100	15.9	0.7	1.6	0.4	64.8	16.6	0.0	0.0	0.0	100
Total	33.3	64.5	2.2	100	31.1	18.4	5.8	1.3	14.1	27.4	0.9	0.1	0.8	100

Appendix 5.4 Sales shares of domestic and imported commodities (%)

Column	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	(7a)	(8a)	(9a)	(10a)	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)	(7b)	(8b)	(9b)	(10b)	(a)	(b)	(c)
	Users' share in the sales of domestic goods										**Users' share in imported goods**										**Source shares in total sales**		
	Interm	**Invest**	**HH**	**EXP**	**GOV**	**STOK**	**Inb Tour**	**Dom Tour**	**Margin**	**Total**	**Interm**	**Invest**	**HH**	**EXP**	**GOV**	**STOK**	**Inb Tour**	**Dom Tour**	**Margin**	**Total**	**Dom**	**Imp**	**Total**
1 Accommodatio	18.69	0.00	0.00	0.00	5.25	0.00	71.09	4.97	0.00	100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00	100	78.42	21.58	100.0
2 Sechomeowner	11.66	0.00	57.19	5.83	0.00	0.00	5.72	19.61	0.00	100	0.00	0.00	70.59	0.00	0.00	0.00	0.00	29.41	0.00	100	87.50	12.50	100.0
3 Restaurant	14.24	0.00	67.16	1.64	0.84	0.00	12.95	3.18	0.00	100	0.00	0.00	73.52	0.00	0.00	0.00	0.00	26.48	0.00	100	94.50	5.50	100.0
4 Railpassserv	18.30	0.00	22.40	10.23	13.13	0.00	8.93	0.00	27.02	100	0.00	0.00	65.66	0.00	0.00	0.00	0.00	34.34	0.00	100	92.07	7.93	100.0
5 Roadpassserv	12.44	0.00	42.10	26.32	0.56	0.00	9.61	8.97	0.00	100	0.00	0.00	80.25	0.00	0.00	0.00	0.00	19.75	0.00	100	92.64	7.36	100.0
6 Waterpasserv	3.36	0.00	15.04	10.73	0.00	0.20	8.21	9.82	52.64	100	2.46	0.00	53.85	0.00	0.00	0.00	0.00	43.70	0.00	100	96.41	3.59	100.0
7 Airpassserv	49.83	0.00	4.58	25.13	2.23	0.00	12.55	0.00	5.68	100	0.00	0.00	75.49	0.00	0.00	0.00	0.00	24.51	0.00	100	88.81	11.19	100.0
8 Transsupserv	60.32	0.00	8.90	13.26	3.84	0.00	8.40	2.06	3.21	100	5.42	0.00	71.39	0.00	0.00	0.00	0.00	23.19	0.00	100	93.00	7.01	100.0
9 Transeqprent	73.99	0.00	16.18	0.70	5.94	0.00	0.27	2.92	0.00	100	96.97	0.00	3.03	0.00	0.00	0.00	0.00	0.00	0.00	100	99.01	1.00	100.0
10 Travelagenci	42.71	0.00	34.82	8.30	0.00	0.00	3.82	10.36	0.00	100	0.00	0.00	12.21	0.00	0.00	0.00	0.00	87.79	0.00	100	88.94	11.06	100.0
11 Culturalserv	22.76	0.00	8.74	26.77	17.46	0.00	11.59	12.69	0.00	100	3.92	0.00	23.00	0.00	0.00	0.00	0.00	73.08	0.00	100	78.98	21.02	100.0
12 Sportrecreat	8.58	0.00	18.54	8.49	13.32	0.00	25.94	25.12	0.00	100	0.00	0.00	22.25	0.00	0.00	0.00	0.00	77.75	0.00	100	59.30	40.70	100.0
13 fruitflowers	52.46	0.00	31.04	6.72	0.22	0.00	0.67	8.90	0.00	100	41.65	0.00	37.71	0.00	0.00	0.00	0.00	20.64	0.00	100	92.18	7.82	100.0
14 Preservfoods	6.66	0.00	5.90	82.13	0.06	3.44	0.41	1.41	0.00	100	71.93	0.00	24.74	0.00	0.00	0.00	0.00	3.32	0.00	100	89.32	10.68	100.0
15 Manudairypro	24.16	0.00	49.83	8.28	0.46	11.78	3.31	2.18	0.00	100	41.30	0.00	51.58	0.00	0.00	0.00	0.00	7.12	0.00	100	70.38	29.62	100.0
16 Manubakerpro	6.57	0.00	54.92	14.49	0.00	4.78	3.52	15.72	0.00	100	14.40	0.00	55.24	0.00	0.00	0.00	0.00	30.36	0.00	100	90.43	9.57	100.0
17 Manucoffetea	73.42	0.00	13.53	6.01	0.00	4.20	2.26	0.59	0.00	100	17.68	0.00	76.41	0.00	0.00	0.00	0.00	5.91	0.00	100	91.28	8.72	100.0
18 Manubeverage	39.97	0.00	91.27	6.81	0.00	-45.47	3.42	4.00	0.00	100	24.57	0.00	41.98	0.00	0.00	0.00	0.00	33.45	0.00	100	79.67	20.33	100.0
19 Manutextiles	27.92	0.11	31.47	31.80	0.07	0.35	7.29	0.98	0.00	100	60.62	0.58	36.26	0.00	0.00	0.00	0.00	2.54	0.00	100	87.95	12.05	100.0
20 Manuleathers	7.31	0.03	40.83	39.14	0.00	6.53	4.03	2.14	0.00	100	13.35	0. 02	71.07	0.00	0.00	0.00	0.00	15.57	0.00	100	92.77	7.23	100.0

Appendix 5.4 Sales shares of domestic and imported commodities (%) (continued)

Column	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	(7a)	(8a)	(9a)	(10a)	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)	(7b)	(8b)	(9b)	(10b)	(a)	(b)	(c)
	Users' share in the sales of domestic goods										**Users' share in imported goods**										**Source shares in total sales**		
	Interm	**Invest**	**HH**	**EXP**	**GOV**	**STOK**	**Inb Tour**	**Dom Tour**	**Margin**	**Total**	**Interm**	**Invest**	**HH**	**EXP**	**GOV**	**STOK**	**Inb Tour**	**Dom Tour**	**Margin**	**Total**	**Dom**	**Imp**	**Total**
21 Manuwoodprod	9.87	24.96	25.44	48.57	0.05	-11.34	1.77	0.69	0.00	100	46.39	12.19	40.31	0.00	0.00	0.00	0.00	1.12	0.00	100	98.17	1.83	100.0
22 Manupaperpro	61.30	0.00	2.20	23.55	6.98	5.77	0.15	0.06	0.00	100	98.24	0.00	1.72	0.00	0.00	0.00	0.00	0.04	0.00	100	72.03	27.97	100.0
23 Publishprint	49.30	0.00	12.33	12.26	19.10	0.17	6.81	0.02	0.00	100	16.69	0.00	83.19	0.00	0.00	0.00	0.00	0.13	0.00	100	73.31	26.69	100.0
24 Petroleumref	69.03	0.00	10.07	16.39	0.89	2.87	0.42	0.33	0.00	100	44.24	0.00	52.05	0.00	0.00	0.00	0.00	3.71	0.00	100	91.05	8.95	100.0
25 Manuceramicw	6.58	0.00	3.80	79.43	0.00	9.86	0.25	0.10	0.00	100	22.81	50.61	25.92	0.00	0.00	0.00	0.00	0.65	0.00	100	83.30	16.70	100.0
26 Manuglasspro	52.70	2.38	0.54	49.72	0.00	-5.36	0.00	0.01	0.00	100	85.08	4.40	10.26	0.00	0.00	0.00	0.00	0.26	0.00	100	64.24	35.76	100.0
27 Manujewelry	16.34	1.35	16.84	28.95	0.00	31.18	3.97	1.39	0.00	100	75.48	0.03	22.01	0.00	0.00	0.00	0.00	2.48	0.00	100	79.92	20.08	100.0
28 Communicatio	58.32	0.00	22.85	13.24	2.99	0.00	1.39	1.22	0.00	100	0.00	0.00	96.42	0.00	0.00	0.00	0.00	3.59	0.00	100	87.45	12.55	100.0
29 Financialint	98.14	0.00	0.92	0.28	0.59	0.00	0.03	0.04	0.00	100	70.38	0.00	26.02	0.00	0.00	0.00	0.00	3.59	0.00	100	98.42	1.58	100.0
30 Realestate	13.75	0.81	54.46	6.39	0.00	0.00	5.72	18.85	0.00	100	0.00	0.00	70.70	0.00	0.00	0.00	0.00	29.30	0.00	100	86.88	13.12	100.0
31 Health	0.07	0.00	41.66	11.91	43.38	0.00	1.26	1.71	0.00	100	0.00	0.00	96.42	0.00	0.00	0.00	0.00	3.58	0.00	100	90.91	9.10	100.0
32 Commperserv	45.52	0.00	4.88	36.81	2.94	0.00	3.28	6.57	0.00	100	11.54	0.00	16.63	0.00	0.00	0.00	0.00	71.83	0.00	100	91.32	8.68	100.0
33 Agriculture	84.30	0.12	14.12	3.54	0.20	-2.27	0.00	0.00	0.00	100	95.56	0.21	4.23	0.00	0.00	0.00	0.00	0.00	0.00	100	91.29	8.71	100.0
34 Miningquarry	92.03	0.01	0.01	12.18	0.00	-4.23	0.00	0.00	0.00	100	99.98	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	100	34.30	65.70	100.0
35 Manufacturin	33.06	5.30	10.53	50.16	0.83	-0.38	0.36	0.14	0.00	100	74.50	19.85	4.71	0.00	0.00	0.00	0.00	0.94	0.00	100	62.68	37.32	100.0
36 Elecgaswater	74.11	0.00	19.94	2.77	3.13	0.06	0.00	0.00	0.00	100	43.29	0.00	56.71	0.00	0.00	0.00	0.00	0.00	0.00	100	97.37	2.64	100.0
37 Construction	1.36	98.00	0.21	0.12	0.32	0.00	0.00	0.00	0.00	100	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100	99.96	0.04	100.0
38 Traderepair	7.33	0.00	4.97	0.00	0.28	0.71	0.00	0.16	86.55	100	0.00	0.00	93.97	0.00	0.00	0.00	0.00	6.03	0.00	100	99.99	0.01	100.0
39 Transportsto	17.95	0.00	4.48	12.52	0.45	1.25	0.00	0.00	63.35	100	23.12	0.00	76.88	0.00	0.00	0.00	0.00	0.00	0.00	100	97.80	2.20	100.0
40 Services	17.04	0.00	15.81	0.84	66.31	0.00	0.00	0.00	0.00	100	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	100	99.60	0.40	100.0
Total	31.14	5.45	15.80	24.29	5.09	0.34	2.11	1.16	14.61	100	71.16	14.22	11.19	0.00	0.00	0.00	0.00	3.43	0.00	100	79.45	20.55	100.0

