ABSTRACT

Title of Dissertation: **A THAI INTERINDUSTRY DYNAMIC MODEL WITH OPTIMIZATION**

Somprawin Manprasert, Doctor of Philosophy, 2004

Dissertation Directed By: **Professor Clopper Almon**
Department of Economics

This study develops a long run forecasting model for Thailand, building a dynamic interindustry model that incorporates detailed sectoral inter-relationships in a consistent manner and that describe how the economy will evolve over a long time period. Policy options can be simulated with the model. An optimization technique allowing policymakers to set an optimal path for tax rates to affect inflation and unemployment is demonstrated.

The Thai Dynamic Interindustry model (TIDY) is constructed from the 'bottom up' and relies on a series of 26-sector input-output tables of Thailand describing all productive activity. Because the model uses a comprehensive and internally consistent representation of all sector interactions, the model provides a tool for studying policy effects at the sectoral level.

A special feature of TIDY is its use of loss functions to improve estimates of two critical macro variables: saving rate and prices. The loss function minimizing estimation errors on two variables, unemployment and inflation, yields estimates of the saving rate that are consistent with underlying economic theory and are an improvement over standard least squares estimates.

Forecasts of the Thai economy are presented for the period through 2020. The results demonstrate that the long run prospects for the economy, as reflected in growth in real consumption, price stability, and full employment, are quite good if stable policies for fiscal policy are followed and exchange rates remain stable. The economy is, however, not immune to major financial shocks such as occurred in the late 1990's.

The model also demonstrates the effects of alternative fiscal policies, by simulating outcomes when the time path of personal direct taxes are set to minimize the deviations of two critical macro variables – inflation and unemployment rates – from desired levels of 3.0 percent. A quadratic objective function, capturing substitution effects between inflation and unemployment, is specified. A time path for the inflation-averse policymaker of increasing tax rates yields slower real growth but relative price stability and a stable trade balance. The alternative of a continuous tax cut for the unemployment-adverse policymaker increases real consumption and inflation, and leads to a widening trade imbalance. These forecasts demonstrate the key role of international trade and capital markets to Thailand's long run future.

A THAI INTERINDUSTRY DYNAMIC MODEL WITH OPTIMIZATION

by

Somprawin Manprasert

Dissertation submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
2004

Advisory Committee:
Professor Clopper Almon, Chair
Professor Mahlon Straszheim
Professor Harry Kelejian
Professor George Quester
Dr. Douglas Nyhus

DEDICATION

To my parents, Supranee and Somswasdi Manprasert.

ACKNOWLEDGEMENTS

I would like to express my sincere thank to Professor Clopper Almon for his guidance, support, and enthusiasm to show me the craft of economic modeling. I am deeply grateful to his attention and assistance in and outside the classroom through my thesis-writing period. I am also indebted Professor Mahlon Straszheim for his helping and providing me with hands-on experience in economic model. I have learned tremendously from being his research assistant.

I wish to extend my appreciation to my other committee members including Professor Harry Kelejian, Dr. Douglas Nyhus, and Professor George Quester for their constructive comments and suggestions. My discussions with the *INFORUM* staff members, including Jeff Werling, Margaret McCarthy, Ron Horst, and San Sampattavanija, are of greatly benefits. I also owe a great deal to Khun Arkhom Termpittayapaisith and other staffs at the Macroeconomic Office at the National Economic and Social Development Board for collaborations on various issues.

On a personal note, I would like to deeply thank my sister, Somsinee Suntornsaratoon, MR. and Ms. Pravitra for their moral supports. To my beloved friends, Pimkae and Jon Wongswan, their encouragement and a first-class hospitality during the final days mean a lot to me. Spiritual supports from every member of Thai UMCP-FED also deserve a special mention. Lastly and most importantly, I would like to especially thank Varinthorn Tephalakul for her understanding, caring and patience during my difficult times. I would not complete this thesis without her love.

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CHAPTER 1: INTRODUCTION

Recent economic events have left Thailand in a very difficult position; the economy has lost both its comparative advantage and competitive edge in international competition. Comments in Thailand have been tinged with a note of despair. This problem is a reason to develop a self-sustaining development program for the country. The objective of the research presented in this study is to build an interindustry model for Thailand to help address central issues in planning for the country's economic development: What is a realistic picture of Thailand's future economy? and How are economic outcomes related to major policy decisions such as public expenditures and tax cuts?

1.1 THAILAND'S RECENT ECONOMIC EXPERIENCE

During the last twenty years, the economic structure of Thailand has changed substantially. From the early 1980's until 1996, Thailand, like other Asian countries, experienced the 'Asian Miracle' of continuous explosive growth. The average real output growth of Thailand from 1987 to 1996 was 9.5 percent per year. At the beginning of this period, the Thai economy was mainly agricultural; by the end, it centered on manufacturing. Unfortunately, a financial crisis occurred in East Asia in 1997, and Thailand's economy suffered greatly from it. Growth of real output in Thailand became negative for the first time in forty years. The unemployment rate jumped from 1.6 percent in 1996 to 4.4 percent in 1998, as the Thai economy went from boom to bust.

After the financial crisis led to the abandonment of the fixed exchange rate regime and a sharp depreciation of the Thai currency in mid-1997, the new lower cost of production attracted a massive influx of foreign direct investment (FDI). The quick change from agricultural to manufacturing activities had created a plentiful, cheap, unskilled labor force. The inflow of FDI increased from $2,271 million in 1996 to $3,627 million in 1997 and on to $5,143 million in 1998.

In response to these circumstances, national policy planners have provided economic incentives to attract FDI. For example, tax exemptions were given and important improvements in infrastructure were made in industrial areas. These measures helped the economy to recover in 1999 and 2000.

However, the investment stream from abroad has dwindled in recent years. The low cost and unlimited supply of unskilled labor in China, coupled with the slowdown of the world economy, has produced a drastic decrease in FDI in Thailand since 1999. Consequently, the economy has significantly slowed since the beginning of 2001. The situation could worsen, as China has recently become a member of the World Trade Organization (WTO).

The problem is labor cost; it is higher in Thailand than for comparable labor in China. In contrast, Thailand is not as 'sophisticated' in manufacturing as Malaysia, Korea, and Singapore. It does not offer a skilled labor force and capable of producing high technological products. Thus, Thailand currently has lost its competitive position - it can neither offer low manufacturing costs nor provide technologically advanced goods. This fact currently puts Thailand into a very difficult position. The question looms: How should the economy be developed further? One of the objectives of this research is to develop a dynamic interindustry model to help understand the structure of Thailand's economy and for use by policymakers in creating a long term development plan.

1.2 WHAT CHARACTERISTICS DOES THE MODEL NEED?

I will argue that the model needs to be disaggregate in sectoral detail and must be dynamic. It should be able to reproduce the historical growth path of the economy and produce forecasts for the future. In addition, it should able to find polices that optimize certain objectives.

To begin the analysis, we need to assess the background structure of the economy. For instance, we examine what happened to the structure of production in the economy during the last quarter century. Then, during the financial crisis episode, what happened to Thai real output in sectoral detail? How have real investment and consumption changed since the financial crisis? Lastly, and most importantly, what are strengths and weaknesses of the current Thai economy? Then, after understanding the structure of the economy and its problems, we may ask about a reasonable pattern of future economic development for the Thai economy.

Setting unrealistic goals does not guarantee positive consequences. Indeed, such goals can waste resources. A realistic strategy should take account of the current capacity and resources available. It should specify development in infrastructures appropriate for anticipated sectoral growth. Inevitably, an interindustry model is required.

The above paragraphs have argued that the study indeed requires an interindustry model; we now argue that this interindustry model also needs to be dynamic. Even though a simple static input-output model could be sufficient for part of the analysis, the study of growth requires dynamic model. Furthermore, when a policy is implemented (or, when an exogenous shock occurs), the consequences are not immediate. It is also unlikely that policy lags for each part of the economy are equal. Therefore, dynamic elements in the interindustry model should be specified explicitly.

Certainly, policymakers also need a model that can do policy design and evaluation. Therefore, capability of the model that could 'search' for the optimal policy variables with a specified objective function is required.

For policymakers whose focus is the stability of the economy, aggregate information may be enough to evaluate the status of the economy. However, for national policy planners who are responsible for laying down the national economic development plan, aggregate information is not enough. Aggregate models tell us little or nothing about the structure of the economy. To be able to analyze the structure of the economy in detail, national policy planners certainly need a dynamic interindustry model. This research project is the first attempt to build a dynamic interindustry model for Thailand. It is also the first interindustry model that has offered explicit optimization.

1.3 Outline of the Dissertation

The structure of this study is as follows. Chapter 2 discusses choices of dynamic interindustry models. It will be shown that the Interindustry Dynamic Macroeconomic Model (Interdyme) developed by the *INFORUM* fits well with the objective of the work. Then, the structure of the Thailand Interindustry Dynamic Model (TIDY), building on the Interdyme model framework, will be presented. A discussion of data sources and a brief review of behavioral equations are included at the end of this chapter.

Chapter 3 provides an overview of the Thai economy during the past two decades. The data reveal that structure of the Thai economy has changed dramatically during the past fifteen years; from its beginnings as a basic agricultural economy, Thailand has now quickly transformed to a newly industrialized country. The chapter also summarizes the causes that may have lead to the financial crisis of 1997-1998.

Chapter 4 examines sectoral private consumption expenditures in Thailand. The Perhaps Adequate Demand Systems (PADS), designed for a long-term forecasting interindustry model, is used to estimate private consumption for 33 sectors during the period 1976-1998. Because private consumption is the largest portion of final demand, the discussion will be thorough. In essence, the biggest consumption shares belong to food, entertainment, and transportation, respectively. These three groups account for as much as 50 percent of total expenditures. The estimation shows that consumption in some certain sectors, such as telecommunications and private cars, is quite responsive to income growth. Expenditures on house furnishing, on the other hand, is particularly sensitive to price changes.

Chapter 5 focuses on sectoral fixed investment. It shows that a decline in capital stock in agriculture has been offset by a growing capital stock in manufacturing. The simple accelerator model is used to estimate 11 sectoral investments during 1975-1998. Main findings suggest that investment in mining is the most sensitive to the output change. Investments in agriculture and dwellings are least sensitive to the change in the economic condition. The analysis also shows that the investment in Thailand has been significantly affected by the financial crisis during 1997-1998.

Components of value-added, namely operating surpluses, wages, net indirect taxes and depreciation, will be examined in chapter 6. Value-added represents total factor payments to primary inputs in the production process and therefore directly influences the determination of the price level. In the present study, each component of the value-added except net indirect taxes will be estimated by regression equations. Tax rates - net indirect taxes per unit of gross output, will be treated as policy instruments and are exogenous to the model.

In chapter 7, sectoral labor productivity in Thailand during the past fifteen years will be explored. Specifically, the manufacturing sectors prove to be the fastest growing in terms of labor productivity; this chapter also includes an estimation of sectoral labor productivity.

Sectoral import equation in TIDY will be briefly discussed in chapter 8. Chapter 9 discusses optimization in an interindustry model and presents its application to the TIDY model. We will see that optimization significantly improves the historical simulation.

Chapter 10 pulls together the parts of the model and presents the main results. The first section presents a base forecast for Thailand's economy to the year 2020. The second section of this chapter explores policy possibilities by using optimization to maximize social welfare.

Chapter 11 concludes the presentation, summarizing the main contribution of this dissertation. A discussions of the model's weaknesses leads to suggestions for further research.

CHAPTER 2: THE STRUCTURE OF TIDY

2.1 THE INTERDYME MODEL FOR THAILAND'S INTERINDUSTRY ANALYSIS

A dynamic interindustry model should exhibit consistency, explicit dynamic elements, and yield sensible results in both historical simulation and long- and short-run predictions. The previous chapter argued that the interindustry dynamic model may be used as a tool for forecasting and policy analysis. In this chapter, it is purported that the Interindustry Dynamic Macroeconomic (Interdyme) model developed by the *INFORUM* is indeed appropriate for the present research. In essence, the complete structure of Thai Interindustry Dynamic Model (TIDY) will be presented.

Several institutions have been developing dynamic interindustry models for forecasting and analyses. Almon (1991) provides brief characteristics of several competing interindustry models. In his list, there are three major types of the dynamic interindustry model: [1] the macroeconomic model with an attached static input-output model (a top-down model), [2] the interindustry dynamic macro model (a bottom-up model), and [3] the computational general equilibrium model (CGE).

The simple macroeconomic model seems to be the economist's oldest tool for conducting forecasts and policy analyses[1]. Sectoral variables can be added into this

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[1] References can be found in Taylor (1993), Almon (1996), and Brayton (1997).

type of model by attaching a static classical input-output model. Such a model lacks sectoral dynamics; the only dynamics are in the macro model "driver." Because the model is constructed from the top-down, it has a serious internal inconsistency. Effects from a shock in the sectoral level will not appear at the aggregate level and will not propagate to other industries. Consequently, policy analysis at the sectoral level cannot be conducted - this problem was pointed out by Almon (1986).

In the second type of interindustry model, much of the dynamics, especially in the investment and productivity area, is modeled and estimated at the sectoral level. Thus, the interindustry dynamic-macro model works the way the economy actually works - from the bottom-up. Estimations are conducted in the sectoral levels; aggregate variables are simply the sum of sectoral estimates. The core of the model is the input-output table; therefore, the consistency between production and price-income variables is assured. Products absorbed by final demands and intermediate requirements must be equal to the total production of the economy. Price of a product is equal to per unit material cost plus per unit value-added. The construction of the model requires a large amount of data and detailed sectoral estimations. Moreover, the model can be tested in simulation over recent history. It is very possible that equations which individually fit well do not work together well to reproduce the behavior of the economy. Thus, these historical simulations are genuine tests of the model. Further discussion about the structure of the model is available in Almon, Buckler, Horwitz, and Reimbold (1974), McCarthy (1991), Klein, Welfe, and Welfe (1999), and Almon (2000).

The third type of interindustry model is the computational general equilibrium model (CGE). This is currently the most popular tool used in policy analysis in the interindustry modeling community. Because it is supported by the neoclassical general equilibrium theory, it appears sophisticated and is conventionally related to the contents of graduate economic courses. The model is often constructed using data from a single year.

This characteristic has both an advantage and disadvantage. It makes the model easy to build and to maintain, but the model does not use as much data as possible (*i.e.* time series data which captures the behavior of economic variables over time). Importantly, by its very nature, a market-clearing condition, an equilibrium, must be assumed in the base year for the parameter calibration. This is a strong assumption. A further assumption in most CGE models is that corresponding to any vector of sectoral prices there is *unique* vector of outputs. In other words, the *curvature* of the production function is very precisely known. Since in practice most firms are willing to produce anywhere within a fairly wide range at existing prices, this assumption implies that the model builder knows their production functions better than they do.

In CGE model, different base years will give different models. Therefore, validity of a model is essentially dependent on finding the appropriate base year. Misjudging the right base year may lead to a seriously misleading result when forecasting and conducting policy analyses. It is very unusual to find the model tested in historical simulation. The application of the model is often to ask what the base year would have looked like had certain factors been different. Evidently, the results of such an application are in no sense a test of the model and are of interest only if one believes in the untested model. Further detail is found in Dervis, deMelo, and Robinson (1982) and Kehoe (1996). A recent review of empirical performance of the CGE model is found in Kehoe (2003).

Monaco (1997) provided an excellent overview of these three models. Instead of giving a conclusive statement about what is "best"[2], Monaco discusses the advantages and disadvantages of each model. He argues that,

> "There is no best model. Models are either more or less appropriate for the intended study, and some models may be just the right tool to use for one part of a study, but exactly wrong tool to use in another. … The best model for any use is that the model whose characteristics are strongest in the areas that are most important to the analysis."

Consequently, the author lists criteria that should be considered for model builders and model users: the model [1] adheres to standard neoclassical general equilibrium theory, [2] incorporates "known" economic data, [3] minimizes maintenance and care costs, [4] is easy to understand and use, [5] has a good track record, and [6] provides policy-relevant output.

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[2] A normative approach employed by most policy oriented economic models.

In essence, Monaco suggests that, from model builder's perspective, the CGE model is ranked high for its general equilibrium setup and is additionally easy to build and maintain. However, from model users' perspectives, the interindustry dynamic-macro model may be more attractive because of the testing that has gone into its development, because of its policy-relevance, and because of its track record.

The Interdyme modeling framework developed by the *INFORUM* is an attractive tool for current research because it follows the interindustry dynamic-macro type, which is both built from the bottom-up and is policy relevant (Almon, 2000). It is well suited to the objective of this thesis: to build policy analysis and forecasting tools for the development plan in Thailand. Also, the model may be utilized for input into the *INFORUM* Bilateral Trade Model which links models of a number of countries by international trade flows at the industry level.

2.2 DATA SOURCES

I have emphasized in the previous section that the interindustry dynamic macro model is distinguished by employing historical time series, many at the sectoral level, in its construction. It is therefore appropriate to begin our discussion of TIDY by describing that database.

The data were compiled from various sources, and various adjustments and modifications were necessary to achieve a consistent statistical basis for construction of the model. The national income accounts of Thailand, published annually by the

National Economic and Social Development Board (NESDB), are available for all years from 1951 to 2001. Although the accounts stretch back to 1951, the classifications in many tables from early releases are not entirely consistent with recent variations. Base years of the constant-price tables also vary every ten to fifteen years. The data bank for the national income accounts has been constructed to give consistent series for the entire period.

The input-output tables of Thailand are also published by the NESDB; some tables are as large as 180x180 sectors. Less-detailed classifications were also available, including tables for 16x16 sectors, 26x26 sectors, and 58x58 sectors. These tables are produced by industrial surveys and, in the period 1975 to 1995, are available every five years; the latest special table was released in 1998, just after the financial crisis. The published input-output tables of Thailand consist of five interrelated tables: [1] a table of flows in purchaser prices, [2] a table for wholesale margins on those flows, [3] a table of retail margins on the flows, [4] a table for transportation costs included in the flows, and [5] a table of imports included in the flows.

The input-output table in producer prices may be calculated by subtracting trade and transportation margins from the purchaser price table. Because the input-output tables are available every five years, the intermediate points of gross output, components of final demands, and value-added have been constructed using the aggregate series published in the national accounts as interpolation guides.

Initially, the sectoral producer prices were gathered from the Ministry of Commerce. The classification of sectoral producer prices has more detail than that in the input-output tables; however, time-series data are available only from 1995. In order to maintain the consistency within the input-output accounting framework, time series of sectoral prices have been calculated from the input-output price identity[3]. These calculated prices were compared to the published producer prices, and consistency found between these two sources. Therefore, the constructed sectoral prices, obtained from the input-output tables, will be used in the TIDY framework.

Labor market data are obtained from the Labor Force Surveys (LFSs), available from 1987 thereafter. The surveys are classified by the International Standard Industrial Classification (ISIC), consisting of 9 main industries and 379 detail industries. Since ISIC classification is very disaggregate, the sectoral wage data classified by the input-output industry was constructed from the LFS's data source. All financial variables, such as interest rates, money supply, and exchange rates are available beginning in 1970 and were obtained from the Bank of Thailand.

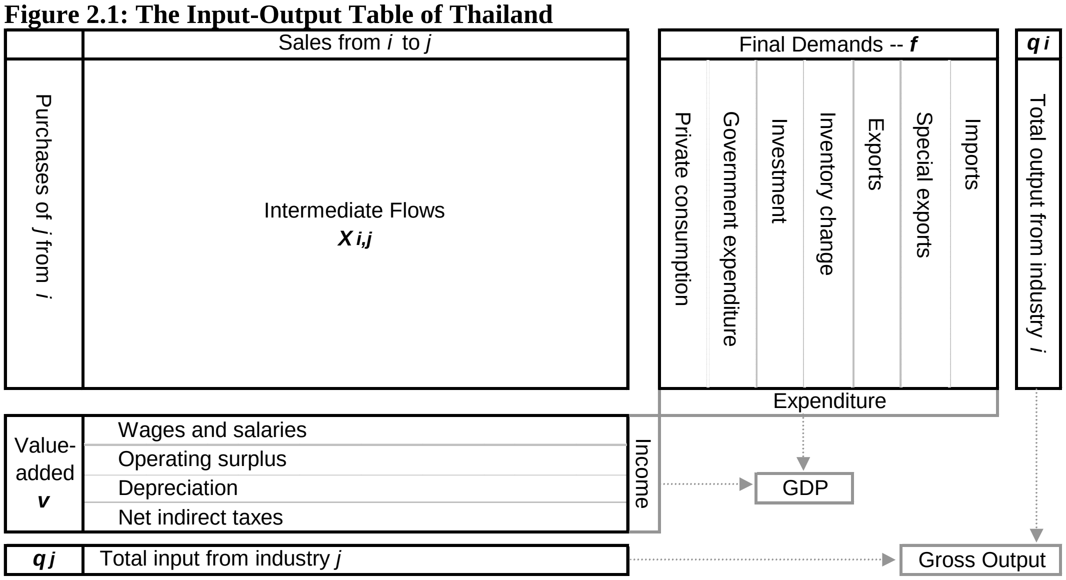
2.3 THE STRUCTURE OF TIDY

The core of the Interdyme model is the input-output table. In essence, there are two types of transactions for produced goods: final sales and intermediate transactions. In the first type, goods are sold by producers directly to the final users; the purposes of acquisition by final users are of various natures: to consume, invest, or export. The

[3] See equation [2.4] below.

second type of transaction involves intermediate sales between producers themselves. Output from one sector is delivered to another as an input for further production. For example, outputs from the metal industry are bought by the automobile industry for car production. The national account system captures only the first type of economic transaction - from producers to end-users. On the other hand, the input-output framework portrays both types of economic activities. TIDY is based on the 26x26, product-to-product, input-output table of Thailand. Figure 2.1 displays the structure of the input-output table of Thailand at producers' prices.

Figure 2.1: The Input-Output Table of Thailand



The table contains three main parts: the intermediate flow matrix, final demands, and value-added. Each row of the table corresponds to the distribution of a product to different buyers – output. Therefore, across the row, an intermediate flow - $x_{i,j,}$ is the amount of product *i* sold to industry *j*. On the other hand, the final demand f_i represents product *i* that was sold directly to final users, such as consumers and investors. For each industry, gross output is the total sum in each row (*i.e.*, a row sum).

Each column of the input-output shows the amount of factor input that industry *j* purchases from others for its production, its inputs. In addition to the intermediate input requirement, primary inputs such as labor and capital are additionally required in the production process. Therefore, value-added represents factor payments to these primary inputs. Total input is simply a column sum.

The national income accounting is captured by the components of final demands and value-added. The total sum of value-added equals to Gross Domestic Product (GDP) from the income side, while the total sum of final demands represents the expenditure on GDP. Theoretically, these numbers should be identical. However, statistical discrepancies are normally included in the national accounts.

In principal, the TIDY model consists of three main components: real side (or, output-employment side), price-income side, and the accountant.

<u>The Real Side</u>

The major task of the real side is to estimate final demand components and to calculate sectoral outputs of the economy. Iterative solutions of sectoral outputs in period *t* are obtained by solving for the convergence of:

$$\boldsymbol{q} = \boldsymbol{A}\boldsymbol{q} + \boldsymbol{f} \qquad [2.1]$$

where $\boldsymbol{q}$ is a vector of outputs in period t,

$\boldsymbol{A}$ is an input-output coefficient matrix in period t,

$\boldsymbol{f}$ is a vector of final demands in period t.

Equation [2.1] simply states that output must be produced in sufficient quantity to satisfy intermediate production requirements and final demands. The preparation for the iteration requires the presence of the estimations of coefficient matrix $\boldsymbol{A}$ and final demand vector $\boldsymbol{f}$. The input-output coefficients may be calculated from:

$$a_{i,j} = \frac{x_{i,j}}{q_j} \qquad [2.2]$$

where $x_{i,j,}$ is the intermediate flow from industry i to industry j, and q_j is the total output of industry j. The published data allows one to calculate the input-output coefficient matrix only in every fifth year during the period 1975-1995, and once in 1998. The coefficients between these years are simply linearly interpolated and the input-output coefficient matrix $\boldsymbol{A}$ is projected by the logistic curve after 1998.

The final demand vector $\boldsymbol{f}$ is a sum of its seven components: shown in Figure 2.1 - private consumption, fixed investment, inventory change, government expenditures, exports, special exports[4], and imports. Each component requires estimation of behavioral equations.

Modeling of private consumption is conducted by the Perhaps Adequate Demand System (PADS) suggested by Almon (1996). Fixed investment was initially modeled by the traditional investment accelerator model. Behavioral equations were estimated in consumption and investment categories, which are released annually in the national accounts. For example, the categories in private consumption are based on types of consumption goods, not input-output sectors. Therefore, the bridge matrix ***BMC*** and ***BMV*** had to be constructed for consumption and investment, respectively. These matrices will be responsible for transforming the estimates of 33 consumption categories and 11 investment industries into 26 input-output sectors. In addition, the consumption bridge and investment bridge matrices are also estimated by logistic curve after 1998.

Inventory change is explained by a level of final sale and its change. Exports and government expenditures are treated as exogenous variables. Exports depend on various external factors such as foreign demand, exchange rate, and international trade agreements. Therefore, an additional model is required to explain exports properly. Government expenditure simply refers to a policy tool employed.

[4] Primarily, they are non-commercial goods and those that are not reported in the government import-export document. These special exports include export-related transportation and insurance fees, expenses from international organizations and governments, and other non-specified-elsewhere final demand.

Imports are treated simply as a linear function of the total demands in the corresponding industry. Since imports also supply products to the demands, they will be calculated simultaneously with output.

On introducing notation for the various components of final demand and the bridge matrices, equation [2.1] can be re-written as equation [2.3]. Equation [2.3] will be solved iteratively by the Seidel process[5]. Then, for a given set of calculated sectoral outputs, labor productivity and labor requirements required for those productions are estimated. The unemployment rate is then calculated . Some of these variables will be passed on to the price-income side and will in part determine components of value-added.

$$\boldsymbol{q = A*q + BMC*c + BMV*vf + vi + g + e + es - m} \qquad [2.3]$$

where q = 26x1 vector of gross output,

A = 26x26 input-output coefficient matrix,

c = 33x1 vector of private consumption by commodity,

vf = 11x1 vector of gross investment,

vi = 26x1 vector of inventory change,

g = 26x1 vector of government expenditure,

e = 26x1 vector of exports,

es = 26x1 vector of special exports,

m = 26x1 vector of imports,

BMC = 26x33 consumption bridge matrix,

BMV = 26x11 investment bridge matrix.

[5] See Almon (1999) and Klein, Welfe and Welfe (1999) for further discussion of the Seidel algorithm.

The input-output tables in constant 1990 prices are constructed and are used within the TIDY framework. Therefore, real outputs are yielded as the results of the calculations in equation [2.3]. Notwithstanding, when we work in real terms, some issues must be addressed. Transforming the table into constant prices, or real terms, is equivalent to measuring products in physical units. Row sums of the input-output table are valid and refer to the real total outputs. However, the column sums are indeed meaningless because each input is measured in different physical units. In real terms, input from the Crops industry could be measured in bushels, Metal in tons, and Crude oil in barrels. Adding these numbers will result in a nonsensical interpretation. Almon (1999) portrays a very good example of this outcome: "the results make just as much sense as saying that five squirrels minus three elephants equals two lions. The arithmetic is right but the units are crazy".

Naturally, row sums and column sums of the input-output table measured in constant prices are incomparable and should by no means be likened to each other. However, many input-output practitioners are unaware of this fact. To get the "constant-price value-added", they normally subtract the deflated total inputs from the deflated gross output; this is called the "double-deflation" method.

To avoid this infamous practice, all value-added components in TIDY should be deflated by the same price index, the GDP deflator. Although these variables are not measured in real terms; this approach has two practical implications. First, because the general price level deflates the variables, the series will portray the purchasing power that laborers and capitalists possess over general products in the market. Second, they may be added up to a meaningful outcome. That is, the total sum of the valued-added deflated by GDP deflator is equal to the total sum of the final demands in real terms. Equivalently, they are both GDP in constant prices.

The Price-Income Side

The primary task of the price-income side is to calculate prices of sectoral outputs. Factor payments to primary inputs (the value-added) are estimated in this portion. Vector of price per-unit of the output at period t is solved iteratively by the Seidel process to satisfy:

$$\boldsymbol{p} = \boldsymbol{p}.\boldsymbol{A} + \boldsymbol{v} \qquad [2.4]$$

where $\boldsymbol{p}$ is a vector of price per-unit of output in period t,

$\boldsymbol{A}$ is an input-output coefficient matrix in period t,

$\boldsymbol{v}$ is a vector of a unit value-added in period t.

The meaning of equation [2.4] is that price per-unit of output is added up from per-unit cost of materials and factor payments of the production. Value-added in the input-output table of Thailand consists of four components: wages and salaries, operating surpluses, depreciation, and net indirect taxes (business taxes minus subsidies). Sectoral regressions are estimated for wages, profits, and depreciation. Tax rates (net indirect taxes per unit of output) are regarded as exogenous because they are used as policy instruments. By substituting these components to the value-added vector $\boldsymbol{v}$, equation [2.4] may be re-written as:

$$\boldsymbol{p} = \boldsymbol{p}^{*}\boldsymbol{A} + \boldsymbol{w} + \boldsymbol{pf} + \boldsymbol{d} + \boldsymbol{\tau} \qquad [2.5]$$

where p = 26x1 vector of a unit price,

A = 26x26 input-output coefficient matrix,

w = 26x1 vector of wages,

pf = 26x1 vector of profits,

d = 26x1 vector of depreciation,

τ = 26x1 vector of net indirect taxes.

The Accountant

The accountant, the last component of TIDY, aggregates sectoral variables, both from the real side and from the price-income side, to macro variables following the national income accounting. Real and nominal GDP, personal disposable income, and personal savings are calculated here. Various macro variables are also estimated in this section.

Gross domestic product, constant in 1990 prices, will equal the total sum of the estimated value-added. On the expenditure side, real GDP is also the total sum of final demand components. Also, the statistical discrepancy is calculated in order to assure the agreement between GDP from the income side and expenditure side. The GDP deflator is estimated by the regression and scaling factors are employed to maintain the consistency between the aggregate GDP deflator and sectoral prices calculated by the previous equation [2.5]. GDP in current prices may be obtained simply by multiplying real terms with the GDP deflator.

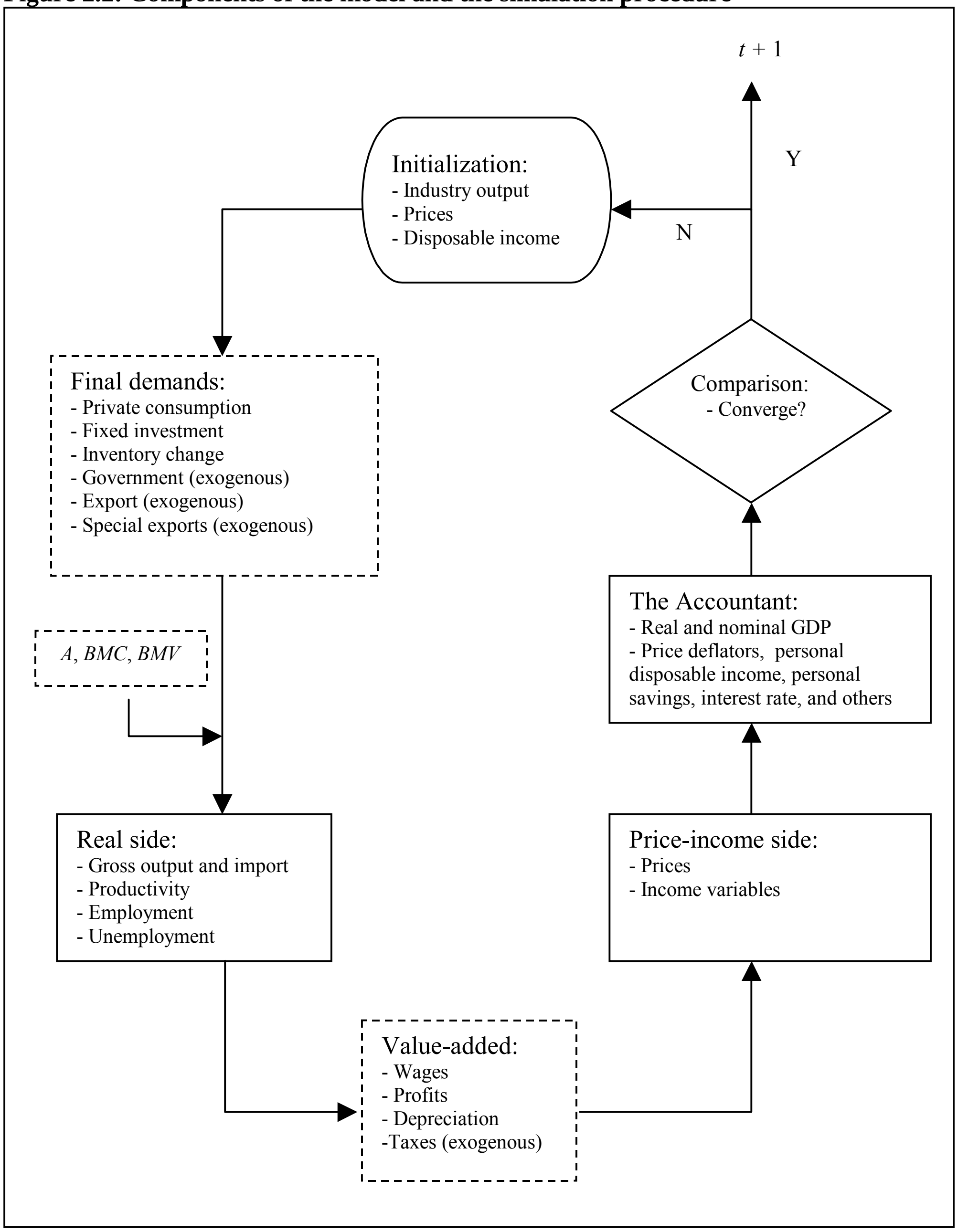
Table 2.1: GDP Accounting and Identities in TIDY

Operation	Description
	Income Side (Deflated by GDP deflator, constant in 1990 prices)
+	Net Domestic Product at Factor Cost
	Wages and Salaries
	Operating Surpluses
+	Provision for Consumption of Fixed Capital
+	Net Indirect Tax
=	**Gross Domestic Product (GDP)**
	Real Side (Constant in 1990 prices)
+	Private Consumption Expenditure
+	General Government Consumption Expenditure
+	Gross Domestic Fixed Capital Formation
+	Change in Inventories
+	Export of Goods and Services
-	Import of Goods and Services
+	Statistical Discrepancy
=	**Expenditure on Gross Domestic Product (GDP)**
	Personal Income and Savings (Current prices)
	Personal Income
-	Direct taxes and transfers
=	Personal Disposable Income
-	Personal Savings
=	Total Private Consumption Expenditure

Personal disposable income and personal savings are also estimated in the macro regressions. The difference between personal disposable income and savings is total personal expenditure, which is used to control the estimation of sectoral consumption. The model simulates period-by-period, starting from the first forecasting period.

Figure 2.2 below depicts components of the model as well as the procedure of the simulation in period *t*.

Figure 2.2: Components of the model and the simulation procedure



The procedure of the model may be discussed in term of three steps: initialization, simulation, and the convergence test.

The model starts at the initialization step. At the beginning of period *t*, the process starts by putting the initial values of the sectoral outputs, sectoral prices, and personal disposable income in the model. The model then passes these initial values to the next step, the simulation. The simulation further consists of four main calculations: final demands, output-employment variables, price-income variables, and finally the accountant calculations.

After finishing the calculation step, the model proceeds to the convergence test, which will compare the simulated values of sectoral outputs and sectoral prices to those initial values. If the simulation gives convergent results, the model proceeds to period *t*+1. Otherwise, the model places the simulated values as initial values and re-simulates the model in period *t* until the results converge.

Table 2.2 lists all variables incorporated in the TIDY framework. For each variable, the third column of the table indicates whether the variable is a macro or sectoral variable. The forth column briefly describes the identities and influences in the regression equations.

Table 2.2: Complete list of variables in TIDY

Name	Variable	Sectors	Influences/Identities
REAL SIDE			
Personal Consumption			
PCE per capita by consumption category, constant in 1990 prices	pcepcC	33	Personal disposable income, relative prices, time trend
PCE per capita by consumption category, current prices	pcepc	33	= pcepcC*ppce
Total PCE per capita, constant in 1990 prices	pcepcCTS	Macro	= pceCTS/pop
Total PCE per capita, current prices	pcepcTS	Macro	= pceTS/pop
PCE by consumption category, constant in 1990 prices	pceC	33	= pcepcC*pop
PCE consumption category, current prices	pce	33	= pcepc*pop
Total PCE, constant in 1990 prices	pceCTS	Macro	= pceTS/ppceTS
Total PCE, current prices	pceTS	Macro	= pidis - savings
PCE by industry, constant in 1990 prices	pceioProR	26	= BMC*pceC
PCE price index by consumption category	ppce	33	= BMC' *pq
PCE price index, total	ppceTS	Macro	= weighted average of ppce
Investment			
Investment by aggregate sector, constant in 1990 prices	capC	11	Change in product outputs, capital stocks
Investment by aggregate sector, current prices	cap	11	= capC*mainp
Investment by industry, constant in 1990 prices	capioProR	26	= BMV*capC
Investment by industry, in current prices	capioPro	26	= capioProR*pq
Total Investment, constant in 1990 prices	capCTS	Macro	= sum of capC
Total Investment, current prices	capTS	Macro	= sum of cap
Inventory			
Inventory change by industry, constant in 1990 prices	invioProR	26	Final sales, and change in final sales
Inventory change by industry, current prices	invioPro	26	= invioProR*pq
Total inventory change, constant in 1990 prices	invRTS	Macro	= sum of invioProR
Total inventory change, current prices	invTS	Macro	= sum of invioPro
Government Expenditure			
Government expenditure by industry, constant in 1990 prices	govioProR	26	Exogenous
Government expenditure by industry, current prices	govioPro	26	= govioProR*pq
Total government expenditure, constant in 1990 prices	govRTS	Macro	= sum of govioProR
Total government expenditure, current prices	govTS	Macro	= sum of govioPro
Exports			
Exports by industry, constant in 1990 prices	expioProR	26	Exogenous
Total exports, constant in 1990 prices	expRTS	Macro	= sum of expioProR
Special Exports			
Special exports by industry, constant in 1990 prices	othioProR	26	Exogenous
Total special exports, constant in 1990 prices	othRTS	Macro	sum of othioProR
Imports			
Imports by industry, constant in 1990 prices	impProR	26	Linear function in total demands
Total Imports, constant in 1990 prices	impRTS	Macro	= sum of impioProR
Gross Domestic Product (GDP)			
GDP, constant in 1990 prices	gdpCTS	Macro	= total sum of constant-price value-added components
GDP, current prices	gdpTS	Macro	= gdpCTS*gdpDTS
Expenditure on GDP, constant in 1990 prices	gdeCTS	Macro	= (total sum of constant-price final demands)/ FdVaRatio
Expenditure on GDP, current prices	gdeTS	Macro	= gdeCTS*gdpDTS
Statistical discrepancy	gdpdiscC	Macro	= gdpCTS – gdeCTS
Statistical discrepancy	gdpdisc	Macro	= gdpTS – gdeTS
GDP deflator	gdpDTS	Macro	Unemployment rate, M2 growth, exchange rate, trend
Gross Output			
Gross output by industry, constant in 1990 prices	qiProR	26	Solution of $q = Aq + f$
Gross output by industry, current prices	qiPro	26	= qiProR*pq
Gross output by aggregate industry, constant in 1990 prices	mainqR	11	= aggregate from qiProR
Gross output by aggregate industry, current prices	mainq	11	= mainqR*mainp
Total gross output, constant in 1990 prices	qRTS	Macro	= sum of qiProR
Total gross output, current prices	qTS	Macro	= sum of qiPro

Table 2.2: Complete list of the variables in TIDY framework

Name	Variable	Sectors	Influences/Identities
Productivity - Employment			
Labor productivity by industry	prod	26	Change in product output, time trend
Employment by industry	emp	26	= qiProR/prod
Total employment	empTS	Macro	= sum of emp
Average annual total employment	empavg	Macro	= eratio*empTS
Aggregate labor productivity	prodTS	Macro	= qRTS/empTS
Capital Stock			
Capital stock in aggregate industry, constant in 1990 prices	stockR	11	= capital accumulation identity
Capital stock in aggregate industry, current prices	stock	11	= stockR*mainp
Total capital stock, constant in 1990 prices	stockRTS	Macro	= sum of stockR
Total capital stock, current prices	stockTS	Macro	= sum of stock
INCOME SIDE			
Wages			
Aggregate wage rates, deflated by GDP deflator	avgwageDTS	Macro	Labor productivity, unemployment rate, time trend
Aggregate wage rates, current prices	avgwageTS	Macro	= avgwageDTS*gdpD
Wage rates by industry, deflated by GDP deflator	avgwageD	26	Aggregate wage rates, labor productivity, time trend
Wage rates by industry,current prices	avgwage	26	= avgwageD*gdpD
Wages by industry, deflated by GDP deflator	wageD	26	= avgwageD*emp
Wages by industry, current prices	wage	26	= wageD*gdpD
Total wages, deflated by GDP deflator	wageDTS	Macro	= sum of wageD
Total wages, current prices	wageTS	Macro	= sum of wage
Profits			
Profits by industry, deflated by GDP deflator	profitD	26	Product output, change in product output, wage, time
Profits by industry, current prices	profit	26	= profitD*gdpD
Total profits, deflated by GDP deflator	profitDTS	Macro	= sum of profitD
Total profits, current prices	profitTS	Macro	= sum of profit
Depreciation			
Depreciation by industry, deflated by GDP deflator	deprecD	26	Lag of gross capital stock
Depreciation ny industry, deflated by GDP deflator	deprec	26	= deprecD*gdpD
Total depreciation, deflated by GDP deflator	deprecDTS	Macro	= sum of deprecD
Total depreciation, current prices	deprecTS	Macro	= sum of deprec
Taxes			
Tax rates by industry	taxrate	26	Exogenous: taxD/qiProD
Net indirect taxes by industry, deflated by GDP deflator	taxD	26	= taxrate*qiProD
Net indirect taxes by industry, current prices	tax	26	= taxD*gdpD
Average tax rate	taxrateTS	Macro	= taxDTS/qRTS
Total net indirect taxes, deflated by GDP deflator	taxDTS	Macro	= sum of taxD
Total net indirect taxes, current prices	taxTS	Macro	= sum of tax
Prices			
Output price by industry	pq	26	Solution of $p = pA + v$
Output price by aggregate industry	mainp	11	= weighted average of pq
MACRO VARIABLES			
Total population	pop	Macro	Exogenous: NESDB projection
Total labor forces	lfc	Macro	Lag of total population
Seasonal workers waiting for cultivation	sunemp	Macro	Total labor forces, average annual employment
Unemployment rate	unrate	Macro	= 100*(lfc-empavg-sunemp)/lfc
Personal income, current prices	income	Macro	wage, profit, time trend
Personal income, constant in 1990 prices	incomeD	Macro	= income/gdpDTS
Direct tax rates	dtaxrate	Macro	Exogenous
Personal disposable income, current prices	pidis	Macro	= income*(1-dtaxrate/100)
Personal disposable income, constant in 1990 prices	pidisD	Macro	= pidis/ppceTS
Personal disposable income per capita, current prices	pidispc	Macro	= pidis/pop
Personal disposable income per capita, constant in 1990	pidispcD	Macro	= pidisD/pop
Saving rates	savrat	Macro	Income growth, unemp rate, nominal interest rate
Personal savings, current prices	savings	Macro	= pidis*savrat
Total personal consumption expenditure, current prices	pceTS	Macro	= pidis – savings
Nominal interest rate	i1y	Macro	Exogenous
Exchange rate (Bahts/U.S. dollar)	exrate	Macro	Exogenous
Money supply (M2)	m2	Macro	Exogenous

2.4 REGRESSION EQUATIONS IN BRIEF

This section briefly presents the functional forms that are used to estimate sectoral regressions in the real side and price-income side within the TIDY model.

