2001

The measurement of maritime policy impacts on Thai economy

Nakorn Indra-Payoong
World Maritime University

WORLD MARITIME UVIVERSITY

Malmö, Sweden

THE MEASUREMENT OF MARITIME POLICY IMPACTS ON THAI ECONOMY

By

NAKORN INDRA-PAYOONG

Thailand

A dissertation submitted to the World Maritime University in partial fulfillment of the requirement of the award of the degree of

MASTER OF SCIENCE

in

MARITIME AFFAIRS

(SHIPPING MANAGEMENT)

2001

DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

…… (Signature)

24 August 2001

Supervised by:
Name: Professor Patrick Donner
Office: Associate Professor, Shipping Management
World Maritime University

Assessor:
Name: Professor Shuo Ma
Office: Professor, Shipping and Port Management
World Maritime University

Co-assessor:
Name: Professor Hercules Haralambides
Office: Professor, Maritime Economics at the Erasmus
University in Rotterdam

ACKNOWLEDGEMENT

Within the available time for doing research, it would have been very hard to complete and achieve a satisfactory result in my work without the following people.

First of all, I owe a special debt of gratitude to my supervisor, Professor Patrick Donner, for constantly helping me to elaborate my research and make it much more readable and for greatly assisting in various other ways.

I am overwhelmingly indebted to my brother, Kaseam Pintong, and my beloved sister, Jittree Indra-payoong, who intellectually advised me on the matters of computer programming and mathematical calculation. Thanks as well to my friends at the World Maritime University, in particular the Thais, who have patiently cheered me up during my research.

Finally, I would very much like to thank all members of my family, my sweetheart and friends of mine staying in my homeland, who have given me indescribable love and infinite encouragement transmitted across continents.

ABSTRACT

Title of Dissertation: **The measurement of maritime policy impacts on Thai economy**

Degree **Master of Science in Maritime Affairs**

Since the economic crisis in the mid-1990s, the government of Thailand has made an enormous effort to recover from the slowdown in economic sectors, in particular the maritime sector, which plays a key role in developing the economy of the country. This research introduces a quantitative method, input-output approach, to provide a measurement of maritime policy impacts by considering both direct and indirect effects on all other economic sectors.

Four scenarios of maritime policy are applied in a case study concerning the maritime sector of Thailand: privatisation of the shipping and port sectors, subsidisation of the shipping and port sectors, investment in maritime infrastructure and promotion of international trade. The indicator of maritime policy impacts is shown in terms of total national income.

The result indicates that the most appropriate maritime policy scenario is the subsidisation of the port and shipping sectors, which shows the greatest sensitivity in increasing the output of total national income. The change by one unit of government expenditure will give a change in output of total national income of 72.32 per cent. The government is, therefore, recommended to continue supporting the maritime sector with limited expenditure and strict criteria for the granting of subsidies.

KEYWORDS: Policy, Maritime policy, Measurement, Input-output, Econometric model, Policy impacts.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

INTRODUCTION

1.1 Background

Thailand, an Asian country, is located in South-East Asia. The economic development in Thailand during the past two decades has been remarkable. Unfortunately, in the mid-1990s, the economic crisis among Asian countries has dramatically affected the Thai economy. The Government of Thailand has, therefore, made enormous efforts to recover economic sectors, particularly, the maritime sector, both shipping industries and port sectors, which play a key role in developing the economy of the country. With a large number of constraints, such as government expenditure, limited resources, technological knowledge and so forth, the policy makers should carefully take into account the outcome of the policy and carefully select the policy that gives the highest profitability among numerous alternatives.

To decide on the policy in a developing economy, it is indispensable to have good data for measuring the outcome of such a policy. If the policy makers use appropriate data and techniques, the economic recovery will be ironed out efficiently; otherwise, it will bring about many coming problems (Lewis, 1991, pp. 256-281)**.** To issue the national policy, studying previous data, collecting new data, and analyzing the relevant data is the first important basis of planning policy.

Different methods of analysis certainly give different results. Therefore, using a method relevant to the objective of the study is the best thing that one could do but it

is inevitably costly to achieve the best result. The policy maker should thus plan wisely and appropriately in order not to obtain the best way out but to get the optimum outcome.

Economic models are employed to analyse and measure the effect of policy issues at both national and regional level. Various approaches, both theoretical and empirical, are used to measure a policy affecting the economy and to try to obtain completely predictive effects from a change in policy. Input-output is one of the popular methods to assess the interdependence of economic sectors (Miller & Blair, 1985, pp. 1-10).

The input-output analysis basically represents the flow of commodities and services in a certain economic period by using the input-output table as an analytical tool. The input-output method has widely been used in many developed countries, such as the United States of America, Japan, Australia and so on (William, 1965, pp. 1-20). This method is suitable for infrastructure planning and policy analysis.

This research will use the advantages of a *17×17* input-output table for Thailand for the year 2002, updated from the base-year table 1990, so as to measure the impact of maritime policy affecting the Thai economy, for example privatising the shipping and port sectors, investing in national port and shipping projects and promoting international trade by reducing and/or exempting the income tax. The details are described in the following chapter.

1.2 Objectives of the research

A main objective of this dissertation is to develop the mathematical model, input-output model, for measuring the impact of maritime policy on Thai Economy. This planning model aims at the national level, which economic data are available, such as

gross national product (GNP), national income, production account, import-export statistics, transport facilities, value added, etc.

The input-output model will be tested by varying the vector of final demand composed of export, private and government consumption to measure the changes in total output of the *17×17* economic sectors. The impacts of maritime policy will be shown in terms of output multipliers.

1.3 Scope of the study

The study of maritime policy affecting on Thai economy will use the input-output table 1975, 1980, 1985, 1990 and 1995 for updating the target-year table 2002. The standard Thai *180×180* input-output table constructed by the National Economic and Social Development Board, (2001) will be aggregated into the *17×17* table for this study. The framework of the research is depicted in figure 1.1

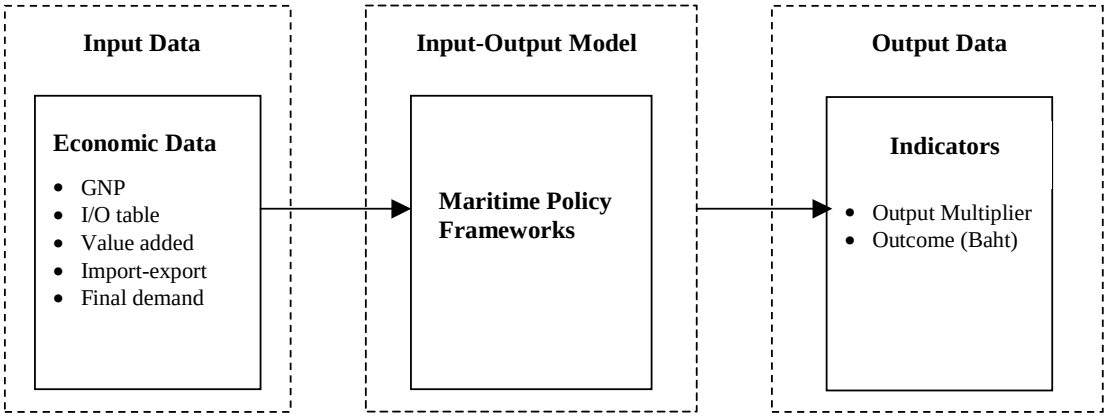

Figure 1.1 Framework of the research

Chapter 2

LITERATURE REVIEW

2.1 Literature review

The development in maritime industries is a key factor to develop the economy of the country. Generally speaking, a good national maritime industry will substantially help to expand the economy of a country. In this chapter, the previous researches and statistics relating to maritime policy are gathered as follows:

A lot of research has been conducted into maritime policy and management interest at the macroeconomic level and also concentrating particularly on the economic development of maritime transport infrastructure improvement. Lee (1996, pp. 311-325) described the major efforts to restructure the Korean economy and analysed the structural reforms that impact on the Korean shipbuilding and port sectors. Input-Output (I/O) analysis have widely been used in policy analysis and for evaluating impacts of transport improvement such as the regional economic effects of expanding a port facility (Stevens *et al*., 1981, pp. 1029-1038)

In regional input-output analysis, the multi-regional input-output models developed by Leontief & Strout (1963, pp. 119-149) have been widely used to describe regional economic activities, especially in their ability to describe interregional trade and inter-industry transactions in regional and industrial detail. Normally, impact studies in input-output analysis are generally used in economic improvement. Linden (2001, pp. 33-54) assessed the potential effects of a set of policy recommendations on the

value added structures of the shipping sector, the economic impact of three policy scenarios were considered: the laissez-faire scenario, the conventional subsidisation scenario and the new policy framework scenario.

Weisbrod & Treyz (1998, pp. 65-79) introduced the concept of bridging local and global perspectives to measure the effects of transport investments at both micro and macro level. Economic models are employed to analyse effects in transportation planning. For example, Daluwatte & Ando (1995, pp. 213-233) proposed a model to estimate effects of transportation plans at national and regional level by using interregional input–output analysis. The Bureau of Economic Analysis (1997) developed the regional input-output model to estimate the regional impacts of airport construction and expansion. The results were showed in terms of earnings and employment.

These models are also applied in analysis in the economic field, especially in freight transportation. Freight flows relate directly to trade coefficients, which are interesting in regional input-output models. For instance, Mizokami (1995, pp. 393-405) combined input-output analysis and price equilibrium to develop an interregional trade model. The Marine Policy Centre (2001) developed the input-output models to estimate the economic impacts of services produced in different economic sectors, which are linked to a marine sector, such as commercial fishing. The European Economic Impact Study for the European shipping sector (2001) used the input-output model as a tool for quantifying both direct and indirect effects of the shipping sectors to the European economies, in terms of value added, employment and backflow to the government.

The consistency of the input-output models mentioned above has successfully been achieved. Therefore, the input-output model can obviously be used for measuring maritime policy impacts.

2.2 The development of the input-output table

2.2.1 The development of the input-output table in Thailand

The Thai *3×3* input-output table was first constructed in 1951. The table was then developed into *11×11* economic sectors in 1954 by using the coefficient of input-output production from India and Nigeria. In 1973, the standard *75×75* input-output table was carried out by using industrial and economic data of the country.

In 1975, the National Economic and Social Development Board of Thailand completely developed the standard *180× 180* input-output table namely; *The Input-Output Table of Thailand, 1975* under the Thailand input-output joint project in cooperation with Japan Institute of Developing Economics. In general, the national input-output table will be constructed every fifth year by the National Economic and Social Development Board of Thailand.

2.2.2 Type of the input-output table

The input-output table basically comprises two types, which are:-

1. Purchaser's price: measured by the real price of products in the economic system, which includes transportation cost and market cost differential.
2. Producer's price: measured by the price at the production unit in the economic system, which does not include transportation cost or market cost differential. The producer's price shows the unit cost of the product.

To construct the input-output table, it is essential to develop three supporting matrices.

- Whole trade margin matrix
- Retail trade margin matrix

- Transport cost matrix

Thus, the producer's price input-output equation can be written as:-

Production (I/O) = *Purchaser's price table – market cost differential - retail cost differential - transport cost* (2.1)

2.2.3 The procedure of constructing input-output table

The input-output structure basically consists of two major components. The columns of the table describe *input structure* of commodities and services in various economic sectors. The rows represent *output structure* to distribute to private consumption expenditure, government consumption expenditure, import-export sectors and stock sectors. The procedure of constructing the input-output table is described as follows:

1. Reviews and preparation

The objective of this process is to review the existing input-output table, 1975, 1980, 1985, 1990, and 1995 and economic data in industrial sectors. This process is also to improve the table regarding to economics condition. Furthermore, the production cost, market cost differential and transportation cost will be surveyed to update the input-output table in the target year.

2. Sector classification

According to the National Economic and Social Development Board of Thailand, the standard input-output table is classified into three types: the 180 economic sectors, the 75 economic sectors and the 16 economic sectors so as to be appropriately used as an analytical tool for different purposes.

3. Data survey

The survey method can be done in three different ways: direct interview, questionnaire and calling interview.

4. Constructing the table

This stage is to fill in the data collected from various sources: production cost, private consumption, government services, financial transactions, value added and import-export value in the input-output table. Based on the basic input-output analysis, the total input must equal the total output, total value added must be equal to total final demand and total intermediate input must equal total intermediate output. If the table does not balance, it is necessary to collect some more data in order to balance such a table.

5. Balancing the table

The iteration technique will be used to balance the input-output table. Normally, the iteration will process many rounds until balancing the table is achieved.

2.3 Shipping and port industries

Thai maritime industries have remarkably expanded over the past several years. Both the port and shipping industries play an important role in economic development. The statistics in table 2.1 show that Thai international trade and transport was mostly carried out by sea transport, contributing more than 90 percent in cargo volume and 70 percent in cargo value of the entire transportation system.