Appendix 5.5 Industry shares in economy-wide production costs (%)

Column	(1)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	Sectoral share of each factor				Share in input components									
Sector	Lab	Cap	Lnd	Total	IntDom	IntImp	Margin	ComTax	Lab	Cap	Lnd	ProdTax	OCT	Total
1 Accommodatio	0.80	0.54	0.00	0.61	0.96	0.28	0.56	0.64	0.80	0.54	0.00	0.64	0.00	0.65
2 Sechomeowner	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 Restaurant	2.31	3.17	0.00	2.81	4.75	0.96	5.86	3.00	2.31	3.17	0.00	2.99	0.00	3.24
4 Railpassserv	0.24	0.01	0.00	0.09	0.04	0.02	0.02	0.08	0.24	0.01	0.00	0.08	-2.86	0.03
5 Roadpassserv	1.33	1.19	0.00	1.21	3.03	0.09	1.48	3.18	1.33	1.19	0.00	3.17	0.00	1.60
6 Waterpasserv	0.18	0.26	0.00	0.23	0.32	0.04	0.10	0.64	0.18	0.26	0.00	0.64	0.20	0.22
7 Airpassserv	0.84	0.44	0.00	0.56	1.50	0.19	0.24	1.17	0.84	0.44	0.00	1.17	1.13	0.78
8 Transsupserv	0.24	0.30	0.00	0.27	0.28	0.03	0.05	0.22	0.24	0.30	0.00	0.21	0.25	0.22
9 Transeqprent	0.03	0.07	0.00	0.06	0.02	0.00	0.00	0.01	0.03	0.07	0.00	0.01	0.00	0.03
10 Travelagenci	0.17	0.25	0.00	0.22	0.21	0.00	0.04	0.11	0.17	0.25	0.00	0.11	0.00	0.16
11 Culturalserv	0.08	0.02	0.00	0.04	0.01	0.01	0.01	0.01	0.08	0.02	0.00	0.01	0.00	0.02
12 Sportrecreat	0.02	0.04	0.00	0.03	0.05	0.02	0.02	0.04	0.02	0.04	0.00	0.04	0.00	0.03
13 fruitflowers	0.52	1.53	0.00	1.16	0.47	0.32	0.76	0.33	0.52	1.53	0.00	0.33	0.00	0.75
14 Preservfoods	1.15	1.37	0.00	1.26	4.32	1.36	4.64	0.96	1.15	1.37	0.00	0.95	0.00	2.42
15 Manudairypro	0.31	0.22	0.00	0.25	0.56	0.33	0.29	0.23	0.31	0.22	0.00	0.23	0.00	0.36
16 Manubakerpro	0.19	0.20	0.00	0.19	0.52	0.22	0.31	0.24	0.19	0.20	0.00	0.24	0.00	0.31
17 Manucoffetea	0.14	0.13	0.00	0.13	0.40	0.05	0.04	0.08	0.14	0.13	0.00	0.08	0.00	0.19
18 Manubeverage	0.65	0.94	0.00	0.83	1.16	1.01	1.12	1.35	0.65	0.94	0.00	1.34	0.00	0.98
19 Manutextiles	3.86	3.66	0.00	3.65	8.00	3.20	6.44	3.22	3.86	3.66	0.00	3.21	0.00	5.05
20 Manuleathers	1.39	1.39	0.00	1.36	1.27	1.03	2.32	0.79	1.39	1.39	0.00	0.78	0.00	1.31

Appendix 5.5 Industry shares in economy-wide production costs (%) (continued)

Column	(1)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	Sectoral share of each factor				Share in input components									
Sector	Lab	Cap	Lnd	Total	IntDom	IntImp	Margin	ComTax	Lab	Cap	Lnd	ProdTax	OCT	Total
21 Manuwoodprod	0.69	0.69	0.00	0.68	0.48	0.65	1.03	0.41	0.69	0.69	0.00	0.41	0.00	0.62
22 Manupaperpro	0.35	1.20	0.00	0.89	0.47	1.81	2.34	1.39	0.35	1.20	0.00	1.38	0.00	1.01
23 Publishprint	0.20	0.30	0.00	0.26	0.41	0.74	0.64	0.48	0.20	0.30	0.00	0.48	0.00	0.42
24 Petroleumref	0.34	1.06	0.00	0.79	0.87	12.15	0.04	11.91	0.34	1.06	0.00	11.88	0.00	3.02
25 Manuceramicw	0.18	0.20	0.00	0.19	0.19	0.17	0.17	0.25	0.18	0.20	0.00	0.25	0.00	0.18
26 Manuglasspro	0.10	0.12	0.00	0.11	0.17	0.38	0.23	0.30	0.10	0.12	0.00	0.30	0.00	0.19
27 Manujewelry	1.34	1.01	0.00	1.10	1.47	3.84	4.59	1.61	1.34	1.01	0.00	1.60	0.00	1.92
28 Communicatio	1.86	2.11	0.00	1.98	1.08	0.01	0.02	0.41	1.86	2.11	0.00	0.41	0.00	1.19
29 Financialint	2.57	2.27	0.00	2.32	0.90	0.03	0.56	0.44	2.57	2.27	0.00	0.77	0.00	1.31
30 Realestate	0.92	4.51	0.00	3.22	0.54	0.01	0.05	0.36	0.92	4.51	0.00	0.36	0.00	1.54
31 Health	3.16	1.04	0.00	1.72	1.04	1.06	1.80	0.83	3.16	1.04	0.00	0.83	0.00	1.37
32 Commperserv	1.71	1.10	0.00	1.28	2.67	1.62	1.87	1.82	1.71	1.10	0.00	1.81	0.00	1.81
33 Agriculture	5.89	5.41	78.72	7.17	4.25	1.29	5.11	3.26	5.89	5.41	78.72	3.25	0.00	4.95
34 Miningquarry	1.64	1.46	21.28	1.95	1.19	0.05	0.24	1.11	1.64	1.46	21.28	1.10	0.00	1.24
35 Manufacturin	15.98	19.21	0.00	17.72	29.78	61.02	40.17	34.33	15.98	19.21	0.00	34.22	0.00	30.85
36 Elecgaswater	4.54	3.87	0.00	4.01	5.11	0.20	0.64	7.45	4.54	3.87	0.00	7.42	0.00	3.47
37 Construction	2.72	2.61	0.00	2.59	4.58	3.23	8.62	3.69	2.72	2.61	0.00	3.68	0.00	3.67
38 Traderepair	13.67	31.07	0.00	24.60	9.30	2.07	4.31	5.56	13.67	31.07	0.00	5.54	97.99	14.80
39 Transportsto	2.31	1.70	0.00	1.87	4.81	0.31	1.71	6.51	2.31	1.70	0.00	6.49	3.29	2.56
40 Services	25.37	3.35	0.00	10.60	2.83	0.20	1.55	1.62	25.37	3.35	0.00	1.62	0.00	5.53
Total	100.0	100.0	100.0	100.0	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Appendix 5.6 Commodity shares in economy-wide aggregate outputs and sales (%)

Column	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	(7a)	(8a)	(9a)	(10a)	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)	(7b)	(8b)	(9b)	(10b)	(a)	(b)	(c)
	Commodity share in the sales of domestic goods										**Commodity share in imported goods**										**Shares in total sales**		
	Interm	**Invest**	**HH**	**EXP**	**GOV**	**STOK**	**Inb Tour**	**Dom Tour**	**Margin**	**Total**	**Interm**	**Invest**	**HH**	**EXP**	**GOV**	**STOK**	**Inb Tour**	**Dom Tour**	**Margin**	**Total**	**Dom**	**Imp**	**Total**
1 Accommodatio	0.39	0.00	0.00	0.00	0.67	0.00	21.98	2.79	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.23	0.00	0.69	0.65	0.69	0.66
2 Sechomeowner	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
3 Restaurant	1.48	0.00	13.75	0.22	0.53	0.00	19.86	8.83	0.00	3.24	0.00	0.00	4.78	0.00	0.00	0.00	0.00	5.62	0.00	0.73	3.24	0.73	2.72
4 Railpassserv	0.02	0.00	0.05	0.01	0.09	0.00	0.14	0.00	0.06	0.03	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.11	0.00	0.01	0.03	0.01	0.03
5 Roadpassserv	0.64	0.00	4.27	1.74	0.18	0.00	7.30	12.35	0.00	1.60	0.00	0.00	3.53	0.00	0.00	0.00	0.00	2.83	0.00	0.49	1.60	0.49	1.37
6 Waterpasserv	0.02	0.00	0.21	0.10	0.00	0.13	0.86	1.86	0.80	0.22	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.40	0.00	0.03	0.22	0.03	0.18
7 Airpassserv	1.25	0.00	0.23	0.81	0.34	0.00	4.64	0.00	0.30	0.78	0.00	0.00	2.56	0.00	0.00	0.00	0.00	2.71	0.00	0.38	0.78	0.38	0.70
8 Transsupserv	0.42	0.00	0.12	0.12	0.16	0.00	0.86	0.39	0.05	0.22	0.01	0.00	0.40	0.00	0.00	0.00	0.00	0.43	0.00	0.06	0.22	0.06	0.19
9 Transeqprent	0.07	0.00	0.03	0.00	0.03	0.00	0.00	0.07	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.02
10 Travelagenci	0.22	0.00	0.35	0.06	0.00	0.00	0.29	1.43	0.00	0.16	0.00	0.00	0.08	0.00	0.00	0.00	0.00	1.98	0.00	0.08	0.16	0.08	0.14
11 Culturalserv	0.02	0.00	0.01	0.02	0.07	0.00	0.11	0.22	0.00	0.02	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.44	0.00	0.02	0.02	0.02	0.02
12 Sportrecreat	0.01	0.00	0.04	0.01	0.09	0.00	0.41	0.71	0.00	0.03	0.00	0.00	0.17	0.00	0.00	0.00	0.00	1.98	0.00	0.09	0.03	0.09	0.04
13 fruitflowers	1.26	0.00	1.47	0.21	0.03	0.00	0.24	5.71	0.00	0.75	0.14	0.00	0.83	0.00	0.00	0.00	0.00	1.47	0.00	0.25	0.75	0.24	0.64
14 Preservfoods	0.52	0.00	0.90	8.17	0.03	24.16	0.47	2.93	0.00	2.42	1.13	0.00	2.47	0.00	0.00	0.00	0.00	1.08	0.00	1.12	2.42	1.12	2.15
15 Manudairypro	0.28	0.00	1.14	0.12	0.03	12.32	0.56	0.68	0.00	0.36	0.34	0.00	2.70	0.00	0.00	0.00	0.00	1.22	0.00	0.59	0.36	0.59	0.41
16 Manubakerpro	0.06	0.00	1.06	0.18	0.00	4.24	0.51	4.12	0.00	0.31	0.03	0.00	0.62	0.00	0.00	0.00	0.00	1.11	0.00	0.13	0.31	0.12	0.27
17 Manucoffetea	0.46	0.00	0.17	0.05	0.00	2.36	0.21	0.10	0.00	0.19	0.02	0.00	0.49	0.00	0.00	0.00	0.00	0.12	0.00	0.07	0.19	0.07	0.17
18 Manubeverage	1.26	0.00	5.67	0.28	0.00	-129.7	1.59	3.37	0.00	0.98	0.34	0.00	3.63	0.00	0.00	0.00	0.00	9.45	0.00	0.97	0.98	0.97	0.98
19 Manutextiles	4.53	0.10	10.06	6.61	0.07	5.19	17.45	4.27	0.00	5.05	2.28	0.11	8.66	0.00	0.00	0.00	0.00	1.98	0.00	2.67	5.05	2.67	4.56
20 Manuleathers	0.31	0.01	3.38	2.11	0.00	24.77	2.49	2.40	0.00	1.31	0.07	0.00	2.50	0.00	0.00	0.00	0.00	1.79	0.00	0.39	1.31	0.39	1.12