Private Consumption Expenditure

The present study will employ the Perhaps Adequate Demand System (PADS), suggested by Almon (1996), to model 33 private consumption sectors in Thailand. The model was designed to be suitable in a long-term forecasting model. In essence, the functional form of PADS suggests that private consumption per capita is a function of real income, change in income, time trend (taste change), own price, and relative prices of complementary and substitute goods.

$$x_i(t) = \left(a_i + b_i(y/P) + c_i\Delta(y/P) + d_i t\right)\cdot\left(\frac{p_i}{P}\right)^{-\lambda_i}\prod_{k=1}^{n}\left(\frac{p_i}{p_k}\right)^{-\lambda_k s_k}\cdot\left(\frac{p_i}{P_G}\right)^{-\mu_G}\left(\frac{p_i}{P_g}\right)^{-\nu_g} \qquad [2.6]$$

where;

$$P_G = \left(\prod_{k\in G} p_k^{s_k}\right)^{1/\sum_{k\in G} s_k}, \; P_g = \left(\prod_{k\in g} p_k^{s_k}\right)^{1/\sum_{k\in g} s_k} \; and \; P = \prod_{k=1}^{n} p_k^{S_k} \qquad [2.7]$$

Dependent variable x_i on the left-hand-side of equation [2.6] is a per capita private consumption in sector i. P_G, P_g, and P, defined in equation [2.7], refers to the price index of consumption group G, the price index of consumption subgroup g, and the general price level, respectively. The intuitive notion in this case is that one categorizes sectors that tend to be highly related into the same group. “Highly-related” sectors refer to sectors whose demands are explicitly either complements or substitutes. This method helps to significantly reduce the number of parameters in the system by the introduction of parameter μ_G and ν_g.

S_k is the expenditure share of product k on total consumption expenditure. p_i and p_k are prices of consumption sectors i and k, respectively. Finally, t and y are time trend and per capita income.

a_i, b_i, c_i, d_i, λ_i, μ_G, and ν_g are all parameters. The estimates of λ_i and s_i are individual; however, μ_G and ν_g are common within the same group and subgroup. Therefore, the number of λ_i’s to be estimated equals the number of consumption sectors. Meanwhile, the numbers of μ_G and ν_g will be equal to the numbers of groups and subgroups, respectively. Positive (negative) μ_G implies a substitution (complementary) within group G and, similarly, positive (negative) ν_g implies a substitution (complementary) within subgroup g.

Fixed Investment

There are two versions of investment equation in TIDY, each of them representing an accelerator model of investment. The first function form is motivated by the flexible accelerator model of investment, which relates net investment to the change in an economic environment. The equation is estimated in terms of gross investment, which includes replacement investment in the equation. The functional form used in the estimation is:

$$I_{i,t} = \alpha_0 + \alpha_1 R_{i,t} + \alpha_2 crisis_t + \sum_{\tau=0}^{2} \beta_\tau \Delta Q_{i,t-\tau} + \varepsilon_t \qquad [2.8]$$

where, $I_{i,t}$ = gross investment of sector *i* at time *t*,

$R_{i,t}$ = replacement investment of sector *i* at time *t*,

crisis = the financial crisis dummy variable,

$\Delta Q_{i,t}$ = output change of sector *i* between *t* and *t*-1.

The coefficient of replacement investment, α_1, is expected to be close to a value of 1. The coefficient α_2 for the *crisis* dummy variable should be negative. Finally, all estimated β's must be positive, as gross investment would positively respond to economic activities.

In the second type of investment equation, investment demands are motivated by the desired level of capital stock. Because the desired level of capital stock is unobservable, we assume that it is a linear function of output, $\alpha + \beta Q_t$. We further suppose that investment is determined to close a constant fraction, λ, of the gap between desired and actual capital. Investment will therefore be:

$$I_t = \lambda(\alpha + \beta Q_t - K_{t-1}) + \delta K_{t-1} \qquad [2.9]$$

where δ is the depreciation rate. Multiplying through by λ and rearranging terms give a regression equation of the form:

$$I_t = \alpha_0 + \alpha_1 Q_t + \alpha_2 K_{t-1} + \varepsilon_t \quad [2.10]$$

where I_t = gross investment,

Q_t = output,

K_{t-1} = capital stock from the previous period.

The coefficient on the output variable is expected to be positive. It represents effects from level of output and the desired level of capital stock on gross investment. We expect the coefficient on a lagged variable of capital stock to be negative.

The introduction of a second type of investment equation is particularly helpful in the model simulations. Thailand recently faced the economic crisis, where output and investment plunged to the lowest points in 15 years. Therefore, investment equation that captures effects from the output change leads to an extremely unstable model. In essence, the model tends to replicate the magnitude from the crisis, thinking that it was a slowdown from the business cycle. This is totally untrue. Therefore, the second version of investment equation is called the 'super smooth' investment function which produces a relatively stable path of investment growth in the forecasts.

Inventory Change

Inventory change is defined as the difference between output and the amount that is sold. Therefore, the primary explanatory variable in the inventory equation is a final sale, which equals the sum of private consumption, investment, government consumption, and exports.

$$Inven_{i,t} = \alpha_0 + \alpha_1 FS_{i,t} + \alpha_2 \Delta FS_{i,t} + \alpha_3 \Delta FS_{i,t-1} + \alpha_4 dummy \qquad [2.11]$$

where, $Inven_{i,t}$ = inventory change of sector i at time t,

$FS_{i,t}$ = final sales of sector i at time t,

$\Delta FS_{i,t}$ = change in final sales of sector i at time t,

$dummy$ = dummy variable.

Labor Productivity

The business cycle mainly affects labor productivity. The estimation for sectoral labor productivity in Thailand imposed the restricted functional form that the effect from economic upturns and economic downturns are symmetric. Time trend variable was also included in order to capture the effect from other factors, such as technological progress; the functional form is simply:

$$\ln\left(\frac{q_{i,t}}{l_{i,t}}\right) = \alpha_{i,0} + \alpha_{i,1} t + \alpha_{i,2} \ln\left(\frac{q_{i,t}}{q_{i,t-1}}\right) + \varepsilon_{i,t} \qquad [2.12]$$

where, $q_{i,t}$ = output of sector i at time t,

$l_{i,t}$ = employment in sector i at time t.

t = time trend.

Because the output growth captures the procyclical behavior of labor productivity over the business cycles, the expected sign of the coefficient is positive and less than unity. A coefficient value greater than 1 would result in a decline in employment if the output growth is positive, and vice versa.

Sectoral Profits

Primary explanatory variables include real sectoral output and its difference. Sectoral output represents business cycle and demand conditions that influence profits. Fluctuation in wages also varies a firm's profit in the short-run. When the cost of production changes, firms usually hesitate to adjust the price charged to buyers. Consequently, real sectoral wages are also included in the regressions. A time trend variable is included in order to capture extraneous effects - those other than output and labor cost. The estimated equation is:

$$profit_{i,t} = \alpha_0 + \alpha_1 q_{i,t} + \alpha_2 \Delta q_{i,t} + \alpha_3 w_{i,t} + \alpha_4 T + \varepsilon_{i,t} \qquad [2.13]$$

where, $profit_{i,t}$ = level of profit in sector *i* at time *t* deflated by GDP deflator,

$q_{i,t}$ = level of output in sector *i* at time *t* deflated by GDP deflator,

$\Delta q_{i,t}$ = output change in sector *i* at time *t*,

$w_{i,t}$ = level of total wage in sector *i* at time *t* deflated by GDP deflator,

T = time trend.

Sectoral output represents business cycle and demand conditions that influence profits. Therefore, the expected signs for both α_1 and α_2 are positive. The coefficient of the real wage variable is responsible for the labor cost in firms' production. When wages increase, corporate profits fall, and vice versa. Thus, the expected sign for α_3 is negative. The coefficient of the time trend variable catches shifts in sectoral profits over time.

Aggregate Wage

The aggregate wage equation in the Interdyme of Thailand is motivated by the conventional Phillips curve with acceleration, which relates the behavior of wages to expected inflation, unemployment, and labor productivity. While the inflation and unemployment rate capture the effect of short-run disequilibrium, economic theory suggests that labor productivity growth influences the determination of wage rates in the long run. The estimated equation is:

$$\ln W_t = \alpha_0 + \alpha_1 \ln LP_t + \alpha_2 U_t + \alpha_3 T + \varepsilon_t \quad [2.14]$$

where, W_t = aggregate wage level deflated by GDP deflator,

LP_t = labor productivity (real output per worker),

U_t = unemployment rate,

T = time trend.

The expected sign for the coefficient of labor productivity is positive. However, the unemployment rate should be negatively related to the wage rate because it represents the bargaining power of the workers. As the unemployment rate increases, the bargaining power of workers decreases, intuitively resulting in lower average wages for those affected.

Sectoral Wage

The sectoral wage equation contains the effects from both aggregate and industry-specific determinants. Sectoral wages are affected by the economy-wide shocks from the aggregate wage. Labor productivity variables, specific to individual industries, were included in the equation in order to capture industry-specific effects. Time trend was included to capture effects from other qualitative factors. The sectoral wage equations are also estimated in real terms. The functional form is:

$$\ln W_{i,t} = \alpha_{0,i} + \alpha_{1,i}\ln W_t + \alpha_{2,i}\ln LP_{i,t} + \alpha_{3,i}T + \varepsilon_{i,t} \qquad [2.15]$$

where, $W_{i,t}$ = wage level in sector i at time t deflated by GDP deflator,

W_t = aggregate wage level at time t deflated by GDP deflator,

$LP_{i,t}$ = labor productivity (real output per worker) in sector i at time t,

T = time trend.

The expected signs of the coefficients for both aggregate real wages and labor productivity are positive.

Depreciation

The determination of depreciation is influenced by the capital accumulation equation. Sectoral depreciation is primarily explained by the level of capital stock from the previous period. However, capital stock data is published in a broad classification, containing 11 sectors. These capital stock sectors are similar to those sectoral investment sectors and are not as disaggregate as the 26 input-output definitions. Consequently, the exact definition of the sectoral stock cannot be included in the equation. Instead, capital stock from the related broad sector is used; for example, capital stock from Agricultural sector is used in the sectoral equations of four industries :Crops, Livestock, Forestry, and Fishery. Although this approach seems to be reasonable, the meaning of the coefficient on capital stock must be interpreted with care. The regression equation for sectoral depreciation is as follows:

$$deprec_{i,t} = \alpha_0 + \alpha_1 K_{j,t-1} + \varepsilon_{i,t} \qquad [2.16]$$

where, $deprec_{i,t}$ = level of capital depreciation in the input-output sector i at time t deflated by GDP deflator,

$K_{j,t-1}$ = level of capital stock in the broad investment sector j at time t-1 deflated by GDP deflator.

In the general analysis, α_1 should represent the depreciation rate of the sectoral capital stock. However, in this study the capital stock from a broader classification is used in the equation. Therefore, the coefficient of capital stock is not exactly the sectoral depreciation rate. Mathematically, it will equal the sectoral depreciation rate, weighted by the proportion of the sectoral capital stock to the broad aggregate stock. In all cases, the coefficient on capital stock variable is expected to be positive and relatively small.

2.5 THE PROJECTION OF THE INPUT-OUTPUT COEFFICIENT MATRIX

In the forecast, the input-output coefficients in *A* matrix are not constant. They were projected by the logistic curve. This section briefly presents the methodology of the logistic curve estimation.

In the logistic curve, the coefficient *c* approaches, as time advances, an asymptote *a*. The percentage rate of change of *c* is proportional to the difference between the current value and the asymptote. Mathematical expression of the logistic curve is thus

$$\frac{1}{c}\frac{dc}{dt} = b(a-c) \qquad [2.17]$$

where, c = coefficient

a = asymptote of the coefficient,

b = constant ratio of the percentage change in c to the gap between the coefficient and the asymptote.

Solving above differential equation, the solution of coefficient c at time t is:

$$c_t = \frac{a}{1+Ce^{-bat}} \qquad [2.18]$$

where, c_t = coefficient at year t,

a = asymptote of the coefficient,

C = constant term from integration,

b = constant ratio of the percentage change in a to the gap between the and the asymptote.

The logistic curve estimation can be applied to either individual coefficient change or across-the-row coefficient changes. In across-the-row method, coefficients in the same row of the matrix A will all move proportionally to the same logistic curve. TIDY employs this across-the-row method to project the input-output coefficient matrix.

To estimate the logistic curve, we must first calculate historical values of the across-the-row adjustment terms. For each row, the adjustment term is defined as the ratio of the intermediate use of each product to its hypothetical intermediate use had all coefficients been constant from the base year. Equation [2.19] represents the across-the-row adjustment term in TIDY.

$$arcc_j = \frac{\sum_{j=1, j\neq i}^{26} a_{i,j} q_j}{\sum_{j=1, j\neq i}^{26} \bar{a}_{i,j} q_j} \qquad [2.19]$$

where, $arcc_j$ = across-the-row coefficient changes for row j,

$a_{i,j,}$ = input-output coefficient,

$\bar{a}_{i,j}$ = input-output coefficient from the base year,

q_j = gross output from row j.

It should be noted that the intermediate use along the main diagonal of the flow matrix (*i.e.*, a use of product i in sector i) does not represent technical change in the production. Consequently, the input-output coefficients along the main diagonal of the *A* matrix were not included in the across-the-row adjustment terms, and were not estimated by the logistic curve. Rather, the input-output coefficients on the main diagonal are fixed from 1998 in the forecast period.

Equation [2.18] was estimated by a non-linear least squares, where the dependant variable is the across-the-row adjustment terms presented in equation [2.19]. The forecasted $arcc_j$ was then applied to the matrix *A* in order to project input-output coefficient matrices.

CHAPTER 3: OVERVIEW OF THE THAI ECONOMY

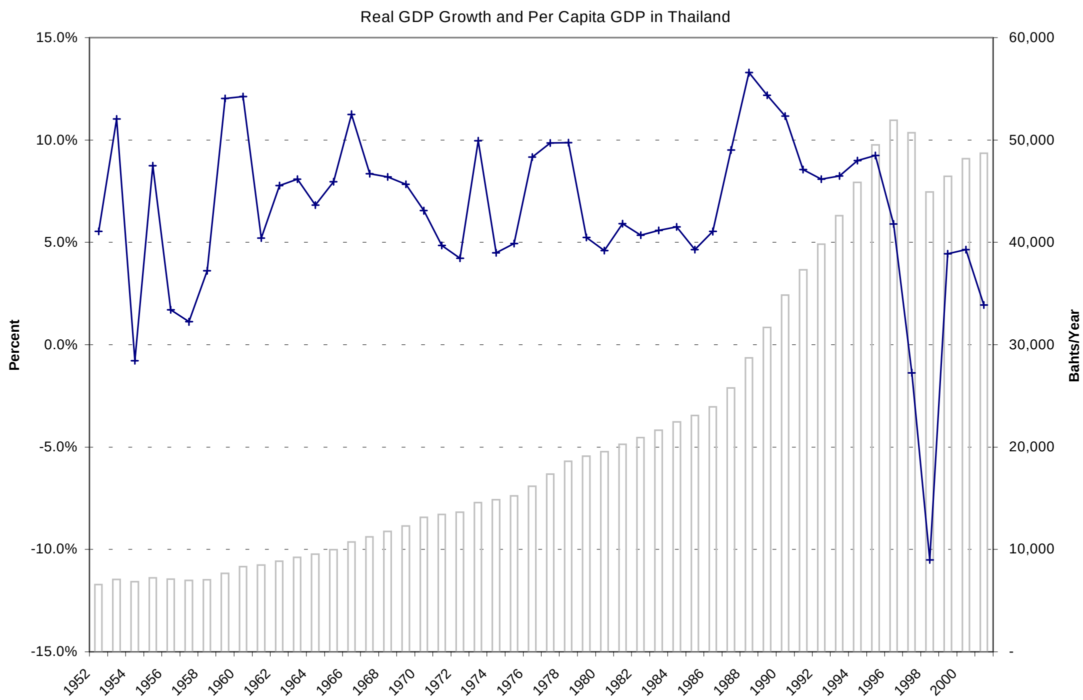
3.1 OVERVIEW OF THE THAI ECONOMY

Thailand is unique. Its conservative, yet open-minded, Buddhist customs have given the Thai economy a distinctive shape. The objective of this chapter is to describe the structure of the Thai economy, narrate its evolution, and tell the story of its notorious financial crisis. We will start with the success story of the continuous and extensive growth of the Thai economy during past 50 years. It will be shown that the structure of the Thai economy has evolved immensely throughout this period in various aspects. From a primitive agricultural economy, Thailand is now quickly becoming a newly industrialized country. Several economic factors that have framed the development of the economy will be discussed. Attention will be given to employment and productivity, capital accumulation and technological progress, international trade and foreign direct investment. These factors have helped the Thai economy grow over time. Thailand's story of booms and bust will be told, and the chapter will be completed by a discussion of the financial crisis during 1997-1998.

3.2 OUTPUT GROWTH AND STRUCTURE OF THE THAI ECONOMY

Thailand has been one of the fastest growing countries in the world. From 1951-2001, the average annual growth rate of real GDP was 6.5% per year. Per capita GDP has been increasing substantially during the past 50 years. Yet, a wealthy country is hardly built within a half century. Thailand is still searching for its way to become a strong and prosperous economy.

Figure 3.1: Real GDP growth and per capita GDP in Thailand during 1952-2001



Although Thailand does not abound with oil and ores, its abundance in other natural resources, such as timber and agricultural products, helped start its growth. Fifty years ago, Thailand was still a primitive economy whose main output was agricultural products, particularly rice. In 1960, agriculture accounted for 32% of the total GDP of the country. At the same time, the share of manufacturing was only 14%. Thailand (or, Siam at that time) was known as the 'rice-economy'. This picture is somewhat reversed nowadays. During the past 40 years, the proportion of agricultural products in the total GDP has been decreasing continuously. In 2000, they provided only 12% of the total product, while manufactures took up 35% share.

Not only has the structure of production changed during the past four decades, but the structure of demand has also evolved. On the expenditure side, the structure of demands for domestic products has changed remarkably. Forty years ago, the main driving force of the economy came from private consumption expenditures. As much as 73% of the total GDP was absorbed by private consumer demand. In the recent decades, however, its role has been reduced. Although the private consumption expenditure is still the largest part of the GDP, private fixed investment has become an important factor. During 1990s, private fixed investment absorbed as much as 40% of the total output of the country. Table 3.1 below summarizes the structure of GDP in Thailand.

Table 3.1: Output growth and the structure of GDP

	1960s	1970s	1980s	1990s	2000s
Real GDP Growth* (Percent)	6.0	7.8	6.7	7.8	4.4
Real Per Capita GDP* (Bahts)	8,329	13,143	19,558	34,839	48,159
Ratio of the Domestic Product by Industrial Origin (selected sectors) to GDP (Percent):					
Agriculture	32	27	20	14	12
Manufacturing	14	17	23	28	35
Transportation and Communication	8	7	7	8	10
Wholesale and Retail Trade	16	18	18	17	15
Services	11	12	13	12	12
Ratio of Expenditure to GDP (Percent):					
Private Consumption	73	70	65	57	56
Government Expenditure	10	11	12	9	11
Fixed Investment	14	24	28	40	22
Net Export	-1	-4	-6	-8	9

Source: National Economic and Social

**10-year average of annual real GDP.*

The abandonment of the fixed exchange regime in 1997 also changed the demand structure from abroad. Prior to 1997, the exchange rate for the baht, the Thai currency, was fixed at an over-valued level. After the baht was floated, net exports of the country have experienced continuously surpluses for the first time. International trade has become increasingly important in the recent years.

3.3 EMPLOYMENT AND LABOR PRODUCTIVITY

Currently, Thailand has a total population of roughly 62 million people. About 34 million people are in labor force, and 94 percent of this labor force is employed. The national unemployment rate was around 3.6% in year 2000. The majority of the workers is still in agriculture; however, it has been continuously losing labor participants to other sectors, especially over the last ten years. The employment share in agricultural sectors fell from 59.5% in 1990 to 45.3% in 1999. In return, shares of the employment in manufacturing, trade, and service sectors have increased gradually. These 14.2 percentage points of share went to manufacturing 3.4 points, trade 4.1 points, services 3.9 points, and other 2.8.

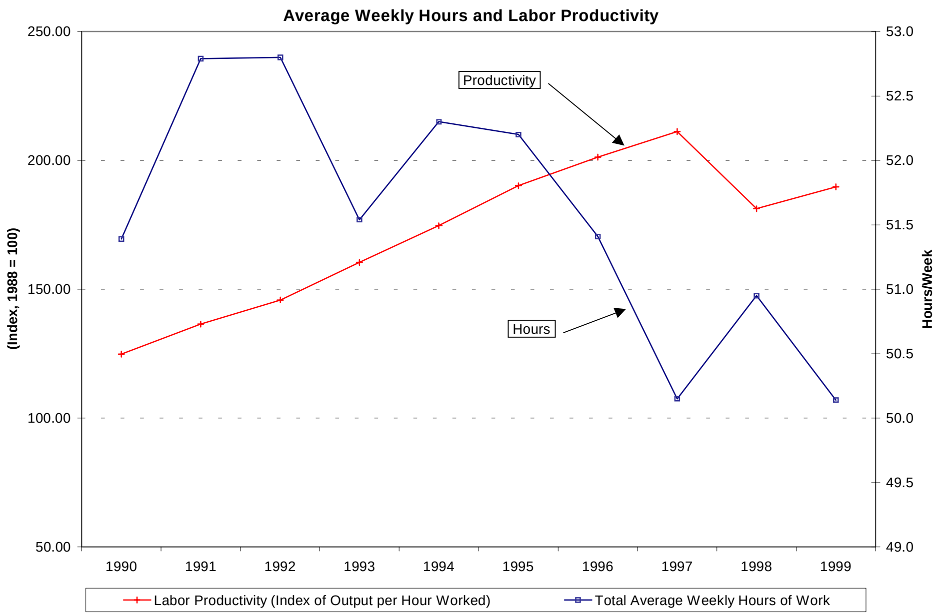
Table 3.2: Employment share by sector

(*Percent of Total Employment*)	**1990**	**1996**	**1997**	**1998**	**1999**
Agriculture	59.5	45.4	45.1	45.7	45.3
Manufacturing	11.5	14.9	14.6	14.8	14.9
Wholesale and Retail Trade	10.2	13.1	13.3	13.8	14.3
Services	8.4	10.1	10.8	11.6	12.3
Others	10.4	16.4	16.1	14.1	13.2

Source: *National Economic and Social Development Board (NESDB)*

Labor productivity in Thailand has been increasing steadily. The average output per hour in 1997 almost doubled that of 1990. The financial crisis in mid-1997 also led to a significant slowdown in labor productivity during the subsequent years. Both growing outputs and the decrease in hours worked contributed to the labor productivity growth in Thailand. Figure 3.2 shows that the average of weekly hours worked by all workers has been decreasing over time.

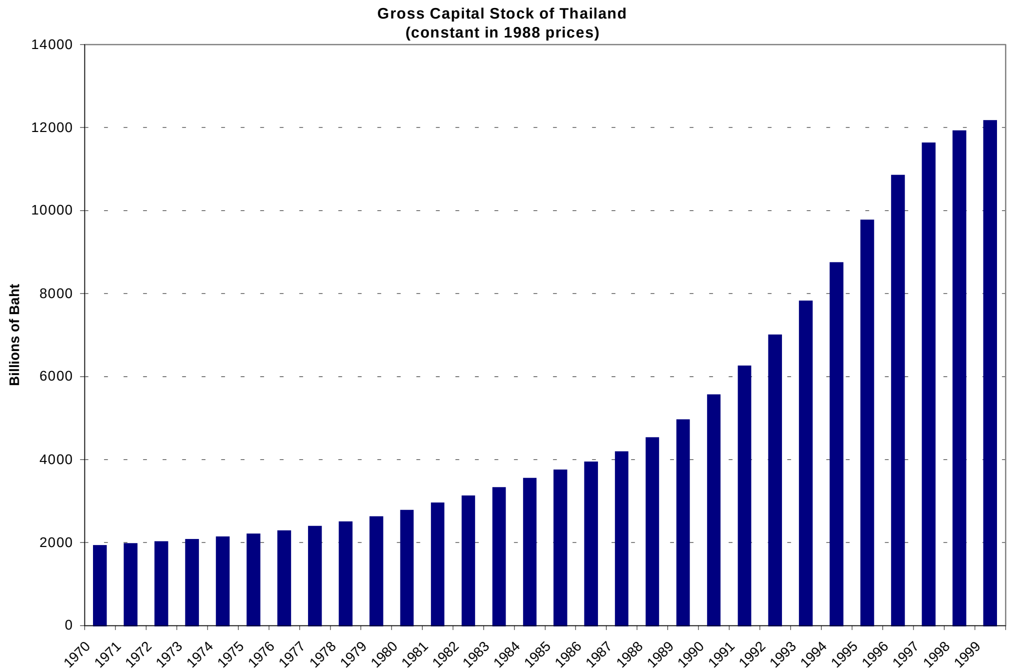
Figure 3.2: Average weekly hours and labor productivity in Thailand



3.4 CAPITAL ACCUMULATION AND TECHNOLOGICAL PROGRESS

Fixed investment has become increasingly important in domestic expenditure. Capital endowment is a crucial factor in economic growth, and part of the massive output growth in Thailand during the past decades has been contributed by capital accumulation. Gross capital stock in Thailand has been increasing continuously over the past three decades. A massive capital accumulation started to take off in the early 1990s. From 1985-1999, the values of gross capital stocks in Thailand have increased by about three times. Tinakorn and Sussangkarn (1994) suggest that capital endowment contributed to 37% of the average real GDP growth during 1978-1990.

Figure 3.3: Gross capital stock in Thailand



Capital endowment alone cannot keep a country growing over the long run. Economic growth theory suggests that sustainable long-term growth is energized by technological progress. There is very little literature that examines the role of technological progress on the output growth in Thailand. Among the few studies, Tinakorn and Sussangkarn (1994) employed the growth-accounting method to study the sources of economic growth in Thailand during 1978-1990. They found that technological progress has **not** been the major factor in the growth in Thai economy during the past decades. As they put it, "Thailand's rapid growth in the past decade or so has been achieved by adding more labor, capital and land to production. Some productivity improvements have been achieved, but these may have been through importing more efficient and modern machinery and through the employment of better or more productive workers". They reported that the total factor productivity

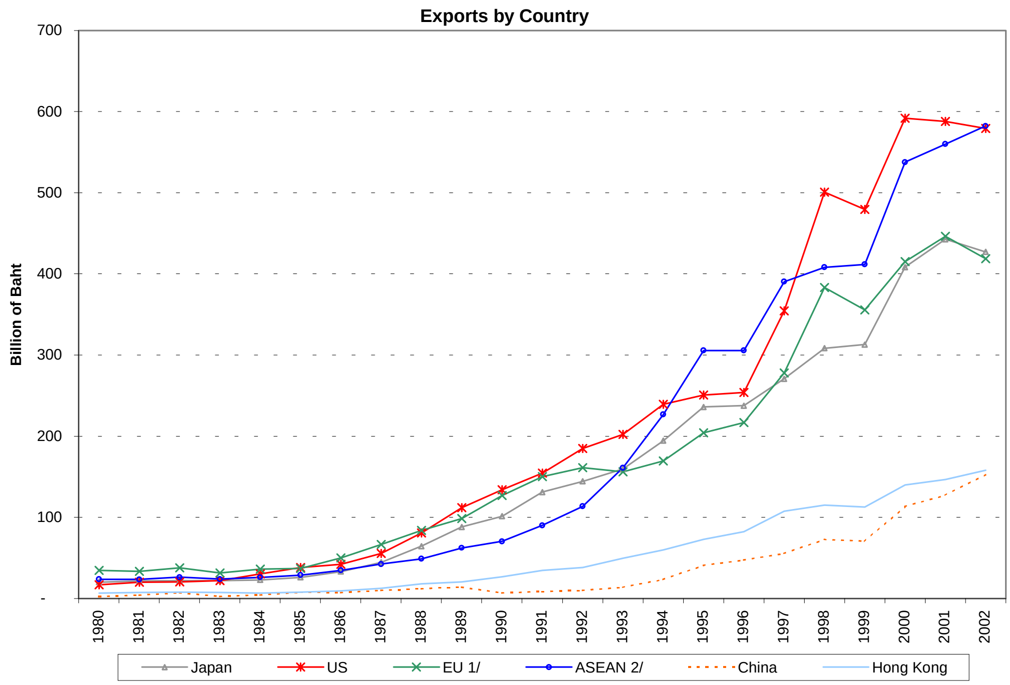
(TFP) explained only 16% of the real GDP growth during 1978-1990, while labor and capital contributed to the GDP growth for 46% and 37%, respectively.

Technological progress in Thailand has been lagging behind. This point is crucial because increased use of basic production resources, such as unskilled labor, land, and low-tech capital is nearing its limit. Technological progress is necessary for the future growth. Failure to improve technology in production may lead to a sluggish development in Thai economy.

3.5 INTERNATIONAL TRADE AND FOREIGN DIRECT INVESTMENT

Thailand's international trade has started to expand since the late 1980s. Important trading partners with Thailand include the U.S., the ASEAN (Association of SouthEast Asian Nations), EU, and Japan. The U.S. is the biggest market for Thai exports. However, there was also a change in the structure of exports worth mentioning. In 1992, the ASEAN countries signed the Free Trade Agreement (AFTA), aiming to reduce the regional trade tariffs to 0-5%. Consequently, the intra-trade within the Southeast Asia countries has expanded extensively. Since 1993, values of the exports to the ASEAN countries have surpassed those to EU and Japan. In spite of the slow down during the crisis periods, the ASEAN intra-trade picked up quickly in 2000. In 2002, the value of export to the ASEAN was about 580 billions bahts (13.5 billion dollars), accounting for 20 percent of the total exports. This figure is approximately equal to the export share to the U.S.

Figure 3.4: Values of the exports by country

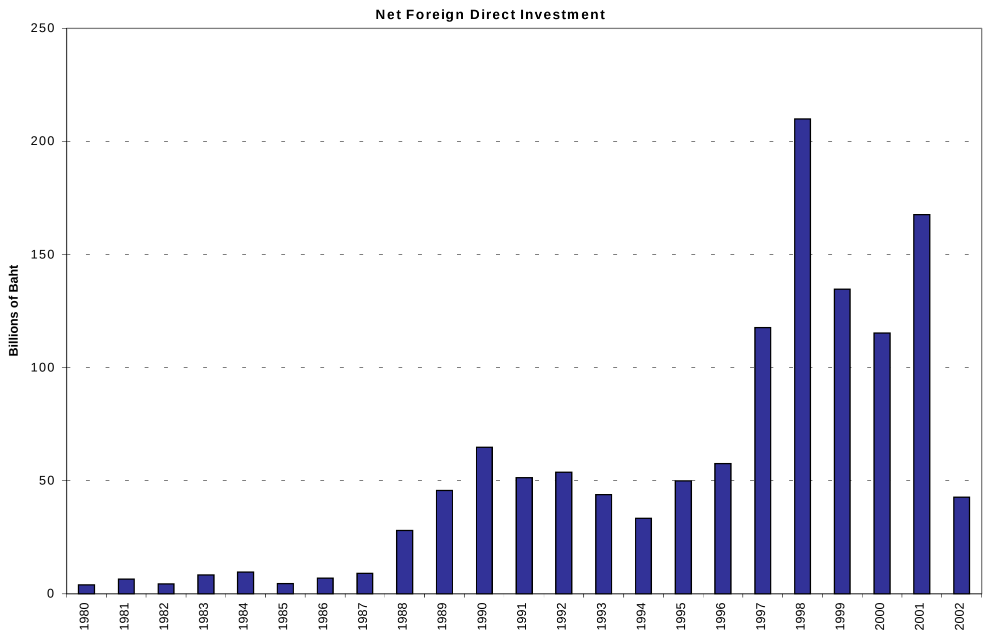


Source: Bank of Thailand and the Customs Department, Ministry of Finance.

In terms of the exported goods, the structure has also changed considerably. In early 1980s, 45% of the total exported goods were food products. However, the share of food products in exports is now replaced by machinery products. Currently, the exports of machinery products accounted for 43%, while food products account only for 14% of the total exports.

Net foreign direct investment (FDI) in Thailand has been significant since the early 1990s. Partly this rise in FDI is due to the abolition of the capital controls over financial capital markets, allowing foreign capital to move in and out of the country freely. The average annual FDI jumped from 13 billion bahts per year during the 1980s to 83 billion bahts per year in the 1990s. The most important sources of net capital inflows, in order of size, were Japan, ASEAN, the U.S., and the EU. Net capital inflows have been most important in manufacturing, trade, and services.

Figure 3.5: Net foreign direct investment



3.6 THE ECONOMIC CRISIS: WHAT WENT WRONG?

At the end of the last millennium, East Asian countries experienced the most notorious economic crisis ever. The crisis originated in Thailand in mid-1997 and later spread out to other countries. The Asian miracle turned to shame. Because of its unexpectedness and its contagion, research on the Asian crisis has been extensive in the international economic literature. For example, Krugman (1998), Miller and Luangaram (1998), Radelet and Sachs (1998a), and Radelet and Sachs (1999) provide good discussion of the onset of the Asian crisis. Siamwala (1997) also provides the excellent overview of the situation particularly for the crisis in Thailand.

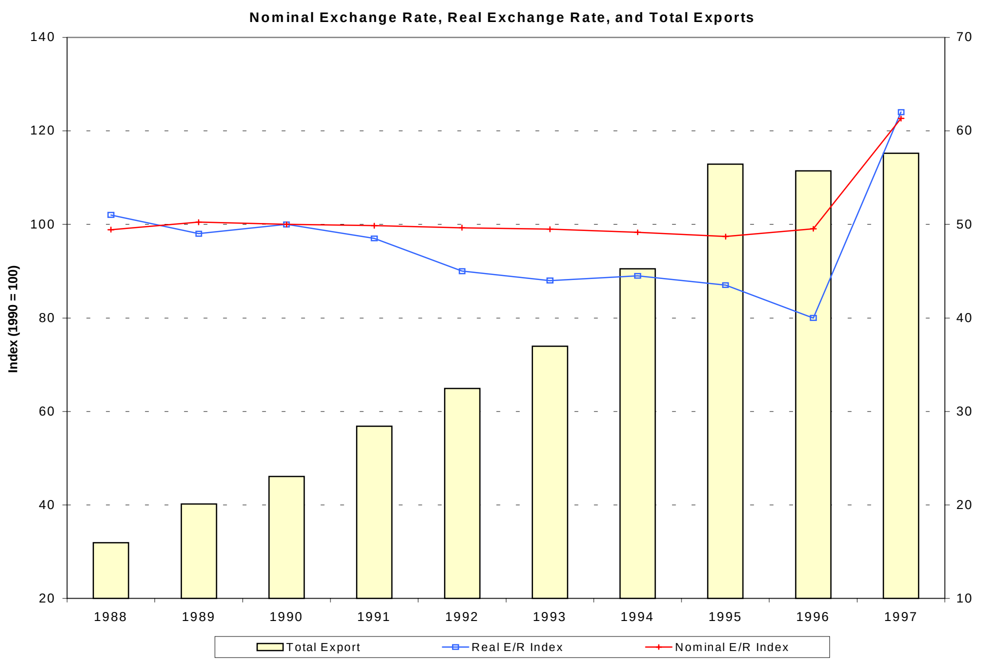
Searching for the cause of the crisis is, of course, beyond the scope this research paper. However, it will be helpful to present some important facts that contributed to the economic crisis in Thailand. Broadly speaking, the crisis in Thailand during 1997-1998 was brought about by three main factors: [1] Fundamental problems and mismanagement in macroeconomic policies, [2] Institutional problems in the financial sector, and [3] A sudden reversal of foreign capital flows.

Fundamental Problems and Mismanagement in Macroeconomic Policies

In the attemp to open up the domestic capital market, the Bangkok International Banking Facility (BIBF) was established in early 1993. The main objective of the BIBF was to fill the investment-saving gap in the country at the time and to make Bangkok a center of the capital market in the Southeast Asia. From Thai authorities' point of view, the benefit from the BIBF was prosperous. To promote the success of the BIBF, a fixed exchange rate regime was maintained to ensure off-shore lenders that the Thai baht wouldl be kept fixed against U.S. dollars in nominal terms. The BIBF was successful. Massive inflow of cheap offshore capital flowed to Thailand. However, it seems that Thai authorities did not think through the entire consequences of these actions. In fact, the consequence of the BIBF was enormous. The combination of the BIBF and a fixed exchange rate system was disastrous.