Table 2.1 Thai trade and transport

	Unit	1995	1996	1997	1998	1999
Cargo volume by sea	%					
Export	95.20	93.32	93.77	94.20	95.65	95.83
Import	94.87	95.49	96.35	96.00	98.60	98.60
Both export and import	95.03	94.69	95.40	95.25	97.07	97.31
Cargo value by sea	%					
Export	71.11	69.30	70.00	71.03	71.01	71.05
Import	72.61	68.64	73.51	73.03	67.70	74.99
Both export and import	71.93	68.93	71.99	72.07	69.55	72.87

Source: Customs Department Estimated by Ministry of Transport (Transport Statistics 1995-1999)

In order to grasp the whole picture of Thai maritime trade, one should take into account components of the trade, such as nationality of ship, ship type, type of service, cargo type and port areas. Although the statistics show that Thai maritime trades have been increasing dramatically, approximately 90 per cent of the maritime trade was carried on foreign flag vessels. The details are shown in table 2.2

Table 2.2 Thai maritime trades

	Unit	1995	1996	1997	1998	1999
Number of trips	Trips	21,035	22,113	23,248	22,874	25,192
Amount of cargo	MT	92.4	106.4	108.5	101.0	123.0
Amount of cargo classified by	MT					
Nationality of Ship						
- Thai Ships		9.9	12.3	12.1	11.8	12.8
- Foreign Ships		82.5	94.1	96.4	89.2	110.1
Ship Type						
- Liquid Bulk		30.3	39.3	40.0	39.0	44.9
- Dry Bulk		14.9	17.2	17.6	14.5	20.7
- Container		19.7	19.5	20.6	17.8	20.5
- Semi-container		2.2	2.6	4.6	3.4	1.5
- Ro-Ro		0.3	0.3	0.3	0.3	0.4
-Conventional		23.9	26.3	24.4	24.5	32.9
- Others		1.1	1.2	1.0	1.5	2.0
Type of service						
- Liner (Conference)		5.6	5.2	5.9	5.8	7.7
- Liner (Non- conference)		28.5	33.0	29.8	28.2	33.4
- Tramp		57.3	65.7	69.3	62.5	76.5
- Others		1.0	2.5	3.5	4.5	5.4

Source: Office of the Marine Promotion Commission 2001

Looking at the marine service sectors, the number of Thai seafarers has changed slightly. Unfortunately, it has been predicted by the Office of the Marine Promotion Commission that by the end of this decade, the number of Thai seafarers would enormously decrease by up to 30 per cent, being replaced by foreign crews from countries, such as Myanmar, the Philippines, India, etc. The number of Thai seafarers classified by nationality of ship and ship type is shown in table 2.3

Table 2.3 The number of Thai seafarers

Unit	1995	1996	1997	1998	1999
Number of seafarers working in commercial ships	83,022	84,046	78,333	74,070	82,963
Number of seafarers working in commercial ships classified by					
Nationality of Ship					
- Thai Ships	5,840	5,879	6,159	5,048	5,133
- Foreign Ships	77,182	78,167	72,174	69,022	77,830
Ship Type					
- Liquid Bulk	13,059	14,330	14,478	13,222	15,368
- Dry Bulk	17,184	17,882	16,118	13,552	16,097
- Container	3,835	4,234	5,419	6,436	6,125
- Semi-container	3,052	3,073	3,760	2,377	1,748
- Ro-Ro	1,874	2,252	1,838	2,043	2,467
- Conventional	37,940	37,841	32,238	30,666	35,558
- Others	6,078	4,434	4,482	5,774	5,600

Source: Office of the Marine Promotion Commission 2001

Maritime operators include sea transport operators, port operators, dockyard owners, multi-modal transport operators (MTO) and logistics providers. These operators considerably support national maritime industries. The development in the numbers of maritime operators was somewhat weak and the role of the maritime operators has changed to a greater extent than the numbers, as shown in table 2.4.

Table 2.4 Maritime operators in Thailand

	Unit	1995	1996	1997	1998	1999
No. of registered operators						
Sea transport operators		324	332	343	349	352
Port operators		116	125	131	113	111
Dockyard operators		18	21	24	27	27
The number of Ports Classified by						
- General		67	69	69	61	61
- Chemical		10	11	12	11	14
- Oil		30	34	35	31	29
- *Container*		9	11	15	10	7
- Total		116	125	131	113	111
The number of Yards Classified by						
- Dry dock		1	1	1	1	1
- Floating dock		2	3	4	4	4
- Lever		9	10	13	14	14
- Others		6	7	7	8	8
- Total		18	21	24	27	27

Source: Harbor department, Ministry of Transport and Communication, 1999

Because of both containerisation and logistics evolution facilitating the growth of international trade, port operators perform their function as gateways or hubs of the country. There are two major port authorities in Thailand: Bangkok port and Laem Chabang port. As traffic and environmental problems are being regarded as serious issues in Bangkok, in 1999 the Thai government decided to limit the container traffic through Bangkok Port to 1.2 million TEU. As a result of this, Laem Chabang Port will have to handle the rapidly increasing number of containers.

Table 2.5 Forecasted future of container transport (TEU) in main ports of Thailand

	1996	2001	2006	2011
Bangkok port	1,295,267	1,200,000	1,200,000	1,200,000
Privat port	243,871	400,000	400,000	400,000
Laem Chabang port	710,094	1,537,617	3,214,179	5,401,568
Songkhla port	55,000	78,000	121,000	165,800
Phuket Port	5,000	6,000	7,000	8,000
Total (TEU)	2,309,232	3,221,651	4,942,179	7,175,368
Total (Ton)	23,173,796	32,005,993	49,669,376	73,062,741

Source: Estimated by Merchant Marine Institute, Chulalongkorn University, 1999

2.4 Economic perspective in Thailand

2.4.1 Economic situation in previous year

In 2000, the Thai economy expanded at a rate of 4.3 percent, which was attributed to 5.7 per cent growth in the first half and 3.0 percent in the second half of 2000. The slowdown in the latter half can be described as follows (Ministry of Commerce, 2001).

a. The slowdown in the world economy caused by the slowdown in the US economy, affected Thai exports. The export value growth of Thailand slowed down in every major market, particularly in the US and Japanese markets.

b. Non-performing loans (NPLs) in the Thai economy remained high, which was an obstacle for the business and financial sectors.

c. The unemployment rate remained high at approximately 3.6 per cent, which was equivalent to 1.2 million unemployed people.

d. The stock market was still inactive. The daily volume of trade was 3,740 million Bath and the Stock Exchange of Thailand (SET) Index decreased by 44 per cent.

2.4.2 Economic projection, 2001-2002

a. Economic indicators of production will remain almost unchanged. Economic indicators of expenditure such as sales of motorcycles, VAT, and import value of consumer goods will slightly increase. However, sales of passenger cars will decrease.

b. Economic indicators of private investment will moderately expand, such as sales of cement, galvanized iron sheets, commercial vehicles, and imported capital goods, but sales of steel bars will decrease.

c. Export value will decrease 3.9 percent, which will mainly be caused by a slowdown in exports to US, Korea and Taiwan.

Table 2.6 Thai economic outlook

	1999	2000	2002*
GDP (Current prices: billion Baht)	4,615.4	4,890.7	5,179.3
GDP Growth rate (price,%)	4.2	4.3	3.5-4.0
Investment (price, %)	-4.0	5.7	5.1-5.9
Private (price, %)	-5.0	14.2	6.8-8.2
Public (price, %)	-2.8	-5.0	2.6
Consumption (price, %)	3.5	4.8	4.1
Private (price, %)	4.0	4.5	4.0-4.2
Public (price, %)	0.9	6.5	4.8
Export value (Billions of US$)	56.8	67.9	72.7-74.0
Growth rate (%)	7.4	19.5	7.0-9.0
Import value (Billions of US$)	47.5	62.4	68.0-70.0
Growth rate (%)	17.0	31.4	9.0-12.2
Balance of Trade (Billions of US$)	9.3	5.5	4.6
Current account (Billions of US$)	12.5	9.2	6.6
Current account balance / GDP (%)	10.2	7.5	5.5
Inflation (%)			
Consumer price index	0.3	1.6	2.2
GDP Deflator	-4.5	1.6	2.4

Source: Estimated by Ministry of Commerce 2001

2.4.3 Economic policy

Because of the slowdown in the world economy, exports will become less significant to growth in 2001-2002. To promote the economic growth, the government will need to issue stimulus programs to increase the domestic demand. In addition, promotion of exports is important for the recovery of the Thai economy. The following are examples of economic policies that could be implemented.

Increase consumption and investment

a. Reallocate the government budget of fiscal year 2002 to projects that generate more income streams to people in the economy. Such projects should make

major contributions to the economy and reduce dependence on the foreign sector.

b. Increase the budget deficit of fiscal year 2002. It should be noted that the budget deficit will be financed by government bonds. The deficits in the coming fiscal year should include a raise in salary of public servants and employment of new graduates for at least one year.

c. Increase service and investment efficiency of state enterprises and encourage potential state enterprises to invest without government support or guarantee. Postpone a rise in VAT to 10 percent for two more years (until September 30, 2003) to maintain people's purchasing power.

d. Accelerate restructuring of NPLs and debt negotiation through Thai Asset Management Corporation, which will start to operate in August 2001, in order to bring back valuable assets to the economy.

<u>Promotion of exports</u>

a. Improve efficiency of management in every stage of production. Eliminate problems and obstacles of exporting, for example improve the quality of infrastructure. Search for new export markets by pursuing negotiations between trade partners to relax rules, which are obstacles for exporting agricultural products.

b. Free trade for industries that can compete in the world economy, such as the automobile, electric and electronic appliance industries. In addition, the government should pursue bilateral co-operation to open new markets for exports. Urge people to consume less of imported luxury goods, reduce travelling abroad and reduce energy consumption.

Chapter 3

RESEARCH METHODOLOGY

3.1 Understanding the input-output approach

The input-output table is constructed by collecting the economic data systematically. The economic activities will then be classified into various sectors. The input-output table illustrates the flow of commodities and services between each sector in an economic system during a certain period, generally a year. The input-output structure basically consists of two major components as shown in Table 3.1. Columns represent the input structure of commodities and services in various production sectors. Rows indicate output distribution to distribute to the household sector, government sector, export sector and stock sector (Miller & Blair, 1985, pp. 1-10).

Table 3.1 The structure of the input-output table

Inter-sector flow (Z_{ij})		Production Input								Final Demand (F_j)				Total Output
		A	M	C	M	T	T	S	O	Priv Exp.	Gov Exp.	Export Import	Stock	(X_j)
Production Output	Agriculture Mining Construction Manufacturing Trade Transportation Services Other													
Value Added (V_i)	Employees Capital Government									GNP				
Total Input (X_i)														

Source: U.S. Department of Commerce, Bureau of Economic Analysis, 1979

Where,

Z_{ij} = Sales of sector *i* to sector *j*

X_j = Total (Gross) output of sector *j*

X_i = Total (Gross) input of sector *i*

F_j = Final demand

V_i = Value added

The rows of a table describe the distribution of a producer output throughout the economy. Assume that there are *n* sectors, the output equation can therefore be written as:-

$$\sum_{j=1}^{n} Z_{ij} + F_j = X_j \qquad (3.1)$$

Similarly, the columns describe the composition of inputs required by a particular sector to produce its output,

$$\sum_{i=1}^{n} Z_{ij} + V_i = X_i \qquad (3.2)$$

The ratio of input to output, denoted a_{ij}, can be found as follows:

$$a_{ij} = \frac{Z_{ij}}{X_j} \tag{3.3}$$

Where, a_{ij} is an input-output coefficient (or intermediate transaction coefficient)

Equation (3.3) can therefore be written in terms of the input-output coefficient as follows:

$$\begin{aligned}
&a_{11}X_1 + a_{12}X_2 + a_{13}X_3 + ... + a_{1n}X_n + F_1 = X_1 \\
&a_{21}X_1 + a_{22}X_2 + a_{23}X_3 + ... + a_{2n}X_n + F_2 = X_2 \\
&a_{31}X_1 + a_{32}X_2 + a_{33}X_3 + ... + a_{3n}X_n + F_3 = X_3 \\
&..... \\
&a_{n1}X_1 + a_{n2}X_2 + a_{n3}X_3 + ... + a_{nn}X_n + F_n = X_n
\end{aligned}$$

By rearranging and collecting terms, the above set of equations can be written as:-

$$\begin{aligned}
&(1-a_{11})X_1 - a_{12}X_2 - a_{13}X_3 - ..... - a_{1n}X_n = F_1 \\
&-a_{21}X_1 + (1-a_{22})X_2 - a_{23}X_3 - ..... - a_{2n}X_n = F_2 \\
&-a_{31}X_1 - a_{32}X_2 + (1-a_{33})X_3 - ..... - a_{3n}X_n = F_3 \\
&..... \\
&-a_{n1}X_1 - a_{n2}X_2 - a_{n3}X_3 - ..... + (1-a_{nn})X_n = F_n
\end{aligned}$$

The above set of equations can further be considered in matrix form, shown as follows:

$$\begin{vmatrix}
(1-a_{11}) - a_{12} - a_{13} - ..... - a_{1n} \\
-a_{21} + (1-a_{22}) - a_{23} - .... - a_{2n} \\
-a_{31} - a_{32} + (1-a_{33}) - .... - a_{3n} \\
..... \\
-a_{n1} - a_{n2} - a_{n3} - ..... - a_{nn}
\end{vmatrix} \times \begin{vmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \\ X_n \end{vmatrix} = \begin{vmatrix} F_1 \\ F_2 \\ F_3 \\ F_4 \\ F_n \end{vmatrix}$$

$$F = [I - A]X$$

Therefore, $$X = [I - A]^{-1} F \qquad (3.4)$$

Where, $[I - A]^{-1}$ is a Leontief inverse matrix (Leontief, 1949, p. 13).