Appendix 5.6 Commodity shares in economy-wide aggregate outputs and sales (%) (continued)

Column	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	(7a)	(8a)	(9a)	(10a)	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)	(7b)	(8b)	(9b)	(10b)	(a)	(b)	(c)
	Commodity share in the sales of domestic goods										**Commodity share in imported goods**										**Shares in total sales**		
	Interm	**Invest**	**HH**	**EXP**	**GOV**	**STOK**	**Inb Tour**	**Dom Tour**	**Margin**	**Total**	**Interm**	**Invest**	**HH**	**EXP**	**GOV**	**STOK**	**Inb Tour**	**Dom Tour**	**Margin**	**Total**	**Dom**	**Imp**	**Total**
21 Manuwoodprod	0.20	2.86	1.01	1.25	0.01	-20.56	0.53	0.37	0.00	0.62	0.03	0.04	0.16	0.00	0.00	0.00	0.00	0.02	0.00	0.05	0.62	0.05	0.51
22 Manupaperpro	2.00	0.00	0.14	0.98	1.39	16.99	0.07	0.05	0.00	1.01	2.10	0.00	0.23	0.00	0.00	0.00	0.00	0.02	0.00	1.52	1.01	1.52	1.12
23 Publishprint	0.66	0.00	0.33	0.21	1.57	0.21	1.35	0.01	0.00	0.42	0.14	0.00	4.37	0.00	0.00	0.00	0.00	0.02	0.00	0.59	0.42	0.59	0.45
24 Petroleumref	6.69	0.00	1.92	2.04	0.53	25.17	0.59	0.87	0.00	3.02	0.71	0.00	5.33	0.00	0.00	0.00	0.00	1.24	0.00	1.15	3.02	1.15	2.63
25 Manuceramicw	0.04	0.00	0.04	0.60	0.00	5.26	0.02	0.02	0.00	0.18	0.05	0.51	0.33	0.00	0.00	0.00	0.00	0.03	0.00	0.14	0.18	0.14	0.18
26 Manuglasspro	0.31	0.08	0.01	0.38	0.00	-2.89	0.00	0.00	0.00	0.19	0.48	0.12	0.37	0.00	0.00	0.00	0.00	0.03	0.00	0.40	0.19	0.40	0.23
27 Manujewelry	1.01	0.48	2.05	2.29	0.00	173.85	3.61	2.28	0.00	1.92	1.98	0.00	3.67	0.00	0.00	0.00	0.00	1.35	0.00	1.87	1.92	1.86	1.91
28 Communicatio	2.22	0.00	1.71	0.65	0.70	0.00	0.78	1.24	0.00	1.19	0.00	0.00	5.66	0.00	0.00	0.00	0.00	0.69	0.00	0.66	1.19	0.66	1.08
29 Financialint	4.13	0.00	0.08	0.02	0.15	0.00	0.02	0.05	0.00	1.31	0.08	0.00	0.19	0.00	0.00	0.00	0.00	0.09	0.00	0.08	1.31	0.08	1.06
30 Realestate	0.68	0.23	5.32	0.41	0.00	0.00	4.19	25.00	0.00	1.54	0.00	0.00	5.69	0.00	0.00	0.00	0.00	7.69	0.00	0.90	1.54	0.90	1.41
31 Health	0.00	0.00	3.61	0.67	11.66	0.00	0.82	2.01	0.00	1.37	0.00	0.00	4.56	0.00	0.00	0.00	0.00	0.55	0.00	0.53	1.37	0.53	1.20
32 Commperserv	2.64	0.00	0.56	2.74	1.04	0.00	2.81	10.21	0.00	1.81	0.11	0.00	0.99	0.00	0.00	0.00	0.00	13.90	0.00	0.66	1.81	0.66	1.57
33 Agriculture	13.39	0.11	4.42	0.72	0.19	-32.67	0.00	0.00	0.00	4.95	2.45	0.03	0.69	0.00	0.00	0.00	0.00	0.00	0.00	1.82	4.95	1.82	4.30
34 Miningquarry	3.66	0.00	0.00	0.62	0.00	-15.21	0.00	0.00	0.00	1.24	12.88	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	9.17	1.24	9.17	2.87
35 Manufacturin	32.76	30.02	20.56	63.71	5.05	-34.05	5.25	3.66	0.00	30.85	74.36	99.15	29.89	0.00	0.00	0.00	0.00	19.43	0.00	71.02	30.85	71.02	39.11
36 Elecgaswater	8.27	0.00	4.38	0.40	2.13	0.55	0.00	0.00	0.00	3.47	0.22	0.00	1.84	0.00	0.00	0.00	0.00	0.00	0.00	0.36	3.47	0.36	2.84
37 Construction	0.16	66.11	0.05	0.02	0.23	0.00	0.00	0.00	0.00	3.67	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	3.67	0.01	2.92
38 Traderepair	3.48	0.00	4.65	0.00	0.81	30.62	0.00	2.01	87.67	14.80	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.01	0.00	0.00	14.80	0.00	11.76
39 Transportsto	1.48	0.00	0.73	1.32	0.23	9.32	0.00	0.00	11.12	2.56	0.07	0.00	1.53	0.00	0.00	0.00	0.00	0.00	0.00	0.22	2.56	0.22	2.08
40 Services	3.03	0.00	5.53	0.19	72.01	0.00	0.00	0.00	0.00	5.53	0.00	0.00	0.77	0.00	0.00	0.00	0.00	0.00	0.00	0.09	5.53	0.09	4.41
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.00	0.00	0.00	0.00	100.00	0.00	100.00	100.00	100.00	100.00

Appendix 5.7 Industry shares in the use of composite commodities for intermediate purposes (%)

V1BAS	1 Accommodatio	2 Sechomeowner	3 Restaurant	4 Railpassserv	5 Roadpassserv	6 Waterpasserv	7 Airpassserv	8 Transsupserv	9 Transeqprent	10 Travelagenci	11 Culturalserv	12 Sportrecreat	13 fruitflowers	14 Preservfoods	15 Manudairypro	16 Manubakerpro	17 Manucoffetea	18 Manubeverage	19 Manutextiles	20 Manuleathers
1 Accommodatio	0.29	0	0.13	0	0.13	0.01	0.18	0.04	0.01	2.71	0	0.07	1.53	0.81	0.43	0.11	0	0.55	2.05	2.38
2 Sechomeowner	7.14	0	0	0	0	0	0	0	0	0	0	0	0	7.14	0	0	0	0	7.14	0
3 Restaurant	0.48	0	0.81	0	1.5	0.24	0.11	0.02	0	0.37	0	0.02	0	0.48	0.05	0.06	0.01	0.15	0.82	4.23
4 Railpassserv	0.28	0	0	0.14	3.12	0	0	0	0	0	0	0	0	1.7	0.14	0.43	0	0.28	0.43	0
5 Roadpassserv	0.46	0	0.16	0	0.75	0	0.23	0.05	0	0.3	0.05	0.07	0.82	0.63	0.09	0.5	0.04	0.5	4.01	0.62
6 Waterpasserv	0	0	0	0	0	0.12	0	0	0	2.53	0	0.12	0	0.12	0	0	0	0.12	0	0
7 Airpassserv	0.29	0	0.06	0	0.07	0.09	**36.83**	5.79	0	0.54	0.04	0.03	0.05	0.13	0	0.05	0	0.15	0.4	0.05
8 Transsupserv	0.15	0	0.11	0	16.25	0.74	17.44	2.74	0	0.37	0.02	0.01	0.7	0.07	0.01	0.03	0	0.86	0.33	0.09
9 Transeqprent	0.04	0	0.16	0	**30.14**	1.34	0.73	0.12	0	0.24	0	0	1.25	0	0.04	0	0	1.46	0.24	0.12
10 Travelagenci	0	0	0.01	0.01	1.15	0.23	**57.89**	9.09	0	4.05	0	0	0	0	0.01	0	0	0	1.57	0
11 Culturalserv	0	0	0.65	0.16	0.16	0	0.16	0.33	0	1.47	0.35	0.16	1.8	3.77	0.33	1.47	0	2.62	4.42	0.33
12 Sportrecreat	0	0	3.91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13 fruitflowers	1.73	0	**22.87**	0	0	0	0.7	0.11	0	0	0.09	0.03	3.09	**37.39**	1.13	0.21	0.04	1.6	0	0
14 Preservfoods	0	0	**20.65**	0	0	0	0	0	0	0	0	0	0	**74.37**	1.76	1.38	0	0	0	0
15 Manudairypro	0.16	0	14.82	0	0	0	0.56	0.09	0	0	0	0	0	0.01	**60.45**	12.5	1.31	3.43	0	0
16 Manubakerpro	0.64	0	**51.9**	0	0.39	0	**15.75**	2.48	0	0	0	0	0	0	0.53	16.6	0	0.04	0	0
17 Manucoffetea	0.02	0	**30.9**	0	0.04	0	0.04	0.01	0	0.01	0	0	0	0	0.18	1.25	**67.41**	0	0	0
18 Manubeverage	4.38	0	**62.48**	0	0.15	0.02	2.17	0.35	0	0.02	0	0	0	0.01	0.01	0.1	0	**24.43**	0	0
19 Manutextiles	2.3	0	0.18	0	0.39	0.14	0	0.01	0	0.01	0	0	0	0.01	0	0	0	0.04	**74.18**	4.5
20 Manuleathers	0.08	0	0.02	0	0	0	0.01	0	0	0	0	0	0	0	0	0	0	0.27	0.52	**33.26**