Opening up the capital account and adopting a fixed exchange rate regime at the same time produced a macroeconomic imbalance. The influx of the foreign capital, resulting from the BIBF, and the economic booms in early 1990s caused domestic prices to rise. Fixing the currency to the appreciating U.S. dollars during 1995-1996, while the country lost its exporting competitiveness, was not a wise thing to do. Several articles suggest that the Thai currency was overvalued, particularly during 1994-1996[6]. Redelet and Sachs (1998a) suggested that Thai currency was overvalued by as much as 20% in real terms. The figure below shows that total exports slowed down in 1996. For the first time, total exports of Thailand declined (-1.3%) in dollar terms.

Figure 3.6: Nominal exchange rate, real exchange rate, and total exports



Sources: Redelet and Sachs (1998a) and Bank of Thailand.

At this point, these fundamental problems were enough to trigger the crisis. With the apparent unsustainability, foreign exchange rate speculators had started to attack Thai baht since 1996. That is, they would sell bahts they did not own for future delivery, hoping to acquire them cheaply before the delivery date. The situation became even

[6] Chinn (1998), Furman and Stiglitz (1998), and Redelet and Sachs (1998a).

worse when the foreign exchange reserves were used to defend the currency. The depletion in international reserves made the country's financial credibility deteriorate.

When the reserves ran out, the Bank of Thailand had no choice but to abandon the fixed exchange rate regime. The baht was floated in July 1997. From 25.78 bahts per dollar in June, the exchage rate had depreciated continuously. By the end of 1997, the exchage rate had sunk to 45.23 bahts per dollar. But that was not the end of the story.

<u>Institutional Problems in the Financial Sector</u>

A massive capital flight from abroad also led to another problem: overinvestment in inefficient and unproductive projects. These external debts were primarily short-term (less than 1 year of maturity) and were uncovered by hedging instruments. Liquidity in the domestic financial market increased immensely as a consequence of the capital account liberalization. Financial institutions could access cheap offshore funds. Without close monitoring from the central bank, moral hazard problems emerged in the financial sector.

A desire to maximize profits encouraged domestic financial institutions to give out loans carelessly. The loans were granted primarily to unproductive sectors, especially to real estate projects. Land was used as a primary collateral. Prior to the BIBF, there were already signs for the excess supply in real estate sector (Siamwala, 1997). A growing number of non-performing loans (NPLs) made the financial sector in Thailand ever more vulnerable. Liberalization of the capital market is not itself a problem. The main problem was that it lacked institutions and regulations that could closely monitor financial instutions in the market-based system. By the end of 1996, not only was the Thai economy facing external pressure from the real exchange rate appreciation and the declining exports, it was also facing the serious internal problem – the moral hazard in the financial sector.

Table 3.3: External debt and international reserves of Thailand

(Billions of US$)	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total External Debt	43.6	52.1	64.9	100.8	108.7	109.3	105.1	95.1	79.7
Public Sector	13.1	14.2	15.7	16.4	16.8	24.1	31.6	36.2	33.9
Private Sector	30.6	37.9	49.2	84.4	91.9	85.2	73.5	58.8	45.8
Long-term	12.2	15.3	20.2	32.1	44.3	46.9	45.2	39.4	31.1
Short-term	18.4	22.6	29.0	52.3	47.7	38.3	28.3	19.4	14.7
Commercial Bank	5.5	4.0	6.4	10.0	8.4	5.2	2.5	1.6	1.3
BIBF	0.0	6.4	15.1	23.7	20.5	19.2	14.9	7.8	4.1
Non-Bank	12.8	12.3	7.4	18.6	18.8	13.9	10.8	9.9	9.2
Debt/GDP(%)	39.1	41.6	44.9	60.0	59.7	70.1	93.2	77.5	64.9
Intl Resrv/Short-term Debt(%)	112.0	112.4	103.8	70.7	81.1	70.4	103.9	178.0	222.3
Exchange Rate (Bahts/Dollar)	25.40	25.32	25.15	24.92	25.34	31.37	41.37	37.84	40.16
International Reserves	21.2	25.4	30.3	37.0	38.7	27.0	29.5	34.8	32.7

Note: Short-term external debt is defined as debt that has an original maturity of one year or less.
Source: Bank of Thailand

Sudden Reversal of Foreign Capital

When the Thai baht was let float after a huge decline in the international reserves, everyone was sure of the coming disaster. Foreign short-term lenders paniced by fear of not getting their money back, made a sudden reversal. The Thai domestic financial market was then faced a huge liquidity problem. A large number of financial institutions were suspended and bankrupt. After the foreign capital had left, Thailand was left with a liquidity problem in the financial sectors, a collapse in the real estate sector, a crash in the stock market, and a huge amount of non-performing loans

(NPLs). It may now become clear that why the crisis was so severe and its consequences were so deep.

Table 3.4: Net flows of private financial account

(Billions of US$)	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total Net Flows	9.5	10.3	12.0	20.8	18.2	-7.6	-15.5	-13.5	-9.8
Bank	1.9	3.6	13.9	11.2	5.0	-5.7	-12.7	-10.6	-6.6
Commercial bank	1.9	-4.1	3.8	3.1	0.4	-5.2	-3.3	-1.3	-2.6
BIBFs	0.0	7.7	10.1	8.1	4.6	-0.5	-9.5	-9.4	-4.0
Non-bank	7.6	6.7	-1.9	9.6	13.2	-1.9	-2.8	-2.9	-3.2

Source: Bank of Thailand

What do we learn from the crisis? The main lesson that we have painfully learned from the crisis is that we did not carefully think through how the economy actually works and is integrated. In this particular situation, the opening of capital account was done with lax implementation. A free capital account was combined with a fixed exchage rate regime. The financial sector was not well functioning and still not ready for the opening of the capital market. Institutions and regulations were not well established in order to closely monitor financial institutions in the 'market-based' financial system.

All in all, this chapter has summarized the big picture of the Thai economy in aggregate terms. The economy has experience both booms and a bust during the past decade. Beneath these macroeconomic changes the structure of the economy has been evolving over time both in the structure of production and in the demands of the economy. We turn in subsequent chapters to the analysis of the changes in the sectoral detail of the Thai economy.

CHAPTER 4: THE DEMAND SYSTEM FOR PRIVATE CONSUMPTION OF THAILAND: AN EMPIRICAL ANALYSIS

Private consumption expenditure is the most important component in economic models. On the expenditure side, it is the largest part of a country's GDP and the biggest component in the input-output table's final demands. Private consumption is certainly crucial to the determination of gross output of the economy. In the past decade, private consumption expenditure in Thailand took up as much as 56 percent of the country's GDP. The objective of this chapter is to estimate the demand system of the private consumption in Thailand during 1976-1998 and to build the consumption part of the Interdyme model for Thai economy.

Previous study of sectoral private consumption in Thailand is rather limited. Pattamasiriwat, Punyasavatsut, and Santawesuk (2000) employed the simple Linear Expenditure System (LES) to examine the private consumption expenditure in Thailand during 1957-1998. This study used both time-series and cross-sectional data from the national accounts and the Socio-economic survey (SES).

In the empirical consumption literature, the most popular demand system was suggested by Deaton and Muellbauer (1980) - the Almost Ideal Demand System (AIDS). The model was carefully set up by a representative agent's optimization problem, which provides theoretical consistency to the microeconomic consumption theory. However, in practice, the model implies peculiar results in the empirical forecasting model. Namely, the functional form of the budget share equations implies that the sum of real income coefficients must be zero. Therefore, as pointed out by Almon (1996), "increasing real income must ultimately drive the consumption of one or more goods negative, unless, of course, it has no effect at all on budget shares." This feature of AIDS makes it highly unsuitable for modeling long-term growth. Cooper and McLaren (1992) noted this problem and seem to have simply dropped the requirement that the sum of the coefficients on real income should be zero. Thereby they would seem to have lost the property that the budget shares add to 1.0 and that the equations result from optimizing behavior.

Rather than try to repair the dysfunctional AIDS framework, the present study will employ the Perhaps Adequate Demand System (PADS), suggested and applied to four countries by Almon (1996), to estimate 33 private consumption sectors in Thailand. The model was designed to be suitable in a long-term forecasting model. Since the model is not derived by utility maximization, there are no assumptions about a representative agent or a specific form of the utility function. Indeed, Almon also shows that those assumptions are neither necessary nor sufficient conditions for deriving a demand system useful for empirical analysis. The capability of PADS in the long-term forecasting model was discussed in Bardazzi and Barnabani (2000), who employed the model to examine the demand systems in Italy during 1985-1996.

The chapter consists of three main sections: In the first section, there will be a specification of the functional form. Data sources and the estimation procedure will also be discussed in this section. The results of the estimation are discussed in detail in section 2. The last section will be final remarks.

4.1 Functional form, data source, and estimation procedure

Essentially, the PADS functional form suggests that private consumption per capita is a function of real income, change in income, time trend (taste change), own price, and relative prices of complementary and substitute goods.

However, the relative price variables lead to a large number of parameters to be estimated. If there are n consumption sectors, there will be $n(n-1)/2$ coefficients for these variables. Therefore, estimating 33 consumption categories leads to 528 parameters to be estimated for the relative prices. PADS suggests a way to reduce these parameters and still have the possibility of particularly strong substitution or complementarity between or among closely related commodities. This possibility is achieved by putting closely related products into groups and subgroups. Table 4.1 illustrates this idea as applied in TIDY.

Table 4.1: Consumption sectors and the specification of groups

[1] Food	**[5] House Furnishing**
[1.1] Protein	18 Furniture and Furnishings
2 Meat	19 Household equipment
3 Fish	20 Domestic Services
1 Rice and Cereals	21 Other expenditure
4 Milk, Cheese and Eggs	**[6] Transportation**
5 Oil and Fat	**[6.1] Private Transportation**
6 Fruits and Vegetables	24 Personal Transportation Equipment
7 Sugar, Preserves, and Confectionery	25 Operation of Personal Transportation
9 Other food	26 Public Transportation
[2] Beverages	**[7] Recreation**
8 Coffee, Tea, Cocoa, etc.	28 Entertainment
10 Non-alcoholic beverages	29 Hotels, Restaurants, and Cafes
11 Alcoholic beverages	30 Books, Newspapers and Magazines
[3] Dress	31 Other Recreation
13 Footwear	**[8] Ungrouped**
14 Clothing	12 Tobacco
15 Other personal effects	22 Personal Care
[4] Utilities	23 Health Expenses
16 Rent and Water charges	27 Communication
17 Fuel and Light	32 Financial services
	33 Other services

Transportation offers a nice illustration of the grouping idea. Three categories of consumption expenditure relate to transportation:

24 Personal transportation equipment

25 Operation of personal transportation equipment

26 Public transportation

All three categories are put into the Transportation group while the first two are also put into the Private transportation subgroup. We expect complementarity between the two categories in the Private transportation subgroup but substitution between that subgroup and Public transportation.

With the groups and subgroups in mind, we can now write the functional form of the PADS system:

$$x_i(t) = \left(a_i + b_i(y/P) + c_i\Delta(y/P) + d_i t\right)\cdot\left(\frac{p_i}{P}\right)^{-\lambda_i}\prod_{k=1}^{n}\left(\frac{p_i}{p_k}\right)^{-\lambda_k s_k}\cdot\left(\frac{p_i}{P_G}\right)^{-\mu_G}\left(\frac{p_i}{P_g}\right)^{-\nu_g} \qquad [4.1]$$

where;

$$P_G = \left(\prod_{k\in G} p_k^{s_k}\right)^{1/\sum_{k\in G} s_k},\ P_g = \left(\prod_{k\in g} p_k^{s_k}\right)^{1/\sum_{k\in g} s_k}\ and\ P = \prod_{k=1}^{n} p_k^{S_k} \qquad [4.2]$$

Equation [4.1] above represents the PADS functional form. The dependent variable x_i on the left-hand-side is a per capita private consumption in sector *i*. P_G, P_g, and P defined in equation [4.2] refer to the price index of group *G*, the price index of subgroup *g*, and the general price level, respectively. S_k is the expenditure share of product *k* of total consumption expenditure. The p_i and p_k are prices of consumption sectors *i* and *k*, respectively. Finally, *t* is a time trend, and *y* is per capita income.

The a_i, b_i, c_i, d_i, λ_i, μ_G, and ν_g are all parameters. The number of λ_i's to be estimated equals the number of consumption sectors. In addition, there will be one μ_G for each group and one ν_g for each subgroup. Positive (negative) μ_G implies substitution (complementary) within group *G* and, similarly, positive (negative) ν_g implies a substitution (complementary) within subgroup *g*.

According to the PADS functional form in equation [4.1], one may be able to derive its properties of demand. The own-price elasticity and the cross-price elasticity can easily be derived. Each of these price elasticities will be a function of λ_i, μ_G, and ν_g. For example, the own-price elasticity of the consumption in sector *i* is[7];

$$\varepsilon_{i,i} = -\lambda_i (1-2s_i) - \sum_{k=1}^{n} \lambda_k s_k \qquad \text{if } i \notin G \text{ and } i \notin g \qquad [4.3]$$

$$\varepsilon_{\substack{i,i \\ i \in G}} = -\lambda_i (1-2s_i) - \sum_{k=1}^{n} \lambda_k s_k - \mu_G \Big(1 - \frac{s_i}{\sum_{k \in G} s_k}\Big) \qquad \text{if } i \in G \qquad [4.4]$$

$$\varepsilon_{\substack{i,i \\ i \in G, i \in g}} = -\lambda_i (1-2s_i) - \sum_{k=1}^{n} \lambda_k s_k - \mu_G \Big(1 - \frac{s_i}{\sum_{k \in G} s_k}\Big) - \nu_g \Big(1 - \frac{s_i}{\sum_{k \in g} s_k}\Big) \text{ if } i \in G \text{ and } i \in g \quad [4.5]$$

Equation [4.3] presents the price elasticity of a sector which is ungrouped. Equation [4.4] refers to the price elasticity of a sector which is a member of a group G, but not of a subgroup. Finally, equation [4.5] represents the price elasticity of a sector which is member of a group G and of a subgroup g.

The λ_i and s_i are specific to a category; however, μ_G and ν_g are common within the same group and subgroup. Thus, the last two equations of price elasticities indicate that price elasticities of grouped sectors share common parameters. This is worth mentioning because it helps us on how the undesired results can be constrained. More detail will be discussed below.

[7] One may derive these equations by taking log in equation [4.1], differentiating it with respect to $ln(p_i)$, and rearranging terms.

4.2 DATA SOURCE AND THE ESTIMATION PROCEDURE

Sectoral time series of the private consumption expenditures were obtained from the national accounts published by the National Economic and Social Development Board (NESDB) of Thailand. The time series for personal disposable income and population were also obtained from the same source. The estimation procedure follows a non-linear least-squares estimation, using the Marquardt algorithm to fit the non-linear system. A list of private consumption sectors and the specification of groups and subgroups has already been presented in Table 4.1 above.

It is important to note that, to achieve sensible results, a number of "soft constraints" were applied. The method of soft constraints is similar to Bayesian regression but is more direct. For example, to softly constrain the coefficient on the income variable to be 0.5, an artificial observation is added that is fit exactly when 0.5 is the coefficient on the income variable. Naturally, adding such an observation moves the estimate towards 0.5. Adding another such observation shifts the estimate further towards 0.5. The more artificial observations it adds, the closer estimated coefficient it is to the desired value. The method thus arranges a compromise between closeness of fit to the data and plausibility of the estimated parameters.

There is no one right way to impose soft constraints. However, the value of a set of soft constraints can be judged by the reasonableness of the results of the estimation. Reasonable results should have positive income elasticities in all sectors, negative own-price elasticities in all sectors, and intuitively plausible values of estimated coefficient of *DInc*, and of μ, and ν.

In addition, a plausible relation between estimated income elasticity and a time trend coefficient for each sector should be maintained. Generally, income variables are closely correlated with the time trend since they are both normally growing through time. The regression process, therefore, often fails to identify reasonable values for the two separately. It may well produce an optimal fit with a very strong positive income effect and a negative time trend, or vice versa.

In order to arrive at the results presented below, soft constraints were applied to each consumption sector, one-by-one. The constraining procedure started at sectors that seem to have the least problem and the least complicated term of price elasticity. That is, I began the process with ungrouped sectors. Soft constraints were applied, if required, to each of those ungrouped sectors to deliver sensible results mentioned above. Then, the process continued with sectors that are in a group which has no subgroup. Next, soft constraints were applied to sectors that are in a group that contains a subgroup. Sectors in subgroups are the last ones that were constrained. This method is particularly helpful for keeping track of how a price elasticity changes after it has been constrained because price elasticities of sectors that are in the same group are interrelated.

4.3 RESULTS AND DISCUSSION

An Overview: The Analysis at Group Levels

The analysis begins with the relationship between demands for goods within each group. Thirty-three private consumption sectors of Thailand were grouped into seven groups and two subgroups. Six consumption sectors remained ungrouped. As implied by the PADS functional form, values of μ and ν indicate whether goods within each group and subgroup, respectively, are complements or substitutes. As a reminder, a positive μ_G implies substitution within group G, while its negative value implies complementarity. A similar inference also applies for the value of ν_g at subgroup level. Table 4.2 below presents the estimated values of μ and ν.

Table 4.2: Estimated values of μ's and ν's

Group	μ	Subgroup	ν
1. Food	0.70	i. Protein	1.02
2. Beverages	0.47		
3. Dress	-0.94		
4. Utilities	-0.44		
5. Housing furnishing	-0.19		
6. Transportation	0.97	ii. Private transportation	-1.00
7. Recreation	-0.77		

Within the Food group, the result implies that demands for food are substitutes. The value of μ_1 is positive and equals to 0.70. Interestingly, as the sectors that give similar dietary source were further added into a subgroup, namely the Protein subgroup, the estimated value of ν_1 (1.02) shows a stronger substitution effect. According to Table 4.3 below, the Food group has accounted for by far the largest expenditure share.

Particularly, Thai people have spent 21.3% of their total consumption expenditure on food.

The second group is Beverages. Similar to those in the Food group, demands for consumption in this group are also substitutes; however, μ_2 (0.47) shows less substitution. The explanation could be that some products in the Beverages group, such as alcoholic beverages and coffee, have a habit-forming property. In contrast to

Table 4.3: Expenditure shares by group

Group	Share	Ungrouped Sectors	Share
1. Food	0.213	Tobacco	0.021
Protein	(0.057)	Personal care	0.017
2. Beverages	0.078	Health expenses	0.075
3. Dress	0.115	Communication	0.009
4. Utilities	0.085	Financial services	0.011
5. House furnishing	0.094	Other services	0.010
6. Transportation	0.127		
Private transportation	(0.082)		
7. Recreation	0.145	Total	1.000

the Food group, however, the expenditure share in Table 4.3 shows that the Beverages group has accounted for the smallest share of any group.

The next group is the Dress group. The negative μ_3 (-0.94) shows that demands for consumption in this group are highly complements. In Thailand, a nice dress would go with a nice pair of shoes. Price decreases in Clothing, for example, could also lead to an increase in consumption in Footwear. Thai people devote 11.5% of their total consumption spending to this group.

Demands for consumption in the Utilities group show complementarity with an estimated μ_4 of -0.44. Intuitively, this group actually consists of Rent and water, and Fuel and light. Therefore, a high rent may imply more space and more luxury, which could cause a higher bill for lighting. The value of μ_5 for the House furnishing group equals -0.19, which also implies a little complementarity within group. A similar explanation also holds for this group.

The next group is the Transportation. There is also the Private transportation subgroup specified in this group. The value of μ_6, which equals to 0.97, implies that private transportation and public transportation are substitutes. The higher the costs of using private cars, the more likely that Thai consumers would commute by public transportation. The value of v_2 for the Private transportation subgroup is negative and equals to -1.00, which indeed suggests strong complementarity between the cost of purchasing a car and the cost of running a car. This is a very interesting and reassuring outcome. The last group is the Recreation. The estimated μ_7 (-0.77) indicates complementarity of demands within this group.

The Analysis of 33 Private Consumption Sectors

This section will present results of the estimation in detail. The results of all 33 private consumption sectors will be presented and carefully discussed. Table 4.4 below presents results of all 33 Thai private consumption sectors.

Table 4.4: Results for 33 sectors

Results by product:

The value of L is 0.26

The mu: 0.70 0.47 -0.94 -0.44 -0.19 0.97 -0.77

The nu: 1.02 -1.00

nsec	title	G	S	P	C	T	I	lamb	share	IncEl	DInc	time%	PrEl	Err%	rho
1	Rice and Cereals	1	0	1	1	1	1	-0.53	0.056	0.10	-0.56	-0.21	-0.30	0.56	0.68
2	Meat	1	1	1	1	1	1	-0.68	0.045	0.29	-0.66	0.00	-0.41	3.40	0.66
3	Fish	1	1	1	1	1	1	-0.31	0.012	0.84	0.39	-2.80	-1.42	12.74	0.49
4	Milk, Cheese and Eggs	1	0	1	1	1	1	-0.80	0.016	1.25	-0.58	-0.32	-0.13	7.71	0.81
5	Oil and Fat	1	0	1	1	1	1	-0.63	0.009	1.22	-0.04	0.34	-0.31	3.64	0.64
6	Fruit and Vegetables	1	0	1	1	1	1	-0.53	0.048	0.62	-0.75	-0.01	-0.33	3.34	0.10
7	Sugar, Preserves and C	1	0	1	1	1	1	-0.66	0.009	1.06	-0.63	-0.15	-0.28	1.78	0.55
8	Coffee, Tea, Cocoa, et	2	0	1	1	1	1	-0.50	0.003	1.31	-0.92	-0.27	-0.22	2.92	0.61
9	Other Food	1	0	1	1	1	1	-0.71	0.018	0.55	-0.73	-0.71	-0.21	4.09	0.52
10	Non-alcoholic beverage	2	0	1	1	1	1	-0.06	0.034	1.33	-0.38	-0.05	-0.47	5.50	0.46
11	Alcoholic beverages	2	0	1	1	1	1	0.63	0.041	1.37	-2.57	-0.05	-1.06	5.15	0.58
12	Tobacco	0	0	1	1	1	1	0.35	0.021	1.02	0.77	-1.65	-0.59	3.48	-0.14
13	Footwear	3	0	1	1	2	1	1.18	0.006	0.30	0.36	13.97	-0.54	3.61	0.43
14	Clothing	3	0	1	1	1	1	0.14	0.099	1.10	0.34	-0.13	-0.23	2.08	0.02
15	Other personal effects	3	0	1	1	2	1	0.96	0.010	0.85	1.30	10.50	-0.35	11.88	0.39
16	Rent and Water charges	4	0	1	1	1	1	0.26	0.066	0.89	-0.94	-0.22	-0.39	3.80	0.82
17	Fuel and Light	4	0	1	1	1	1	0.31	0.019	0.86	-0.73	0.97	-0.22	4.54	0.88
18	Furniture and Furnishi	5	0	1	1	1	1	1.63	0.021	1.14	1.35	-0.10	-1.67	6.63	0.61
19	Households Equipment	5	0	1	1	1	1	0.96	0.056	1.79	0.02	-0.04	-1.04	5.11	0.79
20	Domestic services of H	5	0	1	1	1	1	2.12	0.003	0.62	3.62	-1.48	-2.18	11.51	0.66
21	Other expenditures of	5	0	1	1	1	1	0.28	0.014	1.44	-0.50	-0.52	-0.37	5.68	0.90
22	Personal care	0	0	1	1	1	1	0.71	0.017	1.08	-0.05	-0.17	-0.94	3.73	0.78
23	Health expenses	0	0	1	1	1	1	1.31	0.075	0.91	1.19	0.50	-1.38	4.74	0.71
24	Personal transportatio	6	2	1	1	1	1	0.42	0.047	1.63	3.64	-0.05	-0.82	12.50	0.65
25	Operation of personal	6	2	1	1	1	1	0.09	0.035	1.71	-0.83	-0.07	-0.47	4.63	0.84
26	Purchased transportati	6	0	1	1	1	1	-0.48	0.044	0.76	-0.02	-0.03	-0.44	3.05	0.55
27	Communication	0	0	1	1	3	1	0.09	0.009	1.27	1.59	25.68	-0.35	4.34	-0.02
28	Entertainment	7	0	1	1	1	1	0.86	0.002	0.80	-3.56	-0.48	-0.36	11.72	0.83
29	Hotels, Restaurants, a	7	0	1	1	1	1	0.47	0.103	1.01	1.16	0.01	-0.41	4.12	0.70
30	Books, Newspapers, and	7	0	1	1	1	1	0.63	0.013	1.16	0.57	-0.37	-0.17	6.24	0.71
31	Other Recreation	7	0	1	1	1	1	0.93	0.027	1.49	0.26	-0.10	-0.51	3.68	0.48
32	Financial services	0	0	1	1	1	1	0.28	0.011	1.77	1.47	-0.15	-0.53	6.08	0.70
33	Other services	0	0	1	1	1	1	0.54	0.010	0.94	1.10	-0.32	-0.79	7.50	0.75

Meaning of Columns:

Columns G and S , respectively, represent numbers of groups and subgroups to which a sector belongs. Since the estimation allows flexibility in type of dependent variables, numbers in the P, C, and T columns represent types of population series, types of cstar series (real income), and types of time trend series that were used for a sector. In this case, there is only one type of series for each of population variable and cstar variable. However, there are three types of time trend variables; a normal time trend variable, which is simply a series of years, and special time trend variables for Footwear, Other personal effects, and Communication. These special time trends capture the explosive growth in consumption in these sectors during 1990s. Column I indicates the inclusion code, where code '1' refers to a situation that a sector is price sensitive and price terms were included in the system estimation. However, if a sector is price insensitive (for example, goods that are paid for by a third party such as the government), the inclusion code would be '0'.

The *Lamb* and *Share* columns are estimated λ_i parameter and expenditure share s_i for the consumption sector *i*. The *IncEl* column is the implied income elasticity; while, *DInc* column represents a ratio of the coefficient on income change to the coefficient on income variable. The value in the *Time%* column shows the percentage change in consumers' demands caused by the passage of one year, holding income and price constant. More precisely, it is the coefficient on the time trend expressed as a percent of the value of the dependent variable in the last year. The next column, labeled *PrEl* shows the estimated own price elasticity for each consumption sector. The *Err%*

column shows the standard error of estimate as a percent of the average of the last five historical years. Finally, the *Rho* is an autocorrelation coefficient of the residuals.

Discussion of the Results:

The discussion of results will be taken in the order of groups. The analysis will begin with the Food group. Finally, some of those ungrouped sectors will be examined.

Group 1: Food

There are eight consumption sectors that were specified in the Food group. As indicated in the previous section, demands for food are substitutes. Two consumption sectors that are likely to be closely substituted due to their dietary value, namely Meat and Fish, were further grouped into the Protein subgroup. Indeed, the result shows that they are highly substitutable for each other. It should be remarked that although the Milk, cheese and eggs group also provides protein, it was not included in the Protein subgroup on purpose. The reason is simple. Milk, cheese and eggs affect consumers' choices differently. For example, when one has to make a choice during a meal, he may have to choose between Meat and Fish. However, those dishes may be cooked with eggs or cheese. Moreover, we normally have milk in the morning without concerning whether we will have Meat or Fish at dinner. Table 4.5 below reproduces estimated results for consumption sectors in the Food group.

Table 4.5: Results for Food group

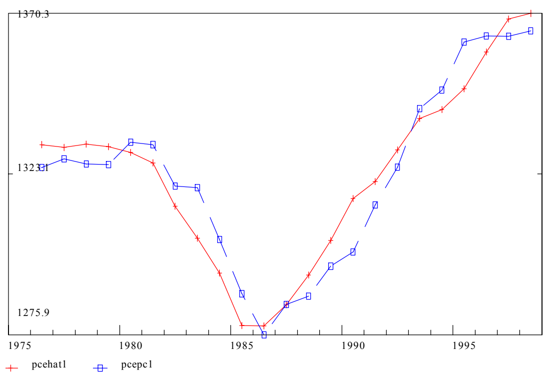
nsec	title	G	S	P	C	T	I	lamb	share	IncEl	DInc	time%	PrEl	Err%	rho
1	Rice and Cereals	1	0	1	1	1	1	-0.53	0.056	0.10	-0.56	-0.21	-0.30	0.56	0.68
2	Meat	1	1	1	1	1	1	-0.68	0.045	0.29	-0.66	0.00	-0.41	3.40	0.66
3	Fish	1	1	1	1	1	1	-0.31	0.012	0.84	0.39	-2.80	-1.42	12.74	0.49
4	Milk, Cheese and Eggs	1	0	1	1	1	1	-0.80	0.016	1.25	-0.58	-0.32	-0.13	7.71	0.81
5	Oil and Fat	1	0	1	1	1	1	-0.63	0.009	1.22	-0.04	0.34	-0.31	3.64	0.64
6	Fruit and Vegetables	1	0	1	1	1	1	-0.53	0.048	0.62	-0.75	-0.01	-0.33	3.34	0.10
7	Sugar, Preserves and C	1	0	1	1	1	1	-0.66	0.009	1.06	-0.63	-0.15	-0.28	1.78	0.55
9	Other Food	1	0	1	1	1	1	-0.71	0.018	0.55	-0.73	-0.71	-0.21	4.09	0.52

The expenditure share suggests that Thai people have spent their food budget primarily on Rice, Meat, and Fruit and vegetables. Particularly, their shares are 5.6%, 4.5%, and 4.8%, respectively. Expenditure shares of these three sectors account for more than half of the Food group.

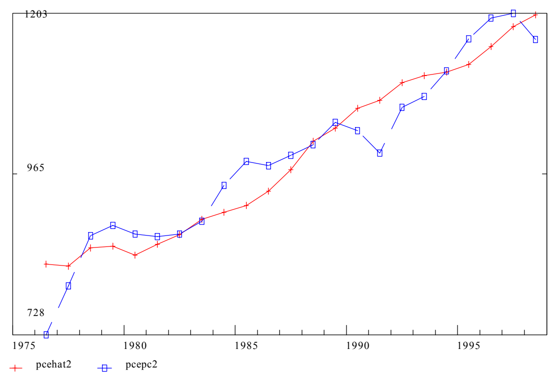
Income elasticities also give us intuitive results. The majority of the consumption sectors in this group have income elasticity less than 1, which implies that food is necessary good. Interestingly, among all of the 33 consumption sectors, Rice has the lowest income elasticity. Price elasticities also imply sensible results. Except for Fish, all price elasticities in these sectors are less than 1 in absolute value. That is, demands for food are inelastic with respect to price changes. Finally, time trend coefficients are, in general, close to 0.

Within the Protein subgroup, although Meat and Fish provide similar dietary values, characteristics of their demands with respect to changes in income, prices, and time trend are quite different. Expenditure on Fish seems to be price elastic while Meat is not. Consumption of Fish also declined through time. Fish has positive *DInc* value, implying that, as the incomes increase, Thai consumers will increase their consumption on these sectors at the higher rate.

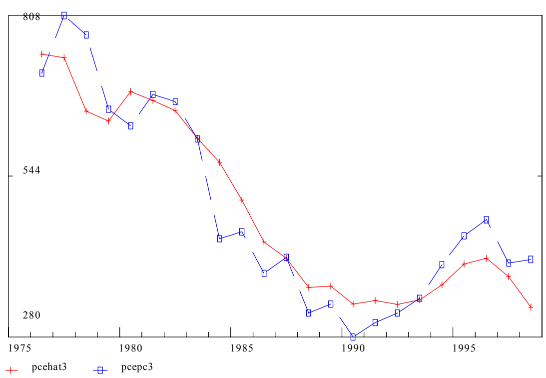
1.Rice and Cereals



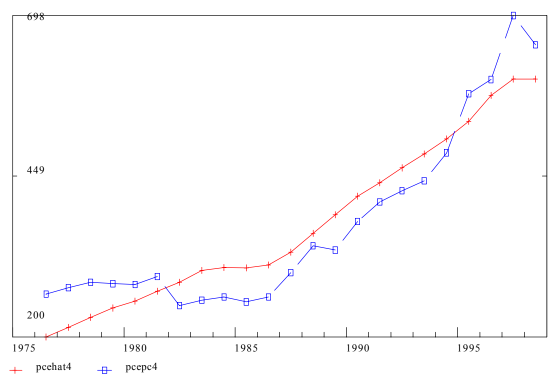
2.Meat



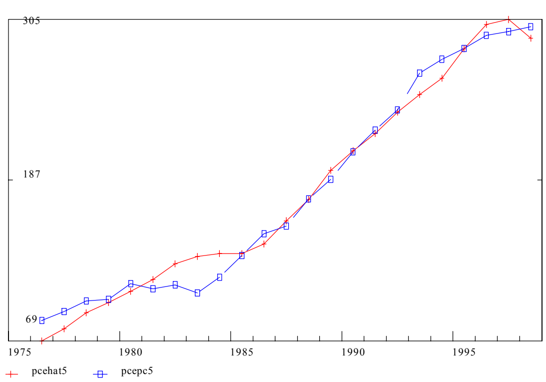
3.Fish



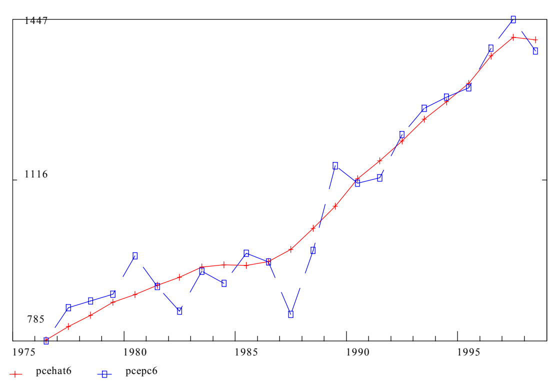
4.Milk, Cheese and Eggs



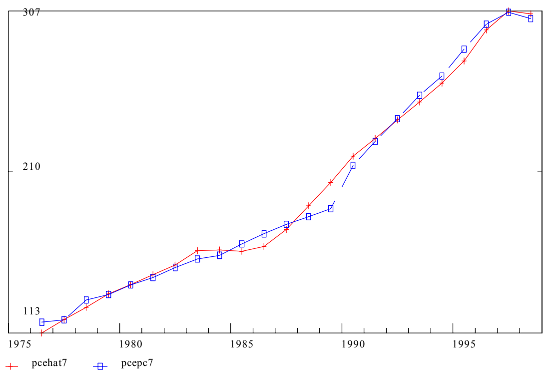
5.Oil and Fat



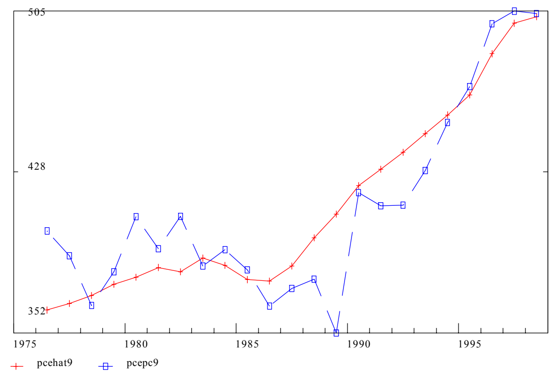
6.Fruit and Vegetables



7.Sugar, Preserves and Confectionery



9.Other Food



Group 2: Beverages

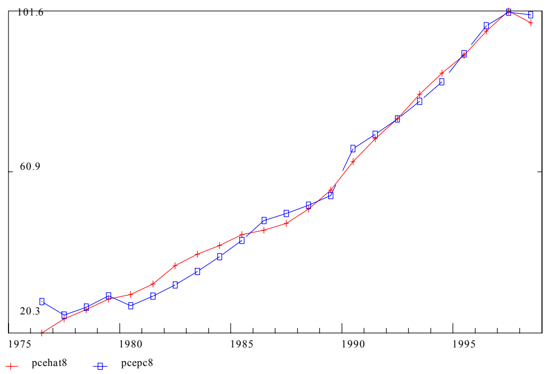
There are three consumption sectors specified in this group, namely, Coffee, tea, cocoa, Non-alcoholic beverages, and Alcoholic beverages. As mentioned in the previous section, consumption goods in Beverages group are substitutes. The results in sectoral detail is presented in table 4.6 below:

Table 4.6: Results for Beverages group

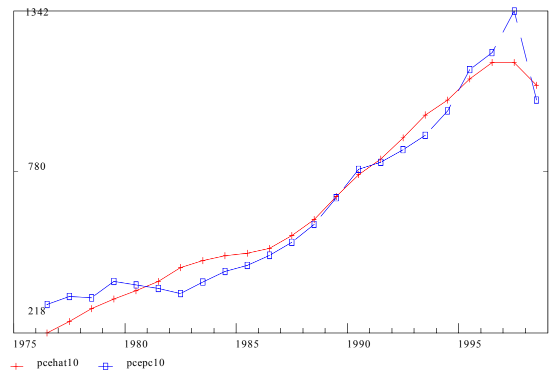
nsec	title	G	S	P	C	T	I	lamb	share	IncEl	DInc	time%	PrEl	Err%	rho
8	Coffee, Tea, Cocoa, et	2	0	1	1	1	1	-0.50	0.003	1.31	-0.92	-0.27	-0.22	2.92	0.61
10	Non-alcoholic beverage	2	0	1	1	1	1	-0.06	0.034	1.33	-0.38	-0.05	-0.47	5.50	0.46
11	Alcoholic beverages	2	0	1	1	1	1	0.63	0.041	1.37	-2.57	-0.05	-1.06	5.15	0.58

Thai consumers spent 7.8% of their total consumption expenditure on this three-category group, a quarter of the total spending on food and beverages. The estimation indicates that income elasticities are all greater than 1. These drinks do not include plain water and they are all considered as luxury goods, especially alcoholic beverages. Except for Alcoholic beverages, price elasticities are less than 1 in absolute terms, implying that the demands are inelastic.

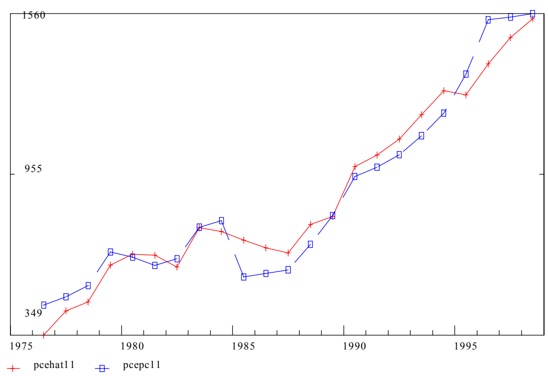
8.Coffee, Tea, Cocoa, etc.



10.Non-alcoholic beverages



11.Alcoholic beverages



Group 3: Dress

There are three consumption sectors specified in the Dress group: Footwear, Clothing, and Other personal effects. According to table 4.2, estimated μ_3 (-0.94) implies that these goods are highly complementary. Table 4.7 below summarizes the results of this group:

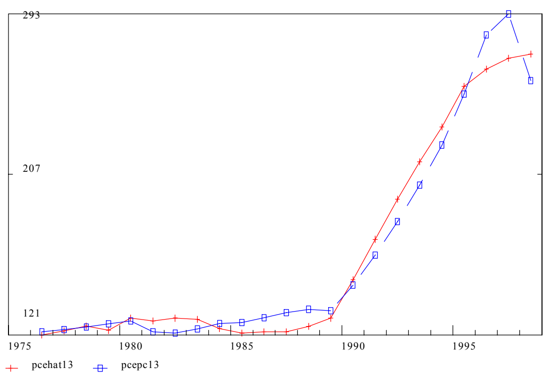
Table 4.7: Results for Dress group

nsec	title	G	S	P	C	T	I	lamb	share	IncEl	DInc	time%	PrEl	Err%	rho
13	Footwear	3	0	1	1	2	1	1.18	0.006	0.30	0.36	13.97	-0.54	3.61	0.43
14	Clothing	3	0	1	1	1	1	0.14	0.099	1.10	0.34	-0.13	-0.23	2.08	0.02
15	Other personal effects	3	0	1	1	2	1	0.96	0.010	0.85	1.30	10.50	-0.35	11.88	0.39

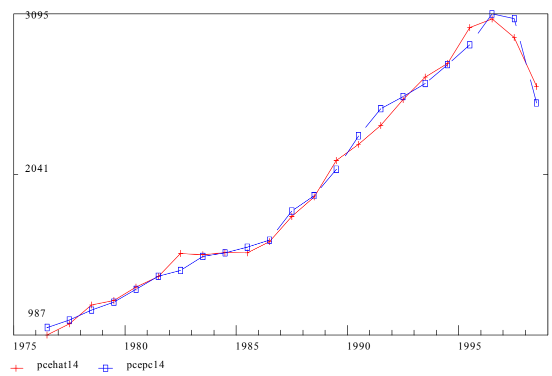
It is important to point out that Clothing has a very large expenditure share. Actually, it is the second largest share of all sectors. About 9.9% of the total consumption expenditure has been allocated to it. Nonetheless, the income elasticity indicates that clothing remains a luxury good. Therefore, as per capita income increases, Thai people will increase expenditure on clothing more than proportionally.