> *'Leontief inverse matrix describes the flow of goods and services between all the individual sectors of a national economy over a stated period of time, say a year'*

Nevertheless, the fact that the input-output model normally involves a large number of economic sectors, certain simplifying assumptions are made as follows: (Chiang, 1974, pp. 186-187)

1. Each economic sector produces only one homogeneous commodity.
2. Each economic sector uses a fixed input ratio for the production of its output.
3. Economies of scale are ignored. As a result, production in every economic sector is subject to constant return to scale.

To construct the input-output table, data collection is basically done by two major techniques.

1. Survey-based method; this method requires both considerable surveying cost and collecting time but, of course, accurate data will be achieved.
2. Non-survey method; this is to collect the economic data from various sources, such as the input-output table from a previous year and then forecast the table in the target year by calibrating with up-to-date data. This method has widely been used for policy analysis and planning.

3.2 Updating input-output table by RAS method

The RAS method, a bi-proportional technique, developed by Professor Stone and his colleagues at Cambridge university in 1952 (Stone *et al*, 1963, pp. 56-63) is widely used to update an existing input-output table (base year) to relate to a year for which the total intermediate input-output are known (target year) but not the intermediate deliveries themselves. The simple RAS method consists of finding a set of multipliers to adjust the rows and columns of the base- year matrix.

The RAS method principally uses a bi-proportional iteration technique to adjust the base matrix from total intermediate output in each row and total intermediate input in each column. It then calculates the modified matrix, which is subject to total intermediate output and input of estimated matrix. The procedure is shown in figure 3.1.

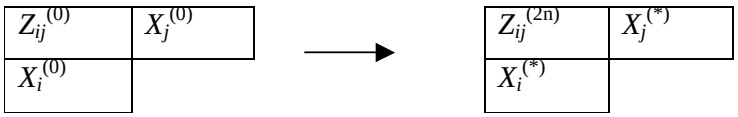

Figure 3.1 Base matrix and estimated matrix

Where,

$Z_{ij}^{(0)}$ = The matrix of base year

$X_i^{(0)}$ = Total intermediate input of sector *i*

$X_j^{(0)}$ = Total intermediate output of sector *j*

$Z_{ij}^{(2n)}$ = The matrix of updating year

$X_i^{(*)}$ = Estimated total intermediate input of sector *i*

$X_j^{(*)}$ = Estimated total intermediate output of sector *j*

By using bi-proportional iteration, $Z_{ij}^{(2n)}$ will be updated as follows:

$$Z_{ij}^{(1)} = \left[\frac{X_j^{(*)}}{X_j^{(0)}}\right] Z_{ij}^{(0)} \quad (3.5)$$

$$Z_{ij}^{(2)} = \left[\frac{X_i^{(*)}}{X_i^{(1)}}\right] Z_{ij}^{(1)} \quad (3.6)$$

From equation (3.5) and equation (3.6) the *n* iteration will be calculated, thus

$$Z_{ij}^{(2n-1)} = \left[\frac{X_j^{(*)}}{X_j^{(2n-2)}}\right] Z_{ij}^{(2n-2)} \quad (3.7)$$

$$Z_{ij}^{(2n)} = \left[\frac{X_i^{(*)}}{X_i^{(2n-1)}}\right] Z_{ij}^{(2n-1)} \quad (3.8)$$

The iteration will terminate at the point where the absolute value of the discrepancy between X^* and X^n is equal to an acceptable error (ε)

$$X_j^{(*)} - X_j^{(2n-2)} < (\varepsilon) \quad (3.9)$$

$$X_i^{(*)} - X_i^{(2n-2)} < (\varepsilon) \quad (3.9)$$

Similarly, the RAS method adjusts coefficient matrix (A) in the rows by matrix R_j and in the columns by matrix S_i

$$A_{ij}^{(*)} = R_j \times A_{ij}^{(0)} \times S_i \quad (3.10)$$

where,

$A_{ij}^{(*)}$ = the coefficient of inter-sector matrix of the updating year
$A_{ij}^{(0)}$ = the coefficient of inter-sector matrix of the base year
R_j = Substitution matrix
S_i = Fabrication matrix

It is noted that (Amachee, 1988, p. 182)

'*The substitution effect is measured by the extent to which commodity (j) has been replaced by other commodities as an intermediate input and the fabrication effect is measured by the extent to which commodity (j) has absorbed a smaller or greater ratio of intermediate to primary inputs.'*

3.3 Research procedure

In order to assess the impact of maritime policy on the Thai economy, the input-output table in year 2002 will be updated by using the RAS method. The research procedure is shown in four main stages in figure 3.2

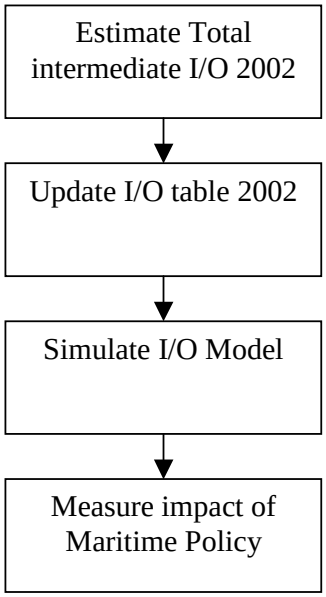

Figure 3.2 Research procedure

Stage 1 Estimate total intermediate input and output in year 2002 by using total output, value added, import-export and final demand data of the previous year to forecast total intermediate input and output in year 2002, based on regression technique.

Stage 2 Update input-output table for year 2002 by bi-proportional iteration, the RAS method. The input-output table constructed for year 2002 will be used for maritime policy analysis and the input-output table year 1990 will be used as a base-year matrix.

Stage 3 Simulate the input-output model, in other words, '*a Leontief inverse matri*x,' to analyze the impact of maritime policy in terms of output multiplier.

Stage 4 Assessment of maritime policy impacting on Thai economy. A sensitivity analysis will be carried out by varying the vector of final demand (V_j) that involves private and government consumption, export, and so on to observe the change in total output (X_j) of the various economic sectors.

3.4 Data collection

The input-output table for 1990 will be used as a base-year matrix, which is surveyed and modified by the Department of the national input-output, the National Economic and Social Development Board. The Thai standard *180×180* input-output table (National Economic and Social Development Board, 2001) normally used as a tool for national policy analysis and planning will be aggregated into a *16× 16* standard input-output table. Since this study emphasises on maritime policy, it is, therefore, better to split sector 14, transportation and communication, into sector 14, transportation and sector 15, communication. As a result of doing that, the *17× 17* input-output table will be achieved, which is classified as follows:

Sector 1 Agricultural
Sector 2 Mining and quarrying

Sector 3	Food, beverage and tobacco
Sector 4	Textiles and textile products
Sector 5	Manufacture of wood and wood products
Sector 6	Paper and paper products printing
Sector 7	Rubber, chemical and petroleum products
Sector 8	Non-metallic mineral products
Sector 9	Metal and metal products, machinery
Sector 10	Other manufacturing industries
Sector 11	Public utilities
Sector 12	Construction
Sector 13	Trade
Sector 14	Transportation
Sector 15	Communication
Sector 16	Services
Sector 17	Unclassified

From all the economic sectors above, the total input in each economic sector in 1980, 1985, 1990, 1995 and 2002 can be shown as the following table:

Table 3.2 Total input in 1980,1985,1990, 1995 and 2002

Sector	Total input (Million Baht)				
	1980	1985	1990	1995	2002*
1	188,314	208,571	333,033	537,000	636,657
2	18,282	38,802	47,870	83,740	105,412
3	183,807	282,252	463,951	768,764	940,210
4	88,493	155,973	356,168	619,168	768,564
5	23,025	23,533	75,237	122,600	151,469
6	23,213	19,553	39,665	102,784	113,681
7	95,529	121,701	211,057	497,079	566,231
8	16,607	34,063	98,972	170,194	213,202
9	117,290	144,473	557,555	1,281,277	1,480,455
10	57,751	38,616	204,110	877,343	908,381
11	18,656	55,090	98,694	206,829	249,627
12	94,692	139,992	439,473	832,547	1,003,166
13	167,968	197,709	478,107	976,930	1,138,286
14	80,438	165,213	279,400	444,062	569,249
15	4,339	10,562	31,201	82,595	93,879
16	203,007	352,652	786,622	1,543,404	1,844,340
17	3,364	8,942	33,819	53,871	68,014
Total	1,384,775	1,997,695	4,534,932	9,200,185	10,850,825

Source: National Economic and Social Development Board, Thai national income, 2000

* Estimated from Regression Analysis (See Appendix C)

In general, the economic structure can mainly be aggregated into three structures as shown in figure 3.3

1. Agricultural structure represented by sector 1 (Agricultural)
2. Industrial structure grouped by sector 2 (Mining) to sector 10 (Other products)
3. Service structure grouped from sector 11 (Utilities) to sector 17 (Others)

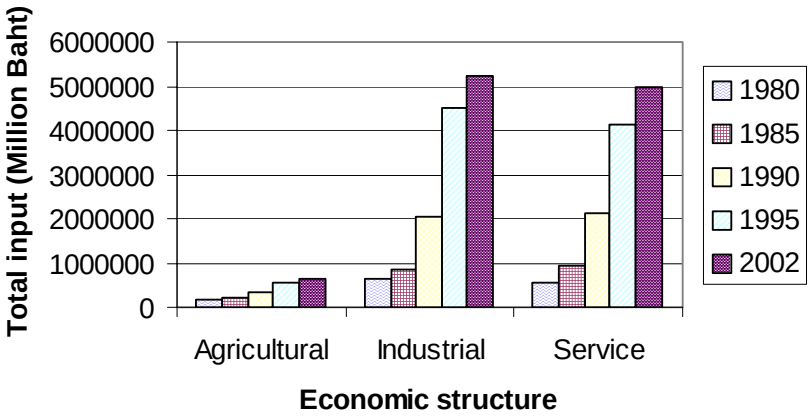

Figure 3.3 Total input classified by economic structure

Figure 3.3 shows that there are small increases in the total input of the agricultural structure in comparison with the industrial and service structures. The trend of the Thai economy has been changing enormously from an agricultural structure to a service structure. According to the Thai Eight National Economic and Development Plan, the maritime industry, which is considered as one of industrial and service structure, is being promoted to be an important key in economic development of the country.