(note: bolded figures are the ones that >20%)

Appendix 5.7 Industry shares in the use of composite commodities for intermediate purposes (%) (continued)

V1BAS	1 Accommodatio	2 Sechomeowner	3 Restaurant	4 Railpassserv	5 Roadpassserv	6 Waterpasserv	7 Airpassserv	8 Transsupserv	9 Transeqprent	10 Travelagenci	11 Culturalserv	12 Sporttrecreat	13 fruitflowers	14 Preservfoods	15 Manudairypro	16 Manubakerpro	17 Manucoffetea	18 Manubeverage	19 Manutextiles	20 Manuleathers
21 Manuwoodprod	2.54	0	0.1	0.01	0.03	0	0	0	0	2.9	0.03	0.05	4.46	0.33	0.01	0.04	0.04	0.46	0.89	0.01
22 Manupaperpro	0.37	0	0.19	0.01	0.76	0	0.15	0.05	0.01	0.07	0.01	0.04	0.01	2.76	0.73	0.37	0.04	1.38	3.9	0.97
23 Publishprint	0.47	0	1.58	0.02	3.2	0.27	0.29	0.05	0	0.2	0.11	0.05	0.17	0.19	0.02	0.05	0.01	0.02	0.24	0.1
24 Petroleumref	0.24	0	1.57	0.28	**13.57**	2.85	4.19	0.69	0.02	0.21	0.01	0.04	0.51	0.77	0.12	0.11	0.09	0.49	1.2	0.23
25 Manuceramicw	0	0	8.11	0	0	0	0	0	0	0	0	0	1.92	0	0	0	0	0	0	0
26 Manuglasspro	0.05	0	3.38	0	0.03	0	0	0	0	0	0	0	0	0.12	0	0.16	0	11.29	0	0
27 Manujewelry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28 Communicatio	4.7	0	2.72	0.01	0.31	0.35	1.53	0.3	0.02	0.7	0.01	0.07	0.32	0.91	0.13	0.25	0.02	0.25	1.67	0.29
29 Financialint	0.97	0	1.39	0.02	0.83	0.09	1.63	0.63	0.12	0.02	0	0.02	0.94	1.31	0.09	0.18	0.03	0.64	3.83	0.55
30 Realestate	3.17	0.03	1.31	0	2.04	0.42	2.6	0.48	0.02	2.13	0	0.2	0.04	3.49	0.22	0.96	0.09	0.43	5.13	0.98
31 Health	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32 Commperserv	0.27	0	0.07	0.09	0.22	0.01	0.12	0.15	0.04	0.94	0.18	0.5	1.06	2.21	0.21	0.86	0	1.61	3.95	0.25
33 Agriculture	0	0	6.49	0	0	0	0	0	0	0	0	0	1.11	14.42	0.67	0.46	0.55	0.12	0.07	0
34 Miningquarry	0	0	0	0.01	0	0	0	0	0	0	0	0	0	0.09	0	0	0	0.01	0.02	0
35 Manufacturin	0.3	0	2.49	0.03	0.73	0.08	0.22	0.05	0.01	0.01	0	0.02	0.38	1.49	0.3	0.47	0.01	1.26	5.28	1.66
36 Elecgaswater	4.29	0	4.58	0.02	0.56	0.03	0.28	0.07	0.01	0.1	0.01	0.12	0.02	0.79	0.24	0.25	0.01	0.32	7.61	0.29
37 Construction	3.8	0	2.08	0.79	2.13	0.21	0.02	0	0	0.03	0.03	0.53	0.28	1.89	0.62	0.4	0.02	0.22	3.01	0.91
38 Traderepair	0.1	0	0.28	0	**33.6**	0.06	0.31	0.21	0.05	0.07	0.02	0.08	0.56	0.6	0.06	0.13	0.03	0.72	0.99	0.32
39 Transportsto	0.07	0	0.03	0	2.85	2.01	10.1	1.59	0	0.57	0.01	0.01	0.13	0.14	0.01	0.02	0	0.22	0.32	0.1
40 Services	2.3	0.01	0.72	0.05	0.96	0.1	3.53	0.64	0.03	2.16	0.01	0.15	0	1.14	0.7	0.65	0.14	2.67	5.86	0.7
Total	0.71	0	3.34	0.03	1.93	0.21	1.01	0.19	0.01	0.13	0.01	0.04	0.41	3.22	0.47	0.41	0.27	1.1	6.21	1.18

(note: bolded figures are the ones that >20%)

Appendix 5.7 Industry shares in the use of composite commodities for intermediate purposes (%) (continued)

V1BAS	21 Manuwoodprod	22 Manupaperpro	23 Publishprint	24 Petroleumref	25 Manuceramicw	26 Manuglasspro	27 Manujewelry	28 Communicatio	29 Financialint	30 Realestate	31 Health	32 Commperserv	33 Agriculture	34 Miningquarry	35 Manufacturin	36 Elecgaswater	37 Construction	38 Traderepair e	39 Transportsto	40 Services	Total
1 Accommodatio	0.22	0.15	0.09	0.35	0.06	0.06	1.14	3.65	2.57	0.15	5.02	8.64	1.97	1.18	13.32	2.61	1.55	**26.25**	0.73	18.86	100
2 Sechomeowner	0	0	0	0	0	0	0	0	7.14	0	0	7.14	0	0	**21.42**	0	0	**35.71**	0	7.14	100
3 Restaurant	0.09	0.12	0.09	0.17	0.03	0.03	0.39	0.15	1.07	0.51	0.37	1.13	0.23	0.29	5.22	0.39	3.53	**67.08**	6.84	2.91	100
4 Railpassserv	0.28	1.28	0	0	0.28	0	4.4	0.14	2.27	0.71	1.99	3.4	0	0.43	**49.08**	0.14	0.28	18.72	7.66	2.41	100
5 Roadpassserv	0.72	0.28	0.43	0.55	0.17	0.15	3.97	0.78	1.43	0.57	0.93	7.97	2.89	0.5	**23.52**	1.39	0.21	**33.64**	2.09	8.57	100
6 Waterpasserv	0	0	0	0	0	0	0	0	0	0	0	9.9	0	**31.07**	9.44	0	0	**43.61**	2.99	0	100
7 Airpassserv	0.14	0.05	0	0.09	0.01	0.02	1.61	2.58	1.18	0.13	0.86	2.63	0	0.28	5.2	0.34	0	**28.22**	10.82	1.25	100
8 Transsupserv	0.11	0.03	0.01	0.31	0.04	0.01	0.81	5.68	1.1	0.06	0.41	1.46	0	0.27	6.66	0.63	0.11	16.9	**24.77**	0.74	100
9 Transeqprent	0.08	0	0	0.49	0.08	0	0.12	8.33	1.05	0	0	0.44	0	0.24	7.93	0.89	0.2	7.16	**36.81**	0.28	100
10 Travelagenci	0.03	0	0	0	0	0.04	0	0.04	0.01	0	0	0	0	0	0.18	0	0	6.15	19.54	0	100
11 Culturalserv	0	0.82	0.16	0.16	0.33	0	0.16	4.58	1.96	0.98	0.16	14.19	3.11	0.16	9.5	0.98	0.65	**32.75**	5.08	6.06	100
12 Sportrecreat	0	0	0	0	0	0	0	0	0.26	0	0	**24.22**	0	0	0	0	0	0	0	**71.61**	100
13 fruitflowers	0.01	1.29	0	0	0	0	0	0	0.12	0.31	3.05	8.44	9.8	0	6.34	0	0.18	0.01	0.2	1.27	100
14 Preservfoods	0	0	0	0	0	0	0	0	0	0	0.05	1.3	0	0	0.42	0	0	0	0	0.08	100
15 Manudairypro	0	0	0	0	0	0	0	0	0	0	2.01	0.85	0.05	0	1.23	0	0	0	0.16	2.35	100
16 Manubakerpro	0	0	0	0	0	0	0	0	0	0	0.53	3.09	0	0	0.21	0	0	0	4.4	3.44	100
17 Manucoffetea	0	0	0	0	0	0	0	0	0	0	0	0.05	0	0	0	0	0	0.07	0.02	0.01	100
18 Manubeverage	0	0	0	0	0	0	0	0	0.03	0.02	0.04	3.91	0	0	0.1	0	0	0.96	0.7	0.15	100
19 Manutextiles	0.13	0.04	0.07	0	0.23	0.01	0.02	0	0.5	0.04	0.68	1.74	0.04	0	9.73	0.05	0.11	3.58	0.99	0.26	100
20 Manuleathers	0.02	0	0.15	0	0.11	0.01	0.44	0	0.1	0	0.13	16.11	0	0	4.99	0	0.09	**43.66**	0.03	0.01	100

(note: bolded figures are the ones that >20%)

Appendix 5.7 Industry shares in the use of composite commodities for intermediate purposes (%) (continued)