The demands for Dress seem to be inelastic to prices change. Price elasticities are all less than 1 in absolute terms.

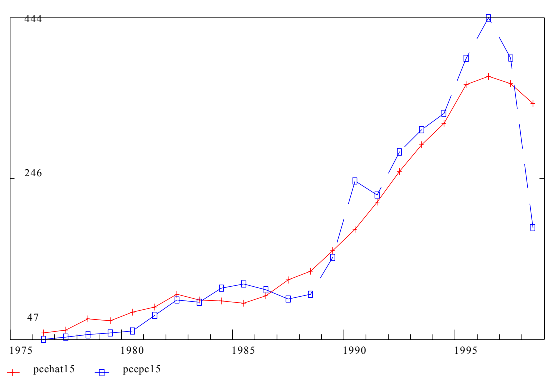
13.Footwear



14.Clothing



15.Other personal effects

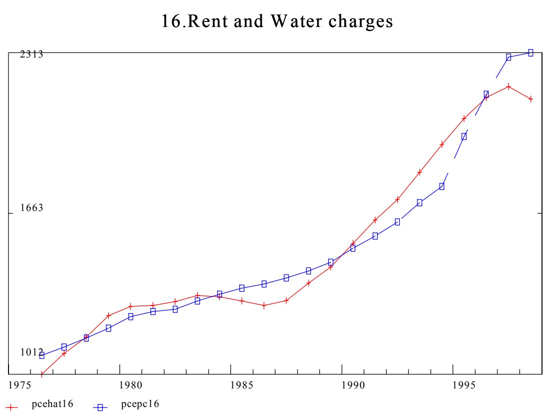


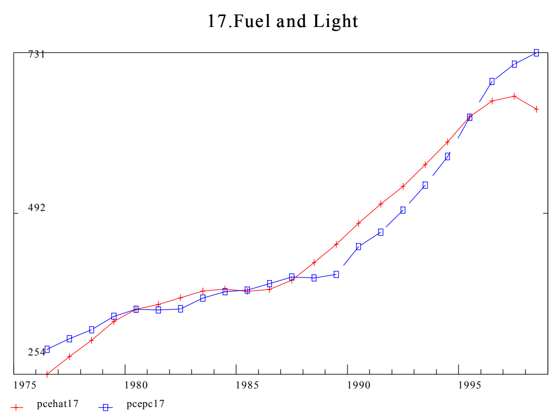
Group 4: Utilities

This group contains Rents and water charges, and Fuel and light. Although the Utilities group contains only two consumption sectors, this group was specified because Rents and Fuel share similar characteristic: consumers must pay these bills monthly. By grouping them together, I anticipated a significant complementarity within this group. This argument was confirmed. The estimated μ_4 equals to –0.44, which suggests that utility bills are complements.

Table 4.8: Results for Utilities group

nsec	title	G	S	P	C	T	I	lamb	share	IncEl	DInc	time%	PrEl	Err%	rho
16	Rent and Water charges	4	0	1	1	1	1	0.26	0.066	0.89	-0.94	-0.22	-0.39	3.80	0.82
17	Fuel and Light	4	0	1	1	1	1	0.31	0.019	0.86	-0.73	0.97	-0.22	4.54	0.88





The expenditure share of the Rent and water charges is about three times larger than that of the Fuel and light sector. Income elasticities and price elasticities suggest sensible values. Income elasticities are less than 1 and equal to 0.89 and 0.86, respectively. Utilities are certainly necessary goods. Price elasticities also imply that demands for these goods are inelastic to prices change. Time trend coefficient for

Fuel and light also shows a positive value. This is not a surprising outcome. Thai people have been consuming more energy during the past decades.

Group 5: House Furnishing and Operation

There are four consumption sectors in this group: Furniture and furnishings, Households equipment, Domestic services, and Other expenditures. The estimated μ_5 presented in table 4.2 indicates that consumption goods in this group are complements. The detail results for each sector are shown below:

Table 4.9: Results for House furnishing group

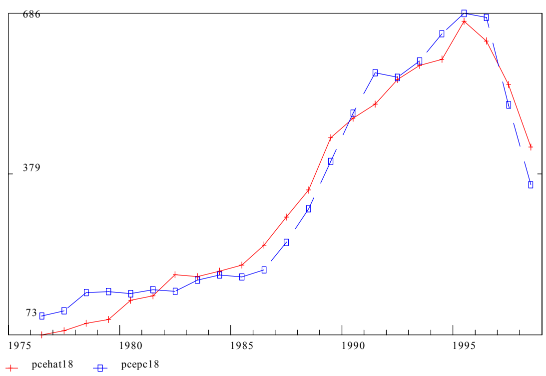
nsec	title	G	S	P	C	T	I	lamb	share	IncEl	DInc	time%	PrEl	Err%	rho
18	Furniture and Furnishi	5	0	1	1	1	1	1.63	0.021	1.14	1.35	-0.10	-1.67	6.63	0.61
19	Households Equipment	5	0	1	1	1	1	0.96	0.056	1.79	0.02	-0.04	-1.04	5.11	0.79
20	Domestic services of H	5	0	1	1	1	1	2.12	0.003	0.62	3.62	-1.48	-2.18	11.51	0.66
21	Other expenditures of	5	0	1	1	1	1	0.28	0.014	1.44	-0.50	-0.52	-0.37	5.68	0.90

Within this group, Thais have a relatively large expenditure share on Household equipment. On the other hand, they apportioned the least share on Domestic service (a housemaid).

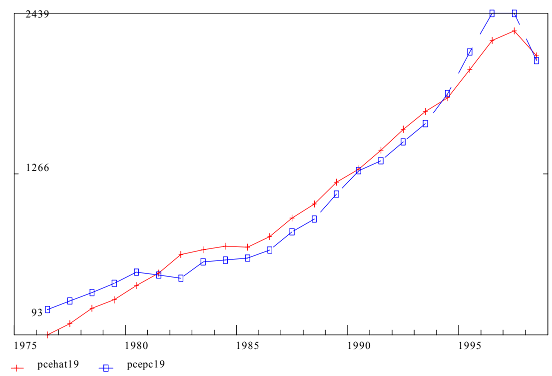
With the exception for Domestic services, income elasticities in other sectors are all greater than 1. Household equipment shows its strong luxury-goods property. All price elasticities are greater than 1 in absolute value. Only the price elasticity of the Other expenditures sector (*i.e.*, expenditure on the maintenance of house furnishing goods and equipment) shows a price inelastic demand. These results are very intuitive because the demands for purchasing furniture and equipment could be price elastic;

however, once the goods are obtained, demand for maintaining them could be relatively more inelastic.

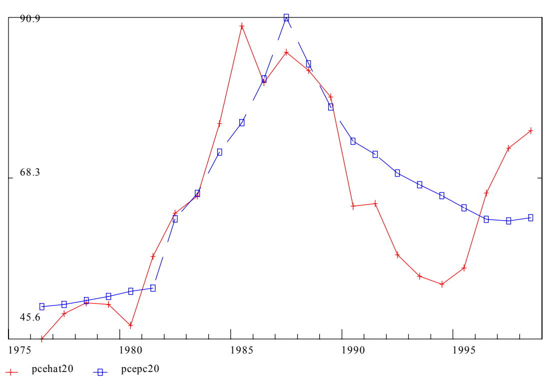
18.Furniture and Furnishings



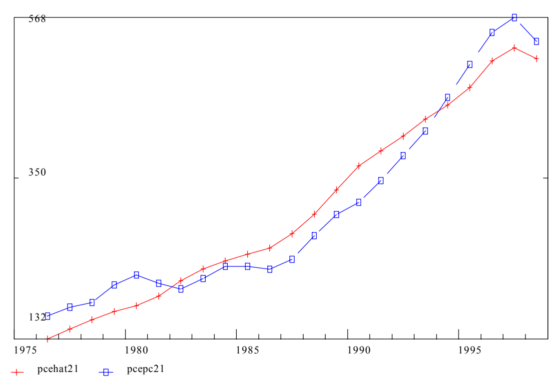
19.Households Equipment



20.Domestic services of Household operation



21.Other expenditures of Household operation



<u>Group 6: Transportation</u>

There are three consumption sectors in this group: Personal transportation equipment, Operation of personal transportation, and Public transportation. The Private transportation subgroup was further specified in order to differentiate expenditures on private cars, which include the cost of a car and its operational costs, from expenditures on public transportation. The intuition is that the expenditure on operational costs of a private car could increase with the cost of a car once a consumer owns it. The more expensive a car is, the higher its running cost. In addition, high cost of operation could discourage the ownership; therefore, these categories can be complement.

On the other hand, a consumer's expenditure on private transportation could decrease in the expenditure on a public transportation. For instance, a consumer may prefer to travel by public bus instead of driving a car if the price of gasoline is relatively high, and vice versa.

By specifying the subgroup, results are expected to show a high complementarity between Personal transportation equipment and Operation of the personal transportation. On the other hand, Private transportation should be substituted for Public transportation. The results and the discussion presented in the previous have proved our argument above.

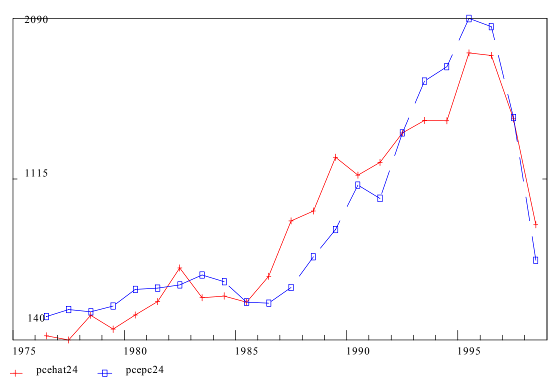
Table 4.10: Results for Transportation group

nsec	title	G	S	P	C	T	I	lamb	share	IncEl	DInc	time%	PrEl	Err%	rho
24	Personal transportatio	6	2	1	1	1	1	0.42	0.047	1.63	3.64	-0.05	-0.82	12.50	0.65
25	Operation of personal	6	2	1	1	1	1	0.09	0.035	1.71	-0.83	-0.07	-0.47	4.63	0.84
26	Purchased transportati	6	0	1	1	1	1	-0.48	0.044	0.76	-0.02	-0.03	-0.44	3.05	0.55

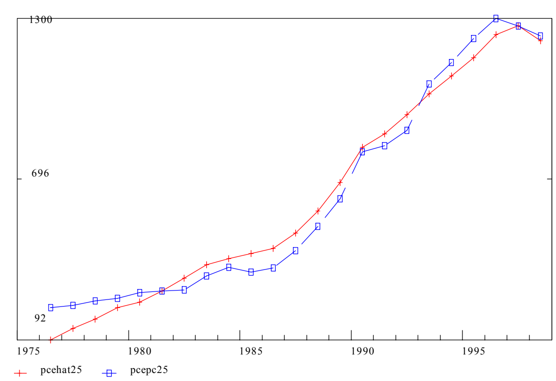
Thais have allocated their budget shares on Private transportation and on Public transportation for 8.2% and 4.4%, respectively. It is interesting that Thai people spent money on public transportation almost as much as that spent on the private cars (4.7%). It implies that the majority of Thai consumers still do not have their own vehicles.

Within the Private transportation subgroup, expenditure share on the costs of personal transportation is larger than the operational costs. This finding is contrast to that found in some developed countries such as the US, Italy, Spain, and France. Almon (1996) reported that the operational costs of cars are about double the costs of purchasing cars in those countries. This is an interesting fact. The results from the current study imply that personal cars in Thailand may be short lived or that the roads are such that the cars are not so much used as in Europe and the USA. .

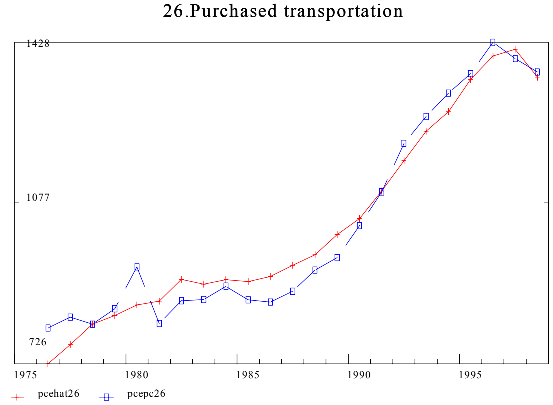
24.Personal transportation equipment



25.Operation of personal transportation equipment



26.Purchased transportation



Income elasticities also give intuitive results. Private cars are luxury goods. They can, of course, represent how well a person lives. On the other hand, Public transportation is a necessity. The income elasticities obtained from the estimation support our argument. Given that the time trend coefficients are all close to zero and the demands are price inelastic, it could be inferred that the dramatic increase in private transportation expenditures since mid 1990s may mainly come from the growing income per capita of the Thai households.

Group 7: Recreation

Four consumption sectors were placed in this group: Entertainment, Hotels and restaurants, Books and newspapers, and Other recreation. These sectors were grouped because they may represent the same type of demand. That is, purchasing of these goods may be not crucial for daily life. However, they provide extra utility for a person when they are consumed. Thus, they should be luxury goods and they are expected to have income elasticities greater than 1.

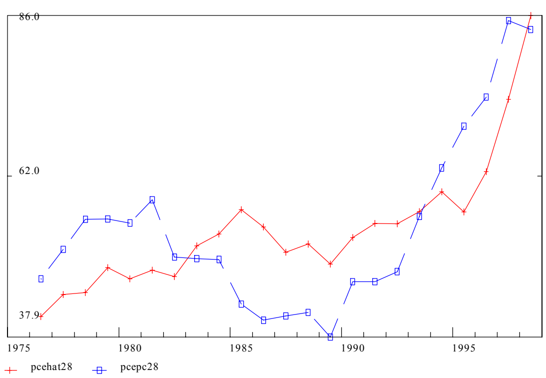
Table 4.11: Results for Recreation group

nsec	title	G	S	P	C	T	I	lamb	share	IncEl	DInc	time%	PrEl	Err%	rho
28	Entertainment	7	0	1	1	1	1	0.86	0.002	0.80	-3.56	-0.48	-0.36	11.72	0.83
29	Hotels, Restaurants, a	7	0	1	1	1	1	0.47	0.103	1.01	1.16	0.01	-0.41	4.12	0.70
30	Books, Newspapers, and	7	0	1	1	1	1	0.63	0.013	1.16	0.57	-0.37	-0.17	6.24	0.71
31	Other Recreation	7	0	1	1	1	1	0.93	0.027	1.49	0.26	-0.10	-0.51	3.68	0.48

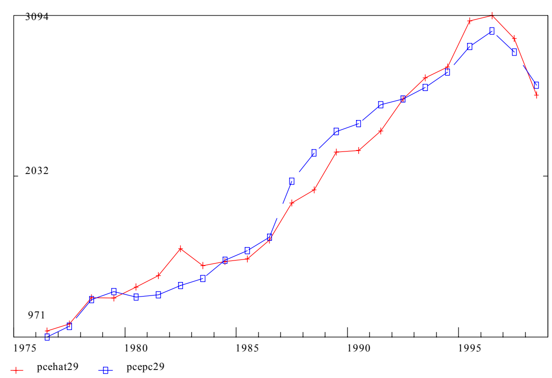
Recall that demands for the goods within this group are complements. Yet, one might question how this complementarity could be explained by real life situations. The interpretation is straightforward. For instance, a consumer may go to a movie theater after dining out.

Income elasticities support the argument made earlier - recreation seems to be a luxury good, and only Entertainment sector has income elasticity less than 1. All price elasticities are less than 1 in absolute terms. It is noteworthy that Hotels and restaurants has the highest consumption share of any one category sectors. Entertainment, by contrast, accounts for the least expenditure of any of the 33 categories.

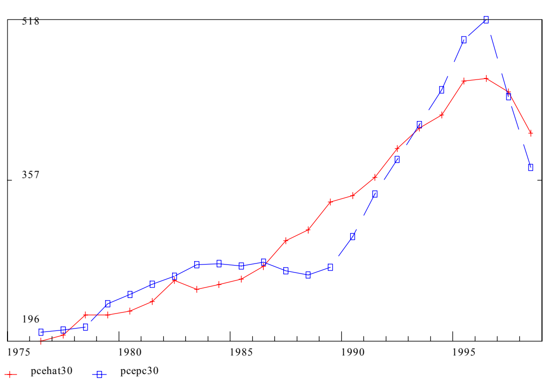
28.Entertainment



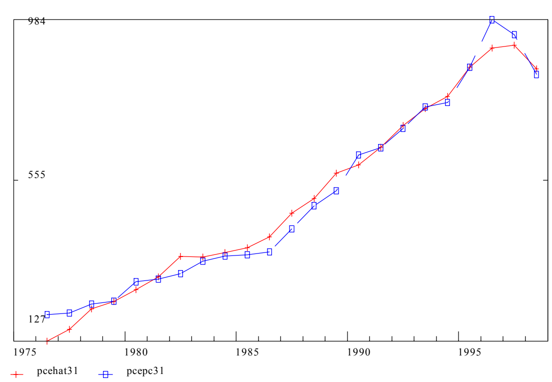
29.Hotels, Restaurants, and Cafes



30.Books, Newspapers, and Magazines



31.Other Recreation



Ungrouped Sectors

There are six consumption sectors that remain ungrouped: Tobacco, Personal care, Health expenses, Communication, Financial services, and Other services. However, some interesting properties of these products will be discussed.

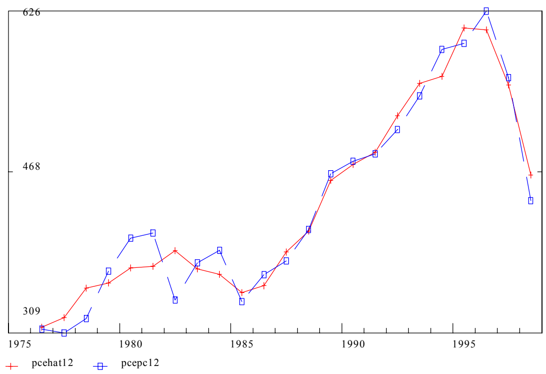
Table 4.12: Results for Ungrouped sectors

nsec	title	G	S	P	C	T	I	lamb	share	IncEl	DInc	time%	PrEl	Err%	rho
12	Tobacco	0	0	1	1	1	1	0.35	0.021	1.02	0.77	-1.65	-0.59	3.48	-0.14
22	Personal care	0	0	1	1	1	1	0.71	0.017	1.08	-0.05	-0.17	-0.94	3.73	0.78
23	Health expenses	0	0	1	1	1	1	1.31	0.075	0.91	1.19	0.50	-1.38	4.74	0.71
27	Communication	0	0	1	1	3	1	0.09	0.009	1.27	1.59	25.68	-0.35	4.34	-0.02
32	Financial services	0	0	1	1	1	1	0.28	0.011	1.77	1.47	-0.15	-0.53	6.08	0.70
33	Other services	0	0	1	1	1	1	0.54	0.010	0.94	1.10	-0.32	-0.79	7.50	0.75

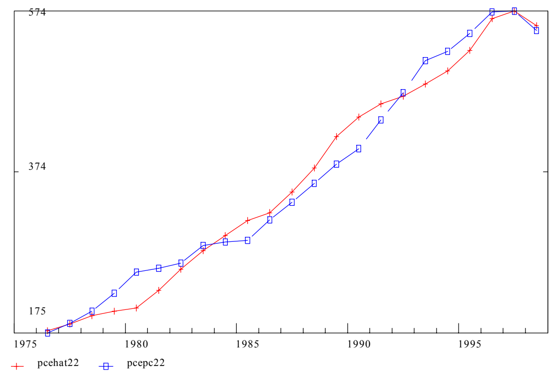
First, a relatively large expenditure share (7.5%) has been spent on Health. Income elasticity suggests that it is necessary; however, health care is elastic with respect to price. This is not surprising. There was still no systematic social health insurance available in Thailand during the estimation period. According to the time trend coefficient, Thai people have, *ceteris paribus*, increasingly paid more attention to health care.

It is also worth mentioning the Communication sector. This product seems to be a luxury good. Although its expenditure share is relatively small, the consumption on Communication has exponential increased since 1990. The time trend coefficient is very high because of the special trend variable was imposed to capture the skyrocket in communication expenditure during these periods.

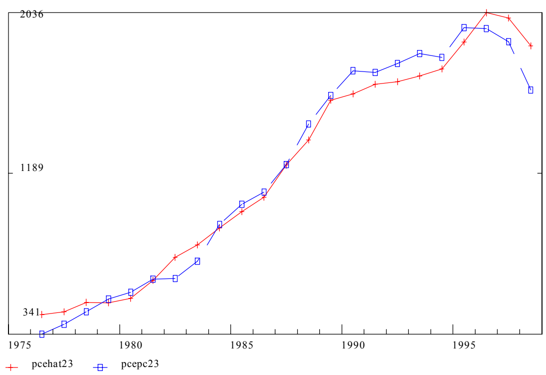
12.Tobacco



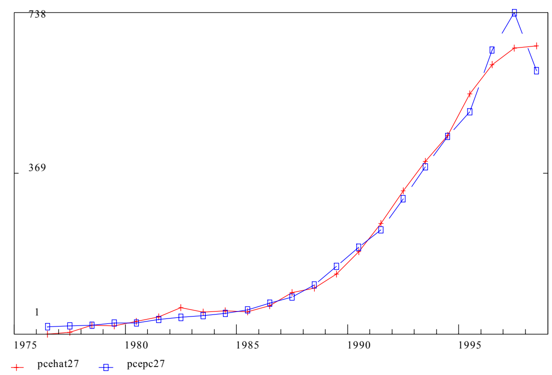
22.Personal care



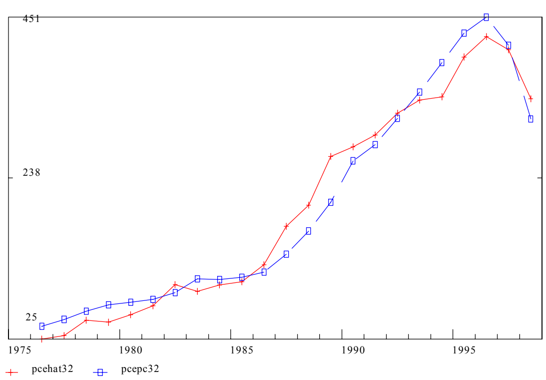
23.Health expenses



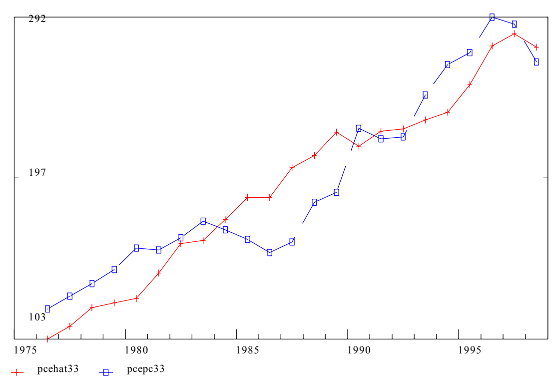
27.Communication



32.Financial services



33.Other services



4.4 CONCLUSION

This study gives us an understanding of the demands for private consumption in Thailand during 1976-1998. It conveys information about the trends of consumers' tastes and their reactions against income and price changes.

The Food group has accounted for the largest consumption share over the past 23 years. However, for an individual sector, Thai people have spent the largest proportions on Hotels and restaurants, Clothing, and Health expenses. Whereas the smallest consumption sector is the Entertainment sector.

Most of sectors have income elasticities greater than 1; however, sectors that show low income elasticities primarily are food products, rent, and utilities. The sector that is most sensitive to income changes is the Personal transportation and the Domestic services (a housemaid).

Price elasticities are less than 1 in absolute terms for most of sectors, indicating that private consumption expenditures are inelastic to price changes. Elastic price elasticities are found only in four sectors: Domestic services, Furniture, Health expenses, and Fish sectors. Sectoral comparison of the income elasticities and the price elasticities implies that income effects dominate consumption pattern of Thai consumers.

Chapter 5: Capital Formation in Thailand and the Accelerator Model of Investment

5.1 Investment growth and the importance of its sectoral decomposition

Fixed investment has become an important part of Thailand's economic development in recent decades. Its proportion in the domestic product has been increasing substantially since the mid 1980s. In 1970, the value of fixed investment was 32 percent of Thailand's GDP. However, by 1996, the year just before the financial crisis, fixed investment had risen to 44 percent of the GDP. Not only is investment necessary for growth of the country but it also generates employment and income for the population. Fixed investment currently plays a crucial role in determining the new economy of Thailand. The objective of this chapter is to examine analytically sectoral investment behavior of Thailand during 1975-1998 and to prepare the investment final demands for the Interdyme model of Thailand.

Why do we need to study investment of the country in sectoral detail? For one reason, values of investment and the relative importance of each sector are not equal. The sectoral composition of investment affects the long term growth of the economy. In addition, the capital-output ratio is very different across industries. Particular capital goods needed by one industry are different from those needed by another. For example, investment by agriculture requires tractors while that by manufacturing requires machinery. Investment behavior in different industries responds differently to economic factors. The share of each sector in investment does not remain constant over time. In fact, the structure of the capital stock in Thailand has changed significantly during the past two decades. The study of investment only in the aggregate cannot clearly convey information on how the structure of production has changed over time.

Figure 5.1: The structure of capital stock of Thailand

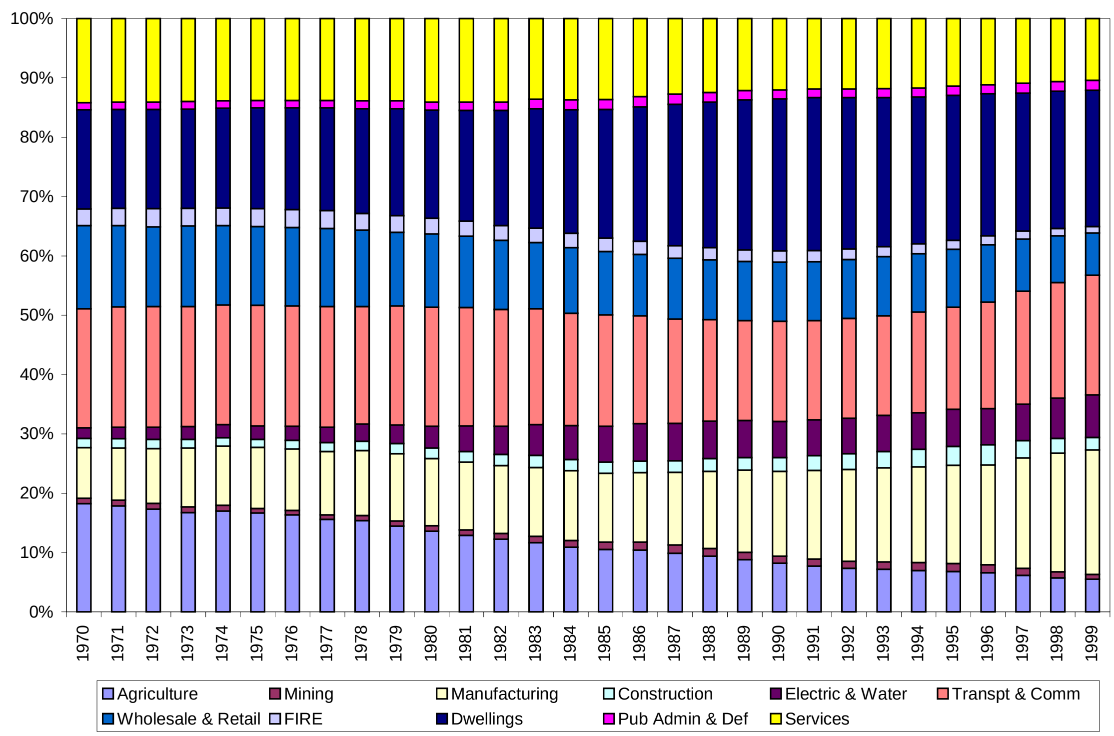


Figure 5.1 above demonstrates why the study of investment in sectoral detail is particularly of interest. The figure presents the evolution of Thailand's capital stock structure during 1970-1999. The vertical axis represents the cumulative proportion of 11 sectoral capital stocks. The first and the third series from the bottom refer to

capital stock shares of Agriculture and Manufacturing sectors, respectively. It can be easily seen from the figure that a reduction in the capital stock share of Agriculture sector was mainly offset by an increase in the Manufacturing's share. Consequently, the structure of production in Thailand has been changed significantly during the past 30 years.

The next section will be a discussion of data availability related to investment and capital stock data as well as a possible methodology for constructing sectoral investment data. Then, in the third section, those sectoral capital formation data will be used to estimate the equations of the investment model. A brief literature review and discussion of the choice of investment model will be included. Estimation results and implications of the study then follow.

5.2 THE CONSTRUCTION OF SECTORAL INVESTMENT DATA FOR THAILAND

The estimation of investment final demands requires time-series data on capital formation in sectoral detail. However, there is no such sectoral investment data for Thailand. Not only could I find none but also major statistical authorities of the country assure me that none exists. Fortunately, there are sectoral capital stock data, published by the National Economic and Social Development Board (NESDB), available from 1970 to 1998. In these data, there are 11 investing sectors. For each sector, there are data for gross capital stock, net capital stock, and annual capital depreciation. From a different source, there is also aggregate investment data, namely, the total Gross Fixed Capital Formation (GFCF), published annually in the

National Income Accounts of Thailand. This series is available from 1952. Before we can estimate investment functions, we must create plausible historical series on sectoral investment flows. To be "plausible", the newly created data must:

[1] have the right total sum, namely the aggregate GFCF published in the National Income Accounts, and

[2] imply, when accumulated over time, capital stocks consistent with those published by NESDB, and

[3] show no negative gross investment.

Methodology

Given the published aggregate investment and the sectoral capital stock data, how can we obtain such plausible sectoral gross investment series? From the capital stock data, which contains net capital stock and annual capital depreciation, the implied gross investment for sector *i* at time *t*, $\hat{I}_{i,t}$, can be obtained simply from the capital accumulation identity:

$$\hat{I}_{i,t} = K_{i,t} - K_{i,t-1} + D_{i,t} \qquad [5.1]$$

where $K_{i,t}$ and $D_{i,t}$ refer to the published net capital stock and annual depreciation, respectively. Unfortunately, these implied sectoral gross investments do not add up to the total GFCF published in the national accounts. To get the right total sum, the implied sectoral gross investment must be scaled. The scaled gross investment for sector *i* at time *t*, $I^*_{i,t}$, that has total sum equal to the published total GFCF can be obtained from:

$$I^*_{i,t} = \frac{\hat{I}_{i,t}}{\sum_i \hat{I}_{i,t}} \mathbf{V}_t \qquad [5.2]$$

where $\hat{I}_{i,t}$ is the initial sectoral gross investment implied by capital stock data, and $\mathbf{V}_t$ is the published total GFCF. Given that the total gross investment implied by capital stock data does not equal to the published total GFCF, that is $\sum_i (K_{i,t} - K_{i,t-1} + D_{i,t}) \neq \mathbf{V}_t$, to obtain capital stock and depreciation data consistent with gross investment data, we must adjust either the capital stocks or the depreciation series. Since each depreciation variable is involved in only one year's identity, it is much easier to adjust depreciation than stocks. As a result, the annual depreciation will be adjusted to make the constructed data on gross investment by industry add up to aggregate investment from the national accounts. The adjusted depreciation $D^*_{i,t}$ is calculated from:

$$D^*_{i,t} = I^*_{i,t} - (K_{i,t} - K_{i,t-1}) \qquad [5.3]$$

where $I^*_{i,t}$ is the scaled sectoral gross investment, and $K_{i,t}$ is the published capital stock. Now, we arrive at the sectoral gross investment flows that have structure similar to those implied by the capital stock of Thailand, that sum up to the published total GFCF, and that accumulate with the adjusted depreciation to the published stock data. The method seems to be simple but reasonable enough to create the series.

Adjustment for Negative Investment

Unfortunately, the results did not totally satisfy the criteria listed earlier. For some sectors, some years, particularly during 1997-1998, the values of gross investment are negative. This result is, of course, nonsense. It arises when $K_{i,t} < (K_{i,t-1} - D_{i,t})$, in other words, when the value of capital stock in period t is less than net value of the previous stock. Therefore, the calculation produces negative gross investment in those years.

If the depreciation for those sectors had been high enough, the relation of $K_{i,t} > (K_{i,t-1} - D_{i,t})$ would have held and the capital stock data would have implied positive gross investment. Therefore, the problem of negative gross investment can be solved by imposing higher depreciation. In fact, the reason why depreciation could be higher is explainable. When the economy faces a depression, such as the Thai crisis of 1997-1998, many firms go out of business and sell their capital at low prices to other companies. The new owner values its assets at their "fire sale" prices. Therefore, the additional mark up of depreciation in these depressed years can be justified by this write-off of capital.

Because we have no clue about how much the depreciation mark up should be, it will not be directly specified. Instead, we will impose maximum decrease in investment during those years to avoid negative gross investment results. When the limit binds –

and it always will where negative gross investment would otherwise be implied - the value of gross investment in that sector will be set by this maximum reduction from the previous year and the implied depreciation will be calculated from $D_{i,t} = I_{i,t} - K_{i,t} + K_{i,t-1}$. In this way, we indirectly impose higher depreciation to those sectors.

For specifying the maximum rates of decline in investment required for this method, the rate of decline of total GFCF in the national accounts will be a good point of reference. From the published data, total GFCF in 1997 and 1998 decreased by 21.7% and 44.2%, respectively. Investment at a sectoral level is certainly more volatile than that at the aggregate level. Therefore, I imposed the maximum limit for the decrease in sectoral investment in 1997 and 1998 to be -50% and -70%, respectively. The implied investment in the remaining sectors, where the limit does not bind, are then re-scaled accordingly in order to make all the sectoral gross investment add up to the published total for GFCF.

Table 5.1 represents the comparison between growth rates of the published total investment (bottom line) and the growth rates of the implied sectoral investment without adjustment of depreciation. In this table, negative gross investment are indicated by growth rates which have values less than -100%.

Table 5.1: Growth of the published total investment and the implied sectoral investment from the capital stock and depreciation data

Growth of the constructed sectoral investment (percent)		***Annual 1977-1986**	***Annual 1987-1996**	**1997**	****1998**
1	Agriculture	3.9	11.2	-54.2	-95.0
2	Mining and Quarrying	13.0	17.4	*-108.5*	*-188.6*
3	Manufacturing	4.5	14.2	55.2	-22.2
4	Construction	13.9	26.4	*-113.7*	*-172.0*
5	Electricity and Water Supply	11.2	13.7	-10.5	84.7
6	Transportation and Communication	-3.1	21.5	-3.2	-35.0
7	Wholesale and Retail Trade	-1.4	14.8	-80.8	*-135.8*
8	Banking, Insurance, and Real Estate	-1.7	5.2	-44.0	*-157.0*
9	Ownership of Dwellings	13.0	8.6	-52.0	-53.0
10	Public Administration and Defense	9.3	12.6	62.9	-37.3
11	Services	2.2	15.2	-28.1	-59.6
Growth of the published total investment (percent)		4.3	14.5	-21.7	-44.2

Note: **Annual compound growth rates with compounding each year.*
***Growth rates in 1998 are obtained after negative investment in 1997 have been solved.*

Negative implied data appear in the Mining and quarrying sector and in the Construction sector in both 1997 and 1998. The Wholesale and retail trade sector and the Banking, insurance and real estate sector also have negatives in 1998.

Sectoral Gross Investment: Results from Data Construction

The sectoral gross investment data in constant 1990 prices for 1971-1998, constructed in the way described, are shown in Table 5.2. Figure 5.2 depicts graphically the results of constructed sectoral gross investment series.

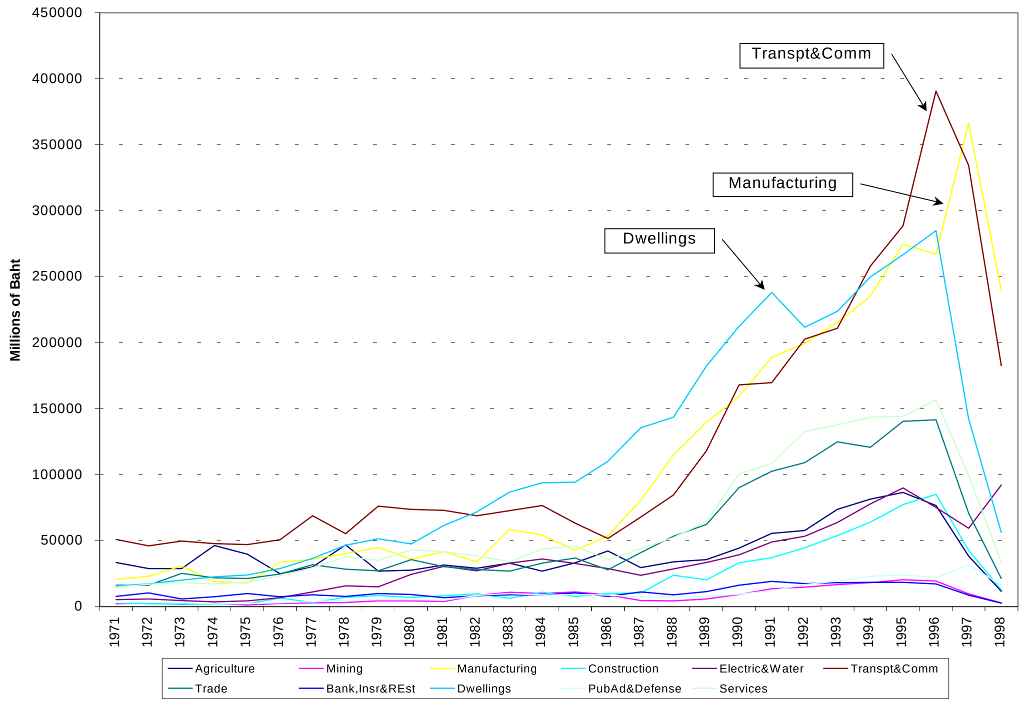
Table 5.2: Constructed data of the sectoral gross investment, constant in 1990 prices (millions of baht)

	1975	1980	1985	1990	1995	1996	1997	1998
Agriculture	39704	27612	33163	44352	86427	76714	38357	11507
Mining & Quarrying	1223	4308	11044	9175	20185	19429	9714	2914
Manufacturing	17766	35783	42587	159213	274631	267014	366233	239183
Construction	2228	6933	7613	33213	77367	85168	42584	12775
Electricity & Water Supply	4240	24397	32703	39355	89982	75045	59330	92019
Transportation & Comm	47069	73613	63123	167957	288638	390664	334376	182588
Wholesale & Retail Trade	21289	35554	36940	90059	140272	141484	70742	21223
Banking, Insurance, Real Est	9849	9087	10329	16131	18474	17279	8640	2592
Ownership of Dwellings	23899	47620	94400	212273	266704	284847	142423	56236
Public Administration & Def	2288	5138	9253	9384	23994	21804	31398	16526
Services	18616	42834	46010	100654	144115	156517	99523	33782

In general, the results look plausible enough. There are no negative values in the constructed gross investment data. Investment was at a peak in 1996 in most sectors and clearly showed a significant slump during 1997-1998 as a result of the Asian crisis. Investment in most of the sectors was immediately affected by the crisis in 1997. In a few sectors, however, namely Manufacturing and Public administration and defense, investment continued to grow in 1997 and then started to decline in 1998. Interestingly, however, investment in Public utilities (*i.e.* in the Electricity and water sector) increased in 1998.