3.5 Estimation of total intermediate input and output, year 2002

In order to develop the input-output table for 2002 by the RAS Method, there are two main compositions: the base year matrix (Z_{ij}), which is based on the existing input-output table for 1990 and target-year table 2002, which total intermediate input and output are known. Therefore, the requirements are both to find out the total intermediate input and output and calculate their intermediate deliveries 2002. The estimation procedure is shown below:

a. Use value added data of each sector from national accounts (National Economic and Social Development Board, 2001), 1990-1995 and 2000 to

draw a trend line. As a result, a simple linear regression model in each sector will be achieved. The result shows that the relationship between value added and year development is quite obvious, with regards to a coefficient of determination (R^2) of each model not less than 0.8. The linear regression models are shown in tables C-1and C-2.

b. Use final demand and net-export data ($F+e$) for 1975,1980,1985,1990 and 1995 to draw a trend line. By following the same procedure as above, the final demand and net export data ($F+e$) for year 2002 can be calculated as shown in tables C-3 and C-4.

c. Use the same procedure to determine the value of total input (X_i) for year 2002. The result is shown in tables C-5 and C-6.

d. Based on the basic input-output method, the total input must equal the total output ($X_i = X_j$); it therefore gives:

$$\sum_{i=1}^{n} X_i = \sum_{i=1}^{m} X_j \qquad (3.11)$$

e. Based on the input-output method, total value added (V_i) must equal the sum of final demand and net export $(F_j+e_j)^n$. In practice, the calculation rarely comes true. Thus, the proportional technique is used to balance both values that can be written as in equation (3.12)

$$\left(F_j + e_j\right)^* = \left(F_j + e_j\right) - \left\{ \frac{\left(F_j + e_j\right)}{\sum_{j=1}^{m}\left(F_j + e_j\right)} \times \left(\sum_{j=1}^{m}\left(F_j + e_j\right) - \sum_{i=1}^{n} V_i \right) \right\} \qquad (3.12)$$

where,

$(F_j+e_j)^*$ = Adjusted final demand and net export of sector *i, 2002*

(F_j+e_j) = Final demand and net export of sector *i, 2002*

V_i = Value added of sector *j*, 2002

It is noted that in this study the value added is used as a base figure to balance value added and the sum of final demand and net export because it is considered as more consistent according to the coefficient of determination (R^2) of the regression model. The result is shown in table C-7.

f. The total intermediate input and output can finally be obtained as in equations (3.13) and (3.14). The result is shown in table 3.3

$$\textit{Total intermediate input} = (X_i) - (V_i) \quad (3.13)$$

$$\textit{Total intermediate output} = (X_j) - (F_j+e_j) \quad (3.14)$$

Table 3.3 Total intermediate input and output, 2002 (Thousand Baht)

Sector	Total Intermediate Input	Total Intermediate Output
1	87,120,105	474,536,199
2	45,351,762	108,462,948
3	687,194,540	418,296,763
4	465,866,416	402,127,025
5	99,139,390	72,960,543
6	69,105,056	74,938,812
7	358,979,573	289,058,434
8	125,266,903	197,683,648
9	1,002,454,380	140,264,019
10	696,124,295	137,351,643
11	110,282,213	208,976,004
12	560,775,909	341,507,252
13	240,290,455	812,146,629
14	250,412,995	351,901,527
15	6,811,893	56,781,811
16	187,419,429	946,068,088
17	68,013,571	27,547,541
Total	5,060,608,885	5,060,608,885

Chapter 4

MEASUREMENT OF EFFECTS OF MARITIME POLICY

4.1 Measurement of effects of policy

To measure the impact of policy and planning depends on determining the objective of such a policy. In general, indicators that can describe the impact of the policy can be listed into seven issues (Lewis, 1991).

1. Employment distribution
2. Individual income distribution at various level
3. Output and income distribution in each region
4. Output and income distribution in each sector
5. Increase in efficiency
6. Increase in output in economy
7. Increase in individual standard of living level

The above indicators can be aggregated into two main objectives; to distribute the economics activities (1 to 4) and to increase economics activities (5 to 7).

The increase in economic activity influences decision making in each policy. Measuring output of an economic system arisen from implementation of a policy can be analysed by using input-output analysis. The indicator of effect in economic output or impact from implementing of a policy will be shown in terms of output multiplier.

In analysing input-output of the economy, the impact on the economic system will be shown in the form of a Leontief inverse matrix. This matrix can describe the direct and indirect relation of each economic sector affecting the whole economic system.

The output multiplier can be calculated from the Leontief inverse matrix that shows the impact of change in final demand of each sector of the economic system. The output multiplier describes the change of total output arisen from the change of final demand by one unit.

4.2 Maritime Policy Review

According to the Eighth National Economic and Social Development Plan (1997-2001), the Office of Maritime Promotion Commission, 2001 has promoted four-major maritime policies as follows:

1. Creation of free and fair international shipping market

The policy of the Thai government provides for free market access for the international shipping market. However, cargo reservation on government and state enterprise imports to be loaded by Thai flagged vessels on specific routes is the only exception to the liberalised policy.

2. Prevention of flagging out

There are no direct measures to prevent flagging out. However, the Government of Thailand provides a number of promotional programmes to attract Thai operators to fly the Thai flag. They are administrative, fiscal and funding programmes.

3. Development and protection of national shipping industry

Even though the Thai fleet is the smallest amongst the Asian countries, the number of Thai flagged vessels has increased significantly during the last decade through the promotional programme. Protection of the shipping industry is done through cargo reservation policy. Nevertheless, such a policy is less effective since the shipping market in Thailand is liberalised and privileges granted by the policy have already ended in December 1998.

4. Review and deregulation of existing regulations in maritime transport related areas.

In order to promote maritime activities, the Thai government has already deregulated some measures, which are;

a. Transport operators who buy ships from other countries are able to have their ships registered without bringing their ships to Thai territories.

b. The Department of Labour has deregulated rules on crew member training courses established by the Department and, at the same time, allowed on board crews exemption from third-country working permit processes. However, the Department of Labour has given authority to immigration to issue working permits by using the seaman's book together with a company authorized-letter as evidence to get third-country working permit.

c. The Department of Communications has given full authority to the Harbor Department to be permanently in charge of full calling signals when ship operators apply for ship registry. However, ship operators must complete informing their calling signal together with ship registry within 45 days.

4.3 Analysis of Leontief inverse matrix and output multiplier

Shown in Table 4.1, the coefficients of the Leotief inverse matrix give the quantity of direct and indirect inputs of commodities and services (*i*) needed to produce one unit of commodity and service (*j*) (Amachee, 1988). The matrix is a result of an infinite chain of inputs as each economic sector requires input from every sector, which requires inputs from all other sectors and so on. This is computed by a computer programme developed for this study as well as the MATLAB software for processing matrix operations as shown in Appendix A.

The configuration of the Leotief inverse matrix shows that all the diagonal elements are greater than or equal to unity. This is because the production of one unit of commodity and service in a particular economic sector not only requires one unit of input from that sector but also additional units from the other sectors supplying it. Afterwards the output multipliers are calculated by summing up the figure of input form each economic sector.

In general, the study of policy impacts uses multiplier analysis derived from the Leotief inverse matrix. The output multiplier is the change of total output derived from the change of final demand of one unit, for example the change of final demand of one unit in the economic sector 1 (Agricultural) will affect the output of all economic sectors 1.2313 times.

4.4 Maritime Policy Impacts

This section gives some examples of measuring the impact of maritime policy on the economy of Thailand. Using the input-output model, the measurement of policy impacts will simply be obtained by changing the vector of final demand (*17×1* matrix), which are private and government consumption expenditure, to the changes both direct and indirect in output of the various economic sectors. Four scenarios of

Table 4.1 The Leontief inverse matrix 2002

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	1.0584	0.0146	0.3924	0.0914	0.2625	0.0390	0.1650	0.0295	0.0220	0.0991	0.0115	0.0267	0.0062	0.0309	0.0014	0.0189	0.1696
2	0.0019	1.0083	0.0056	0.0106	0.0076	0.0156	0.1164	0.0646	0.0211	0.0114	0.0941	0.0285	0.0020	0.0148	0.0008	0.0013	0.0238
3	0.0672	0.0138	1.2738	0.0188	0.0256	0.0363	0.0581	0.0180	0.0169	0.1964	0.0083	0.0106	0.0098	0.0322	0.0020	0.0389	0.2247
4	0.0035	0.0047	0.0125	1.5628	0.0197	0.0199	0.0433	0.0153	0.0241	0.1510	0.0070	0.0084	0.0076	0.0282	0.0008	0.0032	0.1565
5	0.0009	0.0049	0.0022	0.0020	1.1253	0.0092	0.0039	0.0071	0.0144	0.0090	0.0022	0.0460	0.0019	0.0031	0.0005	0.0012	0.0079
6	0.0009	0.0031	0.0095	0.0080	0.0066	1.3169	0.0132	0.0347	0.0141	0.0235	0.0030	0.0077	0.0034	0.0075	0.0016	0.0037	0.0239
7	0.0135	0.0432	0.0325	0.0593	0.0359	0.0485	1.1200	0.0516	0.0701	0.0658	0.0518	0.0267	0.0064	0.1225	0.0023	0.0040	0.1068
8	0.0028	0.0184	0.0095	0.0057	0.0123	0.0335	0.0153	1.1017	0.0340	0.0146	0.0086	0.1742	0.0049	0.0090	0.0018	0.0041	0.0443
9	0.0007	0.0058	0.0034	0.0018	0.0034	0.0052	0.0030	0.0094	1.0844	0.0106	0.0020	0.0151	0.0008	0.0105	0.0003	0.0006	0.0232
10	0.0002	0.0011	0.0008	0.0085	0.0027	0.0020	0.0013	0.0012	0.0041	1.1596	0.0006	0.0011	0.0016	0.0024	0.0002	0.0005	0.0530
11	0.0031	0.0214	0.0172	0.0590	0.0380	0.0416	0.0511	0.0976	0.0650	0.0337	1.3147	0.0255	0.0100	0.0188	0.0046	0.0055	0.0267
12	0.0145	0.1126	0.0402	0.0334	0.0614	0.2040	0.0741	0.1268	0.0846	0.0665	0.0492	1.0808	0.0278	0.0484	0.0113	0.0243	0.1437
13	0.0259	0.0366	0.0928	0.1293	0.1438	0.1373	0.1280	0.0819	0.2322	0.2482	0.0280	0.1561	1.0137	0.0732	0.0033	0.0173	0.2749
14	0.0124	0.0453	0.1660	0.0202	0.0367	0.0343	0.0344	0.0541	0.0590	0.0546	0.0230	0.0144	0.0121	1.0965	0.0043	0.0074	0.1031
15	0.0007	0.0054	0.0057	0.0052	0.0109	0.0087	0.0050	0.0076	0.0175	0.0146	0.0044	0.0063	0.0063	0.0158	1.0200	0.0025	0.0162
16	0.0241	0.2788	0.0970	0.1070	0.1634	0.1380	0.1596	0.2373	0.2694	0.2076	0.1203	0.1653	0.1657	0.1858	0.0397	1.0357	0.2794
17	0.0006	0.0022	0.0051	0.0021	0.0034	0.0030	0.0031	0.0035	0.0051	0.0050	0.0045	0.0038	0.0056	0.0235	0.0006	0.0008	1.0046
Output multipliers	1.2313	1.6202	2.1662	2.1251	1.9592	2.0930	1.9948	1.9419	2.0380	2.3712	1.7332	1.7972	1.2858	1.7231	1.0955	1.1699	2.6823

maritime policy are assumed for this study to show obvious results of implementation of each policy, which are;

- Privatisation of the shipping and port sectors
- Subsidisation of the shipping and port sectors
- Investment in maritime infrastructure
- Promotion of international trade

4.4.1 Privatisation of the shipping and port sectors (non-subsidisation policy)

In order to assess the direct and indirect impacts of privatisation of the shipping and port sectors, the policy should first be quantified in terms of private and government consumption expenditure, in other words, the total final demand. The privatisation of the shipping and port sectors mainly involves economic sector 14 (Transportation) in the *17×17* input-output table. However, the composition of the transportation sector includes rail transport, land transport, air transport, and water transport. To focus on the effect of maritime policy, a maritime sector must be separated from other transport sectors. Based on statistics of the Ministry of Finance 1999, a national expenditure of the maritime sector is allocated 18 percent of all transportation sectors.

According to Table 4.1, the change of final demand by one unit in the economic sector 14 (transportation) will affect all economic sectors 1.7231 times. Suppose that the privatisation of the shipping and port sectors will cut private and government expenditure by 20 per cent. To obtain a variation of the policy, the private and government expenditure will be varied from 0 to minus 40 percent. Using the input-output analysis, the results of direct and indirect output multipliers can be calculated as shown in table 4.2

Table 4.2 The impacts of privatisation of the shipping and port sectors

Percent Changed		Expenditure (Million Baht)	Impacts (Million Baht) Direct	Indirect	Total
Gov. expenditure		217347	238321	136190	374511
Maritime Sec.	0	39123	42898	24514	67412
	-10	35211	38609	22063	60672
Gov. Policy	-20	31298	34318	19611	53929
	-30	27386	30029	17160	47189
	-40	23474	25739	14709	40448

4.4.2 Subsidisation of the shipping and port sectors (subsidisation policy)

In contrast, the subsidisation of the shipping and port sectors is referred to as a traditional subsidisation policy. The government decides to support and protect the shipping and port sectors by subsidies. Nowadays, this policy is considered as an inefficient policy because the huge amount of expenditure spent by the government is not likely to create an innovative and competitive sector. The subsidisation policy seems to serve neither the aim of the government nor the sector in the long run. Implementing a subsidisation policy assumes that in the fiscal year 2002, the government will have to add 20 per cent to private and government expenditure. The policy impacts are shown in table 4.3

Table 4.3 The impacts of subsidisation of the shipping and port sectors

Percent Changed		Expenditure (Million Baht)	Impacts (Million Baht) Direct	Indirect	Total
Gov. expenditure		217347	238321	136190	374511
Maritime Sec.	0	39123	42898	24514	67412
	+10	43035	47188	26966	74154
Gov. Policy	+20	46948	51478	29418	80896
	+30	50860	55768	31869	87637
	+40	54772	60057	34320	94377

4.4.3 Investment in maritime infrastructure

Because of traffic and environmental problems in Bangkok, the Thai government has decided to limit the container traffic through Bangkok Port to 1.2 million TEUs. As a result, Laem Chabang port, located in the eastern region of Thailand, will have to handle the year by year rapidly increasing number of containers, which exceed the existing capacity of phase 1 (Port Authority of Thailand (PAT), 1998). Therefore, PAT will have to construct stage 1 of phase 2, so that the terminal will have sufficient capacity for container handling in the coming year. PAT has signed a contract hiring the Italian-Thai Co., Ltd. to undertake the construction of Laem Chabang port, phase 2, stage 1, the total cost of which amounts to 4,400 million Baht plus VAT (five years estimated construction period).