V1BAS	21 Manuwoodprod	22 Manupaperpro	23 Publishprint	24 Petroleumref	25 Manuceramicw	26 Manuglasspro	27 Manujewelry	28 Communicatio	29 Financialint	30 Realestate	31 Health	32 Commperserv	33 Agriculture	34 Miningquarry	35 Manufacturin	36 Elecgaswater	37 Construction	38 Traderepair e	39 Transportsto	40 Services	Total
21 Manuwoodprod	4.54	0.31	0.03	0.03	0.77	0.28	0.39	0	0.49	0.03	1.26	0.99	4.11	0	**50.97**	0.04	2.47	15.11	0.75	5.52	100
22 Manupaperpro	0.53	**36.28**	14.09	0.12	0.13	0.14	0.15	0.32	2.94	0.08	0.8	2.09	0.23	0.02	16.52	0.32	0.2	2.9	0.49	9.85	100
23 Publishprint	0.11	0.05	0.03	0	0.18	0	0.19	0.7	1.88	0.1	1.64	1.21	0.01	0.15	5.01	0.54	0.3	**22.28**	1.43	**57.17**	100
24 Petroleumref	0.06	0.31	0.05	0.53	0.19	0.46	0.04	0.26	0.14	0.16	0.4	0.61	9.01	3.81	13.75	8.82	1.08	3.44	28	1.69	100
25 Manuceramicw	0	0	0	0	0.43	0	0.34	0	0.04	0.04	0.21	2.22	0.51	0	13.98	0	**66.8**	5.25	0	0.13	100
26 Manuglasspro	0.98	0	0	0	0	9.21	0.01	0	0	0.02	0.08	3.47	0.02	0.03	**64.79**	0	4.51	1.68	0.01	0.15	100
27 Manujewelry	0	0	0	0	0	0	**99.02**	0	0	0	0	0.95	0	0	0.01	0	0	0.02	0	0	100
28 Communicatio	0.15	0.1	0.15	0.97	0.05	0.07	3.14	**21.37**	5.09	0.14	0.7	9.99	0.72	0.24	14.89	0.82	0.56	17.46	2.3	6.53	100
29 Financialint	0.47	0.69	0.1	0.37	0.27	0.16	1.86	2.38	6.2	5.39	0.26	3.87	4.43	0.38	14.88	7.01	2.44	**32.34**	2.35	0.85	100
30 Realestate	0.5	0.18	0.04	0.44	0.24	0.05	1.21	1.06	3.6	1.75	0.21	4.61	1.93	0.88	20.7	0.56	0.75	**30.92**	1.85	4.79	100
31 Health	0	0	0	0	0	0	0	0	0	0	7.76	0	0	0	0	0	0	0	0	**92.24**	100
32 Commperserv	0.04	0.43	0.07	0.32	0.21	0.02	0.13	2.69	1.34	0.59	0.11	17.77	1.8	0.15	6.18	0.7	0.5	19.27	3.21	**31.72**	100
33 Agriculture	0.48	0.12	0	0	0.05	0	0.06	0	0	0	0.18	0.3	7.62	0.02	**66.91**	0	0.22	0	0	0.15	100
34 Miningquarry	0	0.11	0	**68.45**	0.43	0.14	0.39	0	0	0	0	0.2	0.01	0.76	8.08	16.35	4.94	0	0.01	0	100
35 Manufacturin	0.87	0.21	0.44	0.05	0.16	0.29	1.53	0.06	0.08	0.03	1.5	2.22	3.49	0.21	**61.33**	0.26	6.14	5.01	0.93	0.4	100
36 Elecgaswater	0.37	0.64	0.18	1.74	0.46	0.46	0.65	1.28	0.64	1.48	2.1	1.79	0.43	0.42	**29.18**	**24.98**	0.27	10.2	0.5	2.62	100
37 Construction	0.34	0.29	0.58	0.28	0.21	0.36	0.38	2.13	5.69	12.02	2.29	3.01	5.68	2.2	18.01	4.28	3.29	13.97	0.81	7.21	100
38 Traderepair	0.11	0.09	0.06	0.21	0.01	0.13	0.96	0.96	1.26	0.29	0.56	1.5	1.49	3.24	7.67	0.51	1.84	4.5	**33.61**	2.79	100
39 Transportsto	0.1	0.14	0.01	0.22	0.08	0.01	0.42	1.36	0.39	0.04	0.22	1.93	0	4.64	5.6	0.17	**41.58**	13.16	11.42	0.34	100
40 Services	0.42	0.66	0.31	1.56	0.71	0.18	1.03	3.37	3.38	2.34	1.86	1.97	0.77	13.73	**24.41**	1.68	3.53	8.97	3.69	2.91	100
Total	0.55	0.97	0.53	5.06	0.18	0.25	2.35	0.68	0.58	0.34	1.05	2.28	3.15	0.76	41.39	3.29	4.08	6.61	3.14	1.85	100

(note: bolded figures are the ones that >20%)

Appendix 5.8 Composite commodity shares in industry intermediate input costs (%)

V1BAS	1 Accommodatio	2 Sechomeowner	3 Restaurant	4 Railpassserv	5 Roadpassserv	6 Waterpasserv	7 Airpassserv	8 Transsupserv	9 Transeqprent	10 Travelagenci	11 Culturalserv	12 Sportrecreat	13 fruitflowers	14 Preservfoods	15 Manudairypro	16 Manubakerpro	17 Manucoffetea	18 Manubeverage	19 Manutextiles	20 Manuleathers
1 Accommodatio	0.1	0	0.01	0	0.02	0.01	0.04	0.05	0.17	5.09	0	0.47	0.91	0.06	0.23	0.07	0	0.12	0.08	0.5
2 Sechomeowner	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3 Restaurant	0.63	3.43	0.23	0.05	0.72	1.05	0.1	0.1	0.34	2.67	0	0.56	0	0.14	0.11	0.14	0.02	0.13	0.12	3.33
4 Railpassserv	0.01	0	0	0.05	0.02	0	0	0	0	0	0	0	0	0.01	0	0.01	0	0	0	0
5 Roadpassserv	0.26	0	0.02	0	0.16	0	0.09	0.11	0	0.93	2.12	0.72	0.79	0.08	0.08	0.49	0.05	0.18	0.26	0.21
6 Waterpasserv	0	0	0	0	0	0.01	0	0	0	0.3	0	0.05	0	0	0	0	0	0	0	0
7 Airpassserv	0.33	0	0.01	0.05	0.03	0.33	**28.5**	**23.95**	0	3.22	3.48	0.72	0.09	0.03	0.01	0.1	0.01	0.11	0.05	0.03
8 Transsupserv	0.06	0	0.01	0	2.24	0.92	4.58	3.84	0	0.75	0.58	0.1	0.45	0.01	0.01	0.02	0	0.21	0.01	0.02
9 Transeqprent	0	0	0	0	0.68	0.27	0.03	0.03	0	0.08	0	0	0.13	0	0	0	0	0.06	0	0
10 Travelagenci	0	0	0	0.05	0.08	0.15	7.91	6.64	0	4.29	0	0	0	0	0	0	0	0	0.03	0
11 Culturalserv	0	0	0	0.05	0	0	0	0.02	0	0.11	0.37	0.04	0.04	0.01	0.01	0.04	0	0.02	0.01	0
12 Sportrecreat	0	0	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13 fruitflowers	2.06	0	5.77	0	0	0	0.58	0.49	0	0	8.11	0.58	6.29	9.79	2.01	0.44	0.12	1.22	0	0
14 Preservfoods	0	0	4.6	0	0	0	0	0	0	0	0	0	0	17.19	2.77	2.52	0	0	0	0
15 Manudairypro	0.07	0	1.34	0	0	0	0.17	0.14	0	0	0	0	0	0	**38.47**	9.25	1.48	0.94	0	0
16 Manubakerpro	0.04	0	0.77	0	0.01	0	0.77	0.65	0	0	0	0	0	0	0.06	2.03	0	0	0	0
17 Manucoffetea	0.01	0	2.71	0	0.01	0	0.01	0.01	0	0.03	0	0	0	0	0.11	0.9	**73.63**	0	0	0
18 Manubeverage	5.67	0	17.12	0	0.07	0.08	1.96	1.68	0.16	0.11	0	0.04	0	0	0.01	0.23	0	**20.27**	0	0
19 Manutextiles	11.99	0	0.2	0.1	0.75	2.5	0.02	0.1	0.52	0.38	0.58	0.14	0	0.01	0.01	0.01	0	0.12	**44.05**	14.08
20 Manuleathers	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.05	0.02	6.2

(note: bolded figures are the ones that >20%)

Appendix 5.8 Composite commodity shares in industry intermediate input costs (%) (continued)

V1BAS	1 Accommodatio	2 Sechomeowner	3 Restaurant	4 Railpassserv	5 Roadpassserv	6 Waterpasserv	7 Airpassserv	8 Transsupserv	9 Transeqprent	10 Travelagenci	11 Culturalserv	12 Sporttrecreat	13 fruitflowers	14 Preservfoods	15 Manudairypro	16 Manubakerpro	17 Manucoffetea	18 Manubeverage	19 Manutextiles	20 Manuleathers
21 Manuwoodprod	0.49	0	0	0.05	0	0	0	0	0	3	0.38	0.19	1.46	0.01	0	0.01	0.02	0.06	0.02	0
22 Manupaperpro	1.05	0	0.12	0.42	0.8	0.02	0.31	0.53	1.56	1.12	1.53	2.33	0.04	1.74	3.12	1.86	0.29	2.53	1.28	1.68
23 Publishprint	0.31	0	0.22	0.26	0.77	0.59	0.13	0.12	0.18	0.73	5.78	0.58	0.2	0.03	0.02	0.06	0.01	0.01	0.02	0.04
24 Petroleumref	1.52	0	2.1	**37.21**	**31.36**	**59.55**	18.49	16.34	9.73	7.24	4.75	5.17	5.51	1.06	1.12	1.25	1.47	1.99	0.86	0.85
25 Manuceramicw	0	0	0.1	0	0	0	0	0	0	0	0	0	0.19	0	0	0	0	0	0	0
26 Manuglasspro	0.02	0	0.38	0	0.01	0	0	0	0	0	0	0	0	0.01	0	0.15	0	3.83	0	0
27 Manujewelry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28 Communicatio	9.28	6.97	1.14	0.37	0.22	2.25	2.1	2.18	2.95	7.46	1.34	2.53	1.07	0.4	0.37	0.86	0.12	0.32	0.38	0.34
29 Financialint	3.61	0	1.09	1.82	1.12	1.14	4.23	8.8	**30.04**	0.34	0.37	1.76	5.96	1.06	0.49	1.17	0.25	1.51	1.62	1.22
30 Realestate	1.92	**26.91**	0.17	0	0.45	0.84	1.1	1.08	0.84	6.97	0	2.35	0.04	0.46	0.2	1.01	0.15	0.17	0.35	0.36
31 Health	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32 Commperserv	0.66	3.4	0.04	4.48	0.19	0.08	0.21	1.37	7.46	12.21	**33.8**	**23.35**	4.34	1.17	0.74	3.58	0.01	2.48	1.08	0.36
33 Agriculture	0.05	0	18.09	0	0	0	0	0	0	0	2.7	0.05	24.9	41.72	13.2	10.62	18.98	1.02	0.1	0.01
34 Miningquarry	0	0	0	2.59	0	0	0	0	0	0	0	0	0.07	0.21	0	0.02	0	0.05	0.02	0
35 Manufacturin	**20.72**	3.47	**35.86**	**43.91**	18.27	18.82	10.37	12.84	**24.42**	2	19.78	**26.2**	**43.96**	**22.31**	**30.95**	**56.11**	1.86	**54.82**	**40.92**	**67.58**
36 Elecgaswater	32	17.13	7.24	3.08	1.52	0.81	1.46	2.05	4.96	4.13	5.07	17.78	0.23	1.29	2.68	3.23	0.26	1.53	6.47	1.3
37 Construction	0.54	0	0.06	2.38	0.11	0.1	0	0	0	0.03	0.38	1.47	0.07	0.06	0.13	0.1	0.01	0.02	0.05	0.08
38 Traderepair	0.3	0	0.18	0.21	**38.04**	0.64	0.67	2.44	11.24	1.19	5.6	4.58	2.94	0.41	0.29	0.67	0.24	1.44	0.35	0.6
39 Transportsto	0.1	0	0.01	0.05	1.41	8.95	9.52	8	0.18	4.19	0.97	0.29	0.29	0.04	0.01	0.04	0.01	0.19	0.05	0.08
40 Services	6.19	**38.7**	0.41	2.79	0.95	0.93	6.63	6.43	5.27	**31.44**	2.32	7.95	0.02	0.67	2.79	3.02	1.01	4.59	1.79	1.13
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