The pattern of investment in Thailand has changed dramatically during the past two decades. A huge increase in investment in Thailand during the past fifteen years has been primarily taking place in some certain sectors, namely the Manufacturing, Transportation and communication, and Ownership of dwellings. Certainly, these sectors currently account for the biggest share of the investment of the country.

Figure 5.2: Sectoral gross fixed capital formation of Thailand



In the data construction process, the published depreciation was recalculated in order to make the sectoral investment data and the capital stocks satisfy the capital accumulation identity ($K_{i,t} = K_{i,t-1} - D_{i,t} + I_{i,t}$). What does the depreciation look like after they were recalculated? For analytical purposes, I will here discuss depreciation "rates" rather than the level of depreciation. A depreciation rate of the capital stock *i* at time *t* can be obtained simply from $DRate_{i,t} = \frac{D_{i,t}}{K_{i,t-1}}$, where $D_{i,t}$ is a depreciation, and $K_{i,t-1}$ is the capital stock from previous period. Table 5.3 compares capital depreciation rates, before and after the recalculation.

Table 5.3: Comparison between averages of depreciation rates before and after the recalculation

	(Percent)	Avg. of published rates 1971-1996	Rank	Avg. of recalculated rates 1971-1996	Rank	Recalculated rates 1997	1998
1	Agriculture	7.2	7	7.8	7	6.3	6.6
2	Mining & Quarrying	8.3	3	9.4	2	*15.6*	*16.0*
3	Manufacturing	7.7	5	8.7	5	6.1	5.8
4	Construction	8.3	4	9.2	4	*20.9*	*19.0*
5	Electricity & Water Supply	4.0	10	5.0	10	2.2	1.1
6	Transportation & Comm	8.5	2	9.3	3	6.5	6.2
7	Wholesale & Retail Trade	7.0	8	7.6	8	12.2	*11.9*
8	Banking, Insurance, Real Est	9.5	1	10.3	1	8.1	*13.3*
9	Ownership of Dwellings	3.2	11	3.8	11	3.0	2.2
10	Public Administration and Def	7.4	6	8.2	6	4.5	4.7
11	Services	5.6	9	6.3	9	5.0	4.8

Note: *Numbers in Italic represent sectors that previously had negative implied investment.*

The table shows that the averages of depreciation rates during 1971-1996 slightly increase after the recalculation. At the most, the depreciation rate was increased by 1.1%, which occurs in the Mining and quarrying sector. In addition, the rank orders of the average depreciation rates before and after the recalculation are also very similar to each other. Therefore, the general picture of depreciation that was published by NESDB is preserved in the recalculated depreciation. For instance, the capital stock in the Ownership of dwellings sector is still depleted at the slowest rate while stock in the Banking, insurance and real estate sector is still depleted the fastest.

The last two columns of the table show the recalculated depreciation rates during 1997-1998, the crisis episode. It can be seen that there was, indeed, a write-off of existing capital stocks for some sectors as a result of the crisis. The write-off of the capital stock was quite prominent in the Mining and quarrying and in the Construction sectors. In fact, the origin of the crisis actually came from the bursting of the real estate bubble. Moderate write-off of the capital stock can also be found in the Wholesale and retail trade and in the Banking insurance and real estate sectors.

The method presented in this research used information from two published sources, namely the total GFCF data and the capital stock data, to construct sectoral gross investment data. These constructed sectoral gross capital formation data will certainly be a bridge between these two data sources. Having successfully constructed the sectoral gross investment data, we are now ready to move into a more interesting part, the estimation of sectoral investment equation in Thailand.

5.3 THE ESTIMATION OF SECTORAL INVESTMENT EQUATION IN THAILAND

Which investment model should be used in the Interdyme framework of Thailand? There are several criteria that could be considered. First, the model should be based on economic theory and rationale. Second, the model should have a good record of empirical performance, both of in-sample fits and out-of-sample forecasting. Third, because the investment estimation in this analysis will be part of the interindustry model, all variables in the model must be explainable within the model framework. Therefore, the most appropriate investment equation for the model framework may not necessarily to be the most complicated one. There are several literature surveys that could help in choosing the appropriate investment model.

Chirinko (1993) thoroughly provides a critical survey of the existing literature in investment models, both in theoretical and empirical aspects. The survey covers from the traditional investment models, namely the accelerator model (Clark 1917; Clark 1944; Koyck 1954) and the neoclassical model of investment (Jorgenson 1963), until the rational expectation models of investment, including the *q*-theory (Tobin 1969; Brainard and Tobin 1968), Euler equation model (Abel 1980; Morrison 1986), and the direct forecasting model (Bernanke 1983; Morrison 1986). The author pointed out that quantity variables, such as the output, generally seem to be the most important determination of investment behavior. Chirinko also argued that cost-of-capital variables, such as those found in neoclassical Jorgenson-type models and those in Tobin's *q*-model, still fail to contribute significantly to explaining investment behavior in empirical studies.

Another important argument pointed out by Chirinko's survey is that, in practice, the policy-making community still employs traditional investment models for policy evaluation. Those traditional investment models are relatively more user-friendly and generally deliver good estimation results. On the other hand, rational expectation models still prove empirically unsatisfactory, although they were derived by a representative agent's optimization and treated dynamics and expectations explicitly. In fact, a series of works in rational expectation models in investment has been motivated by the famous Lucas critique (LC). Chirinko argued that the role of expectation in investment models has not yet been properly addressed. In reply to the critique, he argued that "the empirical relevance of the LC has been questioned. Absent solution to the expectation problem and evidence of its relative quantitative importance, the LC may well be considered a second-order effect, and may continue to have only a modest direct impact on policy".

Yet, business fixed investment is still unsatisfactorily explained by economists. The recent research in empirical investment has been focused on the examination of investment at the plant or industry level. Most of the empirical research in investment has been done in isolation (*i.e.,* a single equation estimation). Surprisingly, there is very little existing literature that examines the performance of investment models in a comprehensive macroeconomic model, such as in the interindustry model or in the CGE model. Indeed, Meade (1990) is one of the few who examined the performance of eight alternative investment models combined with the *INFORUM*-type U.S. interindustry model, namely *LIFT*. The investment models that were considered include the autoregressive model, flexible accelerator model, Jorgenson's neoclassical Cobb-Douglas model, CES models, generalized Leontief putty-putty and putty-clay models, and the dynamic factor demand model.

Meade (1990) compared performances of those eight alternative investment models for their single-equation forecasts and full real-side simulation forecasts, both within-sample and out-of-sample. In general, he concluded that "none of the models do as well as one would hope, either in within-sample or in out-of-sample simulations". However, by judging from the total sum of Root Mean Square Error (RMSE) across all industries, he found that the generalized Leontief models and the neoclassical Cobb-Douglas model perform in out-of-sample the best for full real-side simulations.

Except for the autoregressive model, which is not based on economic rationale, the accelerator model is the third runner, according to Meade's list. The accelerator model also performs well in an out-of-sample single equation forecast, as well as in within-sample forecasts.

Although Meade has proposed the generalized Leontief models and neoclassical Cobb-Douglas model for the interindustry modeling, the debate over the significance of cost variables in investments is still unsolved. In addition, the restriction that imposes the symmetry on the coefficients of output and cost variables is questionable. While the survey by Chirinko (1993) found the role of cost variables to be trivial, the recent survey by Caballero (1999) found significance for those variables both in long-run and short-run relationships[8].

Although these findings have shed light on the importance of cost variables, the literature still seems to be unclear about this issue and more research is needed. On the other hand, Thailand is a developing country with resources still not evenly distributed. Therefore, the major limit on investments in Thailand may not be the cost of capital, but rather the 'access' to the capital. Investment in Thailand predominantly comes from foreign investors. Given this situation, investment in the country may not be affected by changes in domestic cost of capital. Further study about the role of cost of capital in developing countries is required. Therefore, employing an investment

[8] These findings can be found in Auerbach and Hassett (1992) and Caballero (1994a) for the long-run estimation of neoclassical model, and in Cummins, Hassett and Hubbard (1994, 1996a) for short-run estimation of the *q* model.

model that captures only the effect from the output variable is defensible. In the present research, I will employ the traditional accelerator model.

There are two versions of investment equation in TIDY, each of them uses the assumptions of the accelerator model of investment. The first version of the investment is the flexible accelerator model, suggested by Clark (1944) and Koyck (1954). The second type of investment equation captures demands for investment in order to close the gap between existing capital stock and the desired level of capital stock.

The introduction of a second type of investment equation is particularly helpful in the model simulations. Thailand recently faced the economic crisis, where output and investment plunged to the lowest points in 15 years. Therefore, investment equation that captures effects from the output change leads to an extremely unstable model. In essence, the model tends to replicate the magnitude from the crisis, thinking that it was a slowdown in the business cycle. This is totally untrue. Therefore, the second version of investment equation is called the 'super smooth' investment function which produces a relatively stable path of investment growth in the forecasts. Initially, the flexible accelerator model was used to estimate all investment sectors. The function form was then revised to the super smooth investment equation at the simulations for sectors that exhibit strong volatility in the investment forecasts.

Functional Form 1: The Flexible Accelerator Model of Investment

The simple accelerator model of investment was first suggested by Clark (1917). The principles of the model are based on a simple idea that firms usually evaluate their production capacity relative to their expected sales. Consequently, firms try to adjust their capital stocks in order to maintain their desired production level. If we assume that expected sales can be deduced from output, net investment of the firms could simply be a linear function of output changes. In order to account for the serial correlation, Clark (1944) and Koyck (1954) suggested the flexible accelerator model which includes distributed lags of output changes in the functional form:

$$N_t = \alpha + \sum_{\tau=0}^{n} \beta_\tau \Delta Q_{t-\tau} \qquad [5.4]$$

where N_t is a net investment, ΔQ_t is the output change between t and t-1, α and β's are parameters. Given that gross investment equals net investment plus replacement investment, the functional form for gross investment could be easily derived. In the present analysis, up to three years of lagged changes in output will be used. In addition, to capture the effects of the financial crisis during 1997-1998, a dummy variable *crisis* was added into the equation. Let I_t be gross investment, and R_t be replacement investment. The functional form that will be used in the estimation is:

$$I_{i,t} = \alpha_0 + \alpha_1 R_{i,t} + \alpha_2 crisis_t + \sum_{\tau=0}^{2} \beta_\tau \Delta Q_{i,t-\tau} + \varepsilon_t \quad [5.5]$$

where, $I_{i,t}$ = gross investment of sector *i* at time *t*,

$R_{i,t}$ = replacement investment of sector *i* at time *t*,

crisis = the financial crisis dummy variable,

$\Delta Q_{i,t}$ = output change of sector *i* between *t* and *t*-1.

The coefficient of replacement investment, α_1, is expected to be close to 1. The coefficient α_2 for *crisis* dummy should be negative. Finally, all estimated β's must be positive, as gross investment would positively respond to economic activities.

The replacement investment can be obtained as follows. In essence, replacement investment simply equals the capital that has been worn out from the production process. In other words, replacement investment of a sector is simply capital depreciation. Therefore, replacement investment of a sector can be calculated using information from the capital stock and depreciation rate of that sector. To calculate replacement investment in the present study, a depreciation rate of each sector is assumed to be time-invariant and equals to its average during 1971-1996. At time *t*, replacement investment for sector *i* can be calculated from $R_{i,t} = DRate_i * K_{i,t-1}$, where $DRate_i$ is the average depreciation rate obtained from Table 5.3.

Functional Form 2: A Modified Accelerator Model of Investment

In the second type of investment equation, investment demands are motivated by the desired level of capital stock. Because the desired level of capital stock is unobservable, we assume that it is a linear function of output, $\alpha + \beta Q_t$. We further suppose that investment is determined to close a constant fraction, λ, of the gap between desired and actual capital. Investment will therefore be:

$$I_t = \lambda(\alpha + \beta Q_t - K_{t-1}) + \delta K_{t-1} \qquad [5.7]$$

where δ is the depreciation rate. Multiplying through by λ and rearranging terms give a regression equation of the form:

$$I_t = \alpha_0 + \alpha_1 Q_t + \alpha_2 K_{t-1} + \varepsilon_t \qquad [5.8]$$

where I_t = gross investment,

Q_t = output,

K_{t-1} = capital stock from the previous period.

The coefficient on the output variable is expected to be positive. It represents effects from level of output and the desired level of capital stock on gross investment. We expect the coefficient on a lagged variable of capital stock to be negative.

Estimation Results

The model was estimated during the period from 1975 to 1998, and all data series are in constant 1990 prices. The sectoral gross investment data were obtained from the previous section. Output data for 11 industries were aggregated from the sectoral outputs in the input-output table. Replacement investments were constructed, using the calculation discussed earlier. The average of the depreciation rate for each investing sector was obtained from Table 5.2 in the previous section. The *crisis* dummy variable has 1 in 1997 and 1998, all else equal to 0. However, only for the Electricity and water supply sector, for which the decline in investment appeared only in 1997 and the recovery started in 1998, the *crisis* dummy variable for this specific sector has 1 only in 1997, all else equal to 0.

In the TIDY forecasts, the estimations of investment equation use both functional forms. The first functional form was used in the initial estimations for all sectors. Then, the estimations were revised to the second function form for investment sectors that exhibit extremely volatile cycle. These sectors include Manufacturing, Construction, Utilities, Transportation and communication, Trade, and Services.

In order to arrive at sensible estimated parameters, soft constraints were applied. The estimation results of 11 investing sectors are summarized in Table 5.4 below. In order to show the relative size of gross investment in each sector, the means of dependent variables are tabulated in the first column. $\overline{R}^2$ and standard error of estimate (SEE) are also included in the table to represent the goodness of fit of the estimation. Because the soft constraints were used, *t*-statistics and Mexval became meaningless. Thus, they are exlcuded from the table.

In general, the estimations delivered acceptable results. In terms of the economic meaning, the estimated coefficients are also sensible.

In the first functional form, all coefficients for replacement investment are reasonably close to 1 except Dwellings. Coefficients of the output changes are positive and the coefficients of the distributed lags seem to smooth out. According to the elasticities, investment decisions in Mining and Public administration are responsive to the output changes while investment in Dwellings is not.

Table 5.4: The estimation results of the accelerator model of investment for Thailand

Functional Form 1	Mean	Replace	Crisis	dQ	dQ[1]	dQ[2]	RBSQ	SEE
Agriculture*	43869	0.97	-34782	0.026	0.020	0.012	0.68	10146
				0.17	*0.13*	*0.08*		
Mining and Quarrying	9711	0.94	-18307	0.677	0.529	0.294	0.81	2112
				0.32	*0.26*	*0.12*		
Banking, Insurance, and Real Estate	11637	0.97	-9655	0.076	0.062	0.036	0.78	1998
				0.13	*0.1*	*0.06*		
Ownership of Dwellings	143361	1.55	-103925	1.137	0.942	0.592	0.69	37831
				0.09	*0.07*	*0.05*		
Public Administration and Defense	12427	0.99	6131	0.738	0.843	0.144	0.82	2799
				0.23	*0.26*	*0.04*		

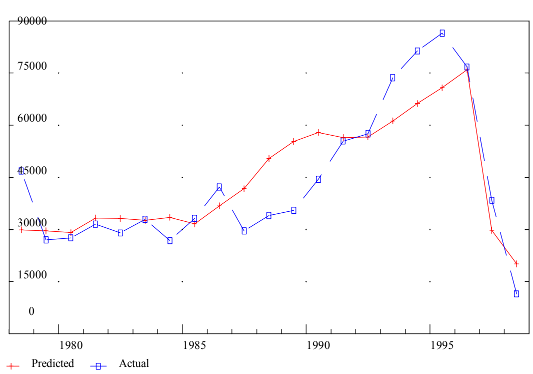
Functional Form 2	Mean	Output	Stock	RBSQ	SEE
Manufacturing	137377	0.098	-0.025	0.91	28800
		1.18	*-0.12*		
Construction	27602	0.191	-0.066	0.56	15642
		1.38	*-0.31*		
Electricity and water supply	44194	0.624	-0.038	0.75	11304
		1.18	*-0.25*		
Transportation and communication	146971	0.659	-0.012	0.74	49274
		1.11	*-0.07*		
Wholesale and retail trade	64322	0.179	-0.029	0.35	32489
		1.16	*-0.21*		
Services	74881	0.434	-0.140	0.60	27161
		2.04	*-1.03*		

*Note: Numbers display in Italic are elasticities. * indicates the equation that used the aggregate output change.*

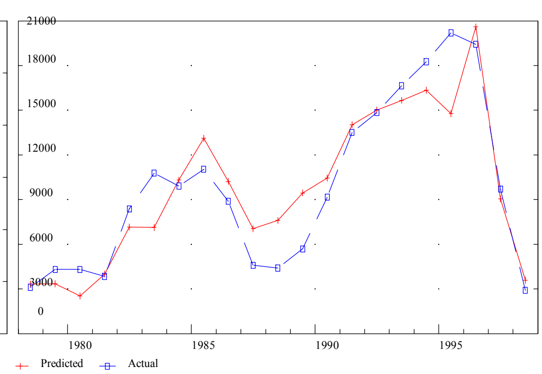
Coefficients of the *crisis* dummy are significantly negative for most of the sectors except the Public administration and defense sector. At the first glance, these results may seem paradoxical. However, according to the historical data, gross investment in the Public administration and defense sector actually went up after the crisis in 1997. Investment in this sector primarily comes from the government. Therefore, it is possible that the government spent more money on public investment in 1998.

In the second functional form, where investment relates to the level of output, the estimations also give plausible results. Coefficients on the lagged value of capital stocks are all negative. Coefficients on output variables are also positive and sensible. According to the elasticities, gross investment in Services and Construction are strongly respond to the level of output. The fitted graphs of all 11 sectors are included below.

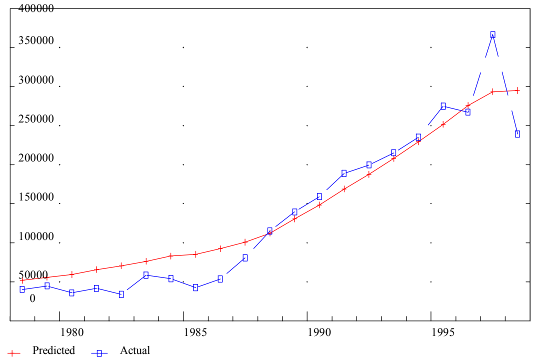
1.Agriculture



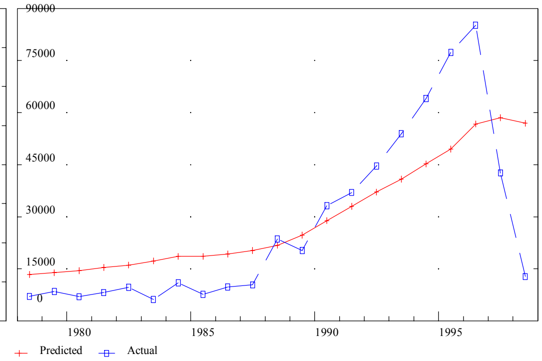
2.Mining & Quarrying



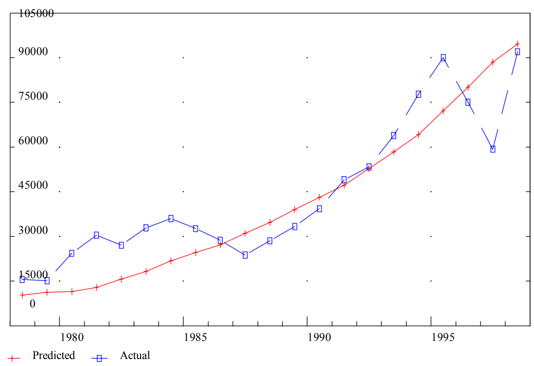
3.Manufacturing



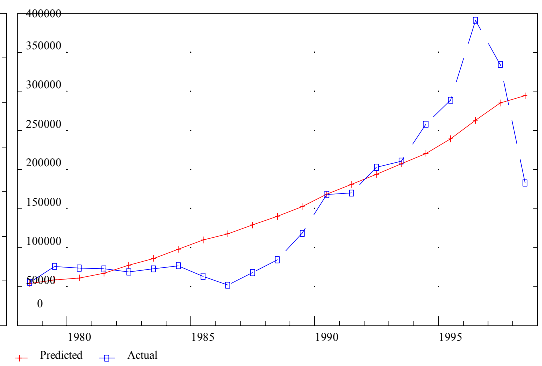
4.Construction



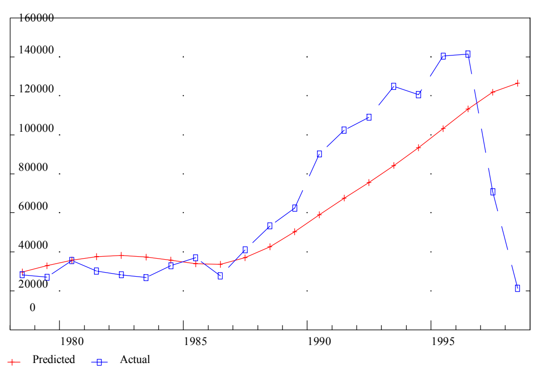
5.Electricity & Water



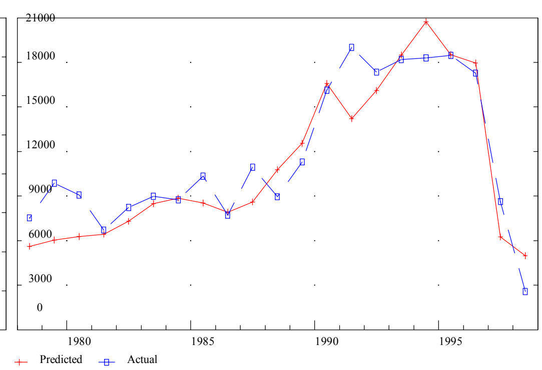
6.Transportation & Communication



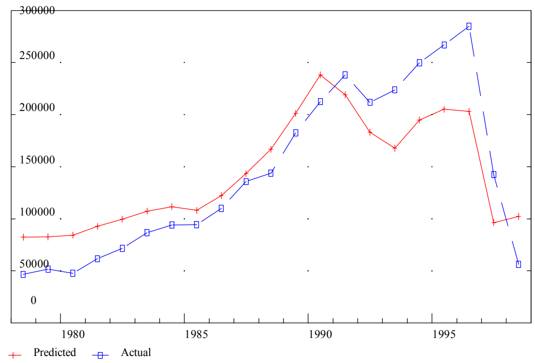
7.Wholesale and Retail Trade



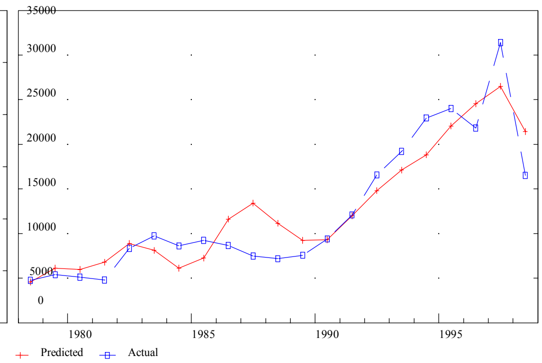
8.Banking, Insurance, and Real Estate



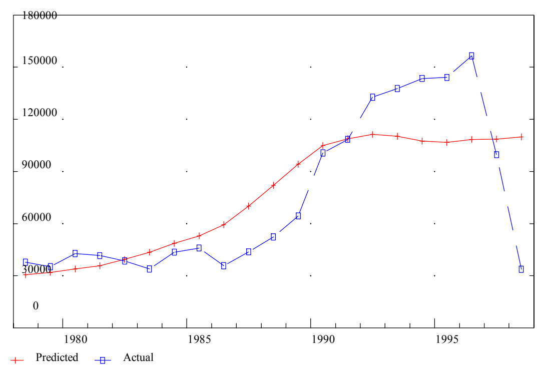
9.Ownership of Dwelling



10.Public Admin and Defense



11.Services



Chapter 6: Sectoral Profit, Wage, and Capital Depreciation in Thailand

Value-added represents total factor payments to primary inputs in the production process. In the input-output table of Thailand, for each production sector, value-added consists of four components: Wages and salaries, Operating surplus, Depreciation, and Net indirect taxes. Why are these components important? Value-added components are important because they contribute to unit costs of production and are directly related to sectoral price determination. According to the input-output price identity, the price for a sector is equal to the sum of per unit intermediate production costs plus the unit value-added. In addition to its role in determining sectoral prices, wages and salaries go into personal income; profits after taxes are partly retained and partly paid to shareholders. Indirect taxes become income for government. These four components determine the Gross Domestic Product (GDP) from the income side. The objective of this chapter is to estimate these value-added components, namely, wages, profit, and depreciation. Net indirect tax rates will be left as an exogenous policy variable.

There are basically two approaches to estimating sectoral prices. The first approach estimates prices directly from the regression; value-added then becomes a residual. The second approach, however, models value-added and obtains sectoral prices from the input-output price identity[9]. The calculation of sectoral prices from a combination of both approaches is also possible. Klein, Welfe, and Welfe (1999) employed the first approach in the interindustry model for transition economies. Monaco (1991), Werling (1992) and Yu (1999) used the second approach to calculate sectoral prices in the interindustry model for the U.S., Spain, and China, respectively. The current research will employ the calculation of sectoral price follows the second approach. Components of the valued-added will be firstly estimated by the regression. Then, the sectoral prices will be computed accordingly.

The estimation of the value-added components in TIDY will be estimated in constant prices, *i.e.* deflated by GDP deflator. There are two major benefits from this method. First, it allows us to compare and maintain the consistency of the real GDP obtained from this income side (the sum of value-added components) and that from the expenditure side (the sum of final demand components). Second, deflating all value-added components by a common aggregate GDP deflator protects us from the infamous "double-deflation" practice.

The structure of this chapter is the following. The next section will be the estimation of sectoral profit equations. The aggregate wage and sectoral wage equations will be included in the second section. The final section will be the estimation for the sectoral depreciation.

[9] Equation [2.4] in chapter 2.

6.1 PROFIT

Profit in the input-output table of Thailand is represented by the operating surplus, which equals to the total payments to the primary inputs less wage payments, capital depreciation, and net indirect taxes. In the input-output table of Thailand, operating surplus, or profit, accounts for the largest part of the value-added component. Therefore, it certainly plays an important role in sectoral price determination.

On the income side, it is well known that profit margins (profit per dollar of output) are extremely volatile. Additional studies at the sectoral level also suggested that profits varied greatly among industries. However, they are all commonly procyclical and respond strongly to demand changes.

Despite this challenge to economic modelers, business profit plays a beneficial role over the business cycle for helps stabilize fluctuations in the economy. For instance, when there is a shock in a factor market that leads to a change in the cost of production, firms do not immediately pass on the variation of the production cost to buyers. Rather than changing the price charged to customers, firms accept the variation of their profits in the short-run until the change is recognized as permanent. This property contributes to the stability of the price level and of consumers' real income.

Explaining Profit

Economists are still having a hard time explaining the behavior of the business profits over the business cycle. Literature suggests that the aggregate profit margin is procyclical and likely to be determined by the rate of change in economic activity rather than by the level. Some refer to this situation as a "profit accelerator". Zarnowitz (1999) found that the aggregate profit margin in the U.S. during 1953-1998 was positively influenced by the growth in real GDP, change in labor productivity, and price level. On the other hand, he also found that unit labor costs, inflation, long-term interest rate, and risk factor all drive down profitability. In a quarterly model of the U.S., Almon (1999) also specified a corporate profit equation that follows the accelerator concept, however, with a much simpler specification. The equation was estimated in real terms. Given that the corporate profit is crucially dependent on economic condition and is extremely volatile, Almon included the gross private product (GPP) and the distributed lags of changes in its peak value in the regression.

In the interindustry modeling literature, Monaco (1991) suggested that demand conditions and costs of production are also the primary sources of the profit determination at the sectoral level. The general form of the profit equation in the U.S. interindustry model included material input cost, labor cost, and demand-condition variables. Werling (1992) followed the same approach in an interindustry model of Spain. However, the profit equations in Werling were estimated in terms of profit mark-up over labor costs. He suggested that the sectoral profits are diverse among industries; however, they respond similarly to the business cycle. As a result, the individual output growth was included in the sectoral profit equations. Because Spain is a small-opened economy, Werling also specified the cost variables differently in tradable and non-tradable goods industries. For non-tradable goods industries, a regular unit real wage was used in the equation. However, a real exchange rate (a ratio of import price to unit wage costs) was substituted into the sectoral equation for those tradable goods industries.

Estimated Equation

Because of limited data, the specification of sectoral profit equation in the Interdyme model of Thailand is relatively simple. Profit equations in the TIDY were estimated in constant prices, deflated by GDP deflator. Because sectoral profits seem to be heterogeneous and industry-specific, the sectoral profit equation in the Interdyme of Thailand contains only industry-specific factors. As in Almon (1999), primary explanatory variables include real sectoral output and its difference. The unit labor costs also play a critical role in affecting the business profits across countries[10]. When the cost of production changes, firms usually hesitate to adjust the price charged to buyers. Therefore, fluctuations in wage rates vary firms' profit in the short-run. Consequently, real sectoral wages were also included in the regressions. A time trend variable was included in order to capture effects other than that of output and labor cost. The estimated equation is presented below:

[10] While Dowrick (1999) found a strong evidence that corporate profits in the UK is negatively affected by the movement in wage, McDonald (1999) suggested the similar findings in Australia. Recently, Farinas and Huergo (2003) confirmed the relationship in Spain.

$$profit_{i,t} = \alpha_0 + \alpha_1 q_{i,t} + \alpha_2 \Delta q_{i,t} + \alpha_3 w_{i,t} + \alpha_4 T + \varepsilon_{i,t} \qquad [6.1]$$

where, $profit_{i,t}$ = level of profit in sector i at time t deflated by GDP deflator,

$q_{i,t}$ = level of output in sector i at time t deflated by GDP deflator,

$\Delta q_{i,t}$ = output change in sector i at time t,

$w_{i,t}$ = level of total wage in sector i at time t deflated by GDP deflator,

T = time trend.

Sectoral output represents business cycle and demand condition that influence profits. Therefore, the expected signs for both α_1 and α_2 are positive. The coefficient on real wage variable is responsible for the labor cost in firms' production. When wage increases, corporate profits will fall, and vice versa. Thus, the expected sign for α_3 is negative. The coefficient on the time trend variable corresponds to the shift in sectoral profits with the passage of time.

It should be remarked that sectoral prices and the aggregate GDP deflator are required in order to construct the real output deflated by GDP deflator, which appears on the right-hand-side of the regression. That is, $q_{i,t} = qR_{i,t} \frac{p_{i,t}}{GDPD_t}$, where $qR_{i,t}$ is the sectoral output in real term obtained from the real-side simulation, $p_{i,t}$ and $GDPD_t$ are, respectively, sectoral price and GDP deflator. In the forecast, the estimated GDP deflator can be obtained directly from the macro regression; however, the sectoral prices must be determined simultaneously with profits. Fortunately, historical data suggest that the ratio of sectoral price to GDP deflator is relatively constant over time.

As a result, to avoid the simultaneity, values of sectoral prices and GDP deflator from the previous period were used instead of the current ones. Particularly,

$$q_{i,t} = qR_{i,t}\frac{p_{i,t-1}}{GDPD_{t-1}}.$$

Estimation Results

The equation was estimated during the period from 1975 to 1998. All data series were obtained from the input-output tables and were deflated by GDP deflator, constant in 1990 prices. Table 6.1 shows the estimation results of the sectoral profit equations. Numbers in parentheses under the estimated coefficients are the marginal explanatory values (Mexval) - the percentage increase in SEE if this variable is left out of the regression. When a coefficient is soft constrained, Mexval becomes meaningless and was not included in the table.

In general, the estimation results of the sectoral profits are plausible. The business cycle, labor costs of production, and a time trend sufficiently explain the movement of the sectoral operating surplus in Thailand. Considering the effects from economic condition, it appears that sectoral profits in Thailand are influenced more by the *level* of output rather than that by its *change* (accelerator). Elasticities on the *level* of output variables show relatively high values. On the other hand, output *change* variables have relatively smaller elasticities in almost all of the sectors except for Utilities. Profits in agricultural sectors seem to be less responsive to the level of economic activities than those in manufacturing and service sectors. Interestingly, within manufacturing sectors, profits in heavy-goods industries, such as Basic metal and Machinery, are less affected by the economic variation.

Coefficients on real wages also show intuitive results. In those heavy-goods industries, which primarily are capital-intensive sectors, coefficients on real wage variables are relatively small comparing to labor-intensive sectors such as agricultural and service sectors. It implies that when the overall real wage increases, a reduction in operating surpluses will be more severe in these agricultural and service sectors.

According to the time trend variable, half of agricultural sectors show downward shifts in sectoral profits. Negative coefficients are also found in some manufacturing industries; however, the majority of manufacturing industries shows the growing profits. Column "% mean" represents the ratio of estimated time trend coefficient over the mean of the dependant variable. Utilities, Textile, Basic metal, and Transportation and telecommunication, respectively, exhibit the strongest shift in the profits over time. This fact is unsurprising. These sectors are among the fastest growing industries in Thailand during the past decade.

Table [6.1]: The estimation results of the sectoral profit equation

	Sector	Mean	Intcpt	*q*		*dq*		*w*		Trend		RBSQ	SEE	MAPE
				Coeff	Elas	Coef	Elas	Coef	Elas	Coef	% mean			
1	Crops	133261	53424	0.346	0.56	0.203	0.01	-0.11	-0.02	562.07	0.42	0.83	7501.9	4.57
			(31.0)	(27.6)		(10.5)		*		(2.4)				
2	Livestock	17886	9248	0.246	0.77	0.028	0.00	-1.66	-0.34	67.40	0.38	0.40	1411.3	6.68
			(17.6)	(12.5)		*		(5.7)		(0.1)				
3	Forestry	7234	5132	0.492	0.75	0.056	0.00	-0.14	-0.03	-236.70	-3.27	0.95	554.8	6.24
			(19.7)	(40.1)		(0.7)		*		(55.2)				
4	Fishery	18522	1030	0.560	1.31	0.054	0.01	-0.18	-0.06	-446.57	-2.41	0.95	1715.6	6.64
			(3.1)	(197.7)		(0.8)		*		(27.6)				
5	Mining and Quarrying	16198	1002	0.279	0.80	0.182	0.04	-0.04	-0.02	144.93	0.89	0.94	1556.7	11.62
			(3.2)	(30.1)		(8.4)		*		(1.0)				
6	Food Manufacturing	48055	10278	0.087	0.63	0.038	0.01	-0.09	-0.05	718.49	1.50	0.97	2329.6	4.80
			(31.1)	(47.9)		(13.5)		*		(15.2)				
7	Beverages and Tobacco Produc	10881	455	0.194	1.46	0.065	0.03	-0.02	-0.01	-438.99	-4.03	0.90	1432.7	10.81
			(0.8)	(63.8)		*		*		(12.7)				
8	Textile Industry	40655	6012	0.071	0.49	0.074	0.03	-0.18	-0.15	1482.21	3.65	0.98	2291.2	4.33
			(37.3)	(12.2)		(10.2)		*		(24.1)				
9	Paper Products and Printing	9278	751	0.315	1.51	0.070	0.03	-0.70	-0.27	-253.74	-2.73	0.93	1300.8	12.18
			(3.2)	(50.4)		*		(0.8)		(5.6)				
10	Chemical Industries	10448	2428	0.173	1.03	0.035	0.02	-0.04	-0.02	-209.74	-2.01	0.98	609.0	5.25
			(96.6)	(281.2)		*		*		(28.2)				
11	Petroleum Refineries	10167	-7624	0.134	1.49	0.035	0.03	-0.03	-0.01	185.97	1.83	0.75	4038.4	49.29
			(25.1)	(25.7)		*		*		(1.0)				
12	Rubber and Plastic Products	7376	1055	0.169	1.39	0.033	0.02	-0.05	-0.04	-294.88	-4.00	0.98	615.5	6.41
			(23.5)	(251.2)		*		*		(49.8)				
13	Non-metallic Products	14739	-951	0.180	0.87	0.012	0.00	-0.07	-0.04	264.75	1.80	0.99	702.5	5.87
			(11.0)	(225.8)		(1.0)		*		(21.6)				

Table [6.1]: The estimation results of the sectoral profit equation

Sector	Mean	Intcpt	*q*		*dq*		*w*		Trend		RBSQ	SEE	MAPE
			Coeff	Elas	Coef	Elas	Coef	Elas	Coef	% mean			
14 Basic Metal	6376	-2065	0.109	0.88	0.041	0.01	-0.04	-0.02	222.07	3.48	0.70	1873.1	19.07
		(6.6)	(15.2)		*		*		(7.7)				
15 Fabricated Metal Products	7644	-34	0.174	0.84	0.029	0.01	-0.03	-0.01	99.47	1.30	0.97	808.2	7.91
		(0.0)	(63.9)		*		*		(2.1)				
16 Machinery	52734	-87	0.122	0.90	0.023	0.01	-0.04	-0.02	455.60	0.86	0.98	5328.0	7.46
		(0.0)	(164.2)		*		*		(1.8)				
17 Other Manufacturing	41117	4062	0.222	1.09	0.026	0.01	-0.48	-0.27	222.12	0.54	0.99	1125.9	2.62
		(52.9)	(182.2)		*		(15.7)		(6.2)				
18 Electricity and Water Works	22519	-1116	0.202	0.81	0.424	0.14	-0.75	-0.38	832.74	3.70	0.97	2012.6	11.65
		(1.8)	(27.7)		(49.3)		(5.1)		(12.0)				
19 Construction	62304	-313	0.211	1.09	0.054	0.01	-0.07	-0.04	-229.12	-0.37	0.99	2331.2	3.66
		(0.1)	(414.1)		(55.1)		*		(2.5)				
20 Trade	230246	3432	0.460	0.86	0.166	0.02	-0.08	-0.02	2237.43	0.97	0.99	8167.9	3.42
		(1.4)	(378.3)		(17.3)		*		(19.3)				
21 Restaurants and Hotels	44834	8427	0.256	1.01	0.171	0.04	-0.20	-0.09	-481.54	-1.07	0.99	1708.7	4.00
		(128.5)	(157.1)		(47.1)		*		(6.0)				
22 Transportation and Communicati	59871	2490	0.294	1.28	0.200	0.05	-1.16	-0.80	1962.81	3.28	0.95	6292.2	11.08
		(0.8)	(12.8)		(14.2)		(4.5)		(3.5)				
23 Banking and Insurance	48117	4399	0.492	1.27	0.011	0.00	-0.18	-0.12	-905.84	-1.88	0.99	1650.0	6.78
		(40.0)	(831.2)		(1.4)		*		(81.5)				
24 Real Estate	23833	-2375	0.230	0.78	0.084	0.01	-0.08	-0.02	592.35	2.49	0.99	1421.4	4.23
		(24.9)	(95.4)		(15.4)		*		(22.4)				
25 Services	34110	698	0.161	1.27	0.163	0.09	-0.15	-0.70	826.05	2.42	0.97	2838.9	8.21
		(0.5)	(49.2)		(20.4)		*		(9.7)				
26 Unclassified	.	.	.		.		.		.	.	.	.	.

Note: Sector 26 contains no observation, and was excluded from the estimation.

6.2 WAGES

According to the data from the Labor Force Surveys (LFSs), conducted by the National Statistical Office of Thailand (NSO), the average wage in real terms has been increasing substantially during the past 15 years. During 1987-1998, the average annual growth of the aggregate real wage equals to 5.8 percent per annum. Prior to the financial crisis in 1997, the aggregate real wage almost doubled its value from the previous decade. This rise was primarily due to a huge productivity growth in manufacturing industries as well as the increasing proportion of employment in these sectors.