In addition, the new government has revitalised the ship breaking industry at Bangsaphan, 200 kilometres south of Bangkok, with facilities for demolition of larger vessels. The estimated cost will be 1,274 million Baht (two and half years estimated construction period).

The investment in shipping and port infrastructure will mainly contribute to economic sector 12 (Construction) in the *17×17* input-output table. Regarding the fiscal year 2002, an amount of expenditure for both projects will be portioned for the year 2002. As a result, the government of Thailand will have to add 1,390 million Baht for implementing those projects. The policy impacts are shown in table 4.4

Table 4.4 The impacts of investment in maritime infrastructure

Percent Changed	Expenditure (Million Baht)	Impacts (Million Baht) Direct	Indirect	Total
Gov. expenditure	661659	715121	474013	1189134
Gov. Policy	1390	1502	996	2498
+10	1529	1653	1095	2748
+20	1668	1803	1195	2998
+30	1807	1953	1295	3248
+40	1946	2103	1394	3497

4.4.4 Promotion of international trade

According to the Ministry of Finance, 1999 concerning the methods on solving the economic problems, a number of economic facilitation programmes will be made, such as reduction and/or exemption of the income tax related to international trade, reduction and/or exemption of custom tariffs for imported goods, reduction of import duty for parts and spare parts for all types of automobiles, reduction of the cost of export production and compensation of tax and duty paid on domestic goods for export.

To measure the direct and indirect impact of promotion of international trade, this policy framework will be defined as economic sector 13 (Trade) in the *17×17* input-output table.

It is noted that the economic facilitation programmes mentioned above intend to reduce an element of import and export cost. On the other hand, the government will have to add a national expenditure in the trade sector. Based on statistics of the Ministry of Finance 1999, the national expenditure of international maritime trade represents 27 per cent of the trade sector.

Consequently, by varying the increase of national expenditure in the international maritime trade from 10 to 40 percent, the result of policy impacts will obviously be obtained as shown in table 4.5

Table 4.5 The impacts of promotion of international trade

Percent Changed		Expenditure (Million Baht)	Impacts (Million Baht) Direct	Indirect	Total
Gov. expenditure		326140	330608	88743	419351
Maritime Trade	0	88058	89264	23961	113225
	+10	96864	98191	26357	124548
Gov. Policy	+20	105670	107118	28753	135871
	+30	114475	116043	31149	147192
	+40	123281	124970	33545	158515

4.5 The selection of maritime policy framework

Using the input-output analysis and simple quantitative method, the measurement of effects of maritime policy can be achieved. However, because of differentiation amongst polices, one policy to another policy, a comparative analysis will be introduced to solve such a problem. Using a simple proportional technique, the apparent output of the national income affected by each policy framework will be seen in Table 4.6

Table 4.6 The effects of maritime policy framework (Million Baht)

Policy Framework	Expenditure (Million Baht)	Income output (Million Baht) Direct	Indirect	Total	Changed (%)
Privatisation	-7825	-8580	-4904	-13484	-72.32
Subsidisation	7825	8580	4904	13484	72.32
Inv. of Infrastructure	1390	1502	996	2498	79.71
Promotion of Trade	17612	17854	4792	22646	28.58

The maritime policy frameworks are compared in terms of output of the national income they generate, both the direct and indirect effect to the national economic sectors. Evidently, the promotion of international trade gives the highest output of the total national income amounting to 22,646 million Baht. However, it should not be considered as the best alternative because the expenditure spent is considerably greater than for the other alternatives.

Hence, the comparison of policy frameworks should basically rely on the output of the total national income in terms of percentage changed. The privatisation and subsidisation policy give the same figure, which is 72.32 per cent because they both represent the transportation sector. The investment in port and shipping infrastructure generates 79.71 per cent and the promotion of trade gives 28.58 per cent output of the total national income generated.

As considered above, the investment in maritime infrastructure policy seems to be the best alternative compared to the others as it gives the highest percentage of the total national income. Nevertheless, because of a dramatic change in the construction industry in the mid-1990s, this is very likely to make the prediction of the construction sector not reliable and consistent.

Disregarding the policy framework of investment in maritime infrastructure, the privatisation and subsidisation of the shipping and port sectors would result in great reduction and increase of the government expenditure respectively. Because of the slowdown in the economy of Thailand, the privatisation policy is being taken into account so as to decrease the national expenditure. However, implementing such a policy will also generate an enormous reduction in output of the national income.

In summary, the maritime policy framework for 2002 should be laid down in a subsidisation of the shipping and port sector policy, which the government still supports with limited and strict criteria for the granting of subsidies so that the

shipping and port sectors are able to compete or survive on the basis of economic efficiency.

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This study focuses on measuring maritime policies affecting the economy of Thailand. The total intermediate input and output 2002 are first predicted by using the proportional technique and regression method. Afterwards a computer programme, based on the RAS method, is used to conveniently update the *17×17* base year input-output table of 1990 to relate to the *17×17* target year input-output table 2002 for which the total intermediate input and output are already known.

The Leotief inverse matrix and the output multiplier are then employed to test maritime policy scenarios. The analysis gives the output in terms of the total national income.

The measurement of policy impacts is tested by changing the vector of final demand (*17×1* matrix), which are private and government consumption expenditure, to the changes, both direct and indirect, in output of the various economic sectors. The scenarios of maritime policy are: privatisation of the shipping and port sectors, subsidisation of the shipping and port sectors, investment in maritime infrastructure and promotion of international trade.

Having deeply analysed the frameworks of maritime policy, the subsidisation of the port and shipping sectors show the greatest sensitivity in increasing the output of the total national income. The change of final demand by one unit in this economic

sector (Transportation) will affect the output of the whole economy 1.7231 times. Regarding the matter of the maritime policy proposed, the change by one unit of the government expenditure will change the output of total national income by 72.32 per cent, amounting to 13,484 million Baht. In conclusion, it is obvious that the selection of subsidisation of the shipping and port sectors is the most appropriate policy framework for the Thai economy.

5.2 Recommendations

Even though the major merit of this research is that it eliminates a subjective decision of the policy maker, there remains room for further development as follows:

First of all, a measurement of broad conceptual policy scenarios should be elaborated and developed further. For instance, the investment in maritime infrastructure, falling under the construction sector, had much better be categorised in detail, such as residential construction, non-residential construction, public construction, etc. However, it is hard to achieve such a goal and some difficulties still unavoidably arise. The further research should be designed very well regarding both method and data collection.

Considering the RAS method, the accuracy in updating data depends upon the primary data. Because of the lack of data and inconsistent information, the input-output table for 1990 is ponderously selected as a base year to fill up the intermediate input-output table for 2002. However, it should be noted that the economic crisis in the mid-1990s has enormously affected the industrial sector of the country. Since then most companies have started minimising their investment cost in terms of logistics concept so as to survive in the economic battle. As a result, this has changed the structure of the intermediate input and output of the country. Therefore, in order to decrease errors stemming from the change in structure of the intermediate input

and output, the base-year matrix should be up-to-date and calibrated with additional survey-based data.

Unlike RAS, time series and other techniques simply evaluating their models by using a number of preceding year data, an evaluation of the input-output model has not successfully been achieved and most researchers have neglected to delve deep into this point. This may be due to the fact that the input-output model fundamentally simulates the flow of commodities and services between each sector in economic transactions in an economic system during a certain period, generally a year. As a result, it is very hard to evaluate the model while the real economic data have not yet happened. Therefore, further research may iron out the problems by performing the input-output model on a small part of the economy and afterwards enlarging it to a national scale.

This study aims at a national level, which merely simulates the flow of commodities and services within the Thai economy. Since maritime industries are mainly involved in regional and global environments, the maritime policy of the country should also be made based on the international concern. Consequently, the further study may combine and develop the input-output model at an international level so as to assess maritime policy impacts between countries.

REFERENCES

Amachee, S. (1988). Investment Appraisal in Developing Countries, Averbury Gower Publishing Company Limited, England Athenaeum Press Limited, Newcastle upon Type.

Bureau of Economic Analysis. (1997). Regional Multipliers from the Regional Input Output Modeling System (RIMS II): Retrieved 15 May, 2001 from the World Wide Web: http://www.bea.doc.gov/bea/regional/rims/brfdesc.htm

Chiang, A. C. (1974). Fundamental Methods of Mathematical Economics (2nd Ed) McGraw Hill Book Company.

Daluwatte, S. & Ando, A. (1985). Transportation and Regional Agglomeration in Japan: Though a Long-Term Simulation Model 1920-85, *Journal of Advanced Transportation*, 29,2,213-233.

European Economic Impact Study for the European shipping sector. (2001). E-EIS – Economic Impact Assessment. Retrieved 22 June, 2001 from the World Wide Web: http://www.maritime.deslab.naval.ntua.gr/mtrans/dgvii/E-EIS.html

Lee, T. W. (1996). Restructuring of the economy and its impacts on the Korean maritime industry. *Maritime Policy and Management, 26*, 311-325.

Leontief, W. (1996). Input-Output Economics. Harvard University Press, New York.

Leontief, W., & Strout, A.(1963). Multi-regional Input-Output Analysis in Structural Independence and Economic Development, Edited by T. Banar. London, St. Martin's Press.

Lewis, D. (1991). Primer on Transportation, Productivity and Economic Development, Washington D.C.: National Cooperative Highway Research Program Report 342 (pp. 256-281). Transportation Board.

Linden, A. J. (2001). The economic impact study of maritime policy issues: application to German case. *Maritime Policy and Management, 28*, 33-54.

Marine Policy Center. (2001). Woods Hole Oceanographic Institute. Retrieved 22 June, 2001 from the World Wide Web: http://www.whoi.edu/science/MPC/dept/overview_main.html

Miller, R., & Blair, P. (1995). Input-Output Analysis: Foundations and Extensions. Prentice-Hall International, Inc.

Ministry of Finance. (2001). Thai economic outlook Retrieved 15 May, 2001 from the World Wide Web: http://www.moc.go.th/

Mizokami, S. (1995). An Inter-regional Trade Model Considering I/O Frame and Price Equilibrium, Proceeding of the 7th World Conference of Transport Research, 2 (pp. 393-405). Tokyo.

National Economic and Social Development Board. (2001) Retrieved 22 June, 2001 from the World Wide Web: http://www.nesdb.go.th/

Stevens, B., Treyz, G., I., and Kindahl, K., J. (1981). Conjoining an Input-Output Model and a Policy Analysis Model: a Case Study of the Regional Economic Effects of Expanding a Port Facility. *Environmental and Planning A*, 13, 1029-1038.

Stone, R. (1963). Input-Output Relationships 1954-1966 Vol.3 of R. Stone *et al.* A Programme for Growth' Chapman and Hall, London.

Weisbrod, G. & Treyz, F. (1998). Productivity and Accessibility: Bridging Project-Specification and Macroeconomic Analyses of Transportation Investments, *Journal of Transportation and Statistics*, 65-79.

William, H. M. (1965). The Element of Input-Output Analysis. New York: Random House.

Appendix A

THE COMPUTER PROGRAMME

A.1 The computer programme for the RAS method

The computer programme developed for this study is based on the Visual Basic programming Language, which is added in the spreadsheet in form of a macro programme performing on the Microsoft Excel platform.

A.2 The computer programme for processing a matrix operation

This study uses the language of technical programming performing in the environment of MATLAB version 5.2 to calculate the 17×17 Leontief inverse matrix and also to process a matrix operation in the input-output model.