(note: bolded figures are the ones that >20%)

Appendix 5.8 Composite commodity shares in industry intermediate input costs (%) (continued)

V1BAS	21 Manuwoodprod	22 Manupaperpro	23 Publishprint	24 Petroleumref	25 Manuceramicw	26 Manuglasspro	27 Manujewelry	28 Communicatio	29 Financialint	30 Realestate	31 Health	32 Commperserv	33 Agriculture	34 Miningquarry	35 Manufacturin	36 Elecgaswater	37 Construction	38 Traderepair e	39 Transportsto	40 Services	Total
1 Accommodatio	0.1	0.04	0.04	0.02	0.08	0.06	0.12	1.31	1.1	0.11	1.18	0.93	0.15	0.38	0.08	0.2	0.09	0.98	0.06	2.5	0.25
2 Sechomeowner	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3 Restaurant	0.16	0.11	0.15	0.03	0.16	0.1	0.16	0.2	1.73	1.41	0.33	0.46	0.07	0.35	0.12	0.11	0.8	9.43	2.03	1.46	0.93
4 Railpassserv	0.01	0.02	0	0	0.02	0	0.02	0	0.05	0.03	0.02	0.02	0	0.01	0.01	0	0	0.04	0.03	0.02	0.01
5 Roadpassserv	0.53	0.12	0.33	0.04	0.37	0.25	0.68	0.46	1	0.67	0.35	1.41	0.37	0.26	0.23	0.17	0.02	2.05	0.27	1.86	0.4
6 Waterpasserv	0	0	0	0	0	0	0	0	0	0	0	0.07	0	0.63	0	0	0	0.1	0.01	0	0.02
7 Airpassserv	0.2	0.04	0.01	0.01	0.06	0.06	0.54	2.95	1.6	0.3	0.64	0.91	0	0.29	0.1	0.08	0	3.34	2.7	0.53	0.78
8 Transsupserv	0.05	0.01	0	0.02	0.06	0.01	0.09	2.21	0.51	0.05	0.1	0.17	0	0.1	0.04	0.05	0.01	0.68	2.1	0.11	0.27
9 Transeqprent	0.01	0	0	0	0.02	0	0	0.53	0.08	0	0	0.01	0	0.01	0.01	0.01	0	0.05	0.51	0.01	0.04
10 Travelagenci	0.01	0	0	0	0	0.02	0	0.01	0	0	0	0	0	0	0	0	0	0.13	0.86	0	0.14
11 Culturalserv	0	0.01	0	0	0.02	0	0	0.06	0.03	0.03	0	0.06	0.01	0	0	0	0	0.05	0.02	0.03	0.01
12 Sportrecreat	0	0	0	0	0	0	0	0	0	0	0	0.06	0	0	0	0	0	0	0	0.22	0.01
13 fruitflowers	0.01	1.13	0	0	0	0	0	0	0.17	0.78	2.45	3.12	2.62	0	0.13	0	0.04	0	0.05	0.58	0.84
14 Preservfoods	0	0	0	0	0	0	0	0	0	0	0.03	0.42	0	0	0.01	0	0	0	0	0.03	0.74
15 Manudairypro	0	0	0	0	0	0	0	0	0	0	0.58	0.11	0.01	0	0.01	0	0	0	0.02	0.38	0.3
16 Manubakerpro	0	0	0	0	0	0	0	0	0	0	0.03	0.07	0	0	0	0	0	0	0.07	0.09	0.05
17 Manucoffetea	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0	0	0	0.29
18 Manubeverage	0	0	0	0	0	0	0	0	0.05	0.06	0.03	1.57	0	0	0	0	0	0.13	0.2	0.08	0.92
19 Manutextiles	0.85	0.16	0.51	0	4.54	0.09	0.03	0	3.23	0.42	2.4	2.82	0.05	0	0.87	0.05	0.1	2	1.17	0.52	3.69
20 Manuleathers	0.01	0	0.06	0	0.13	0.01	0.04	0	0.04	0	0.03	1.55	0	0	0.03	0	0	1.45	0	0	0.22

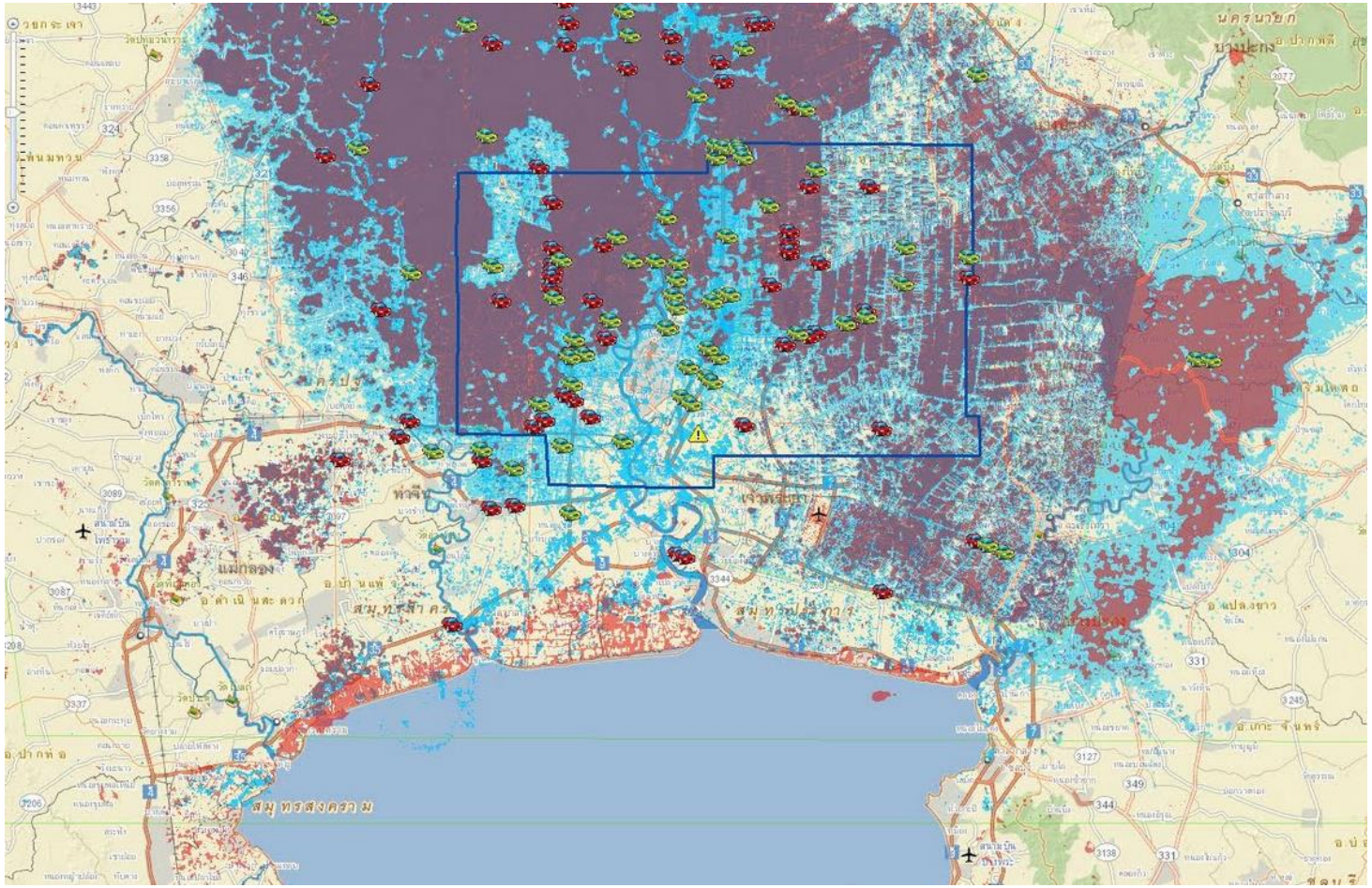
(note: bolded figures are the ones that >20%)

Appendix 5.8 Composite commodity shares in industry intermediate input costs (%) (continued)