Figure 6.1: Real Wage

(Bahts/Person/Year)

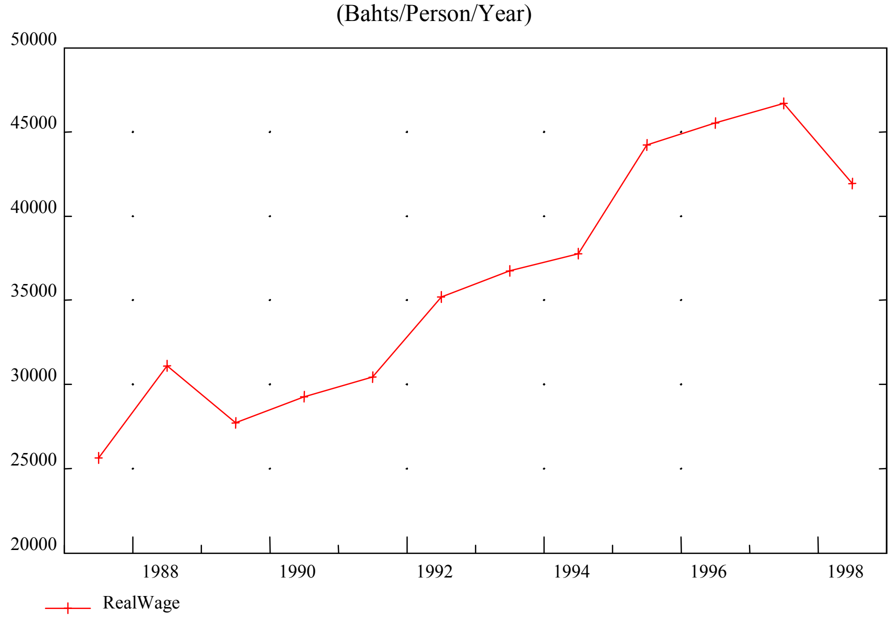
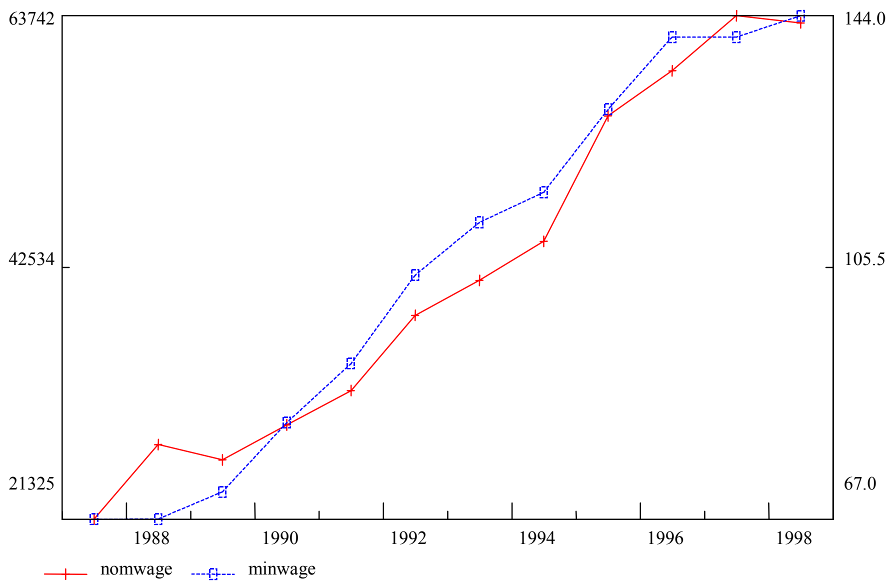


Figure 6.2: Nominal Wage and Minimum Wage Requirement

(Bahts/Person/Year, Bahts/Day)



The summary of sectoral real wage is presented in Table 6.2 below. Wage behavior in various industries seems very diverse. Even though the aggregate data show a strong positive growth, sectoral data reveal that there is also negative growth in real wages in some sectors, namely, Beverage and tobacco, Petroleum, and Rubber and plastic. In the broad categories, labor income in service sectors was the highest. Workers in manufacturing sectors and agricultural sectors have received lower pays, respectively. In 1998, only 6 out of 26 sectors had wage levels less than the average aggregate wage. It implies that these 6 sectors contain most of the country's employment. These low-income sectors are primarily agricultural sectors, namely, Crops, Livestock, and Forestry, accounting for almost 50 percent of the total employment. The wage disparity assures us that sectoral analysis is important.

Table 6.2: Sectoral real wage and its average growth rate during 1987-1998

	Annual growth (percent)	Real wage* (baths/person/year)				Employment (thousands)
	1987-1998	1987	1996	1997	1998	1998
Crops	4.8	14,764	24,271	22,813	22,553	15,251
Livestock	10.7	16,473	43,196	50,021	35,827	503
Forestry	1.1	17,764	25,229	25,555	20,007	156
Fishery	3.0	40,248	62,961	68,973	53,574	401
Mining	4.6	25,890	58,881	57,069	39,092	41
Food Manuf.	3.6	30,535	46,889	55,654	42,541	652
Beverages & Tobacco	-0.4	63,863	77,118	71,774	60,966	87
Textile	2.8	29,704	34,656	39,491	38,950	956
Paper & Printing	0.5	60,660	62,671	88,713	64,264	154
Chemical	2.5	53,249	79,242	71,229	67,618	196
Petroleum	-2.8	125,006	79,913	62,422	87,142	7
Rubber & Plastic	-2.6	61,604	47,312	46,243	43,938	77
Non-metallic	4.0	38,245	51,702	50,259	54,925	200
Basic Metal	2.1	57,276	70,294	71,607	70,281	96
Fabricated Metal	3.2	42,214	64,219	55,606	57,235	178
Machinery	3.2	44,018	61,432	71,771	59,587	821
Other Manuf.	4.2	28,452	38,814	43,622	41,478	758
Utilities	4.7	85,560	104,531	125,539	129,508	163
Construction	2.4	38,413	49,001	52,728	48,765	1,279
Trade	4.2	42,636	74,678	76,051	62,174	4,097
Restaurants & Hotels	1.6	47,728	62,853	68,751	56,149	1,175
Transportation & Comm	4.2	46,344	77,856	72,834	67,540	923
Banking and Insurance	3.3	76,980	116,295	105,955	104,745	299
Real Estate	7.0	62,203	147,032	99,781	110,312	48
Services	4.5	47,471	74,955	78,973	71,068	3,412
Unclassified	-3.1	93,400	65,037	62,907	61,236	4
Total	5.8	25,623	45,543	46,686	41,953	31,935

** Sectoral wages are deflated by GDP deflator, constant in 1990 prices.*

The Minimum Wage Law

The minimum wage law has been implemented in Thailand since 1973. The wage committee, which consists of government, employer and employee representatives, is responsible for setting the national minimum wage in order to maintain standards of living of the workers. Since then, the minimum wage has also played an important role in determining the movement of overall nominal wage in Thailand. Imudom (2000) found that the nominal minimum wage in Thailand was closely related to inflation during 1976-1999. The author suggested that the direction of the relationship was likely to come from inflation to minimum wage, not in the opposite way. In addition to the influence from inflation, Imudom found that the minimum wage was also influenced by labor productivity growth.

Currently, the minimum wage regulation is implemented under 1998 legislation. Because the difference in living costs between urban and rural areas is widening, the new law provides for a decentralized process that can set the minimum wage individually in different areas and occupations.

The Financial Crisis and its Effects on the Wage Level

Behrman, Deolalikar, and Tinakorn (2001) suggested that although there is an adverse effect from the crisis on the aggregate wage level in Thailand, the decreases in labor income were not significant comparing to other quantitative variables. Employment, for example, was significantly affected by the economic downturn resulting from the crisis. It was empirically shown that the collapse of the economy induced business firms to lay off workers and keep only part of the productive labor forces paid at the pre-crisis rate. Paitoonpong (2001) confirmed this finding at the sectoral employment level. However, he pointed out that wages in different areas were unevenly affected by the collapse. Urban areas, which consist mainly of industrial and manufacturing employment, were less affected by the crisis than were rural areas. Most of the rural employment is, of course, in agriculture.

The Determination of Wage Equation

Understanding wage movement is nontrivial. The question whether wages are procyclical or countercyclical has been long debated in macroeconomic literature. While some theory suggested that wages are countercyclical (Keynes 1936; Barro 1990; Christiano and Eichenbaum 1992), others defended that wages are actually procyclical (Long and Plosser 1983; Rotemberg and Woodford 1991). Empirical studies also found mixed results (Bodkin 1969). Silver and Sumner (1989) concluded that the empirical relationship between wages and business cycles is crucially dependent on the period of the examination. Aggregate real wages are procyclical when there is an aggregate supply shock (*e.g.* an oil price shock). A countercyclical behavior, on the other hand, usually associates with the period when an aggregate demand shock plays role (*e.g.* an unanticipated money supply shock). Subsequent research by Abraham and Haltiwanger (1995) provided a complete survey on the issue but also suggested a similar finding. It is difficult to reach a conclusion for the behavior of real wages over business cycles.

Although the relationship between wages and business cycles is still unsolved, economists have learned that there are some important factors that determine nominal wage. Intermediate macroeconomic theory suggests at least three basic factors that commonly determine nominal wages across countries (Blanchard 2000). First, the expected inflation is crucial for wage determination because it is normally used as a reference for a wage negotiation (indexation). Second, wages also depend on labor market conditions. Higher unemployment implies low bargaining power of workers, and consequently lowers the wage level. Last, long-run growth in wages must be associated with labor productivity growth. These factors will be considered in the specification of the wage equations in the Interdyme of Thailand.

There are several interindustry modeling studies that can help us in selecting wage equations in the current analysis. In the multisectoral model of Spain (MIDE), Werling (1992) estimated firstly the equation for aggregate wage. Then, the aggregate wage, along with sectoral labor productivity, was used in the sectoral wage equations. The estimation of the aggregate wage in Werling's work was motivated by the traditional Phillips curve, where the nominal wage rate is influenced by the expected inflation and unemployment rate (particularly, the difference between the "natural", or non-accelerating inflation rate, of unemployment and unemployment rate). Because there was no data available for the natural rate of unemployment in Spain, the author used a four-period moving average of the past unemployment rates as an approximation. The adaptive expectation was used to form expected inflation. Current and lagged values of consumer's prices were used.

The sectoral wage equation in MIDE was formulated in terms of wage index. Explanatory variables include the index of aggregate wage and sectoral labor productivity. Werling defined labor productivity as the output per hour. The inclusion of the sectoral labor productivity in sectoral wage equation implies that the model allows for the divergence of sectoral wage in the long run.

In the interindustry model for China - Mudan, Yu (1999) also follows the similar estimation for aggregate wage and sectoral wages. However, because of the difference in the wage setting mechanism between agricultural and non-agricultural sectors in China, the aggregate wages for those sectors were estimated separately. The expected inflation in Mudan is the lagged value of the rate of change of the consumer price index. The natural rate of unemployment was also assumed to be a constant, unknown value which was determined by regression. Labor productivity was, however, measured in terms of output per worker.

In contrast to MIDE, sectoral wage equations in Mudan were estimated in the 'relative' terms (sectoral wages relative to the aggregate wage). The primary explanatory variable of a relative wage in sector *i* was a relative employment of sector *i*. The specification was motivated by equilibrium condition in the competitive labor market. That is, if there is an excess demand for labor (an increase in relative employment) in industry *i*, the relative wage in sector *i* will be increased in order to attracted potential workers until the equilibrium condition is attained. In short, a relative wage tends to rise when there is an excess demand for labor, and vice versa. The equation also included a time trend variable to capture all effects other than the relative employment.

Another interindustry model by Klein, Welfe and Welfe (1999) also employed the Phillips curve approach to estimate the aggregate wage equation. The equation was estimated in terms of the wage growth. Primary determinants are the growth rate in consumer prices and a labor market condition variable. However, the unemployment rate was not used in the regression. To represent labor market condition, the unemployment rate was replaced by rate of excess demand for labor, where it equals to the difference between labor vacancies and the number of registered unemployed persons divided by the total number of employed persons. The reason of introducing this variable to the equation is that it can also depict the situation where there is "negative" unemployment. As it was defined by the authors, this situation occurs when there is an excess demand in labor market. In order to account for the long-run growth in wage, labor productivity growth was also included in the equation.

The Estimated Equation

The estimation of the wage equation in the TIDY also separates the aggregate equation and sectoral equation. The aggregate wage will be estimated first. Then, it will be used in the sectoral regressions. The consistency between the estimated aggregate wage and sectoral wage will be maintained by scaling factors at the end of the simulation.

Aggregate Wage Equation

The aggregate wage equation in the Interdyme of Thailand is also motivated by the conventional Phillips curve with acceleration, which relates the behavior of wage to expected inflation, unemployment, and labor productivity. While the inflation and unemployment rate capture the effect from short-run disequilibrium, economic theory suggests that labor productivity growth influences the determination of wage rate in the long-run. Following Yu (1999) and Klein, Welfe and Welfe (1999), the nominal aggregate wage can be explained as:

$$W_t = e^{\beta} P_t^{\alpha_0} \left(\frac{Q_t}{L_t} \right)^{\alpha_1} e^{\alpha_2 (U_t - NU_t)} \qquad [6.2]$$

where, W_t = nominal aggregate wage,

P_t = price,

Q_t/L_t = productivity (output per worker),

U_t = unemployment rate,

NU_t = natural rate of unemployment.

Assuming that the effect from price change is proportionally passed to the nominal wage, α_0 will be equal to 1 and the functional form can be written in real terms. By taking natural logarithms, we can obtain a linear equation that could be estimated by OLS. Labor productivity is defined as annual outputs per worker. The natural rate of unemployment is also assumed to be constant and unknown. Time trend variable was also included in the equation in order to capture effects other than productivity growth and unemployment rate. Intuitively, the time trend variable can be represented as other qualitative variables, such as institution and government regulations. The estimated equation is:

$$\ln W_t = \alpha_0 + \alpha_1 \ln LP_t + \alpha_2 U_t + \alpha_3 T + \varepsilon_t \qquad [6.3]$$

where, W_t = aggregate wage level deflated by GDP deflator,

LP_t = labor productivity (real output per worker),

U_t = unemployment rate,

T = time trend.

The expected sign for the coefficient on labor productivity is positive. The unemployment rate should be, on the other hand, negatively related to the wage rate because it represents the bargaining power of the workers. The higher unemployment rate is, the less bargaining power and the lower wage the workers have.

Sectoral Wage Equation

Sectoral wage equation in the Interdyme of Thailand follows Werling (1992), which contains the effects from both aggregate and industry-specific determinants. Sectoral wages will be affected by the economy-wide shocks from the aggregate wage. The individual industry labor productivity was included in the equation in order to capture the industry-specific effect. Productivity growth in agricultural sectors is certainly not similar to that of manufacturing sectors. The inclusion of the industry labor productivity is particularly important because it determines wages over the long-run. Time trend was included to capture effects from other qualitative factors. The sectoral wage equations were also estimated in the real term. The functional form is:

$$\ln W_{i,t} = \alpha_{0,i} + \alpha_{1,i}\ln W_t + \alpha_{2,i}\ln LP_{i,t} + \alpha_{3,i}T + \varepsilon_{i,t} \quad [6.4]$$

where, $W_{i,t}$ = wage level in sector i at time t deflated by GDP deflator,

W_t = aggregate wage level at time t deflated by GDP deflator,

$LP_{i,t}$ = labor productivity (real output per worker) in sector i at time t,

T = time trend.

The expected signs of the coefficients for both aggregate real wage and labor productivity are positive.

Data Sources and the Consistency of the Data

The best source of labor market data in Thailand is the Labor Force Surveys (LFSs). These surveys have been conducted quarterly and are classified by the International Standard Industrial Classification (ISIC), consisting of 9 main industries, and 379 detail industries. Unfortunately, time series data are quite limited, only the 3rd quarter data survey is available from 1987 thereafter. Luckily enough the 3rd quarter of the survey represents the cultivating season and the peak of the employment in Thailand during a year. It also depicts accurately permanent jobs of the majority of Thai workers.

Because the industry classification in the ISIC is very disaggregate, the sectoral wage classified by the input-output industry can be constructed from the LFSs data source. I have successfully mapped the wage-employment data from the LFSs into the input-output classification. It is unfortunate, however, that the wage data constructed from the LFSs are not consistent to those published in the input-output table.

Figure 6.3: Survey vs. IO Wages - Total

(Billions of Baht)

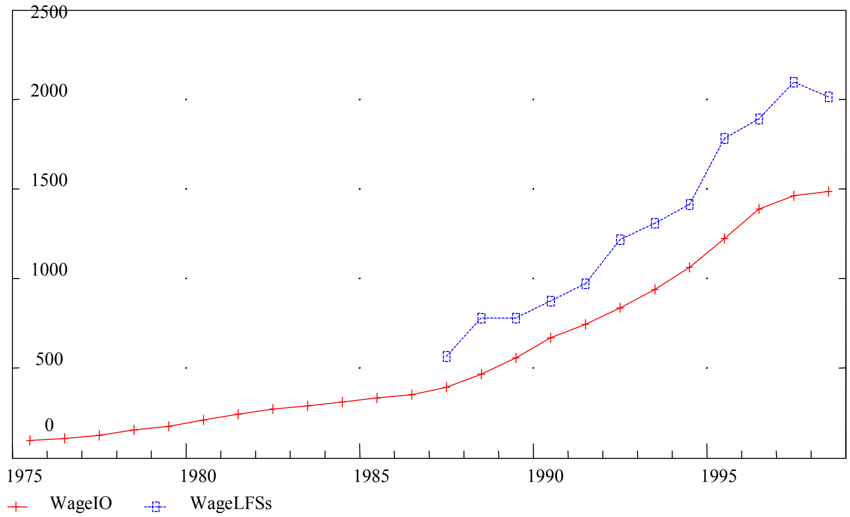


Figure 6.4: Survey vs. IO Wages - Crops

(Billions of Baht)

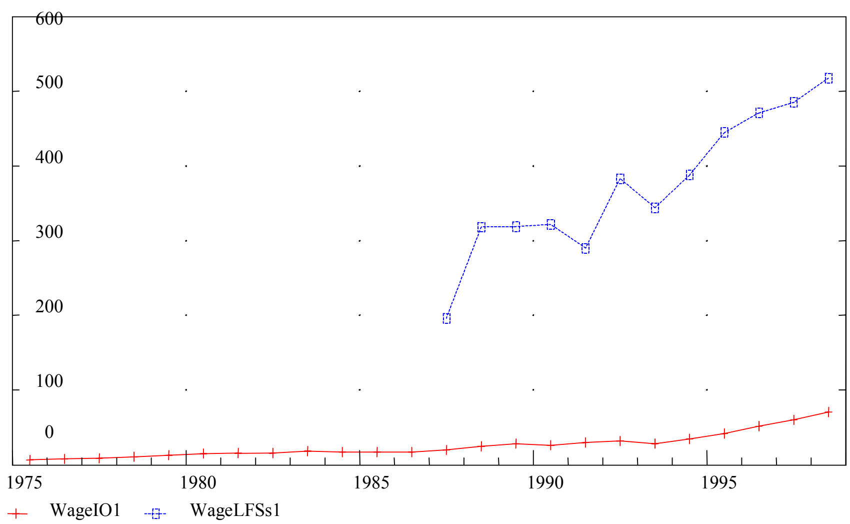


Figure 6.5: Survey vs. IO Wages - Food Manufacturing

(Billions of Baht)

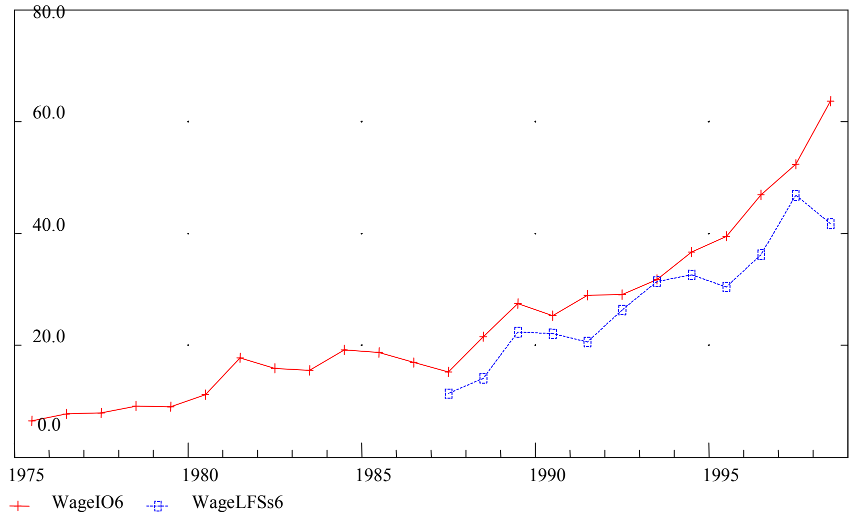
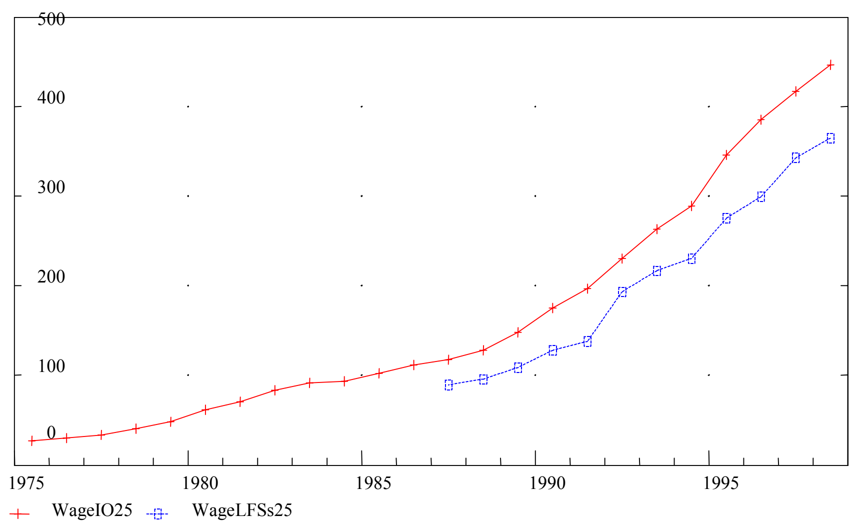


Figure 6.6: Survey vs. IO Wages - Services

(Billions of Baht)



Figures 6.3-6.6 plot wages obtained from the surveys and input-output table for some selected sectors. Figure 6.3 shows that the aggregate wage published by the LFSs is greater than that implied by input-output table. The immediate explanation would be that the input-output data may not fully account for self-employed workers. A closer

examination in sectoral detail confirms our suggestion. The higher wages from LFSs data are the greatest in agricultural sectors, such as Crops, Livestock, and Fishery. These sectors consist mainly of self-employed workers. In contrast, the plots from manufacturing and service sectors show the reverse. These findings in manufacturing and service sectors seem perplexing at first and require for more explanation of the nature of the labor market in Thailand.

Almost 50 percent of the total employment in Thailand is still in agricultural sectors. They are farmers, fishermen, and others who are primarily self-employed. These workers usually work in fields or on fishermen boats almost through out the year. However, there is also off-season period for these workers during a calendar year. For example, there is no work on the fields for farmers during dry season. There is also a certain period that prohibits fishermen from fishing in order to allow fish to fertilize. As a result, these workers are free and usually go to work in factories during such a period. Working in these factories normally does not require specific skills. However, when the cultivating period arrives, these workers leave their temporary jobs in the factories and return to their permanent jobs in the fields. The data constructed using the 3rd quarter of the LFSs represents employment level at its peak. The constructed wages from the LFSs reflect employment level when workers are at their permanent jobs (*i.e.* away from the factories) while the data published in the input-output table represents the annual average. Therefore, it is logical that the constructed data from LFSs in those manufacturing and service industries show the total wage less than that from the input-output table. In addition to the seasonal effect, part of the income for self-employed workers may be also go into operating surpluses and capital income in the input-output table.

Although the constructed data from the LFSs seem to well illustrate the labor market in Thailand, the wage data from the input-output publication will be used in the current research in order to maintain the consistency of price-income side in the model. However, it should be remarked that employment data from the LFSs will be used to calculate the sectoral average wage because it is the only source. Although it seems to be inconsistent between wage and employment data, the calculated average wages look plausible enough and assure us two things. First, it will give us a consistency in the wage-price side of the model. Second, the employment used and simulated in the model will be consistent to that reported by the LFSs.

<u>Estimation Results</u>

Wage and output data were obtained from the input-output tables. Data for employment and unemployment rate were, however, obtained from the LFSs. All data series were deflated by GDP deflator to yield data in constant 1990 prices. In order to capture effects from the financial crisis in 1997, the crisis dummy variable (equals to 1 in 1997-1998, otherwise 0) was initially included in the regression. However, the estimated coefficient on the crisis dummy was neither significant nor of the right sign. This finding somewhat agrees with that suggested by Behrman, Deolalikar, and Tinakorn (2001) and Paitoonpong (2001). Therefore, the crisis dummy variable was dropped from the regression. The result of the aggregate wage estimation is presented below.

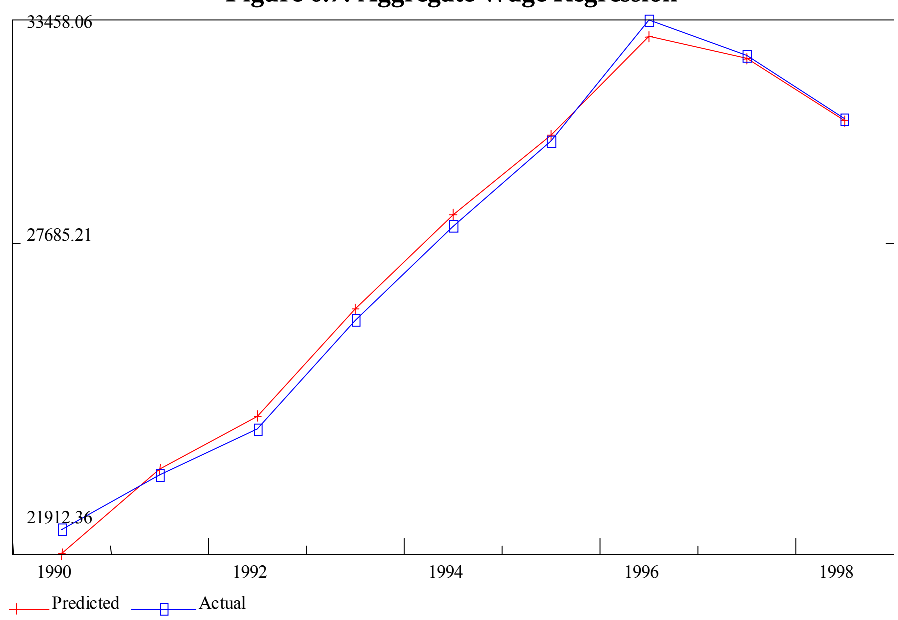
Table 6.3: Regression of the aggregate wage equation

Aggregate Wage Equation

```
SEE    =       0.01 RSQ    = 0.9954 RHO =    0.38 Obser  =     9 from 1990.000
SEE+1 =        0.01 RBSQ   = 0.9926 DW  =    1.25 DoFree =     5 to   1998.000
MAPE   =       0.08
```

Variable name	Reg-Coef	Mexval	Elas	NorRes	Mean
0 $\ln W_t$	- - - - - - -	- - - - -	- - - -	- - - - -	10.23
1 intercept	1.42255	7.2	0.14	216.63	1.00
2 U_t	-0.00491	2.3	-0.00	163.05	2.65
3 $\ln LP_t$	0.70233	138.5	0.84	1.65	12.18
4 time	0.01325	28.5	0.03	1.00	20.00

Figure 6.7: Aggregate Wage Regression



The result of the aggregate equation was obtained satisfactorily without soft constraints. The marginal explanatory value (Mexval) shows that labor productivity seems to be the most important determinant on the aggregate wage equation. The coefficient on the aggregate labor productivity (LP_t) is positive and less than unity.

Coefficient on unemployment rate is negative; however, its Mexval is relatively small. A time trend, which captures influences from other qualitative variable, is found positively related to the aggregate real wage.

For the sectoral wage equations, the initial unconstrained estimation did not deliver the desired results. In many sectors, the coefficient on the aggregate wage variable was initially found negative, though small. As a result, soft constraints were applied to make the coefficient on the aggregate wage variable positive. Table 6.4 presents the estimation results of the sectoral wage. The estimations are fairly good. $\overline{R}^2$ for all sectors are high, exception for Machinery and Trade. Numbers in parentheses under the estimated coefficients represent the marginal explanatory values (Mexval). An asterisk (*) indicates a soft constrained coefficient.

Table 6.4: The estimation results of the sectoral wage equation

	Sector	Intcpt	$\ln W_t$	$\ln LP_{i,t}$	Trend	RBSQ	SEE	MAPE
1	Crops	-10.68	0.018	1.88	0.0050	0.96	0.04	0.51
		(66.9)	*	(125.3)	(0.5)			
2	Livestock	-5.43	0.278	1.03	-0.0215	0.97	0.03	0.25
		(37.8)	(8.3)	(384.2)	(18.3)			
3	Forestry	-11.84	0.764	1.15	0.0583	0.92	0.07	0.59
		(32.1)	(11.6)	(315.8)	(18.0)			
4	Fishery	-3.66	0.039	1.10	0.0163	0.94	0.03	0.29
		(56.4)	*	(334.6)	(49.8)			
5	Mining and Quarrying	-2.39	0.029	1.05	-0.0248	0.97	0.04	0.29
		(4.1)	*	(77.9)	(3.5)			
6	Food Manufacturing	-3.69	0.018	1.03	0.0223	0.84	0.05	0.42
		(9.1)	*	(87.5)	(31.5)			
7	Beverages and Tobacco Products	-5.08	0.028	1.12	0.0069	0.95	0.04	0.31
		(87.5)	*	(393.3)	(6.3)			
8	Textile Industry	-4.27	0.194	1.02	0.0009	0.99	0.01	0.03
		(252.6)	(118.0)	(1628.0)	(1.4)			
9	Paper Products and Printing	-5.38	0.424	0.94	-0.0363	0.94	0.03	0.22
		(31.2)	(9.8)	(207.4)	(34.0)			
10	Chemical Industries	0.24	0.019	0.79	-0.0056	0.68	0.06	0.45
		(0.0)	*	(54.6)	(1.0)			
11	Petroleum Refineries	-4.53	0.008	1.05	-0.0006	0.98	0.08	0.44
		(86.4)	*	(667.8)	(0.0)			
12	Rubber and Plastic Products	-2.13	0.080	0.92	0.0026	0.97	0.03	0.22
		(31.7)	*	(398.6)	(1.4)			
13	Non-metallic Products	4.32	0.040	0.48	-0.0083	0.58	0.03	0.25
		(28.7)	*	(49.2)	(6.9)			

Note: Numbers in parentheses are Mexval, the asterisk indicates a soft constrained coefficient.

Table 6.4: The estimation results of the sectoral wage equation

Sector	Intcpt	$\ln W_t$	$\ln LP_{i,t}$	Trend	RBSQ	SEE	MAPE
14 Basic Metal	-3.82	0.006	1.06	0.0163	0.73	0.10	0.77
	(13.3)	*	(122.3)	(7.6)			
15 Fabricated Metal Products	-7.26	0.008	1.40	-0.0178	0.59	0.08	0.58
	(21.8)	*	(98.2)	(14.7)			
16 Machinery	5.37	0.019	0.42	-0.0086	-0.38	0.07	0.49
	(6.5)	*	(7.2)	(2.4)			
17 Other Manufacturing	0.59	0.219	0.64	-0.0119	0.94	0.02	0.12
	(1.4)	(6.8)	(105.6)	(13.8)			
18 Electricity and Water Works	-1.33	0.018	0.94	-0.0090	0.97	0.02	0.13
	(6.0)	(0.1)	(497.6)	(7.8)			
19 Construction	-1.83	0.267	0.83	-0.0428	0.99	0.01	0.02
	(162.3)	(254.4)	(1022.9)	(467.3)			
20 Trade	5.86	0.070	0.31	-0.0100	-0.24	0.04	0.32
	(28.8)	*	(11.8)	(10.4)			
21 Restaurants and Hotels	-5.70	0.427	0.98	-0.0293	0.99	0.01	0.07
	(182.2)	(80.1)	(325.4)	(69.4)			
22 Transportation and Communication	-0.04	0.070	0.82	-0.0099	0.94	0.02	0.12
	(0.0)	*	(217.5)	(31.5)			
23 Banking and Insurance	-2.09	0.184	0.91	-0.0002	0.99	0.01	0.08
	(20.4)	(8.3)	(851.4)	(0.0)			
24 Real Estate	-4.07	0.059	1.06	-0.0121	0.97	0.03	0.21
	(75.4)	*	(496.8)	(35.9)			
25 Services	-0.84	0.656	0.49	-0.0134	0.89	0.02	0.16
	(0.4)	(74.1)	(13.2)	(15.0)			
26 Unclassified	.	.	.	.	.	.	.

Note: Numbers in parentheses are Mexval, the asterisk indicates a soft constrained coefficient. Sector 26 contains no observation, and was excluded from the estimation.

Because the regression was estimated in logarithmic form, coefficients on the aggregate wage and labor productivity represent elasticities of sectoral wage with respect to these variables. In general, the aggregate wage exhibits small effects on the sectoral wage determination. Interestingly, in some service sectors, such as

Restaurants and hotels and Services, the coefficients on the aggregate wage are relatively larger. The sectoral labor productivity variable plays an important role in determining the sectoral wage. Coefficients on sectoral labor productivity were not constrained and all showed desired positive values, either less than or close to 1. In the broad category, the role of labor productivity in explaining sectoral wages is most important in agricultural sectors. The effect of productivity on the wage seems to be low in manufacturing and least in service sectors.

Many of the coefficients on time trend variable are negative, implying that the majority of sectoral wages have been slowly declining. Positive time trend coefficients are found in Crops, Forestry, Fishery, Food manufacturing, Beverages and tobacco, Textile, Rubber and plastic, and Basic metal.

6.3 DEPRECIATION

Depreciation represents the decline in productive efficiency, tear, and wear out of the present capital stocks. In the input-output table of Thailand, the depreciation is measured from all of the fixed capital, including both structures and equipment. However, it only accounts for the small part of the value-added component in the input-output table.

Capital depreciation is important because it helps us to deduce gross capital stock and net investment. However, its definition makes the measurement of the depreciation difficult because it is intangible. Much literature have been devoted to the measurement of capital depreciation. There are two major methods that have been used to measure the depreciation of the capital stock: the vintage-price method and the investment method. In the vintage-price method, the depreciation is estimated by the decrease in price of the homogenous capital goods over time. Hulten and Wykoff (1981a, 1981b) used the vintage-price method, employing the Box-Cox transformation regression, to estimate the capital depreciation.

The alternative method suggested by Jorgenson (1973) measures capital depreciation simply from the capital accumulation identity. Jorgenson found that the rate of capital replacement tends to be a constant. Therefore, he argued that "the geometric mortality distribution, resulting in a constant rate of replacement of the capital stock, may provide a useful approximation to replacement requirements for a broad class of mortality distributions". Capital depreciation can be simply calculated by $D_t = \delta K_{t-1}$, where D is a level of capital depreciation, K is a level of capital stock, and δ is a constant depreciation rate. Recent empirical study also strengthens the validity of this method. Terregrossa (1997) empirically examines various types of the measurement of capital depreciation. His findings are also consistent to that suggested by Jorgenson's approach.

Estimated Equation

The estimation for the sectoral depreciation equation follows the simple investment approach. Sectoral depreciation will be mainly explained by the level of capital stock from the previous period. Unfortunately, there are no sectoral capital stock measures classified by 26 input-output industries available in Thailand. The capital stock data are published in the broad classification, containing 11 sectors. These capital stock sectors are similar to those sectoral investment sectors and are not as disaggregate as the 26 input-output definition[11]. Consequently, the exact definition of the sectoral stock cannot be included in the equation. Instead, capital stock from the related broad sector will be used. For example, capital stock from Agricultural sector will be used in the sectoral equations of Crops, Livestock, Forestry, and Fishery. Although the this approach seems to be reasonable, the meaning of the coefficient on capital stock must be interpreted with care. The estimated equation is:

$$deprec_{i,t} = \alpha_0 + \alpha_1 K_{j,t-1} + \varepsilon_{i,t} \qquad [6.5]$$

where, $deprec_{i,t}$ = level of capital depreciation in the input-output sector i at time t deflated by GDP deflator,

$K_{j,t-1}$ = level of capital stock in the broad investment sector j at time t-1 deflated by GDP deflator.

In the general analysis, α_1 should represent the depreciation rate of the sectoral capital stock. In this study, however, the capital stock from a broader classification was used in the equation. Therefore, the coefficient on the capital stock is not exactly the sectoral depreciation rate. Mathematically, it will be equal to the sectoral depreciation rate weighted by the proportion of the sectoral capital stock to the broad aggregate stock. Particularly, $\alpha_{1,i} = \delta_i(K_{i,t}/K_t)$, where δ_i is actual capital depreciation

[11] They are: 1. Agriculture, 2. Mining and quarrying, 3. Manufacturing, 4. Construction, 5. Utilities, 6. Transportation and communication, 7. Wholesale and retail trade, 8. Banking, insurance, and real estate, 9. Ownership of dwelling, 10. Public administration and defense, and 11. Services.

and K is capital stock. In any case, coefficient on capital stock variable is expected to be positive and small.

Estimation Results

The equation was estimated during the period from 1975 to 1998. All data series were deflated by GDP deflator, constant in 1990 prices. The estimated results of the coefficients on capital stock variable satisfy the expected sign. No soft constraints were applied to the estimation. However, a dummy variable, accounted for a structural change in the time series, was included in the Forestry industry equation[12]. Table 6.5 presents results of the sectoral depreciation equation. Numbers in parentheses are Mexval.

[12] The dummy variable is equal to 1 during 1989-1998, otherwise 0.

Table 6.5: The estimation results of the sectoral depreciation equation

	Sector	Mean	Intcpt	$K_{j,t-1}$ Coeff	Elas	RBSQ	SEE	MAPE	Type of Stocks
1	Crops	4971	-1699	0.0182	1.34	0.90	537.1	9.34	Agriculture
			(26.3)	(227.9)					
2	Livestock	1208	-457	0.0045	1.38	0.80	201.2	18.25	Agriculture
			(14.3)	(130.9)					
3	Forestry*	272	241	0.0003	0.40	0.82	29.0	9.10	Agriculture
			(51.0)	(8.3)					
4	Fishery	3156	-4376	0.0206	2.39	0.88	689.5	20.58	Agriculture
			(84.3)	(192.4)					
5	Mining and Quarrying	4205	908	0.0641	0.78	0.87	885.0	18.62	Mining
			(16.1)	(179.8)					
6	Food Manufacturing	7251	2602	0.0074	0.64	0.92	1111.6	19.83	Manufacturing
			(80.0)	(262.1)					
7	Beverages and Tobacco	2597	419	0.0035	0.84	0.98	245.4	7.15	Manufacturing
			(48.2)	(645.4)					
8	Textile Industry	12322	1522	0.0172	0.88	0.92	2644.2	31.58	Manufacturing
			(6.6)	(254.3)					
9	Paper Products and Printing	2207	222	0.0032	0.90	0.98	231.5	11.57	Manufacturing
			(17.3)	(620.4)					
10	Chemical Industries	2593	170	0.0039	0.93	0.99	241.9	7.73	Manufacturing
			(9.7)	(739.3)					
11	Petroleum Refineries	5344	874	0.0071	0.84	0.88	1346.7	28.20	Manufacturing
			(8.3)	(193.7)					
12	Rubber and Plastic	1980	96	0.0030	0.95	0.98	255.6	9.15	Manufacturing
			(2.9)	(521.3)					
13	Non-metallic Products	4494	847	0.0058	0.81	0.82	1368.0	41.54	Manufacturing
			(7.5)	(143.4)					

Note: Numbers in parentheses are Mexval.