INDRARAS PROGRAMME

```
Dim nSector, rowNow, colNow
Dim ErrCheck
Dim sumR(60), sumC(60)
Dim sumRTg(60), sumCTg(60)
Dim DataTag(60, 60), dataBase(60, 60)
Dim RowScaling(60), ColScaling(60)
Dim errArray(60, 60)
Dim ErrChk As Boolean
Dim iloop As Integer

'Step  Click  Run Program

Sub Proportional()
   nYear = Cells(1, 3)    ' nSector is Number of Sector.
   ErrCheck = Cells(1, 5)
   ErrChk = True

'**************************  Step 1 Load DATA  **************************
'Load  Array DATA
For i = 1 To nSector
   ii = i + 2
   For j = 1 To nSector
      jj = j + 1
      DataTag(i, j) = Cells(ii, jj)
   Next
   sumRTg(i) = Cells(i + 2, nSector + 3)
   sumCTg(i) = Cells(nSector + 4, i + 1)
Next
'**************************  Step 2 Sum DATA  **************************
'Clear Array
For i = 1 To nSector
   sumR(i) = 0
   sumC(i) = 0
Next
' sum DATA
For i = 1 To nSector
   For j = 1 To nSector
      sumC(j) = sumC(j) + DataTag(i, j)
      sumR(i) = sumR(i) + DataTag(i, j)
   Next
Next
' Print DATA
For i = 1 To nSector
   Cells(nSector + 2 + 1, i + 1) = sumC(i)
   Cells(i + 2, nSector + 1 + 1) = sumR(i)
Next

'**************************  Step 3 Row scaling  **************************
For i = 1 To nYear
   RowScaling(i) = sumRTg(i) / sumR(i)
   Cells(i + 2, nYear + 3 + 1) = RowScaling(i)
Next
Call Swop(0)
For i = 1 To nSector
   For j = 1 To nSector
      DataTag(i, j) = DataTag(i, j) * RowScaling(i)
   Next
Next
Call PrintMatrix(DataTag)
```

```
'*************************  Step 4 Sum DATA  *************************

'Clear Array
For i = 1 To nSector
   sumR(i) = 0
   sumC(i) = 0
Next
Sum data
For i = 1 To nSector
   For j = 1 To nSector
      sumC(j) = sumC(j) + DataTag(i, j)
         sumR(i) = sumR(i) + DataTag(i, j)
   Next
Next
' Print DATA
For i = 1 To nSector
   Cells(nSector + 2 + 1, i + 1) = sumC(i)
   Cells(i + 2, nSector + 1 + 1) = sumR(i)
Next

'*************************  Step 5 Col scaling  *************************
For i = 1 To nYear
   ColScaling(i) = sumCTg(i) / sumC(i)
   Cells(nSector + 4 + 1, i + 1) = ColScaling(i)
Next

Call Swop(1)

For i = 1 To nSector
   For j = 1 To nSector
      DataTag(i, j) = DataTag(i, j) * ColScaling(j)
   Next
Next
Call PrintMatrix(DataTag)
Call ErrorCheck

End Sub
Sub Swop(LoopNo)
Cells(1, nSector + 6) = "Swop Matrix ( " & LoopNo & " )"
For i = 2 To nSector + 3
   For j = 1 To nSector + 2
   Cells(i, j + nSector + 5) = Cells(i, j)
   ii = i - 2: jj = j - 1
   If (ii >= 1 And ii <= nSector) And (jj >= 1 And jj <= nSector) Then
      dataBase(ii, jj) = Cells(i, j)
   End If
   Next
Next
End Sub
Sub PrintMatrix(dD())
For i = 1 To nSector
   ii = i + 2
   For j = 1 To nSector
   jj = j + 1
   Cells(ii, jj) = dD(i, j)
   Next
Next
End Sub

Sub ErrorCheck()
Cells(1, (nSector + 5) * 2) = "Error Checking"
ErrChk = True
For i = 2 To nSector + 3
   For j = 1 To nSector + 2
   ii = i - 2: jj = j - 1
   If (ii >= 1 And ii <= nSector) And (jj >= 1 And jj <= nSector) Then
      Cells(i, j + (nYear + 4) * 2) = Abs(Cells(i, j) - Cells(i, j + nYear + 5))
      If Abs(ErrCheck) < Abs(Cells(i, j) - Cells(i, j + nSector + 5)) Then ErrChk = False
```

```
        ' Debug.Print , Abs(ErrCheck), Abs(Cells(i, j) - Cells(i, j + nYear + 5)), ErrChk
        Else
          Cells(i, j + (nSector + 4) * 2) = Cells(i, j)
        End If
        Next
      Next
      If ErrChk = True Then MsgBox "Tum krap it ok ?? " & Chr(13) & "Now the all of error variable  is less than " & ErrCheck & Chr(13) & "Iterate No. " & iloop
      End Sub

      'Auto Running Program and Error checking
      '
      Sub AutoProportional()


      nYear = Cells(1, 3)    ' nYear is Number of Sector. cells(1,3) is Cell [C1] in the excel active sheet
      ErrCheck = Cells(1, 5)
      ErrChk = False
      iloop = 0
      '*************************** Step 1 Load DATA  ***************************
      While Not (ErrChk)
      iloop = iloop + 1
      'Load  Array DATA
      For i = 1 To nSector
        ii = i + 2
        For j = 1 To nSector
        jj = j + 1
        DataTag(i, j) = Cells(ii, jj)
        Next
        sumRTg(i) = Cells(i + 2, nSector + 3)
        sumCTg(i) = Cells(nSector + 4, i + 1)
      Next
      '*************************** Step 2 Sum DATA  ***************************
      'Clear Array
      For i = 1 To nSector
        sumR(i) = 0
        sumC(i) = 0
      Next
      ' sum DATA
        For i = 1 To nSector
        For j = 1 To nSector
          sumC(j) = sumC(j) + DataTag(i, j)
          sumR(i) = sumR(i) + DataTag(i, j)
        Next
      Next
      ' Print DATA
      For i = 1 To nSector
        Cells(nSector + 2 + 1, i + 1) = sumC(i)
        Cells(i + 2, nSector + 1 + 1) = sumR(i)
      Next

      '*************************** Step 3 Row scaling  ***************************
      For i = 1 To nSector
        RowScaling(i) = sumRTg(i) / sumR(i)
        Cells(i + 2, nSector + 3 + 1) = RowScaling(i)
      Next
      Call Swop(iloop)
      For i = 1 To nSector
        For j = 1 To nSector
          DataTag(i, j) = DataTag(i, j) * RowScaling(i)
        Next
      Next
      Call PrintMatrix(DataTag)
      '*************************** Step 4 Sum DATA  ***************************
      '   Clear Array
      For i = 1 To nSector
        sumR(i) = 0
        sumC(i) = 0
```

```
Next
' sum DATA
For i = 1 To nSector
   For j = 1 To nSector
      sumC(j) = sumC(j) + DataTag(i, j)
      sumR(i) = sumR(i) + DataTag(i, j)
   Next
Next
' Print DATA
For i = 1 To nSector
   Cells(nSector + 2 + 1, i + 1) = sumC(i)
   Cells(i + 2, nSector + 1 + 1) = sumR(i)
Next

'*************************  Step 5 Col scaling  *************************
For i = 1 To nSector
   ColScaling(i) = sumCTg(i) / sumC(i)
   Cells(nSector + 4 + 1, i + 1) = ColScaling(i)
Next

Call Swop(iloop + 1)

For i = 1 To nSector
   For j = 1 To nSector
      DataTag(i, j) = DataTag(i, j) * ColScaling(j)
   Next
Next
Call PrintMatrix(DataTag)
Call ErrorCheck
Wend
End Sub
```

Appendix B

THE CALCULATION OF THE INPUT-OUTPUT TABLE

The input-output table used for this study is the *17 ×17* input-output table 1990. The result of the *17 ×17* input-output table 2002 updated form 1990 and the coefficient of input-output table 2002 are shown in this section.

Table B-1 The input-output table 1990 (Production's Price)

(Unit: Thousand Baht)

Economic Sectors	1	2	3	4	5	6	7	8	9	10
1 Agricultural	28,202,712	31,318	164,811,147	16,383,628	11,703,789	472,075	16,949,436	724,805	81,217	1,779,955
2 Mining and Quarrying	31,668	0	280,096	2,693	0	348,002	45,923,437	10,363,525	3,609,041	243,342
3 Food, Beverage and Tobacco	25,571,802	0	68,658,291	549,148	5,866	386,793	2,503,099	106,465	11,209	8,493,317
4 Textile and Textile Product	1,191,723	8,954	1,844,475	142,449,483	533,078	323,533	3,602,342	432,657	1,881,666	9,998,066
5 Manufacture of Wood and Wood Product	513,291	4,116	200,067	182,533	15,652,809	18,653	158,211	207,092	3,771,571	1,249,628
6 Paper and Paper Product Printing	13,653	25,063	3,856,861	1,571,225	252,411	14,427,700	1,578,084	2,291,213	1,854,685	2,089,590
7 Rubber, Chemical and Petroleum Products	26,458,811	3,803,664	10,541,307	35,781,121	3,709,238	3,413,411	44,766,161	6,669,111	26,809,135	13,916,450
8 Non-Metallic Mineral Products	290,669	2,195	2,164,436	137	192,434	14,875	712,266	10,334,572	5,936,213	513,033
9 Metal and Metal Product, Machinery	5,293,796	2,816,514	10,831,290	4,160,257	1,980,749	1,124,808	2,504,828	8,592,498	291,891,996	17,264,881
10 Other Manufacturing Industries	146,681	75,212	186,460	5,081,260	293,292	116,946	181,968	77,344	1,367,029	48,685,858
11 Public Utility	813,871	490,386	4,437,125	10,792,865	1,396,279	876,343	4,805,082	4,926,827	7,541,255	1,540,520
12 Construction	421,618	183,659	509,401	220,405	112,688	289,672	300,534	315,104	470,084	187,032
13 Trade	11,154,563	282,443	24,022,264	20,127,965	4,758,790	2,350,736	10,213,507	2,329,900	25,424,510	15,443,136
14 Transportation	2,885,450	1,803,627	88,884,055	3,664,595	1,732,261	892,954	2,774,597	3,343,435	9,436,378	2,525,134
15 Communication	92,997	98,879	894,454	615,477	356,774	148,553	249,195	235,811	1,823,606	837,966
16 Services	5,255,857	4,917,321	10,614,797	8,082,939	3,126,567	1,234,187	5,924,981	5,851,580	16,602,023	6,540,351
17 Unclassified	78,048	20,151	394,572	120,634	70,374	24,266	141,960	72,884	301,227	175,138
190 Total Intermediate Input	108,417,210	14,563,502	313,131,098	249,785,364	45,877,399	26,463,507	143,289,688	56,874,823	398,809,845	131,453,397
201 Wages and Sararies	38,945,055	7,815,140	29,965,738	44,036,509	10,296,517	3,457,070	14,119,739	11,661,325	47,137,901	25,424,129
202 Operating Surplus	175,467,994	18,293,248	65,378,658	45,462,230	16,332,524	7,129,058	24,591,094	21,615,290	79,345,927	38,519,708
203 Depreciation	9,329,654	4,183,164	10,262,134	13,927,925	1,785,103	1,799,085	6,467,161	6,059,045	16,603,102	5,377,785
204 Net Indirect Tax	871,599	3,014,888	45,212,752	2,955,897	944,671	816,443	22,589,081	2,761,549	15,656,783	3,334,570

209 Total Value Added	224,614,302	33,306,440	150,819,282	106,382,561	29,358,815	13,201,656	67,767,075	42,097,209	158,743,713	72,656,192
210 Total Input	333,031,512	47,869,942	463,950,380	356,467,925	75,236,214	39,665,163	211,056,763	98,972,032	557,553,558	204,109,589

Table B-1 The input-output table 1990 (Production's Price) continued

(Unit: Thousand Baht)

Economic Sectors	11	12	13	14	15	16	17	190 Total intermediate output	301 Private Consumption
1 Agricultural	90	1,488,147	1,513	29,654	0	19,383,035	1,638,978	263,681,500	77,182,091
2 Mining and Quarrying	17,122,195	13,275,740	0	0	0	5,620	529,405	91,734,766	26,245
3 Food, Beverage and Tobacco	17	0	582,269	1,236,757	3,619	64,388,126	2,180,465	174,677,246	198,718,766
4 Textile and Textile Product	137,245	492,578	2,887,439	2,420,519	17,485	5,624,435	2,340,813	176,186,495	116,659,888
5 Manufacture of Wood and Wood Product	1,815	26,090,377	1,037,090	315,442	0	765,951	48,057	50,216,708	20,577,824
6 Paper and Paper Product Printing	98,836	234,981	2,004,405	890,976	115,224	12,683,724	433,012	44,421,649	11,093,330
7 Rubber, Chemical and Petroleum Products	7,957,471	10,863,667	6,489,193	62,904,181	290,939	17,712,320	5,475,949	287,562,136	51,016,257
8 Non-Metallic Mineral Products	54,039	82,099,981	310,358	32,088	0	888,141	861,439	104,406,884	2,062,121
9 Metal and Metal Product, Machinery	643,072	70,423,871	2,294,464	33,611,494	112,214	8,546,353	9,208,291	471,301,385	102,804,991
10 Other Manufacturing Industries	23,829	250,743	2,418,158	380,515	27,778	3,680,898	3,288,883	66,282,864	54,034,860
11 Public Utility	21,360,943	1,174,462	5,062,754	1,476,588	281,222	12,661,168	73,045	79,710,746	16,845,014
12 Construction	95,357	666,225	779,579	266,108	37,658	3,767,467	121,447	8,744,050	3,468,267
13 Trade	514,581	26,643,927	2,447,491	5,891,629	30,832	28,046,115	3,640,833	183,323,235	187,729,771
14 Transportation	1,157,817	24,188,268	8,423,400	20,399,165	351,650	7,408,012	1,766,557	181,637,369	107,346,697
15 Communication	142,158	691,552	3,281,294	2,043,807	1,320,247	5,997,789	196,124	19,026,698	10,472,193
16 Services	2,505,555	12,496,284	61,832,953	14,020,232	1,557,732	51,037,418	2,014,724	213,615,517	357,612,061
17 Unclassified	201,448	537,580	3,561,126	3,825,142	27,550	1,263,143	0	10,815,260	119,000
190 Total Intermediate Input	52,016,468	271,618,383	103,413,486	149,744,297	4,174,150	243,859,715	33,818,022	2,347,310,544	1,317,769,346
201 Wages and Sararies	11,713,230	59,515,377	72,792,300	40,874,080	7,393,108	243,815,835	0	668,963,254	0