V1BAS	21 Manuwoodprod	22 Manupaperpro	23 Publishprint	24 Petroleumref	25 Manuceramicw	26 Manuglasspro	27 Manujewelry	28 Communicatio	29 Financialint	30 Realestate	31 Health	32 Commperserv	33 Agriculture	34 Miningquarry	35 Manufacturin	36 Elecgaswater	37 Construction	38 Traderepair e	39 Transportsto	40 Services	Total
21 Manuwoodprod	1.12	0.04	0.01	0	0.57	0.16	0.02	0	0.12	0.01	0.16	0.06	0.18	0	0.17	0	0.08	0.31	0.03	0.4	0.14
22 Manupaperpro	1.97	**76.48**	**54.2**	0.05	1.42	1.17	0.13	0.94	10.36	0.45	1.55	1.86	0.15	0.07	0.81	0.2	0.1	0.89	0.32	10.82	2.04
23 Publishprint	0.1	0.02	0.03	0	0.45	0.01	0.04	0.48	1.52	0.14	0.73	0.25	0	0.09	0.06	0.08	0.03	1.57	0.21	14.41	0.47
24 Petroleumref	0.48	1.45	0.43	0.47	4.63	8.44	0.08	1.69	1.08	2.12	1.71	1.19	12.79	**22.29**	1.48	11.99	1.18	2.32	**39.91**	4.08	4.47
25 Manuceramicw	0	0	0	0	0.1	0	0.01	0	0	0.01	0.01	0.04	0.01	0	0.01	0	0.68	0.03	0	0	0.04
26 Manuglasspro	0.67	0	0	0	0	14.04	0	0	0	0.03	0.03	0.57	0	0.01	0.59	0	0.41	0.1	0	0.03	0.37
27 Manujewelry	0	0	0	0	0	0	**57.66**	0	0	0	0	0.57	0	0	0	0	0	0	0	0	1.37
28 Communicatio	0.39	0.15	0.39	0.27	0.34	0.42	1.86	**43.59**	12.32	0.58	0.93	6.11	0.32	0.43	0.5	0.35	0.19	3.68	1.02	4.91	1.4
29 Financialint	2.26	1.88	0.49	0.19	3.88	1.72	2.08	9.14	**28.22**	41.59	0.65	4.45	3.69	1.31	0.94	5.6	1.57	12.83	1.97	1.2	2.62
30 Realestate	0.39	0.08	0.03	0.04	0.55	0.08	0.22	0.67	2.68	2.2	0.09	0.86	0.26	0.49	0.21	0.07	0.08	2	0.25	1.11	0.43
31 Health	0	0	0	0	0	0	0	0	0	0	0.02	0	0	0	0	0	0	0	0	0.1	0
32 Commperserv	0.11	0.75	0.24	0.11	1.96	0.11	0.09	6.68	3.94	2.96	0.18	13.24	0.97	0.34	0.25	0.36	0.21	4.95	1.74	**29.08**	1.7
33 Agriculture	8.13	1.15	0	0	2.29	0	0.24	0	0	0	1.59	1.22	**22.56**	0.19	15.08	0	0.51	0	0.01	0.76	9.32
34 Miningquarry	0	0.78	0	**95.73**	16.4	3.9	1.18	0	0	0	0.01	0.62	0.02	7.06	1.38	**35.22**	8.57	0	0.01	0	7.08
35 Manufacturin	**76.76**	10.39	**39.82**	0.48	**40.86**	**56.83**	**31.33**	4.52	6.77	4.45	**68.68**	**47.02**	**53.36**	13.17	**71.44**	3.85	72.53	**36.55**	14.38	10.37	48.21
36 Elecgaswater	3.52	3.51	1.76	1.82	13.07	9.77	1.46	9.89	5.84	**23.01**	10.55	4.15	0.72	2.93	3.72	**40.11**	0.35	8.14	0.83	7.46	5.28
37 Construction	0.06	0.03	0.11	0.01	0.11	0.15	0.02	0.32	1	3.58	0.22	0.13	0.18	0.29	0.04	0.13	0.08	0.21	0.03	0.39	0.1
38 Traderepair	0.45	0.21	0.25	0.09	0.17	1.2	0.89	3.06	4.8	1.86	1.17	1.44	1.03	9.29	0.41	0.34	0.99	1.49	**23.47**	3.29	2.19
39 Transportsto	0.18	0.14	0.02	0.04	0.42	0.04	0.17	1.9	0.64	0.1	0.2	0.81	0	5.81	0.13	0.05	9.73	1.9	3.48	0.17	0.96
40 Services	1.47	1.3	1.1	0.59	7.3	1.36	0.84	9.38	11.13	13.09	3.36	1.64	0.46	**34.19**	1.12	0.97	1.65	2.58	2.24	2.98	1.9
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

(note: bolded figures are the ones that >20%)

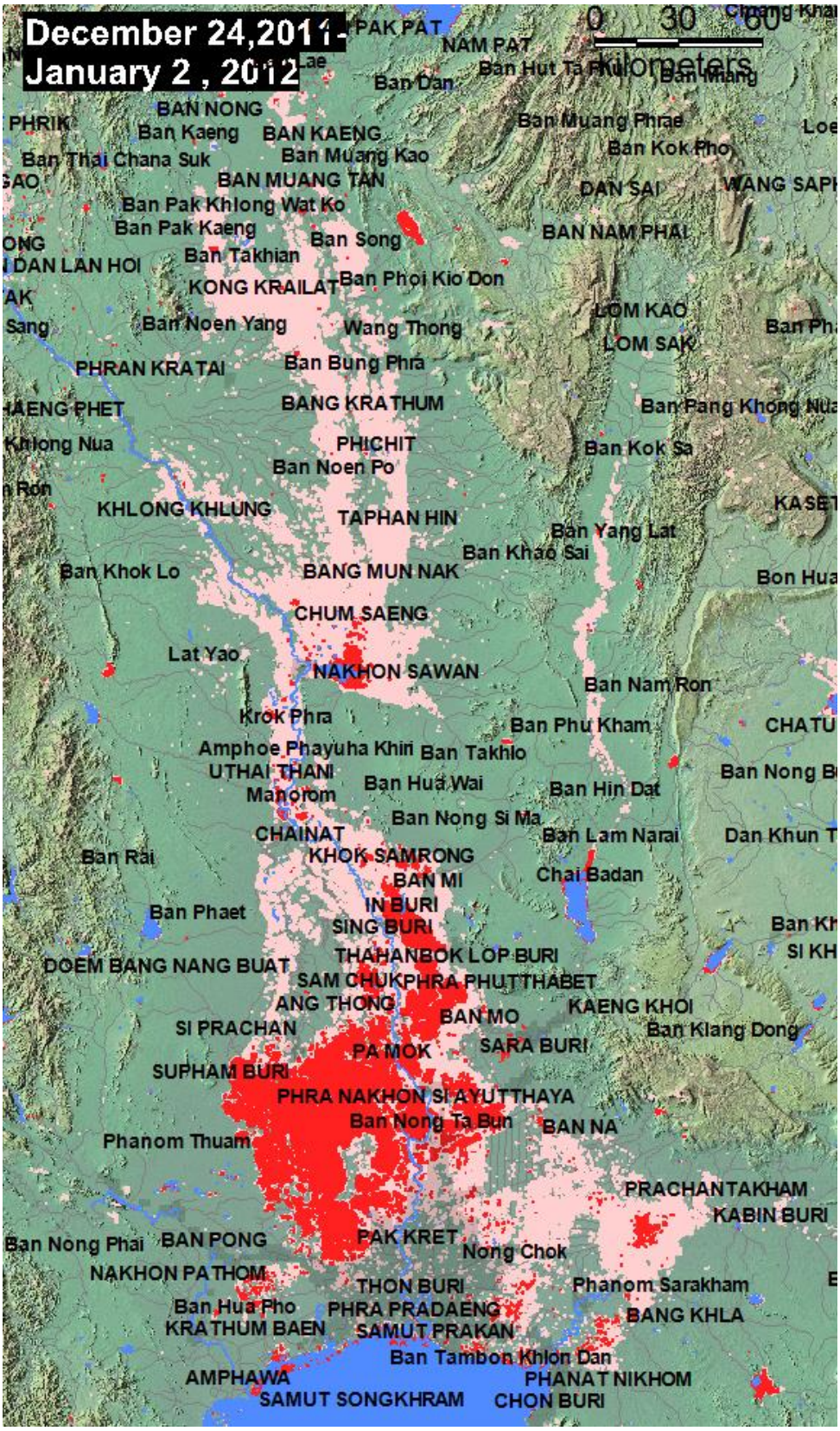
Appendix 8.1 A: Geographical depiction of the flood in October 2011, Bangkok and surrounded area (Source: ESRI, Thailand)



Note: the blue box area depicts the Bangkok metropolitan area

Appendix 8.1 B: Situation of the flood, year end of 2011, Northern & Central region.

(Source:http://floodobservatory.colorado.edu/RapidResponse/2011Thailand6.jpg)



Appendix 8.2 : More results on policy simulations, deviations from Baseline forecast

Deviations from Baseline of 40 sectoral outputs with sub-totals of external shock (2012)

	Column	Demand-side (Behavioural effects)		Supply-side (Resource-loss effects)			%
Row	External Shocks (2012)	Shift in inbound tourists' demand	Decline in national tourists' demand	Losses in Agricultural Land	Labour productivity change	Capital Damages	Annual Total
	Sectoral Outputs	(1)	(2)	(3)	(4)	(5)	(6)
1	Accommodation	-1.547	-0.705	0.209	0.802	-1.868	-2.552
2	Second home ownership	-0.023	-1.841	0.097	-2.876	-0.301	-5.181
3	Restaurant and similar	-0.104	0.490	0.016	-2.517	-0.251	-2.640
4	Railway passenger transport services	-0.151	0.069	0.057	-2.321	-0.987	-3.264
5	Road passenger transport services	-0.072	-0.836	0.088	-1.557	-1.139	-3.475
6	Waterway passenger transport services	-0.107	-1.075	-0.029	-1.911	-1.111	-4.194
7	Air passenger transport services	-0.243	-0.068	0.038	-1.437	-1.569	-3.117
8	Transport supporting services	-0.133	-0.330	0.038	-1.610	-1.207	-3.180
9	Transport equipment rental	0.016	-0.253	0.025	-1.785	-0.688	-2.701
10	Travel agencies and similar	-0.048	-0.982	0.047	-1.901	-0.804	-3.771
11	Cultural services	-0.167	-1.876	0.027	-1.021	-1.220	-4.092
12	Sporting and other recreational services	-0.321	-2.872	0.096	-0.669	-0.906	-4.717
13	Growing of fruit & flowers	0.028	-0.691	-0.027	-1.105	-1.191	-3.037
14	Preserving of foods	0.179	-0.421	-0.059	-1.410	-1.988	-3.475
15	Manufacture of dairy products	-0.037	0.030	-0.068	-2.263	-0.722	-3.186
16	Manufacture of bakery products	-0.015	-1.697	-0.002	-1.965	-0.746	-4.573
17	Manufacture of coffee and tea	-0.071	0.102	-0.003	-1.880	-0.840	-2.771
18	Manufacture of beverages	-0.008	0.405	0.105	-2.908	-0.863	-3.593
19	Manufacture of textiles	-0.037	0.088	0.073	-2.404	-1.435	-3.729
20	Manufacture of leather products	0.040	-0.023	0.050	-1.911	-1.299	-3.163
21	Manufacture of wood products	0.063	-0.007	-0.028	-2.768	-1.505	-4.248
22	Manufacture of paper and paper products	0.052	-0.108	0.007	-1.014	-1.406	-2.403
23	Publishing and printing	-0.092	0.009	0.042	-1.019	-0.998	-2.035
24	Petroleum refinery	0.035	-0.093	-0.064	-1.858	-1.317	-3.278
25	Manufacture of ceramic wares	0.170	-0.268	-0.018	-1.460	-1.862	-3.240
26	Manufacture of glass products	0.138	-0.203	0.013	-1.973	-1.900	-3.793
27	Manufacture of jewelry and related articles	0.019	-0.133	0.053	-1.153	-1.224	-2.354
28	Communication	-0.002	-0.154	0.029	-1.923	-0.885	-2.958
29	Financial intermediation	0.004	0.000	-0.075	-2.381	-1.088	-3.589
30	Real estate activities	-0.002	-0.419	0.028	-1.350	-1.182	-3.028
31	Health	0.066	0.131	0.067	-3.983	-0.205	-4.112
32	Community and personal service activities	0.043	-1.025	-0.003	-1.551	-1.441	-3.858
33	Agriculture	0.105	-0.046	-1.952	-1.081	-0.883	-3.765
34	Mining and quarrying	0.044	-0.059	0.022	-2.818	-1.022	-3.966
35	Manufacturing	0.130	-0.125	-0.042	-2.546	-1.789	-4.253
36	Electricity, gas and water supply	-0.003	0.116	0.043	-4.857	-0.969	-5.893
37	Construction	-0.106	0.008	-0.198	-5.515	-0.428	-6.541
38	Trade and repair of goods	-0.003	0.246	-0.031	-2.550	-0.902	-3.372
39	Transportation and warehousing services	0.054	-0.010	-0.076	-2.723	-1.246	-4.030
40	Services	0.012	0.107	0.014	-1.225	-0.120	-1.315