Table 6.5: The estimation results of the sectoral depreciation equation

Sector	Mean	Intcpt	$K_{j,t-1}$ Coeff	$K_{j,t-1}$ Elas	RBSQ	SEE	MAPE	Type of Stocks
14 Basic Metal	1596	332 (21.2)	0.0020 (252.8)	0.79	0.92	310.8	18.03	Manufacturing
15 Fabricated Metal Products	1239	86 (1.6)	0.0018 (230.4)	0.93	0.90	304.5	41.73	Manufacturing
16 Machinery	13927	-1827 (9.4)	0.0251 (408.7)	1.13	0.96	2627.9	11.89	Manufacturing
17 Other Manufacturing	6127	-29 (0.0)	0.0098 (190.6)	1.00	0.88	1877.9	40.30	Manufacturing
18 Electricity and Water Works	7789	-487 (9.9)	0.0316 (846.8)	1.06	0.99	610.7	10.41	Utilities
19 Construction	11504	1172 (1.9)	0.0917 (153.8)	0.90	0.84	4019.6	32.91	Construction
20 Trade	24070	-18145 (191.7)	0.1019 (609.5)	1.75	0.98	2781.8	7.77	Trade
21 Restaurants and Hotels	5332	-2216 (67.3)	0.0151 (423.6)	1.42	0.96	756.0	9.24	Services
22 Transportation and Comm	21381	-720 (0.5)	0.0292 (266.9)	1.03	0.92	3781.7	23.77	Trans&Comm
23 Banking and Insurance	5984	-16012 (160.6)	0.2696 (256.5)	3.68	0.92	1715.9	48.92	Bank, Ins, RE
24 Real Estate	32253	-12428 (34.4)	0.5476 (248.6)	1.39	0.91	3571.6	10.43	Bank, Ins, RE
25 Services	12650	-890 (6.6)	0.0272 (540.7)	1.07	0.97	1101.4	7.37	Services
26 Unclassified	.	.	.	.	.	.	.	.

Note: Numbers in parentheses are Mexval. Equation for Forestry included dummy variable for a structural change in the series, which equals to 1 during 1989-1998, otherwise 0. Sector 26 contains no observation, and was excluded from the estimation.

Although the estimated coefficients on the capital stock variable cannot exactly represent the depreciation rate, some plausible results emerged from the estimation. For those sectors which have one-to-one match between depreciation and capital stock, the estimated coefficients imply intuitive results. For example, the implied depreciation rates for Mining and Trade sectors are 6.4 percent and 10.2 percent, respectively. In addition, the sum of the estimated coefficients on $K_{j,t-1}$ for the same type of capital *j* will equal to the depreciation rate in that investment sectors (*e.g.* the sum of the estimated coefficients on capital stock for Crops, Livestock, Forestry, and Fishery will be equal to the depreciation rate for Agriculture). These numbers are also plausible.

CHAPTER 7: THE ESTIMATION OF LABOR PRODUCTIVITY IN THAILAND

In the present study, labor productivity is defined as the level of output per worker. It is therefore the fundamental determinant of economic growth and the wage level in the long-run. Sustainable economic development includes the effects of both improvement in human capital and growth in physical capital per worker. The objective of this chapter is to estimate labor productivity functions in Thailand and to incorporate them into the TIDY model. Given sectoral output levels, the estimated sectoral labor productivity is sufficient to determine labor requirements.

7.1 SECTORAL LABOR PRODUCTIVITY AND EMPLOYMENT IN THAILAND

Over the ten year period 1987-1997, the average of annual labor productivity growth in Thailand is 7.2% per year. Table 7.1 below presents growth rates of the average labor productivity as well as sectoral labor productivity in 1987. Although aggregate productivity has exhibited a positive trend through time, labor productivity varies across sectors. In general, higher growth rates are in capital-intensive sectors. Such strong labor productivity growth is exhibited in industries like Mining, Machinery, and Utilities. On the other hand, the labor productivity figures in the Crops sector, containing 50% of the employment, reveal a relatively slow growth rate -- 3.9% per year. Interestingly, Construction and Real estate sectors both showed negative growth in productivity during the previous 10 years *prior* to the real estate bubbles and the financial crisis in 1997.

Table 7.1: Labor productivity growth and Employment level in Thailand

	Sector	Productivity Growth (%)		Employment (thou)
		1987-1997	1997-1998	1998
1	Crops	3.93	1.43	15,251.4
2	Livestock	4.85	-19.95	502.6
3	Forestry	-6.44	-38.18	155.7
4	Fishery	4.58	13.62	401.3
5	Mining and Quarrying	12.42	1.64	41.3
6	Food Manufacturing	3.57	-4.81	652.2
7	Beverages and Tobacco Products	5.71	-31.51	86.6
8	Textile Industry	1.45	-14.83	955.6
9	Paper Products and Printing	4.12	-2.53	153.9
10	Chemical Industries	1.02	13.03	196.4
11	Petroleum Refineries	-5.27	-20.82	7.4
12	Rubber and Plastic Products	2.27	1.03	77.2
13	Non-metallic Products	4.47	-6.50	200.1
14	Basic Metal	3.11	31.41	96.3
15	Fabricated Metal Products	1.04	5.45	178.3
16	Machinery	7.31	-3.34	820.9
17	Other Manufacturing	7.24	-10.66	758.3
18	Electricity and Water Works	7.83	-14.05	162.6
19	Construction	-2.87	-1.14	1,279.1
20	Trade	6.62	-7.28	4,097.0
21	Restaurants and Hotels	-1.70	-8.35	1,175.2
22	Transportation and Communication	3.83	-3.23	922.8
23	Banking and Insurance	7.19	-10.98	298.7
24	Real Estate	-5.22	10.63	47.6
25	Services	3.32	-4.44	3,412.4
26	Unclassified	19.92	14.60	3.9
	Total	7.164	-6.694	31,935.0

Note: Labor productivity is defined as the value of annual output per worker. Growth rate is computed with compounding each year.

The second column of the figures clearly shows that labor productivity in Thailand declined hugely as a result of the financial crisis in 1997. The average labor productivity declined by 6.7% during the crisis periods. Negative productivity growth appeared in many production sectors. Surprisingly, some industries also showed strong labor productivity growth; for example, Real Estate, Chemical, and Basic metal. The explanation could be that, relative to output decreases, the employment in these sectors massively declined during the crisis. Further study should be undertaken to clarify this suggestion.

7.2 THE DETERMINATION OF LABOR PRODUCTIVITY

Unlike other economic variables, economists are quite certain about the behavior of labor productivity over business cycle. As was first suggested by Hultgren (1960), aggregate labor productivity is procyclical. Subsequent empirical supports have been extensive, for example, Kuh (1965), Solow (1968), and Sims (1974). In addition, the recent Baily, Bartelsman, and Haltiwanger (2001) study reveals that labor productivity, at the firm-level, shows a stronger procyclical behavior than does that of the aggregate.

Aside from the agreement on its behavior over business cycle, reasons behind the theory of procyclical labor productivity have long been debated. Generally, the controversy arises from three possible explanations. The first is the traditional "labor hoarding" theory put forward by Becker (1962), Oi (1962), and Rosen (1968). This theory suggests that firms cannot fully adjust employment level in response to economic fluctuations in the short run. They keep more workers than are required for the production process, thus "hoarding" during economic downturns. Therefore, employers usually keep existing workers but vary physical capital utilization rates with changes in the economy. Consequently, labor productivity varies with the business cycle.

Second, labor productivity is procyclical because of the “increasing returns” in the production function (Hall 1987; 1988a; 1988b). Increasing returns to scale implies that, when the economy is boom, firms will be more efficient. Outputs per unit of factor input will rise when the economy accelerates, and vice versa. Therefore, labor productivity will exhibit procyclicality. Empirical works on increasing return theory are exhibited in Ramey (1987) and Chirinko (1989).

Third, the Real Business Cycle theory suggests that the procyclical behavior of labor productivity is simply because of the “technology shocks” during economy upturns and downturns (Prescott, 1986).

Series of empirical research suggests the results in favor of both the increasing returns and labor hoarding explanations. Using two-digit manufacturing industries, Bernanke and Parkinson (1991) suggested a strong rejection in the technology shock theory and its role in explaining the procyclical behavior of labor productivity. However, the hypotheses from both the increasing returns and labor hoarding theories cannot be statistically rejected. Bernanke and Parkinson thus concluded that the procyclical behavior of labor productivity could be a combination of both explanations. Aizcorbe (1992) examined the U.S. automobile industry at plant-level data and suggested that his findings are consistent with such claims. Basu (1996) provided a strong conclusion that procyclical labor productivity does indeed come from a changing labor utilization rate; the increasing return hypothesis makes only a minor contribution.

The objective of this chapter is to estimate sectoral productivity in Thailand, allowing for procyclical fluctuations, whatever their cause. With these function and sectoral output, employment required in the production process can be calculated.

7.3 THE ESTIMATION OF LABOR PRODUCTIVITY IN THE INTERINDUSTRY MODEL

The U.S. interindustry *LIFT* model (Meade, 2001) estimates labor productivity simply by capturing its procyclical behavior. Output growth is the main explanatory variable in the labor productivity regression. However, the functional form is specified such that the effects from positive and negative shocks are not symmetric. The specification also allows for the depreciation in production capacity over the long-run. Labor productivity was defined as output per hours worked.

Werling (1992) follows the same approach for the interindustry model for Spain. In the Mudan model of China, Yu (1999) also includes sectoral capital-labor ratio in the regression in order to capture the consequence of the growing capital accumulation in China. However, it does not help improve the estimation results. Many dummy variables were applied to the regressions in order to fit the historical data.

Due to the limitation of the data, the estimation for sectoral labor productivity in Thailand imposed the restricted functional form that labor productivity respond similarly to economic upturns and downturns. A time trend variable was also included in order to capture the effect from other factors, such as technological progress. The functional form is simply:

$$\ln\left(\frac{q_{i,t}}{l_{i,t}}\right) = \alpha_{i,0} + \alpha_{i,1}t + \alpha_{i,2}\ln\left(\frac{q_{i,t}}{q_{i,t-1}}\right) + \varepsilon_{i,t} \qquad [7.1]$$

where, $q_{i,t}$ = output of sector *i* at time *t*,

$l_{i,t}$ = employment in sector *i* at time *t*.

t = time trend.

Because the output growth captures the procyclical behavior of labor productivity over the business cycles, the expected sign of the coefficient is positive and less than unity. A coefficient greater than 1 would result in a decline in employment if output growth is positive, and vice versa.

7.4 ESTIMATION RESULTS AND DISCUSSION

Compared to other sectoral regressions, the results of the sectoral labor productivity regression are less successful. Coefficients on time trend variables indicate that the majority of the sectoral labor productivity has been growing. Strong positive coefficients are present in Mining and Banking sectors. Negative time trend coefficients also appear in several sectors - regardless of the effect of economic cycles, labor productivity in Forestry, Textile, Petroleum, Construction, Restaurant and hotel, and Real Estate sectors have been declining over time.

Table 7.2: The estimation results of the sectoral labor productivity equation

Sector	Intcpt	*time*	$\ln(q_t/q_{t-1})$	RBSQ	SEE
1 Crops	-5.0238	0.0400	0.4512	0.89	0.04
	(2017.1)	(236.0)	(20.5)		
2 Livestock	-2.5146	0.0250	0.9913	0.04	0.18
	(175.2)	(10.9)	*		
3 Forestry	-0.8174	-0.0799	0.7717	0.44	0.25
	(15.2)	(46.5)	(5.6)		
4 Fishery	-2.9936	0.0522	0.9903	0.52	0.13
	(348.7)	(75.0)	*		
5 Mining and Quarrying	-1.6757	0.1033	0.0103	0.91	0.10
	(185.7)	(251.1)	(0.0)		
6 Food Manufacturing	-0.8318	0.0265	0.5959	0.55	0.07
	(125.5)	(59.7)	(22.2)		
7 Beverages and Tobacco Products	-0.3873	0.0440	0.8598	0.18	0.19
	(3.7)	(21.2)	(1.9)		
8 Textile Industry	-0.4910	-0.0079	0.1493	-0.08	0.09
	(43.0)	(4.7)	*		
9 Paper Products and Printing	-1.5737	0.0506	0.6838	0.61	0.12
	(128.4)	(76.2)	(3.4)		
10 Chemical Industries	-0.7872	0.0174	0.0991	-0.04	0.13
	(48.3)	(9.9)	*		
11 Petroleum Refineries	6.8177	-0.1622	0.2316	0.32	0.59
	(133.3)	(37.4)	*		
12 Rubber and Plastic Products	-0.5832	0.0433	0.9930	0.25	0.18
	(15.5)	(28.7)	*		
13 Non-metallic Products	-1.6884	0.0519	0.3937	0.70	0.08
	(139.6)	(67.3)	(9.4)		
14 Basic Metal	-1.0408	0.0364	0.5058	0.16	0.17
	(39.6)	(20.9)	(4.2)		
15 Fabricated Metal Products	-1.0017	0.0052	0.0982	-0.25	0.10
	(106.5)	(1.6)	*		
16 Machinery	-1.1425	0.0623	0.2673	0.66	0.12
	(28.2)	(39.7)	(1.2)		

Table 7.2: The estimation results of the sectoral labor productivity equation

Sector	Intcpt	*time*	$\ln(q_t/q_{t-1})$	RBSQ	SEE
17 Other Manufacturing	-2.5253	0.0868	0.9295	0.84	0.08
	(89.2)	(54.6)	(8.3)		
18 Electricity and Water Works	-1.0901	0.0578	0.9907	0.63	0.13
	(84.0)	(83.8)	*		
19 Construction	-0.8112	-0.0116	0.5675	0.76	0.07
	(63.7)	(6.2)	(42.6)		
20 Trade	-3.0336	0.0662	0.9910	0.79	0.08
	(580.9)	(194.4)	*		
21 Restaurants and Hotels	-1.1638	-0.0089	0.8830	0.56	0.06
	(117.6)	(4.5)	(11.7)		
22 Transportation and Communication	-1.4940	0.0342	0.4987	0.79	0.05
	(358.3)	(135.6)	(12.8)		
23 Banking and Insurance	-2.3078	0.1062	0.9980	0.73	0.15
	(189.2)	(155.9)	*		
24 Real Estate	1.5440	-0.0238	0.9333	0.63	0.12
	(107.1)	(14.4)	(29.0)		
25 Services	-2.5656	0.0258	0.7083	0.70	0.05
	(482.6)	(82.9)	(3.1)		
26 Unclassified	-1.0294	0.1415	0.3109	0.44	0.43
	(2.2)	(19.0)	(0.1)		

In the broad view, output growth appears to most strongly affect labor productivity in service industries. According to the coefficients on the output growth, it is clear that labor productivity in those service sectors, such as Trade, Banking, and Real estate, are more sensitive to changes in the economic environment. In contrast, less procyclical behaviors were found in agricultural sectors and manufacturing sectors, respectively. This is especially true for some heavy-goods industries, such as Mining, Chemical, and Fabricated metal; these sectors seem not to sensitive to output growth.

Several sectors have negative coefficients on the time trend variable. These sectors include Forestry, Textile, Petroleum, Construction, Restaurants and hotels, and Real estate. While a declining productivity in Forestry is explainable – that the scarce amount of forest areas and timbers leads to lower output per worker, decreases in labor productivity in other sectors are questionable. These findings prompt high a priority for further study in sectoral labor productivity in Thailand.

CHAPTER 8: SECTORAL IMPORT EQUATIONS IN TIDY

Imports represent domestic demands for foreign products. Various factors influence imports of a country. The amount of country's imports is usually associated with domestic income and economic environment. Other factors include the exchange rates and relative prices, tariffs, and international trade policy.

8.1 IMPORT EQUATION

In the present study, imports are modeled very simply. Sectoral import in TIDY is a linear function of the sectoral total demand. Although the equation does not include relative prices and trade tariffs, it captures effects from domestic economic conditions on import demands. Equation [8.1] below displays the sectoral import equation in TIDY.

$$imp_{i,t} = \alpha_0 + \alpha_1 totald_{i,t} + \varepsilon_{i,t} \quad [8.1]$$

where, $imp_{i,t}$ = import of sector i at time t,

$totald_{i,t}$ = total demands of sector i at time t.

Total demand is the only explanatory variable in the import regression. The coefficient on total demand is expected to be positive and less than 1, as the amount of imports should be less than or equal to the amount of total demand.

8.2 ESTIMATION RESULTS

Table 8.1 presents the estimation results of the sectoral import equation. The means historical values of sectoral imports are also included in order to show relative size of each sector's import.

In terms of value of imports, Machinery has been imported the most to Thailand. On average, the value of Machinery products imported by Thailand equals to 334 billion bahts per year during 1975-1998. The second and third ranks of the imported goods belong to Chemical products and Basic metal. Thailand has imported annually 82 billion bahts of Chemical products and 77 billion bahts of Basic metal during the same period. In general, raw materials and machineries have been the largest values in Thai import structure.

The linear regressions of sectoral import equation give reasonable fits. The third column of table 8.1 displays effects from total demand on the value of imports. From elasticities, values of imports in agricultural products respond strongly to the total demands. Imports for Livestock, Crops, Fishery, and Forestry all have elasticities greater than 1.

Manufacturing sectors have the largest value of imports. However, they are less responsive to the sectoral total demands than that appears in agricultural sectors. Several manufacturing sectors such as Chemical, Basic metal, and Fabricated metal have import elasticities to the total demand close to 1. These sectors have the biggest import shares among all of the sectors.

Table 8.1: The estimation results of the sectoral import equation

Sector	Mean	Intcpt	Total demand Coeff	Total demand Elas	RBSQ	SEE
1 Crops	12084	-17398 (119.4)	0.1410 (254.5)	2.44	0.92	2054.7
2 Livestock	1038	-1757 (118.8)	0.0505 (237.2)	2.69	0.91	249.5
3 Forestry	10413	-5067 (98.4)	0.8287 (442.7)	1.49	0.96	570.7
4 Fishery	294	-422 (46.5)	0.0168 (116.4)	2.44	0.78	127.1
5 Mining and Quarrying	45075	3844 (6.0)	0.4707 (352.4)	0.91	0.95	5657.3
6 Food Manufacturing	25025	-20849 (112.1)	0.1300 (350.2)	1.83	0.95	3886.7
7 Beverages and Tobacco Products	10525	-5125 (104.4)	0.1676 (518.0)	1.49	0.97	1296.7
8 Textile Industry	25396	-9259 (59.8)	0.1183 (443.5)	1.36	0.96	3611.3
9 Paper Products and Printing	15861	-3660 (22.5)	0.3269 (352.3)	0.12	0.95	2669.9
10 Chemical Industries	82093	-429 (0.1)	0.5796 (1050.0)	1.01	0.99	5052.1
11 Petroleum Refineries	32652	9712 (8.0)	0.1778 (46.9)	0.70	0.52	10695.7
12 Rubber and Plastic Products	14909	-4819 (122.3)	0.2717 (915.1)	1.32	0.99	1442.0
13 Non-metallic Products	7153	881 (14.8)	0.0795 (407.2)	0.88	0.96	918.4

Note: *Numbers in parentheses are Mexval.*

Table 8.1: The estimation results of the sectoral import equation

Sector	Mean	Intcpt	Total demand Coeff	Total demand Elas	RBSQ	SEE
14 Basic Metal	76879	-12418	0.6990	1.16	0.99	6209.5
		(53.9)	(941.2)			
15 Fabricated Metal Products	27792	-3554	0.4845	1.13	0.98	3289.3
		(21.7)	(705.7)			
16 Machinery	334273	3645	0.4488	0.99	0.99	31337.2
		(0.3)	(848.5)			
17 Other Manufacturing	55426	-5033	0.2354	1.09	0.99	3565.6
		(32.6)	(1233.8)			
18 Electricity and Water Works	651	136	0.0060	0.79	0.66	247.8
		(4.8)	(76.4)			
19 Construction	31	-24	0.0002	1.78	0.45	38.7
		(5.8)	(37.6)			
20 Trade	.	.	.	.	.	.
21 Restaurants and Hotels	11421	-2134	0.0738	1.19	0.81	2877.2
		(4.5)	(134.9)			
22 Transportation and Communication	14049	-7327	0.0809	1.52	0.95	2800.3
		(62.6)	(340.3)			
23 Banking and Insurance	2476	185	0.0188	0.93	0.88	730.3
		(1.4)	(191.1)			
24 Real Estate	3507	-3212	0.0811	1.92	0.80	1689.8
		(32.6)	(128.2)			
25 Services	12504	-11412	0.0899	0.19	0.83	5087.1
		(40.4)	(150.6)			
26 Unclassified	7102	5907	0.0403	0.17	0.01	3601.7
		(28.8)	(1.8)			

Note: *Numbers in parentheses are Mexval.*
Sector 20 contains no observation and was excluded from the estimation.

CHAPTER 9: REFINING THE MACRO EQUATION USING OPTIMIZATION

9.1 REFINING THE ESTIMATION TECHNIQUES

The sectoral components of the model are estimated by least squares, motivated by the desire to best fit the data. Issues of simultaneity are ignored in this approach. This is the usual approach followed in large scale empirical modeling, since there is generally insufficient information available to support specific assumptions about the 'true' specification of every equation (that would be required if simultaneous equation techniques were to be formally applied).

The estimation procedures also constrain coefficients in order to be consistent with economic theory, even though such constraints necessarily reduce the accuracy of the fit. This issue is particularly important in the macro model, where ordinary least squares yields implausible estimates for key parameters that both misrepresent the underlying structure of the model and result in implausible forecasts when used to make a long run forecast.

9.2 OPTIMIZATION IN TIDY

Optimization in a complete model can be used for two quite distinct purposes:

[1] selected regression coefficients can be varied to optimize how well the model reproduces past historical data, or

[2] policy variables can be adjusted to optimize some welfare function.

A new feature of the Interdyme software, optimization, successfully applied for the first time in TIDY[13]. We shall demonstrate first, in this chapter, the first type of optimization and then turn in the next chapter to policy optimization.

In many cases, model builders do not get plausible coefficients from an OLS regression. While the estimation may provide a good fit, it somehow delivers a non-sensical economic meaning. Simultaneous equation bias is, among other things, one of the causes of this problem. Several econometric methods, such as instrumental variables and two-stage least squares, are supposed to yield unbiased and consistent parameters, but they often make little difference in the estimates.

In practice, economic modelers often apply soft constraints in estimating an equation in order to arrive at sensible outcomes[14]. However, this method is highly subjective and relies heavily on personal judgment. There is, however, an alternative way to handle this problem that appears to be a more promising and less subjective method, namely, optimization in the complete model.

[13] It should be remarked that the optimization in TIDY works only with the 'macro-type' variables at the moment. In other words, it does not deal with sectoral estimations that use a 'detached-coefficient' method. However, the optimization at sectoral level can be conducted. When necessary, we can easily re-specify a detached-coefficient estimation as a macro-type estimation.

[14] See Almon (1999a) for further discussions of soft constraints.

The optimization in a complete model fitting solves simultaneous bias problem because it does not use regression and consequently has no disturbance that would be contemporaneously correlated with endogenous regressors. This approach is also considerably more comprehensive than the Full Information Maximum Likelihood (FIML) method. In FIML, the lagged values of endogenous variables are treated as exogenous. In a complete model simulation, they may be very much influenced by coefficients that are being changed.

In this chapter, optimizing TIDY with respect to the parameters of the savings rate equation shows that marginal adjustments in the parameters can result in a significant improvement of the historical simulations. To compare and contrast results, this section discusses the forecast of savings rates that result from three different approaches:

[1]. Unconstrained estimation

[2]. Constrained estimation

[3]. Optimization of the complete model.

9.3 APPLYING OPTIMIZATION TO THE SAVINGS RATE EQUATION

Personal savings play an important role in the expenditure side of the model. They are buffers when consumers experience shocks in income. In the short run, consumers adjust their saving rate in response to income changes; this behavior is an attempt to smooth consumption in line with their currently available and expected future income. Therefore, the estimation of the saving equation is crucial in an economic model. A bad estimation can lead to a non-convergent simulation.

The Savings Rate Equation in TIDY

TIDY estimates a saving equation in terms of a saving rate – a ratio of personal saving over personal income. Equation [9.1] presents the saving rate equation in TIDY.

$$savrat_t = \alpha_0 + \alpha_1 YC_t + \alpha_2 U_t + \alpha_3 i_t + \alpha_4 \pi_t + \alpha_5 dummy + \varepsilon_t \qquad [9.1]$$

where, $savrat_t$ = saving rates (total savings/personal income),

YC_t = growth rate of real income,

U_t = unemployment rate,

i_t = nominal interest rate,

π_t = inflation rate

$dummy$ = dummy variable (1998 = 1, otherwise 0).

The coefficient for real income growth is expected to be positive. For instance, a decrease in income prompts consumers to reduce their saving rates, and vice versa.

The inclusion of an unemployment rate is also important in the savings equation as it helps to stabilize the model. When unemployment is high, as a result of an economic downturn, declining saving rates induce higher consumption levels and help alleviate cyclical behavior in the model. Saving rates should exhibit a negative correlation with unemployment rates.

Specific to nominal interest rates, the relevant literature suggests that they exert both positive and negative effects (Yu 1999; Campbell and Mankiw 1989). High interest rates attract more savings; therefore saving rates may be expected to increase with higher interest rates. However, high interest rates may also discourage savings because increased interest payments on consumer debt reduce income available for saving or consuming. Therefore, either a positive or negative coefficient may be expected on an interest rate variable. In spite of its ambiguity, inclusion of the interest rate provides a policy tool because it is exogenous to the model.

Inflation rates represent the opportunity costs of holding money. When inflation is high, consumers tend to invest more in real assets rather than in bank deposits. Therefore, higher inflation induces less savings and we expect a negative sign from inflation variable. A dummy variable is included in the equation in order to capture effects from the financial crisis in 1998.

The Objective Function for Optimization in Historical Simulation

We specify the objective function to be minimized as the sum of squared errors of the unemployment rate and of the price deflator. All coefficients in the savings rate and GDP deflator equations, except the dummy variable, are allowed to be varied. Box 9.1 displays the objective function specified in the master file. Each period's contribution to the objective function (err) is a sum of the unemployment rate (err1) and GDP deflator (err2). The full objective function is the sum of the contributions over all periods, which is the value of *error* in the last period.

Box 9.1: The objective function of optimization in the historical simulation

```
# Objective function, minimizing sum of square
# residuals of unemployment rates (unrate) and
# GDP deflator (gdpDTS)

fex unact = unrate
fex gdpDact = gdpDTS

f err1 = @sq(unrate - unact)
f err2 = 0.5*@sq(100.*(gdpDTS - gdpDact)/gdpDact)

f err = err1 + err2
f error = @cum(error,err,0)
```

Table 9.1 compares the estimated coefficients in the savings rate equation from three different approaches: unconstrained estimation, constrained estimation, and optimization. The plots of the regression fit for the unconstrained and constrained estimations display in figure 9.1 and 9.2 below.

Table 9.1: The comparison of results from different savings rate estimations

	intcpt	*YC*	*U*	*i*	*π*	*Dummy*
Unconstrained	1.685	0.196	1.827	0.567	-0.687	8.52
		(22.8)	(100.8)	(42.5)	(21.1)	(75.4)
Soft constrained	7.081	0.481	-0.493	0.758	-0.603	12.70
		(29.1)	*	(14.8)	(3.0)	(36.9)
Optimization	7.283	0.686	-0.375	0.743	-0.855	12.70

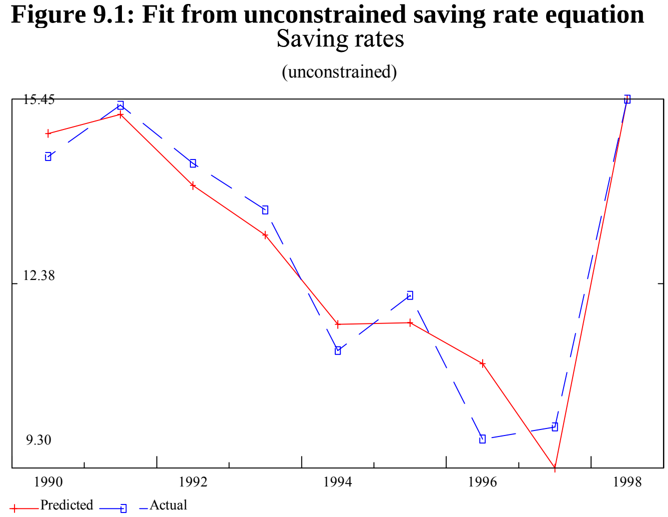
*Note: Numbers in parentheses are Mexval, and * indicates soft constrained coefficient.*

Unconstrained Estimation

All estimated coefficients from the unconstrained estimation, except for the unemployment rate, have the expected signs. The positive coefficient on the unemployment rate implies that savings will increase as the unemployment rate rises. Including this equation in the model makes it highly unstable. The positive coefficient probably arises from simultaneous equation bias: a positive "shock" in savings equation can well produce an increase in unemployment.

Figure 9.1 shows the regression fit when using the unconstrained estimation. If we accept the unconstrained results solely on the basis of the fit, we will begin to experience serious problems with the model. In TIDY, these unconstrained results lead to a non-converging model. Since the model would not solve with this equations, the forecast of the saving rates cannot be shown here. This example is an important lesson regarding incorrect model building: a good regression fit, without apparent or sensible economic rationale, results in a bad model.

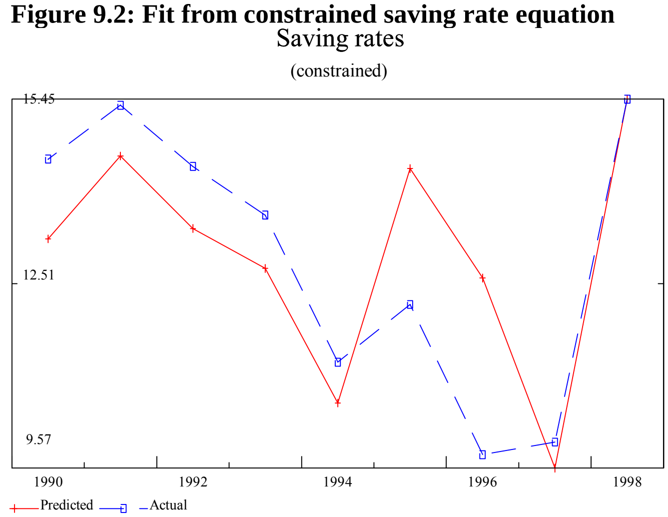
Figure 9.1: Fit from unconstrained saving rate equation



Constrained Estimation

The second row of table 9.1 displays results from the constrained estimation. With economic intuition in mind, the positive coefficient on unemployment rates must be constrained to be negative. In this specific case, we decide arbitrarily to constrain the coefficient to be -0.5. When the unemployment coefficient is constrained with a negative value, increased effects from income growth on saving rates are observed. The income growth coefficient increases, from 0.196 to 0.481, between the unconstrained and constrained estimations. Below, Figure 9.2 displays the regression fit from the constrained estimation.

Figure 9.2: Fit from constrained saving rate equation



The plot illustrates that the constrained estimation clearly makes the fit considerably worse. However, the model converges and does fairly well in simulation. With the change in the sign of unemployment coefficient, the model generates the forecasts for savings rate, unemployment rate, and inflation plotted in figure 9.3-9.5 below.

Figure 9.3: Savings rate from historical simulation (constrained)

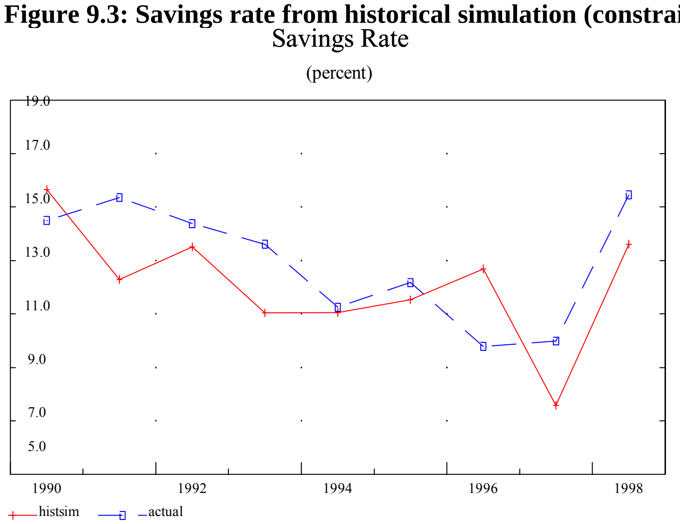


Figure 9.4: Unemployment rate from historical simulation

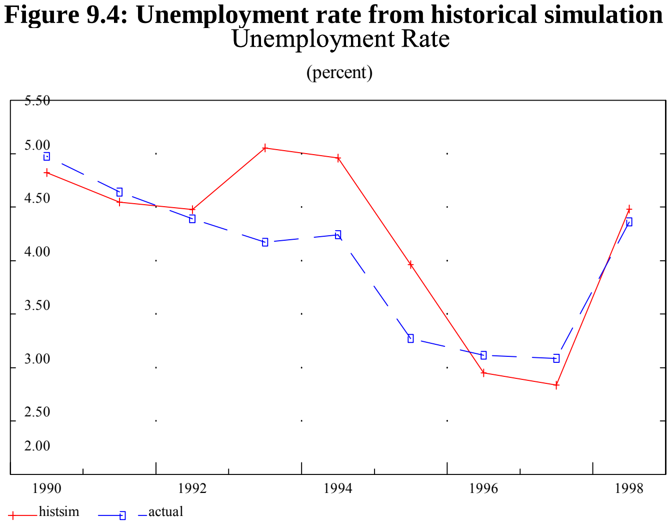
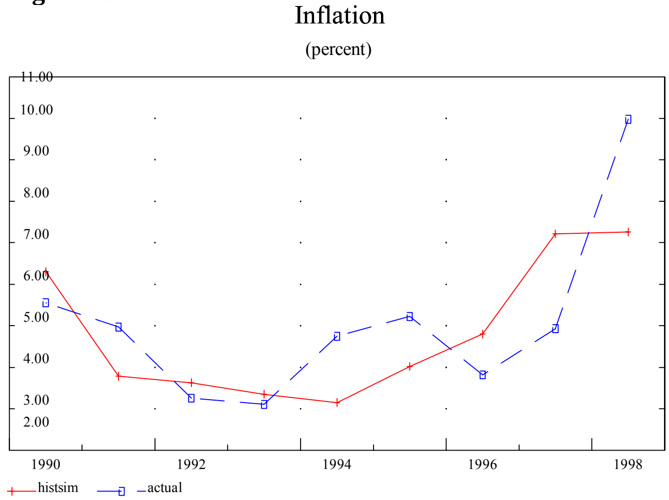


Figure 9.5: Inflation from historical simulation



The method employed thus far, that of changing the coefficient, is quite common. Economic model builders usually revise and revisit their equations in order to arrive at sensible forecasts. Quite obviously, this technique has been utilized when constructing and analyzing this model.

Optimization in the Simulation

An alternative method exploits benefits from optimization in a historical simulation forecast. After specifying the objective function, optimization adjusts selected coefficients to minimize it. In this case, optimization varies coefficients in the savings rate and GDP deflator equations.

The third row of table 9.1 shows coefficients from the savings rate equation obtained from optimization. Because inflation is also a part of the savings rate equation, it is also included in the objective function. However, results from the GDP deflator equation are not presented here because the focus is limited to the savings rate equation. In fact, optimization insignificantly alters the GDP deflator results.

According to the results, optimization slightly varies the coefficients from the constrained estimation. Interestingly, it delivers a stronger positive effect from income growth and a more negative effect from inflation. In contrast, there is a less negative effect from unemployment rates on saving rates. The coefficient on interest rates is slighted adjusted. Figure 9.6-9.8 display the results of saving rates, unemployment rates, and inflation simulated by the optimized model.

Figure 9.6: Savings rate from historical simulation (optimization)

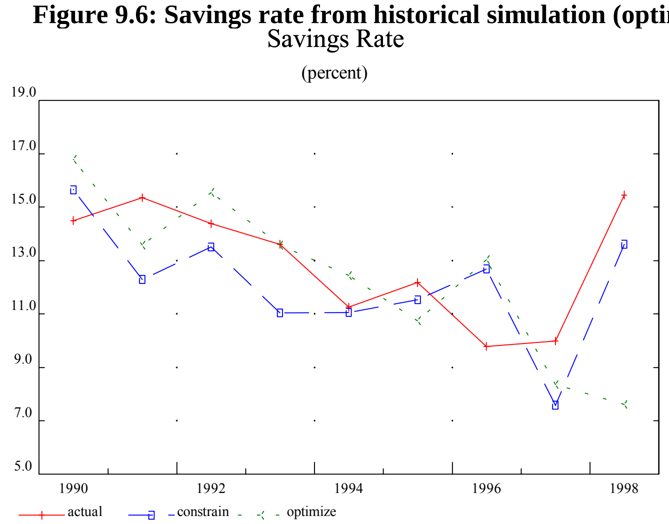
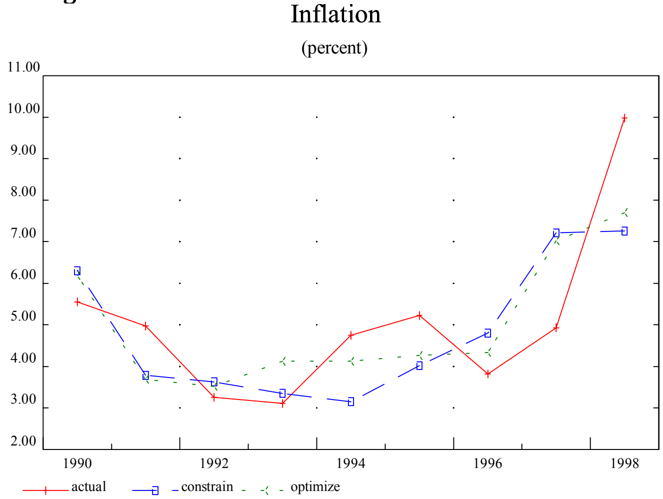


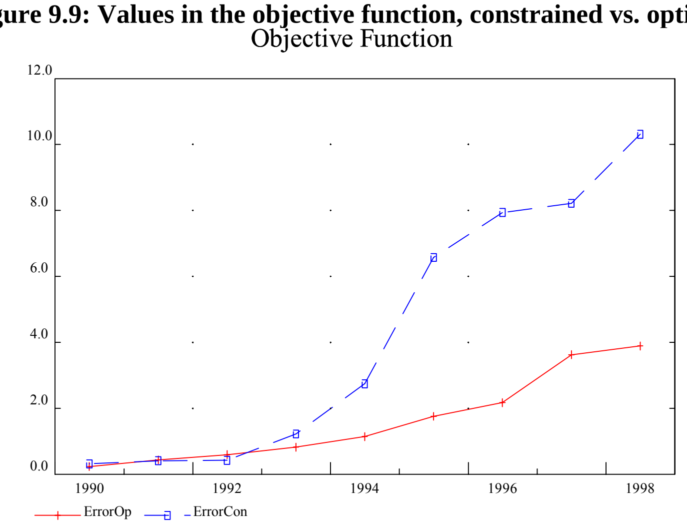
Figure 9.7: Unemployment rate from historical simulation

Figure 9.8: Inflation from historical simulation



The plots show that the simulated values of unemployment rates and inflations are improved from the constrained simulation. Figure 9.9 below compares values of the objective function between the constrained and optimizing simulations. It shows that the sum of square residuals of unemployment rates and inflation is significantly decreased by optimization. The value of the objective function is reduced by 60 percent at the end of the historical simulation period.

Figure 9.9: Values in the objective function, constrained vs. optimization

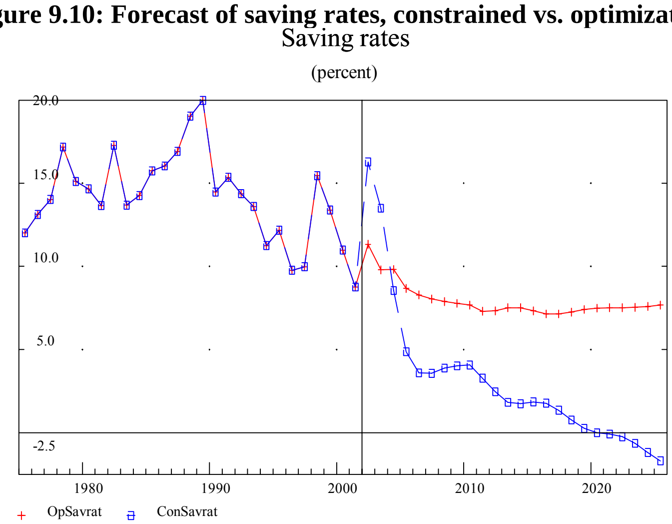


It should be noted that the differences between “constrained” and “optimized” results only record my own experience with the two methods. It could happen that one would pick the constraints and the objective function such that the two methods give the same results. I expect, however, that my experience is likely to be typical.