202 Operating Surplus	25,987,698	90,982,636	274,671,545	65,861,594	16,608,763	181,454,360	0	1,147,702,529	0
203 Depreciation	8,919,675	11,830,646	22,979,778	21,025,473	3,001,672	61,657,886	0	205,209,491	0
204 Net Indirect Tax	55,953	5,525,800	4,249,319	1,893,367	22,770	55,832,859	0	165,738,505	0
209 Total Value Added	46,676,556	167,854,459	374,692,942	129,654,514	27,026,313	542,760,940	0	2,187,613,178	0
210 Total Input	98,693,024	439,472,842	478,106,428	279,398,811	31,200,463	786,620,655	33,818,022	4,535,223,533	1,317,769,346

Table B-1 The input-output table 1990 (Production's Price) continued

(Unit: Thousand Baht)

Economic Sector	302 Government Consumption	303 Fixed cap. formation	304 Increase in stock	305 Exports	306 Special export	309 Total final demand	310 Total demand	409 Imports	600 Total out put
1 Agricultural	672,744	497,542	8,991,802	13,038,185	407,275	100,789,640	364,471,140	-31,439,626	333,031,514
2 Mining and Quarrying	0	0	-3,506,163	4,941,100	0	1,461,184	93,195,950	-45,326,004	47,869,946
3 Food, Beverage and Tobacco	766,374	0	-13,980,530	148,316,560	7,367,932	341,189,105	515,866,351	-51,914,965	463,951,386
4 Textile and Textile Products	226,588	1,551,555	-8,868,550	87,710,674	19,488,511	216,768,670	392,955,165	-36,787,232	356,167,933
5 Manufacture of Wood and Wood Products	105,824	18,468,406	-6,118,162	10,056,464	899,261	43,989,622	94,206,330	-18,970,106	75,236,224
6 Paper and Paper Product Printing	1,697,652	640	-3,405,317	1,424,021	1,266,541	12,076,873	56,498,522	-16,833,347	39,665,175
7 Rubber, Chemical and Petroleum Products	5,460,978	798,545	3,842,543	38,282,540	3,233,957	102,634,827	390,196,963	-179,137,186	211,059,777
8 Non-Metallic Mineral Products	163,633	1,854,167	-3,455,919	4,658,371	21,813	5,304,194	109,711,078	-10,739,030	98,972,048
9 Metal and Metal Products, Machinery	1,961,369	355,444,132	40,302,101	140,939,849	973,415	642,425,866	1,113,727,251	-556,173,675	557,553,576
10 Other Manufacturing Industries	2,284,772	14,337,127	37,250,313	86,483,411	8,495,362	202,885,855	269,168,719	-65,059,140	204,109,579
11 Public Utility	2,807,414	0	0	0	374,912	20,027,351	99,738,097	-1,045,051	98,693,046
12 Construction	1,581,567	425,679,000	0	0	0	430,728,846	439,472,896	0	439,472,896
13 Trade	2,294,945	59,441,694	5,593,381	30,457,361	9,266,054	294,783,219	478,106,454	0	478,106,454
14 Transportation	4,783,628	15,916,204	106,534	14,913,097	47,862,624	190,928,798	372,566,167	-13,167,328	359,398,839
15 Communication	591,451	0	0	0	2,406,325	13,469,984	32,496,682	-1,296,189	31,200,493
16 Services	166,244,152	15,933,000	0	0	60,409,976	600,199,205	813,814,722	-27,164,034	786,650,688

17 Unclassified	25,003,643	0	0	15,843	1,260,363	26,398,866	37,214,126	-3,396,070	33,818,056
190 Total Intermediate Input	216,646,734	909,922,012	56,752,033	581,237,506	163,734,321	3,246,062,142	5,593,372,686	-1,058,448,983	4,534,923,703
201 Wages and Sararies	0	0	0	0	0	201	668,963,455	0	668,963,455
202 Operating Surplus	0	0	0	0	0	202	1,147,702,731	0	1,147,702,731
203 Depreciation	0	0	0	0	0	203	205,209,694	0	205,209,694
204 Net Indirect Tax	0	0	0	0	0	204	165,738,709	0	165,738,709
209 Total Value Added	0	0	0	0	0	209	2,187,613,387	0	2,187,613,387
210 Total Input	216,646,734	909,922,012	56,752,033	581,237,506	163,734,321	3,246,062,162	7,781,285,695	-1,058,448,983	6,722,836,712

Table B-2 The input-output table 2002 updated by using the input-output table 1990 as a base year

(Unit: Thousand Baht)

Economic Sectors	1	2	3	4	5	6	7	8	9
1 Agricultural	21906967	91010	274887213	36263403	32154703	1357428	69554226	2312311	712155
2 Mining and Quarrying	7329	0	139183	1776	0	298125	56145361	9850173	9428243
3 Food, Beverage and Tobacco	31707089	0	182795125	1940223	25725	1775367	16396455	542170	156891
4 Textile and Textile Product	807682	22703	2684198	275101679	1277858	811705	12898140	1204322	14396076
5 Manufacture of Wood and Wood Product	153150	4594	128176	155189	16518563	20602	249383	253776	12703166
6 Paper and Paper Product Printing	6941	47671	4210426	2276255	453890	27153579	4238601	4784259	10644420
7 Rubber, Chemical and Petroleum Products	5982321	3217388	5117649	23052629	2966271	2856949	53471968	6193001	68425593
8 Non-Metallic Mineral Products	109262	3087	1746995	147	255846	20699	1414456	15954989	25189298
9 Metal and Metal Product, Machinery	180820	359909	794393	404917	239295	142223	451995	1205401	112547779
10 Other Manufacturing Industries	35107	67346	95826	3465439	248283	103614	230087	76029	3693463
11 Public Utility	533283	1202104	6242815	20151438	3235944	2125645	16633356	13258771	55780469
12 Construction	6065918	9885336	15736704	9035786	5734317	15427601	22842724	18619374	76346513
13 Trade	10626589	1006640	49139626	54639700	16034835	8290098	51403550	9116169	273419993
14 Transportation	1661273	3884867	109882363	6012023	3527504	1903142	8439260	7905953	61329473
15 Communication	83924	333827	1733207	1582686	1138769	496263	1188043	874004	18577323
16 Services	7189554	25164530	31177889	31506114	15127000	6249624	42817596	32874969	256363261
17 Unclassified	62896	60752	682755	277012	200586	72389	604373	241228	2740263

190	Total Intermediate Input	87120105	45351762	687194540	465866416	99139390	69105056	358979573	125266903	1002454380
209	Total Value Added	549537000	60059900	253015000	302698000	52329800	44576400	207251000	87935300	478001000
210	Total Input	636657105	105411662	940209540	768564416	151469190	113681456	566230573	213202203	1480455380

Table B-2 The input-output table 2002 updated by using the input-output table 1990 as a base year
(continued)

(Unit: Thousand Baht)

	Economic Sectors	10	11	12	13	14	15	16	17	190 Total intermediate output	309 Total final demand
1	Agricultural	14700200	294	5585081	2386	88094	0	10055523	4865205	474,536,199	162120906
2	Mining and Quarrying	598746	16680856	14844091	0	0	0	869	468196	108,462,948	-3051285
3	Food, Beverage and Tobacco	111968336	89	0	1465503	5864741	6863	53320270	10331915	418,296,763	521912777
4	Textile and Textile Product	72045043	391578	1612993	3972338	6273980	18126	2545867	6062736	402,127,025	366437390
5	Manufacture of Wood and Wood Product	3964213	2280	37611959	628113	359950	0	152632	54796	72,960,543	78508647
6	Paper and Paper Product Printing	11295343	211537	577219	2068565	1732411	89602	4306791	841302	74,938,812	38742644
7	Rubber, Chemical and Petroleum Products	33454206	7574096	11867743	2978230	54393666	100615	2674646	4731464	289,058,434	277172139
8	Non-Metallic Mineral Products	2050399	85513	149109587	236811	46130	0	222969	1237461	197,683,648	15518555
9	Metal and Metal Product, Machinery	6269961	92469	11622259	159084	4390719	5863	194962	1201971	140,264,019	1340191361
10	Other Manufacturing Industries	123892604	24009	289962	1174823	348306	10169	588390	3008187	137,351,643	771029652
11	Public Utility	10732289	58922193	3718206	6733753	3700249	281846	5540736	182907	208,976,004	40651409
12	Construction	28609888	5775456	46311685	22766993	14642145	828697	36200816	6677300	341,507,252	661658657
13	Trade	156422662	2063723	122639911	4732935	21465752	44927	17844548	13254971	812,146,629	326139826
14	Transportation	15457342	2806233	67285981	9844261	44916855	309670	2848530	3886797	351,901,527	217347468

15	Communication	8040166	540062	3015316	6010755	7053831	1822350	3614918	676368	56,781,811	37097682
16	Services	95122297	14428416	82590782	171690616	73347113	3259208	46627124	10531996	946,068,088	898272341
17	Unclassified	1500601	683410	2093136	5825289	11789054	33958	679839	0	27,547,541	40466030
190	Total Intermediate Input	696124295	110282213	560775909	240290455	250412995	6811893	187419429	68013571		
209	Total Value Added	212257000	139345200	442390000	897996000	318836000	87067600	1656921000	0		
210	Total Input	908381295	249627413	1003165909	1138286455	569248995	93879493	1844340429	68013571		

Table B-3 The coefficient of the input-output model (A) 2002

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	0.0344	0.0009	0.2924	0.0472	0.2123	0.0119	0.1228	0.0108	0.0005	0.0162	0.0000	0.0056	0.0000	0.0002	0.0000	0.0055	0.0715
2	0.0000	0.0000	0.0001	0.0000	0.0000	0.0026	0.0992	0.0462	0.0064	0.0007	0.0668	0.0148	0.0000	0.0000	0.0000	0.0000	0.0069
3	0.0498	0.0000	0.1944	0.0025	0.0002	0.0156	0.0290	0.0025	0.0001	0.1233	0.0000	0.0000	0.0013	0.0103	0.0001	0.0289	0.1519
4	0.0013	0.0002	0.0029	0.3579	0.0084	0.0071	0.0228	0.0056	0.0097	0.0793	0.0016	0.0016	0.0035	0.0110	0.0002	0.0014	0.0891
5	0.0002	0.0000	0.0001	0.0002	0.1091	0.0002	0.0004	0.0012	0.0086	0.0044	0.0000	0.0375	0.0006	0.0006	0.0000	0.0001	0.0008
6	0.0000	0.0005	0.0045	0.0030	0.0030	0.2389	0.0075	0.0224	0.0072	0.0124	0.0008	0.0006	0.0018	0.0030	0.0010	0.0023	0.0124
7	0.0094	0.0305	0.0054	0.0300	0.0196	0.0251	0.0944	0.0290	0.0462	0.0368	0.0303	0.0118	0.0026	0.0956	0.0011	0.0015	0.0696
8	0.0002	0.0000	0.0019	0.0000	0.0017	0.0002	0.0025	0.0748	0.0170	0.0023	0.0003	0.1486	0.0002	0.0001	0.0000	0.0001	0.0182
9	0.0003	0.0034	0.0008	0.0005	0.0016	0.0013	0.0008	0.0057	0.0760	0.0069	0.0004	0.0116	0.0001	0.0077	0.0001	0.0001	0.0177
10	0.0001	0.0006	0.0001	0.0045	0.0016	0.0009	0.0004	0.0004	0.0025	0.1364	0.0001	0.0003	0.0010	0.0006	0.0001	0.0003	0.0442
11	0.0008	0.0114	0.0066	0.0262	0.0214	0.0187	0.0294	0.0622	0.0377	0.0118	0.2360	0.0037	0.0059	0.0065	0.0030	0.0030	0.0027
12	0.0095	0.0938	0.0167	0.0118	0.0379	0.1357	0.0403	0.0873	0.0516	0.0315	0.0231	0.0462	0.0200	0.0257	0.0088	0.0196	0.0982
13	0.0167	0.0095	0.0523	0.0711	0.1059	0.0729	0.0908	0.0428	0.1847	0.1722	0.0083	0.1223	0.0042	0.0377	0.0005	0.0097	0.1949
14	0.0026	0.0369	0.1169	0.0078	0.0233	0.0167	0.0149	0.0371	0.0414	0.0170	0.0112	0.0000	0.0086	0.0789	0.0033	0.0015	0.0571
15	0.0001	0.0032	0.0018	0.0021	0.0075	0.0044	0.0021	0.0041	0.0125	0.0089	0.0022	0.0030	0.0053	0.0124	0.0194	0.0020	0.0099
16	0.0113	0.2387	0.0332	0.0410	0.0999	0.0550	0.0756	0.1542	0.1732	0.1047	0.0578	0.0823	0.1508	0.1288	0.0347	0.0253	0.1549
17	0.0001	0.0006	0.0007	0.0004	0.0013	0.0006	0.0011	0.0011	0.0019	0.0017	0.0027	0.0021	0.0051	0.0207	0.0004	0.0004	0.0000