Note: Simulation results

Deviations from Baseline of 40 commodity prices with sub-totals of external shock (2012)

	Column	Demand-side (Behavioural effects)		Supply-side (Resource-loss effects)			%
Row	External Shocks (2012)	Shift in inbound tourists' demand	Decline in national tourists' demand	Losses in Agricultural Land	Labour productivity change	Capital Damages	Annual Total
	Commodity Prices	(1)	(2)	(3)	(4)	(5)	(6)
1	Accommodation	-2.125	-0.994	0.035	7.942	-2.718	2.592
2	Second home ownership	-0.172	-3.380	-0.085	3.153	-1.212	-1.547
3	Restaurant and similar	-0.294	0.670	0.177	-0.727	-0.592	-0.769
4	Railway passenger transport services	-0.058	-0.244	-0.328	8.522	-2.238	5.863
5	Road passenger transport services	-0.157	-0.802	-0.159	-0.181	-0.804	-2.034
6	Waterway passenger transport services	-0.532	-3.166	-0.286	-0.600	-2.242	-6.470
7	Air passenger transport services	-0.319	-0.499	-0.194	3.795	-2.190	0.785
8	Transport supporting services	-0.594	-1.122	-0.149	1.407	-3.001	-3.126
9	Transport equipment rental	-0.029	-1.482	-0.141	-3.332	-2.113	-7.011
10	Travel agencies and similar	-0.424	-2.987	-0.109	1.979	-1.902	-3.175
11	Cultural services	-0.173	-1.473	-0.215	5.964	-1.999	2.270
12	Sporting and other recreational services	-1.611	-6.852	0.004	4.583	-1.621	-4.621
13	Growing of fruit & flowers	0.149	-4.598	-0.125	-1.973	0.598	-5.741
14	Preserving of foods	0.313	-0.931	0.916	0.485	-1.521	-0.564
15	Manufacture of dairy products	0.045	-0.273	0.282	2.609	-0.810	1.951
16	Manufacture of bakery products	0.028	-2.111	0.167	2.059	-0.309	-0.075
17	Manufacture of coffee and tea	-0.167	-0.016	0.220	1.945	-0.369	1.715
18	Manufacture of beverages	-0.032	0.521	0.030	-0.771	-0.037	-0.285
19	Manufacture of textiles	-0.058	-0.010	-0.066	2.933	-0.830	2.073
20	Manufacture of leather products	0.040	-0.107	-0.102	1.386	-0.541	0.771
21	Manufacture of wood products	0.135	-0.105	-0.184	-0.951	-0.691	-1.686
22	Manufacture of paper and paper products	0.350	-0.667	-0.140	-2.205	-0.236	-2.708
23	Publishing and printing	-0.129	-0.168	-0.082	0.980	-0.011	0.718
24	Petroleum refinery	0.216	-0.545	-0.164	0.015	-0.789	-1.113
25	Manufacture of ceramic wares	0.377	-0.777	-0.217	2.578	-1.776	0.422
26	Manufacture of glass products	0.282	-0.438	-0.144	1.425	-1.442	-0.128
27	Manufacture of jewelry and related articles	0.017	-0.151	-0.129	1.745	-0.464	1.115
28	Communication	-0.136	-0.635	-0.182	1.214	-3.086	-2.641
29	Financial intermediation	-0.096	-0.161	-0.451	-1.960	-3.341	-5.931
30	Real estate activities	-0.244	-5.202	0.057	-1.156	1.040	-5.328
31	Health	-2.125	-0.994	0.035	7.942	-2.718	2.592
32	Community and personal service activities	-0.172	-3.380	-0.085	3.153	-1.212	-1.547
33	Agriculture	-0.294	0.670	0.177	-0.727	-0.592	-0.769
34	Mining and quarrying	-0.058	-0.244	-0.328	8.522	-2.238	5.863
35	Manufacturing	-0.157	-0.802	-0.159	-0.181	-0.804	-2.034
36	Electricity, gas and water supply	-0.532	-3.166	-0.286	-0.600	-2.242	-6.470
37	Construction	-0.319	-0.499	-0.194	3.795	-2.190	0.785
38	Trade and repair of goods	-0.594	-1.122	-0.149	1.407	-3.001	-3.126
39	Transportation and warehousing services	-0.029	-1.482	-0.141	-3.332	-2.113	-7.011
40	Services	-0.424	-2.987	-0.109	1.979	-1.902	-3.175

Note: Simulation results

Appendix 8.3 : More results on policy simulations, Tax incidence

Deviations from Baseline of 40 sectoral outputs & commodity prices with tax incentive

	Column	Sectoral Outputs				Commodity Prices			
Row	External Shocks (2012)	Tax Cut	Annual Total	Without Tax cut Total	Difference	Tax Cut	Annual Total	Without Tax cut Total	Difference
	Sector/Commodity	(t)	(w)	(w/o)	(w) – (w/o)	(t)	(w)	(w/o)	(w) – (w/o)
1	Accommodation	3.839	1.275	-2.552	3.827	4.739	7.325	2.592	4.733
2	Second home ownership	0.133	-4.751	-5.181	0.43	0.371	-1.166	-1.547	0.381
3	Restaurant and similar	0.409	-2.002	-2.640	0.638	0.643	-0.124	-0.769	0.645
4	Railway passenger transport services	0.439	-2.836	-3.264	0.428	0.155	6.028	5.863	0.165
5	Road passenger transport services	0.251	-3.079	-3.475	0.396	0.338	-1.695	-2.034	0.339
6	Waterway passenger transport services	0.361	-3.697	-4.194	0.497	0.904	-5.626	-6.470	0.844
7	Air passenger transport services	0.664	-2.38	-3.117	0.737	0.718	1.507	0.785	0.722
8	Transport supporting services	0.41	-2.655	-3.180	0.525	1.183	-1.968	-3.126	1.158
9	Transport equipment rental	-0.005	-2.563	-2.701	0.138	0.088	-6.917	-7.011	0.094
10	Travel agencies and similar	0.228	-3.361	-3.771	0.41	0.836	-2.355	-3.175	0.82
11	Cultural services	0.468	-3.611	-4.092	0.481	0.408	2.688	2.270	0.418
12	Sporting and other recreational services	1.144	-3.441	-4.717	1.276	2.631	-2.167	-4.621	2.454
13	Growing of fruit & flowers	-0.05	-2.975	-3.037	0.062	-0.263	-5.985	-5.741	-0.244
14	Preserving of foods	-0.375	-3.845	-3.475	-0.37	-0.645	-1.194	-0.564	-0.63
15	Manufacture of dairy products	0.124	-2.876	-3.186	0.31	-0.085	1.875	1.951	-0.076
16	Manufacture of bakery products	0.085	-4.29	-4.573	0.283	-0.065	-0.137	-0.075	-0.062
17	Manufacture of coffee and tea	0.255	-2.371	-2.771	0.4	0.424	2.158	1.715	0.443
18	Manufacture of beverages	0.087	-3.244	-3.593	0.349	0.089	-0.187	-0.285	0.098
19	Manufacture of textiles	0.165	-3.438	-3.729	0.291	0.156	2.238	2.073	0.165
20	Manufacture of leather products	-0.049	-3.097	-3.163	0.066	-0.073	0.703	0.771	-0.068
21	Manufacture of wood products	-0.125	-4.218	-4.248	0.03	-0.266	-1.946	-1.686	-0.26
22	Manufacture of paper and paper products	-0.121	-2.483	-2.403	-0.08	-0.685	-3.368	-2.708	-0.66
23	Publishing and printing	0.245	-1.743	-2.035	0.292	0.334	1.064	0.718	0.346
24	Petroleum refinery	-0.06	-3.233	-3.278	0.045	-0.435	-1.531	-1.113	-0.418
25	Manufacture of ceramic wares	-0.354	-3.584	-3.240	-0.344	-0.756	-0.311	0.422	-0.733
26	Manufacture of glass products	-0.322	-4.057	-3.793	-0.264	-0.566	-0.676	-0.128	-0.548
27	Manufacture of jewelry and related articles	0.013	-2.258	-2.354	0.096	-0.023	1.097	1.115	-0.018
28	Communication	0.046	-2.764	-2.958	0.194	0.296	-2.338	-2.641	0.303
29	Financial intermediation	0.026	-3.417	-3.589	0.172	0.203	-5.729	-5.931	0.202
30	Real estate activities	0.03	-2.862	-3.028	0.166	0.493	-4.833	-5.328	0.495
31	Health	-0.089	-4.204	-4.112	-0.092	0.001	9.953	2.592	7.361
32	Community and personal service activities	-0.045	-3.871	-3.858	-0.013	-0.037	2.057	-1.547	3.604
33	Agriculture	-0.177	-3.845	-3.765	-0.08	-0.511	1.329	-0.769	2.098
34	Mining and quarrying	-0.114	-3.938	-3.966	0.028	-0.214	-5.954	5.863	-11.817
35	Manufacturing	-0.266	-4.459	-4.253	-0.206	-0.547	3.134	-2.034	5.168
36	Electricity, gas and water supply	0.048	-5.675	-5.893	0.218	0.13	15.758	-6.470	22.228
37	Construction	0.191	-6.075	-6.541	0.466	0.216	-2.469	0.785	-3.254
38	Trade and repair of goods	0.031	-3.158	-3.372	0.214	0.297	-5.161	-3.126	-2.035
39	Transportation and warehousing services	-0.102	-3.994	-4.030	0.036	-0.069	-0.661	-7.011	6.35
40	Services	-0.012	-1.32	-1.315	3.827	0.133	12.398	-3.175	4.733

Note: Simulation results