Appendix C

THE CALCULATION OF TOTAL INTERMEDIATE INPUT AND OUTPUT

Table C-1 Value added of each sector, 1990,1991,1992,1993,1994,1995, and 2000

Sector	Value added (Million Baht)						
	1990	1991	1992	1993	1994	1995	2000
1	272,935	317,085	351,890	336,430	389,560	461,734	480,128
2	34,835	39,372	42,306	44,703	48,456	50,554	53,447
3	114,416	134,221	135,946	147,469	169,555	193,953	222,361
4	122,053	147,969	163,586	176,171	198,065	225,691	261,945
5	29,799	31,856	33,264	34,788	40,880	42,442	46,811
6	13,169	16,034	17,826	20,724	24,196	31,682	37,432
7	55,416	76,435	82,805	97,648	113,463	138,694	175,119
8	36,776	45,422	46,378	51,996	57,605	64,684	77,152
9	149,750	168,104	200,566	250,117	279,297	340,890	397,558
10	72,624	87,860	98,616	113,581	132,531	146,286	181,455
11	47,746	53,461	65,506	75,739	84,523	99,305	117,701
12	136,235	168,278	190,529	220,769	267,190	306,129	372,071
13	386,273	426,957	477,030	534,065	606,234	687,737	771,388
14	131,602	146,799	167,611	193,721	216,726	239,315	272,091
15	24,964	30,440	37,605	44,035	53,574	66,012	69,928
16	554,952	616,642	669,213	837,495	952,993	1,107,727	1,424,877
17	0	0	0	0	0	0	0

Table C-2 Regression model and estimated value added of each sector.

Sector	Regression Model	R^2	Value added 2002
1	y = 20966x + 276979	0.8362	549,537
2	y = 1809.3x + 36539	0.8395	60,060
3	y = 11071x + 109092	0.9355	253,015
4	y = 13956x + 121270	0.9399	302,698
5	y = 1804.6x + 28870	0.8992	52,330
6	y = 2558.8x + 11312	0.9308	44,576
7	y = 12054x + 50549	0.9605	207,251
8	y = 3992.1x + 36038	0.9565	87,935
9	y = 26436x + 134333	0.9202	478,001
10	y = 11065x + 68412	0.9585	212,257
11	y = 7312.4x + 44284	0.9368	139,345
12	y = 24331x + 126087	0.9435	442,390
13	y = 40615x + 370001	0.9152	897,996
14	y = 14644x + 128464	0.9109	318,836
15	y = 4795.2x + 24730	0.8459	87,068
16	y = 92111x + 459478	0.9691	1,656,921
17	0	0	0

y = value added (Million Baht), x =1 (1990) , x = 13 (2002)

Table C-3 Final demand and net export of each sector, 1975,1980,1985,1990,and 1995

Sector	Final demand and net export (Thousand Baht)				
	1975	1980	1985	1990	1995
1	58,971,442	111,468,208	92,916,351	100,789,639	232,882,251
2	2,690,040	6,683,965	3,112,229	1,461,182	-523,821
3	101,012,660	177,499,257	257,689,835	341,189,102	666,795,329
4	24,283,469	60,332,542	103,580,155	216,768,666	461,299,867
5	5,485,247	14,443,413	14,971,354	43,989,617	102,319,012
6	3,467,535	11,661,680	10,233,845	12,076,867	56,954,976
7	23,065,508	73,201,920	87,731,440	102,634,820	391,665,520
8	2,063,113	4,022,451	5,425,438	5,304,186	22,509,422
9	48,597,761	146,833,992	180,625,088	642,425,857	1,786,187,535
10	28,640,769	65,693,501	92,621,986	202,885,875	1,128,666,998
11	2,408,683	3,750,319	12,011,986	20,027,340	52,835,983
12	38,407,757	92,008,606	122,083,061	430,728,804	817,113,188
13	127,464	35,528,121	153,487,067	294,783,206	319,943,258
14	14,668,816	46,298,289	82,919,342	190,928,784	232,966,763
15	1,038,985	2,043,471	5,182,768	13,469,969	51,504,184
16	89,576,596	178,084,329	289,452,443	600,199,189	1,103,432,885
17	916,694	1,631,717	16,555,363	26,398,849	46,458,971

Table C-4 Regression model and estimated final demand and net export 2002

Sector	Regression Model	R^2	Final demand and net export
1	y = 6742860.98x + 45234107.42	0.6443	240,777,076
2	y = -465488.10x + 8967478.10	0.9684	-4,531,677
3	y = 25905103.66x + 23881096.34	0.8727	775,129,102
4	y = 20609378.40x - 53450222.60	0.8518	544,221,751
5	y = 4464274.68x - 12865292.88	0.7909	116,598,673
6	y = 2147801.38x - 4746834.58	0.6199	57,539,405
7	y = 15332658.48x - 32999401.68	0.6874	411,647,694
8	y = 843487.06x - 1413435.66	0.6459	23,047,689
9	y = 79415428.26x - 312635664.26	0.7557	1,990,411,755
10	y = 46744896.64x - 210492037.24	0.6296	1,145,109,965
11	y = 2342632.42x - 7562094.42	0.8073	60,374,246
12	y = 37922621.20x - 117080550.00	0.8403	982,675,465
13	y = 17977733.46x - 36981244.86	0.9524	484,373,025
14	y = 11624527.78x - 14313406.78	0.9520	322,797,899
15	y = 2247137.92x - 10070641.72	0.7039	55,096,358
16	y = 48996548.76x - 86812947.96	0.8837	1,334,086,966
17	y = 2317033.72x - 7095052.12	0.9311	60,098,926

y = final demand and net export (Thousand Baht), x =1 (1975) , x = 29 (2002)

Table C-5 Total input of each sector, 1975,1980,1985,1990,and 1995

Sector	Total input (Thousand Baht)				
	1975	1980	1985	1990	1995
1	106,663,013	188,313,896	208,571,121	333,032,540	536,999,618
2	6,291,833	18,281,873	38,802,212	47,870,112	83,740,011
3	103,667,679	183,806,980	282,251,652	463,950,920	768,764,135
4	33,769,193	88,492,742	155,972,825	356,168,012	619,168,025
5	8,611,023	23,024,990	23,532,501	75,236,821	122,599,783
6	6,323,786	23,213,082	19,553,107	39,665,113	102,783,514
7	35,248,338	95,528,621	121,700,680	211,057,007	497,078,509
8	5,685,274	16,606,918	34,062,710	98,972,325	170,194,139
9	39,766,091	117,290,382	144,472,840	557,554,582	1,281,277,255
10	22,228,129	57,750,933	38,615,611	204,110,120	877,342,698
11	7,608,381	18,655,841	55,090,111	98,693,534	206,828,592
12	41,788,009	94,692,413	139,991,805	439,473,005	832,546,974
13	78,646,579	167,967,791	197,709,325	478,106,862	976,930,234
14	30,624,393	80,438,245	165,213,005	279,399,634	444,062,394
15	1,919,490	4,339,365	10,561,924	31,200,851	82,594,636
16	104,130,821	203,007,393	352,651,512	786,621,546	1,543,403,555
17	3,338,493	3,363,755	8,941,581	33,818,659	53,870,677

Table C-6 Regression model and estimated total input, 2002

Sector	Regression Model	R^2	Total input, 2002
1	y = 20107837.08x + 53529829.72	0.9003	636,657,105
2	y = 3689691.90x - 1589402.70	0.9508	105,411,662
3	y = 32206737.04x + 6214165.76	0.9239	940,209,540
4	y = 28769458.68x - 65749886.08	0.9027	768,564,416
5	y = 5603787.02x - 11040633.62	0.8678	151,469,190
6	y = 4187429.74x - 7754006.74	0.7608	113,681,456
7	y = 20783774.56x - 36498889.16	0.8165	566,230,573
8	y = 8227662.74x - 25400016.94	0.889	213,202,203
9	y = 58465730.56x - 215050806.16	0.7968	1,480,455,380
10	y = 37131766.50x - 168439933.30	0.652	908,381,295
11	y = 9569562.30x - 27889893.50	0.8797	249,627,413
12	y = 38525970.44x - 114087233.64	0.8491	1,003,165,909
13	y = 42134127.62x - 83603245.62	0.8296	1,138,286,455
14	y = 20516747.82x - 25736691.82	0.9561	569,248,995
15	y = 3764235.56x - 15283337.96	0.7842	93,879,493
16	y = 69243192.42x - 163712151.22	0.8627	1,844,340,429
17	y = 2630385.44x - 8267606.84	0.8594	68,013,571

y = Total input (Thousand Baht), x =1 (1975) , x = 29 (2002)

Table C-7 Balancing Value added (V) and final demand and net export (F+e), 2002

Sector	V	(F+e)	(F+e)/Total	[(F+e)/Total] * [V-(F+e)]	(F+e)- {[(F+e)/Total * [V-(F+e)]}
1	549,537,000	240,777,076	0.0280	78,656,170	162,120,906
2	60,059,900	-4,531,677	-0.0005	-1,480,392	-3,051,285
3	253,015,000	775,129,102	0.0901	253,216,325	521,912,777
4	302,698,000	544,221,751	0.0633	177,784,361	366,437,390
5	52,329,800	116,598,673	0.0136	38,090,026	78,508,647
6	44,576,400	57,539,405	0.0067	18,796,761	38,742,644
7	207,251,000	411,647,694	0.0479	134,475,555	277,172,139
8	87,935,300	23,047,689	0.0027	7,529,134	15,518,555
9	478,001,000	1,990,411,755	0.2315	650,220,394	1,340,191,361
10	212,257,000	1,145,109,965	0.1332	374,080,313	771,029,652
11	139,345,200	60,374,246	0.0070	19,722,837	40,651,409
12	442,390,000	982,675,465	0.1143	321,016,808	661,658,657
13	897,996,000	484,373,025	0.0563	158,233,199	326,139,826
14	318,836,000	322,797,899	0.0375	105,450,431	217,347,468
15	87,067,600	55,096,358	0.0064	17,998,676	37,097,682
16	1,656,921,000	1,334,086,966	0.1551	435,814,625	898,272,341
17	0	60,098,926	0.0070	19,632,896	40,466,030
Total	**5,790,216,200**	8,599,454,319		check	**5,790,216,200**

Unit : (Thousand Baht)

Table C-8 Total intermediate input and output, 2002 (Thousand Baht)

Sector	Control Total Input and Output	Value added (V)	Final demand and export (F+e)	Total Intermediate Input	Total Intermediate Output
1	636,657,105	549,537,000	162,120,906	87,120,105	474,536,199
2	105,411,662	60,059,900	-3,051,285	45,351,762	108,462,948
3	940,209,540	253,015,000	521,912,777	687,194,540	418,296,763
4	768,564,416	302,698,000	366,437,390	465,866,416	402,127,025
5	151,469,190	52,329,800	78,508,647	99,139,390	72,960,543
6	113,681,456	44,576,400	38,742,644	69,105,056	74,938,812
7	566,230,573	207,251,000	277,172,139	358,979,573	289,058,434
8	213,202,203	87,935,300	15,518,555	125,266,903	197,683,648
9	1,480,455,380	478,001,000	1,340,191,361	1,002,454,380	140,264,019
10	908,381,295	212,257,000	771,029,652	696,124,295	137,351,643
11	249,627,413	139,345,200	40,651,409	110,282,213	208,976,004
12	1,003,165,909	442,390,000	661,658,657	560,775,909	341,507,252
13	1,138,286,455	897,996,000	326,139,826	240,290,455	812,146,629
14	569,248,995	318,836,000	217,347,468	250,412,995	351,901,527
15	93,879,493	87,067,600	37,097,682	6,811,893	56,781,811
16	1,844,340,429	1,656,921,000	898,272,341	187,419,429	946,068,088
17	68,013,571	0	40,466,030	68,013,571	27,547,541
Total				**5,060,608,885**	**5,060,608,885**