The Forecasts from Optimization and Constrained Regression

Though the coefficients are slightly changed, the out-of-sample forecasts of saving rates from constrained regression and optimization are significantly different. Figure 9.10 plots savings rate forecasts result from optimization and constrained regression. Notably, these forecasts are obtained from the same set of macro and sectoral adjustment factors. All sectoral equations and macro equations, except savings rate equation, are also identical.

Figure 9.10: Forecast of saving rates, constrained vs. optimization



As it appears, saving rates forecasted from the constrained equation decline continuously through time and eventually become negative. In contrast, the optimized savings rate equation delivers much more plausible out-of-sample forecasts. Indeed, one may note that a superior forecast is achieved through small changes in the coefficients of the savings rate equation.

9.4 Conclusion

This chapter has shown the effects of optimization in an interindustry dynamic model. Using optimization significantly improves the model estimation and its forecast. This approach could be applied to more than one equation at a time, though computational costs are significant. This technique would be especially useful if longer time series data were available for key variables. Rate of unemployment not known prior to 1990.

CHAPTER 10: LONG TERM FORECAST OF THAILAND'S ECONOMY AND POLICY OPTIMIZATION

Long term forecasts of the Thai economy using the model describe both the aggregate performance of the economy and changes in its sectoral composition. The latter is especially important for long term planning. The forecast is based on a number of exogenous variables that shape long term growth such as population and labor force participation. The forecast also depends on monetary and fiscal policies, exchange rates, and export growth. These can all be varied to generate different scenarios.

The base case forecast is built on assumptions of stable fiscal and monetary policy, stable exchange rates, and stable export growth. The assumptions are consistent with recent experience, abstracting from the financial crisis period of 1997-98. These assumptions generate a stable long term economic path, with growth in real income and output, growth in investment exceeding that in consumption, price stability, stable interest rates, and little change in unemployment rates.

The model is not designed to forecast or analyze sudden financial crises. It does not include a model of the financial structure that would be required for such analysis. The model would be suitable for describing how an exogenously specified shock to investment or consumption in particular or all sectors would affect outcomes by sector throughout the economy. This exercise is, however, not presented here.

The model is also used to examine how tax policy can influence inflation and unemployment, by deriving the optimal path for personal income taxes that produces certain objectives.

10.1 The base forecasts of the Thai economy

Base Forecast Assumptions

Exogenous variables in the present TIDY forecasts are: total population, government expenditures, exports, tax rates, nominal interest rates, exchange rates, and money supply. Table 10.1 summarizes assumptions made on these variables from 2000 to 2020.

Table 10.1: Assumptions on exogenous variables

	2000	2005	2010	2015	2020
Export growth in real terms (%)	2.0	4.5	4.4	4.2	4.1
Direct tax rates (%)	3.9	4.6	5.2	5.8	6.4
Nominal interest rate (%)	3.3	1.6	2.5	3.0	3.5
Exchange rate (Bahts/US Dollar)	40.2	39.8	38.6	37.4	36.2
Money supply growth (%)	3.6	3.6	5.0	5.7	6.3
Population (Million people)	62.2	64.8	67.0	69.1	70.8

Population data is obtained from "The Population Projections for Thailand: 1990-2020" published by the National Economic and Social Development Board (NESDB). This population data is used in the national development plan, promulgated by the government of Thailand. In essence, the projection estimates a declining growth rate of the Thai population through time.

In the year 2000, the total population of Thailand stood at 62.2 million people; this figure is projected to increase to 67.0 million people by 2020, effectively adding 4.8 million people in the decade 2000-2010. However, in the decade 2010-2020, total population is projected to grow by 3.8 million people; thus, the total population of Thailand in the year 2020 should be roughly 70.8 million people.

The base forecast assumes conservative government expenditures. In real terms, government consumption is projected to grow by a constant 2.5 percent per year throughout the forecast period. Though this assumption is slightly less than the average of the expenditure growth observed during the 1980s and early 1990s, contemporary policy has changed; the government expenditure growth has been declining in recent years.

The base forecast also assumes conservative export growth. Exports, in real terms, should grow from 4.0 to 4.5 percent per year. In nominal terms, they grow at around 8.0 to 9.0 percent per year. This conservative assumption regarding exports results in small negative values in net exports; however, the share of net exports when compared to GDP still remains low. We will see below that, even if we impose this conservative assumption, the trade balance will be improved in 2015 as a result of a structural change in the Thai production pattern and a stronger economy.

The forecasts assume that indirect tax rates for each sector remain constant from 1998 to the end of the forecast period. Personal income tax rates are projected by a simple linear time trend. Nominal interest rates gradually increase from 1.44 percent in 2003 to 3.5 percent in year 2020. The Thai baht is also expected to appreciate through time as the economy grows stronger. From an exchange rate of 41 bahts per U.S. dollar in 2003, the baht strengthens to 36 bahts per U.S. dollar in the year 2020.

A conservative money supply growth is also assumed. M2 should grow between four and six percent per year. Though the average of past growth is higher, data in recent years shows that M2 growth remains low after the financial crisis and the adoption of a free capital market. A rising oil price also influences us to impose a conservative money supply growth in the base case.

The Macro Outlook

In general, Thailand seems to be a good place to live during the next two decades; output and income grow steadily, inflation and unemployment are both moderate. Table 10.2 summarizes the forecast in the main accounts through 2020.

Thai economy will exhibit strong growth during next few years. Real GDP growth will equal to 4.3 percent in 2004 and 5.4 percent in 2005. Over the long run, the Thai economy will grow at an average of 4.4 percent per year during the next 20 years. This number is somewhat lower than the 5.0 percent growth rate in the past decades, but in a more sustainable path.

Table 10.2: Main Account

Real Activity (Values in 1990 prices, billions of baht)											Annual Growth Rates						
	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
Gross Domestic Product	3372	3550	3644	3805	4041	4220	4452	5791	7167	8540	3.8	4.3	5.4	5.3	4.3	3.5	4.4
Private consumption	1761	1778	1774	1766	1856	1944	2081	2811	3496	4110	0.9	4.6	6.8	6.0	4.4	3.2	4.2
Government expenditure	361	370	380	389	399	409	419	475	539	610	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Gross fixed investment	832	1041	1162	1368	1607	1747	1874	2565	3249	3920	13.0	8.4	7.0	6.3	4.7	3.8	6.6
Inventory change	37	47	49	49	49	51	49	50	54	54	-0.0	2.3	-2.7	0.2	1.6	0.1	0.8
Net exports	291	219	215	180	111	84	55	-86	-134	-57							
Exports	1868	1906	1984	2068	2157	2254	2357	2941	3647	4493	2.9	4.4	4.5	4.4	4.3	4.2	4.3
Imports	1578	1687	1769	1888	2046	2169	2302	3027	3781	4550	5.3	5.8	6.0	5.5	4.4	3.7	5.0
Statistical discrepancy	91	96	65	53	18	-16	-26	-24	-36	-98							
Real personal income	2094	2054	2002	2053	2132	2261	2415	3218	3976	4691	-0.1	5.9	6.6	5.7	4.2	3.3	4.1
Real personal disposable income	2015	1973	1922	1967	2040	2161	2304	3051	3746	4392	-0.1	5.7	6.4	5.6	4.1	3.2	4.0

Nominal Activity (Values in current prices, billions of baht)																	
	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
Gross Domestic Product	5114	5646	6142	6688	7353	7916	8655	13632	20580	29718	7.8	7.4	8.9	9.1	8.2	7.3	8.3
Private consumption	2656	2804	2966	3085	3368	3646	4051	6620	10016	14220	4.8	7.9	10.5	9.8	8.3	7.0	8.1
Government expenditure	575	635	701	758	805	845	892	1186	1576	2082	7.7	4.9	5.5	5.7	5.7	5.6	5.9
Gross fixed investment	1169	1528	1806	2220	2707	3046	3400	5874	9410	14160	17.1	11.8	11.0	10.9	9.4	8.2	11.1
Inventory change	54	68	76	79	84	89	91	114	152	188	-0.0	6.1	1.5	4.5	5.8	4.2	5.1
Net exports	523	459	484	453	356	320	272	-105	-470	-592							
Exports	2669	2851	3165	3468	3780	4107	4485	7005	10884	16590	7.3	8.3	8.8	8.9	8.8	8.4	8.8
Imports	2146	2392	2681	3016	3424	3787	4213	7110	11353	17182	9.5	10.1	10.6	10.5	9.4	8.3	9.9
Statistical discrepancy	138	153	109	94	33	-29	-51	-57	-104	-340							
Personal income	3176	3266	3375	3608	3879	4242	4693	7575	11418	16326	3.9	8.9	10.1	9.6	8.2	7.2	8.0
Direct tax rates (percent)	3.8	3.9	4.0	4.2	4.3	4.5	4.6	5.2	5.8	6.4							
Personal disposable income	3056	3138	3240	3457	3712	4053	4479	7183	10758	15283	4.0	8.8	10.0	9.4	8.1	7.0	7.9
Saving rates (percent)	13.4	11.0	8.8	10.7	9.1	9.7	9.2	7.9	7.2	7.4							

Table 10.2: Main Account (cont.)

Value added (Values in current prices, billions of baht)													Annual Growth Rates				
	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
Wages	1566	1731	1892	2072	2228	2354	2539	3752	5309	7209	8.2	5.5	7.5	7.8	6.9	6.1	7.1
Operating surpluses	2423	2735	2983	3258	3643	3943	4324	6826	10261	14737	8.8	7.9	9.2	9.1	8.2	7.2	8.4
Depreciation	728	750	799	849	912	993	1095	1876	3135	4947	4.3	8.5	9.8	10.8	10.3	9.1	9.4
Net indirect taxes	398	430	468	509	570	627	697	1178	1875	2826	6.7	9.5	10.7	10.5	9.3	8.2	9.4
Price Indexes, 1990=100																	
GDP deflator	151.7	159.0	168.6	175.8	182.0	187.6	194.4	235.4	287.2	348.0	4.0	3.0	3.6	3.8	4.0	3.8	3.9
PCE deflator	150.2	157.3	167.0	174.5	181.5	187.8	195.1	236.9	288.6	348.8	4.1	3.4	3.8	3.9	3.9	3.8	4.0
Employment and Population																	
	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
Unemployment rate	4.2	3.6	3.2	2.2	3.3	3.8	3.9	3.3	3.4	3.7							
Labor productivity																	
(real output/worker, thou. bahts)	220.9	228.4	237.8	251.3	270	289.5	305.6	384.2	470.7	568.2	4.7	7.0	5.4	4.6	4.1	3.8	4.6
Labor force	32.7	33.2	33.9	34.2	34.7	35.1	35.3	36.7	37.9	39.0	1.4	1.2	0.5	0.8	0.7	0.6	0.8
Population	61.7	62.2	62.7	63.1	63.7	64.2	64.8	67.0	69.1	70.8	0.7	0.8	0.9	0.7	0.6	0.5	0.6
Financial Variables																	
Nominal interest rate (1yr deposit)	4.7	3.3	3.0	2.6	1.4	1.5	1.6	2.5	3.0	3.5							
Money supply growth (M2)	2.1	3.6	4.1	2.5	3.0	3.3	3.6	5.0	5.7	6.3							
Exchange rate (bahts/US dollar)	37.8	40.2	44.5	43.0	41.5	40.0	39.8	38.6	37.4	36.2							

On the expenditure side, sources of the steady real GDP growth come from both private consumption and fixed investment. Both of these variables exhibit strong growth during the period 2004-2005. Private consumption in real terms is expected to grow at 4.6 percent in 2004 and remain high at 6.8 percent in 2005 - an election year. On average, personal consumption should grow by 4.2 percent per year, in real terms, from 2000-2020; this is slightly slower than the real GDP growth.

Fixed investment also shows a strong growth of 8.4 percent in real terms in 2004; however, it slows down to 7.0 percent in 2005. Growth of fixed investment in real terms should average 6.6 percent per year in the long run.

As the economy grows, surpluses on net exports should gradually decline through time. This deteriorating trade balance is primarily due to the importation of machinery and industrial equipment. Although net export will become negative in 2010, trade deficits remain low. The export growth should become higher than import growth after 2015; negative net export should begin to improve. This result has very a nice implication: a huge industrial equipment importation investment during the next decade promises to eventually pay off - specifically, in about 10 years. In the end, less imports will be required and domestic goods should realize an increase in consumption by both the domestic and external markets.

Negative growth in real personal disposable income during the period 1998-2003 should quickly return to positive growth during 2004-2005. Real disposable income should grow by 5.7 percent in 2004 and 6.4 percent in 2005. In the long run, average real disposable income should grow by 4.0 percent during the next 20 years.

Labor productivity should also exhibit strong growth in 2004, equals to 7.0 percent. On average, it should grow by 4.6 percent during the next 20 years. Strong economy and steady job growth also leads to a healthy condition in the labor market. Unemployment rates decreased from 2000 to 2002, then gradually increase from then on; however, it should end at a low 3.7 percent in the year 2020.

Inflation is moderate. The GDP deflator grows by 3.9 percent per year during 2000-2020, promising less inflation in the future than that realized on average in the past. A conservative monetary policy, including a decreased money supply growth rate and persistence in interest rates lead to the low inflation in our forecasts.

During the period 2000-2020, the forecast also exhibits changes in the structure of GDP in both the expenditure and income side. Table 10.3 show shares of the income and expenditure in GDP during 2000-2020.

On the expenditure side, the share of private consumption expenditures in GDP slowly decreases through time; however, it still remains the biggest part of GDP. Private consumption expenditures take up the 48.1 percent share of GDP in the year 2020. On the other hand, fixed investment should significantly increase its share of GDP. At the end of year 2020, the proportion of fixed investment in GDP will be almost as big as the private consumption expenditure. The share of 29.3 percent in year 2000 will increase to 45.9 percent in the year 2020.

Table 10.3: Structure of GDP by its expenditure and income (percent)

	2000	2005	2010	2015	2020
Expenditure (% of GDP)					
Private consumption	50.1	46.7	48.5	48.8	48.1
Government expenditure	10.4	9.4	8.2	7.5	7.1
Fixed investment	29.3	42.1	44.3	45.3	45.9
Income (% of GDP)					
Labor income	30.7	29.3	27.5	25.8	24.3
Profits	48.4	50.0	50.1	49.9	49.6
Capital consumption allowances	13.3	12.7	13.8	15.2	16.6
Net indirect taxes	7.6	8.1	8.6	9.1	9.5

On the income side, the structure of GDP also slightly changes. Labor income should lose share to other components. The labor income share decreases from 30.7 percent of the GDP to 24.3 percent during 2000-2020. Profits remain the biggest component that contribute to GDP from the income side. Share of corporate profits increase slightly, and accounts almost 50 percent of the GDP in the year 2020.

The Sectoral Forecasts: Structural Change in Thai Economy

Gross Output – Output share remains high in manufacturing and the rapid growth occurs in heavy-goods manufacturing industries.

Table 10.5 displays the forecasts of gross output in real terms. In the short run, real output exhibits strong growth during the period 2004-2005. Sectors that should show significant growth include: Banking and insurance, Chemical, Fabricated metal products, Mining, and Electricity and water works.

In the long-run, output from manufacturing industries still continues to grow at a rapid pace. Service sectors also show moderate output growth, while output from agricultural sectors grow at the slowest rates.

During the twenty years, the most rapid output growth appears in the Banking and insurance industry. This sector has an average annual growth of 7.5 percent per year. Strong positive output growth should be observed in some heavy-goods industries, such as: Basic metal, Chemical, Non-metallic products, Fabricated products, Mining, and Construction. Gross output in these sectors grow by 6.3-7.0 percent per year, in real terms. In terms production values, the biggest industries are Machinery, Trade, and Construction, respectively.

On the other hand, the Crops industry, which provides most of the employment, shows a very low output growth at 1.9 percent per year. Forestry should realize no output growth during the next 20 years; this is a result of declining timbers and forest areas in Thailand. Currently, the forest area has reached a critically low level. In 1998, only 25 percent of the country is comprised of forests.

Table 10.4 shows that the proportion of manufacturing output remains high, increasing from 66.8 percent in 2000 to 68.4 percent share in 2020. In contrast, output share from agricultural sectors is decreasing throughout the forecast. It seems that agriculture has relinquished its share mainly to manufacturing industries. The output share from service sectors remains relatively constant through the period.

Table 10.4: Structure of output and employment (percent)

	2000	2005	2010	2015	2020
Output					
Agriculture	5.6	4.6	4.2	3.8	3.5
Manufacturing	66.8	68.2	68.3	68.3	68.4
Services	27.6	27.1	27.5	27.9	28.1
Employment					
Agriculture	50.8	44.9	40.3	36.6	33.4
Manufacturing	19.7	24.0	26.5	28.8	30.7
Services	29.5	31.2	33.1	34.7	35.8

Employment – Increasing employment share in manufacturing and service sectors. Agricultural sectors continue to lose jobs to manufacturing and service sectors. Table 10.4 shows that the present 50.8 percent employment share in agriculture should eventually decrease to 33.4 percent during the period 2000-2020. During the same period, employment shares in manufacturing and service sectors should increase by 11.0 and 6.3 percent, respectively. At the end of the forecast, agricultural sectors will no longer contain the largest number of employment, but service sectors will; rather, the service sector should comprise the vast majority of the employment. In the year 2020, 35.8 percent of the total employment will be in service sectors.

According to table 10.6, the sectoral forecast of employment shows that rapid job growth will most likely be realized in Construction, Fabricated metal products, Chemical, and Real estate.

Although Crops industry has the most jobs in it, numbers of employment in this sector decrease through time. On average, jobs in agriculture decreases by 1.6 percent per year. The current investment booms in manufacturing also decrease the number of jobs in agriculture during 2003-2004. Apparently, fewer Thai workers will be working in the Crops industry in the near coming decades. Other sectors that contain large number of jobs include Trade and Services. These sectors exhibit moderate job growth.

Labor Income and Profits – Strong labor income growth in heavy-goods industries and rapid profit growth in Banking and insurance.

In general, labor compensation in heavy-goods industries exhibit the strongest growth; this includes Basic metal, Fabricated metal products, Rubber and plastic, and Chemical. It is plausible that higher compensation growth appears in these unpleasant working environment jobs.

According to table 10.7, Basic metal industry exhibits the most rapid labor income growth during the period 2000-2020; it should be roughly 12.1 percent per year, in nominal terms. Strong labor income growth also appears in Banking and insurance. Interestingly, labor income growth in the Construction industry is relatively low, although strong output and employment growth will be evident in this sector. Over 20 years, labor income in Construction grows by only 5.9 percent per year, in nominal terms.

Profits are more volatile than wages. Table 10.8 shows that economic growth in the period 2003-2005 prompt profits to grow significantly in several industries. In the long run, the most rapid profit growth should be found in the Banking and insurance, Paper and printing, Chemical, and Textile industries. In contrast, sectoral profits in agricultural sectors show that returns to farm owners should remain low.

Private Consumption – More private cars on the street.

Table 10.9 displays the forecast of private consumption per capita in 33 consumption categories. The decrease in real personal disposable income, resulting from the financial crisis in 1997, contributed to the decrease in consumption during the period 1998-2003. However, low interest rates induced rapid growth in the consumption of durable goods, such as private vehicles and household appliances.

Consumption in food sectors grows steadily and remain low in the long run. High growth rates should be present in durable-good commodities, such as furniture and private vehicles. Strong growth rates also appear in those income-sensitive categories, such as Recreation, Entertainment, and Health care.

Net Exports – Trade deficits are not as bad.

The aggregate forecast shows that trade balance will be deteriorating. The current level of net export surpluses, resulting from the baht depreciation from 1997, should disappear in the next decade. However, trade balances should improve again after the year 2015.

Table 10.10 displays sectoral forecasts of net exports. The sectoral forecasts show that trade deficits appear mainly in material and industrial equipment industries, such as Mining, Chemical, Basic metal, Fabricated metal, and Machinery. The explanation is straightforward. Though the economy grows and changes from an agricultural to an industrialized economy, the country still lacks of raw materials and high-tech machinery demanded by industry. These input requirements will be imported during the next decades. In fact, strong positive net exports do show up in some less capital intensive sectors. These sectors include Food manufacturing, Textile, Trade, Transportation and communication, and Other manufacturing. Table 10.11-10.12 print out sectoral forecasts of exports and imports.

Table 10.5: Gross Output (Values in 1990 prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	266	267	267	266	272	276	284	324	358	388	0.4	1.6	2.7	2.6	2.0	1.6	1.9
2	Livestock	74	74	75	76	79	81	84	103	120	138	1.2	2.7	3.9	4.0	3.2	2.7	3.1
3	Forestry	7	7	7	7	7	7	7	7	7	7	-0.2	-0.2	0.0	-0.1	0.0	0.3	0.0
4	Fishery	69	73	76	79	85	91	99	140	184	228	4.5	6.6	7.8	7.0	5.4	4.3	5.7
5	Mining and quarrying	106	117	125	135	149	160	173	245	326	415	9.3	7.3	7.5	6.9	5.7	4.8	6.3
6	Food manufacturing	515	523	533	542	562	582	608	762	930	1112	1.9	3.4	4.4	4.5	4.0	3.6	3.8
7	Beverages and tobacco products	155	158	160	157	163	168	177	234	291	342	0.7	3.2	5.3	5.6	4.3	3.3	3.9
8	Textile industry	513	516	527	548	578	611	651	855	1063	1277	4.6	5.6	6.3	5.4	4.4	3.7	4.5
9	Paper products and printing	95	101	104	109	116	123	131	178	232	293	4.0	5.9	6.3	6.1	5.3	4.7	5.4
10	Chemical industries	166	174	184	197	215	232	251	365	504	669	7.9	7.6	8.0	7.5	6.5	5.7	6.7
11	Petroleum refineries	196	206	214	223	238	251	266	352	441	531	2.1	5.2	6.0	5.6	4.5	3.7	4.7
12	Rubber and plastic products	136	145	153	164	177	190	204	286	382	490	6.0	6.8	7.1	6.7	5.8	5.0	6.1
13	Non-metallic products	112	131	144	165	189	206	221	308	397	488	10.9	8.3	7.4	6.6	5.1	4.1	6.6
14	Basic metal	104	116	125	138	154	167	180	259	356	470	10.7	7.9	7.7	7.3	6.3	5.6	7.0
15	Fabricated metal products	97	107	114	124	138	149	161	230	308	395	10.6	7.4	7.8	7.1	5.9	5.0	6.5
16	Machinery	1062	1170	1253	1371	1513	1622	1733	2358	3063	3851	8.5	7.0	6.6	6.2	5.2	4.6	6.0
17	Other manufacturing	387	404	418	436	466	492	522	689	865	1048	4.3	5.6	6.0	5.5	4.6	3.8	4.8
18	Electricity and water works	200	211	222	233	253	271	293	416	555	706	4.9	6.8	7.7	7.0	5.7	4.8	6.0
19	Construction	344	429	477	559	655	711	761	1032	1298	1557	12.7	8.2	6.8	6.1	4.6	3.6	6.4
20	Trade	828	889	933	993	1085	1161	1245	1720	2231	2770	5.9	6.7	7.0	6.5	5.2	4.3	5.7
21	Restaurants and hotels	256	258	259	264	277	290	308	408	505	598	1.6	4.6	6.0	5.6	4.3	3.4	4.2
22	Transportation and communication	476	500	517	543	582	615	652	858	1078	1310	4.3	5.4	5.9	5.5	4.6	3.9	4.8
23	Banking and insurance	236	259	279	302	337	369	405	624	883	1171	8.3	9.0	9.5	8.6	6.9	5.7	7.5
24	Real estate	112	115	118	118	126	131	140	186	234	282	0.0	4.3	6.1	5.7	4.6	3.8	4.5
25	Services	484	498	511	526	549	570	595	732	884	1053	3.0	3.9	4.3	4.1	3.8	3.5	3.7
26	Unclassified	49	54	58	63	70	77	84	133	196	271	7.2	9.1	9.4	9.1	7.8	6.5	8.1

Table 10.6: Employment (Thousand persons)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	15698	15615	15726	15467	15067	14207	13966	13225	12307	11285	-0.7	-5.9	-1.7	-1.1	-1.4	-1.7	-1.6
2	Livestock	492	481	483	484	484	498	507	590	663	723	-2.1	2.8	1.8	3.0	2.3	1.7	2.0
3	Forestry	119	123	126	129	134	138	142	165	193	227	1.6	3.0	2.9	3.0	3.1	3.3	3.1
4	Fishery	369	361	369	375	380	396	410	508	580	625	1.5	4.2	3.5	4.3	2.7	1.5	2.7
5	Mining and quarrying	43	45	45	47	49	50	51	57	59	59	3.1	2.2	2.5	1.9	0.7	-0.1	1.3
6	Food manufacturing	608	601	598	596	598	607	617	698	772	838	-0.7	1.5	1.7	2.5	2.0	1.6	1.7
7	Beverages and tobacco products	77	75	75	74	72	74	75	91	105	115	-3.3	1.7	1.8	4.0	2.8	1.7	2.1
8	Textile industry	1005	1003	999	1014	1045	1081	1127	1349	1545	1724	2.7	3.4	4.2	3.6	2.7	2.2	2.7
9	Paper products and printing	130	128	130	131	134	138	142	167	189	207	-0.2	3.2	3.0	3.2	2.5	1.9	2.4
10	Chemical industries	232	238	244	253	266	279	293	370	448	525	4.7	4.6	5.0	4.6	3.8	3.2	4.0
11	Petroleum refineries	6	5	4	4	4	4	4	5	6	7	-21.2	-1.8	0.1	2.9	4.6	5.3	1.9
12	Rubber and plastic products	80	80	82	84	86	90	94	112	129	142	1.5	4.7	3.4	3.6	2.8	2.0	2.9
13	Non-metallic products	164	175	190	206	227	243	253	295	321	333	3.1	6.7	4.0	3.0	1.7	0.7	3.2
14	Basic metal	110	120	127	133	142	150	156	189	220	248	3.4	5.6	4.1	3.8	3.1	2.4	3.6
15	Fabricated metal products	228	246	255	270	292	308	324	411	496	575	7.9	5.1	5.2	4.8	3.7	3.0	4.2
16	Machinery	688	729	762	804	857	898	930	1085	1212	1306	3.6	4.6	3.6	3.1	2.2	1.5	2.9
17	Other manufacturing	716	824	826	821	825	846	861	941	980	979	4.4	2.6	1.7	1.8	0.8	0.0	0.9
18	Electricity and water works	139	136	139	141	143	150	156	190	219	238	-0.6	4.9	3.5	4.0	2.7	1.7	2.8
19	Construction	1041	1113	1292	1441	1655	1839	1946	2436	2872	3211	4.1	10.5	5.7	4.5	3.3	2.2	5.3
20	Trade	4007	4274	4194	4290	4455	4465	4591	5283	5738	5928	3.4	0.2	2.8	2.8	1.7	0.7	1.6
21	Restaurants and hotels	1206	1173	1154	1133	1132	1163	1193	1441	1649	1813	0.5	2.7	2.6	3.8	2.7	1.9	2.2
22	Transportation and communication	898	896	904	913	940	970	995	1134	1241	1317	-0.6	3.2	2.6	2.6	1.8	1.2	1.9
23	Banking and insurance	242	268	307	317	330	349	362	436	483	499	7.5	5.6	3.7	3.7	2.1	0.7	3.1
24	Real estate	48	43	44	44	44	47	48	63	77	91	-4.0	5.2	3.6	5.1	4.1	3.4	3.7
25	Services	3606	3877	3943	4012	4106	4180	4250	4677	5080	5446	4.7	1.8	1.7	1.9	1.7	1.4	1.7
26	Unclassified	4	4	4	4	4	5	5	6	7	7	-0.8	4.0	3.9	3.7	2.4	1.1	2.7

Table 10.7: Total wage (Values in current prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	67	69	72	75	80	87	94	136	187	244	3.9	7.5	7.7	7.5	6.4	5.3	6.3
2	Livestock	8	8	9	9	10	10	10	14	18	22	3.7	2.3	5.3	5.8	4.9	4.2	4.9
3	Forestry	5	5	6	6	7	7	8	11	15	19	9.0	5.4	7.1	7.0	6.0	4.7	6.4
4	Fishery	22	25	27	30	33	35	39	65	98	136	8.7	7.4	10.6	10.1	8.2	6.6	8.6
5	Mining and quarrying	22	25	28	31	34	36	39	58	83	111	10.9	6.0	8.1	8.1	6.9	5.9	7.4
6	Food manufacturing	63	68	74	79	83	87	94	139	199	270	6.3	4.5	7.4	7.9	7.1	6.2	6.9
7	Beverages and tobacco products	14	15	16	16	17	18	19	30	43	58	4.7	3.9	8.0	8.6	7.3	6.0	6.8
8	Textile industry	108	114	124	137	148	159	175	279	421	607	9.0	7.2	9.7	9.4	8.2	7.3	8.4
9	Paper products and printing	10	11	12	13	14	14	15	21	28	36	5.1	4.4	6.4	6.7	5.8	4.9	5.8
10	Chemical industries	20	22	25	27	30	32	36	58	90	133	10.4	7.3	9.6	9.7	8.8	7.9	8.9
11	Petroleum refineries	9	10	11	12	13	14	15	24	36	51	6.9	6.4	9.0	9.0	7.9	6.9	8.1
12	Rubber and plastic products	19	21	24	27	30	32	36	60	96	145	9.9	8.1	10.1	10.3	9.4	8.4	9.6
13	Non-metallic products	15	18	20	24	27	29	31	45	61	77	9.8	7.7	7.6	7.4	6.0	4.8	7.4
14	Basic metal	14	17	20	23	27	30	34	63	113	192	16.5	10.6	12.3	12.5	11.6	10.7	12.1
15	Fabricated metal products	13	15	17	19	21	23	25	41	62	89	13.5	7.4	9.7	9.7	8.4	7.2	9.0
16	Machinery	91	102	114	126	138	146	156	220	299	388	8.5	5.7	6.8	6.9	6.1	5.2	6.7
17	Other manufacturing	65	73	79	84	89	93	100	141	189	241	7.4	4.9	6.6	6.9	5.9	4.9	6.0
18	Electricity and water works	35	38	42	46	50	54	59	93	140	198	7.4	6.7	9.3	9.3	8.0	6.9	8.2
19	Construction	58	71	81	96	110	116	123	163	198	228	11.4	6.0	5.8	5.5	4.0	2.8	5.9
20	Trade	155	173	183	197	209	214	227	315	411	506	7.1	2.4	6.1	6.5	5.3	4.2	5.4
21	Restaurants and hotels	43	45	47	50	52	54	58	83	109	136	3.6	3.9	7.0	7.1	5.6	4.4	5.5
22	Transportation and communication	108	116	126	137	147	155	166	242	338	452	6.3	5.2	7.3	7.5	6.6	5.8	6.8
23	Banking and insurance	93	107	124	141	159	177	200	364	610	947	12.5	10.2	12.3	12.0	10.3	8.8	10.9
24	Real estate	9	10	11	11	12	12	13	20	28	38	2.8	4.1	7.9	8.0	6.9	5.9	6.7
25	Services	500	553	602	655	690	721	767	1067	1440	1886	8.2	4.5	6.2	6.6	6.0	5.4	6.1
26	Unclassified	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0

Table 10.8: Total profits (Values in current prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	251	256	270	284	304	320	343	448	583	748	4.1	5.2	6.7	5.4	5.3	5.0	5.4
2	Livestock	31	35	37	39	41	44	47	65	88	116	6.4	6.0	7.1	6.3	6.0	5.6	6.1
3	Forestry	4	3	2	2	1	0	0	0	0	0	-26.0	-86.9	-0.0	-0.0	-0.0	-0.0	-0.0
4	Fishery	65	63	62	63	67	74	84	156	260	396	3.3	8.8	12.7	12.5	10.2	8.4	9.2
5	Mining and quarrying	48	53	57	64	73	80	87	137	206	299	10.6	8.1	9.3	9.0	8.2	7.4	8.6
6	Food manufacturing	115	119	127	135	146	156	169	242	343	474	6.0	6.5	7.9	7.2	7.0	6.5	6.9
7	Beverages and tobacco products	26	26	27	26	29	32	37	74	126	195	0.1	10.1	15.6	13.9	10.6	8.7	10.1
8	Textile industry	107	110	120	132	144	155	168	237	333	460	8.3	7.1	7.8	7.0	6.8	6.4	7.1
9	Paper products and printing	29	29	30	33	38	43	50	97	168	271	3.4	14.2	15.0	13.0	11.0	9.6	11.2
10	Chemical industries	37	40	45	51	58	66	75	134	227	359	12.3	11.7	12.8	11.8	10.5	9.2	11.0
11	Petroleum refineries	35	33	35	38	43	48	54	89	138	205	1.6	10.0	11.5	10.1	8.8	7.9	9.1
12	Rubber and plastic products	23	26	29	33	38	43	48	82	131	193	9.7	11.2	12.0	10.8	9.2	7.8	9.9
13	Non-metallic products	34	42	45	51	57	60	63	97	142	198	11.7	5.3	5.7	8.6	7.6	6.6	7.8
14	Basic metal	20	20	23	26	30	32	36	58	91	137	13.9	9.1	9.9	9.8	8.9	8.1	9.5
15	Fabricated metal products	27	27	29	31	35	37	40	66	103	151	9.5	6.2	7.2	10.0	8.9	7.8	8.6
16	Machinery	182	206	226	254	283	305	329	557	889	1332	11.0	7.2	7.7	10.5	9.3	8.1	9.3
17	Other manufacturing	108	117	127	138	154	169	186	292	443	651	7.4	9.0	9.8	9.0	8.4	7.7	8.6
18	Electricity and water works	56	76	88	91	98	100	105	155	225	314	10.2	2.2	4.7	7.9	7.4	6.7	7.1
19	Construction	92	128	141	166	193	203	214	334	489	675	17.1	4.7	5.3	8.9	7.6	6.5	8.3
20	Trade	644	732	807	895	1015	1114	1236	1929	2837	4015	9.7	9.3	10.4	8.9	7.7	6.9	8.5
21	Restaurants and hotels	85	95	101	109	122	134	151	244	367	526	6.5	9.5	11.8	9.6	8.2	7.2	8.6
22	Transportation and communication	145	187	200	209	226	236	250	376	549	774	10.7	4.3	5.8	8.1	7.6	6.9	7.1
23	Banking and insurance	130	149	169	194	229	264	308	593	994	1497	11.8	14.2	15.3	13.1	10.3	8.2	11.5
24	Real estate	55	66	72	74	81	84	90	137	209	301	6.1	4.1	7.0	8.4	8.4	7.4	7.6
25	Services	75	96	113	121	137	145	156	225	321	450	7.3	6.0	7.1	7.3	7.1	6.8	7.7
26	Unclassified	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0

Table 10.9: Personal consumption Per Capita (Values in 1990 prices, bahts)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Rice & cereals	1306	1318	1324	1325	1332	1338	1349	1418	1480	1535	-0.5	0.4	0.8	1.0	0.8	0.7	0.8
2	Meat	1108	1112	1112	1107	1124	1140	1166	1316	1450	1568	-0.7	1.3	2.3	2.4	1.9	1.6	1.7
3	Fish	373	381	383	382	402	421	449	603	740	860	-0.2	4.4	6.7	5.9	4.1	3.0	4.1
4	Milk,cheese & eggs	524	536	540	498	509	509	532	707	876	1016	-5.0	0.0	4.4	5.7	4.3	3.0	3.2
5	Oil & fat	263	270	273	262	272	279	295	399	499	588	-1.9	2.4	5.6	6.0	4.5	3.3	3.9
6	Fruit & vegetables	1224	1231	1220	1132	1150	1147	1191	1515	1812	2046	-3.7	-0.2	3.7	4.8	3.6	2.4	2.5
7	Sugar,preserves & confectionery	267	273	275	264	271	276	288	370	448	516	-2.2	1.5	4.4	5.0	3.8	2.8	3.2
8	Coffee,tea,cocoa,etc.	87	89	90	86	89	92	97	132	165	195	-2.4	2.4	5.8	6.2	4.5	3.3	3.9
9	Other food	445	453	456	438	438	434	438	486	533	570	-2.8	-1.1	0.9	2.1	1.8	1.3	1.2
10	Non-alcoholic beverages	1041	1049	1043	1011	1055	1089	1159	1553	1903	2192	0.4	3.3	6.2	5.8	4.1	2.8	3.7
11	Alcoholic beverages	1386	1421	1423	1306	1320	1302	1340	1669	1965	2165	-3.3	-1.4	2.9	4.4	3.3	1.9	2.1
12	Tobacco	514	510	500	510	525	543	566	671	755	822	3.6	3.3	4.1	3.4	2.4	1.7	2.4
13	Footwear	235	237	237	219	224	224	235	311	383	440	-2.8	0.2	4.6	5.6	4.1	2.8	3.1
14	Clothing	2699	2704	2676	2731	2877	3042	3254	4293	5207	6016	2.7	5.6	6.7	5.5	3.9	2.9	4.0
15	Other personal effects	290	283	275	301	329	364	402	572	718	852	11.6	10.1	10.0	7.0	4.6	3.4	5.5
16	Rent & water charges	1927	1915	1912	1827	1890	1931	2029	2552	3010	3388	-4.0	2.1	5.0	4.6	3.3	2.4	2.9
17	Fuel & light	612	602	600	577	600	617	653	841	1008	1147	-3.9	2.9	5.6	5.1	3.6	2.6	3.2
18	Furniture & furnishings	520	515	504	545	594	655	724	1032	1300	1546	10.1	9.8	10.0	7.1	4.6	3.5	5.5
19	Households equipment	2003	2018	1998	1917	2010	2087	2241	3089	3812	4382	-0.8	3.7	7.1	6.4	4.2	2.8	3.9
20	Domestic services of household	56	53	51	49	51	54	57	79	100	122	-4.1	4.6	7.1	6.3	4.9	3.8	4.2
21	Other expenditures of household	477	476	473	437	451	456	480	644	804	945	-3.4	1.1	5.2	5.9	4.4	3.2	3.4
22	Personal care	542	544	545	547	568	590	619	772	913	1040	0.7	3.7	4.9	4.4	3.3	2.6	3.2
23	Health expenses	1863	1811	1777	1859	1966	2099	2246	2904	3510	4090	3.8	6.6	6.8	5.1	3.8	3.1	4.1
24	Personal transportation equipment	1237	1154	1087	1348	1492	1704	1885	2469	2900	3302	17.5	13.3	10.1	5.4	3.2	2.6	5.3
25	Operation of private transportation	1215	1269	1272	1217	1269	1311	1401	1938	2424	2831	0.6	3.2	6.7	6.5	4.5	3.1	4.0
26	Purchased transportation	1280	1265	1250	1225	1251	1270	1310	1495	1647	1770	-1.7	1.5	3.1	2.6	1.9	1.4	1.7
27	Communication	594	599	606	590	612	627	656	789	891	962	0.3	2.4	4.5	3.7	2.4	1.5	2.4
28	Entertainment	82	83	85	87	91	95	101	127	155	184	1.6	4.8	5.2	4.7	4.0	3.4	4.0
29	Hotels,restaurants & cafes	2606	2572	2522	2515	2626	2738	2918	3928	4818	5577	-0.1	4.2	6.4	5.9	4.1	2.9	3.9
30	Books,newspapers & magazines	420	424	419	420	433	447	468	575	664	735	3.2	3.1	4.6	4.1	2.9	2.0	2.8
31	Other recreation	785	757	729	700	755	809	902	1441	1970	2444	-2.1	7.0	10.9	9.4	6.2	4.3	5.9
32	Financial services	352	350	344	355	381	410	446	617	770	913	3.7	7.2	8.5	6.5	4.4	3.4	4.8
33	Other services	257	253	249	240	250	258	273	359	440	512	-1.2	3.2	5.8	5.5	4.1	3.0	3.5

Table 10.10: Net exports (Values in current prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
1	Crops	-5	-5	-3	-2	-2	-1	-1	-2	4	21
2	Livestock	-1	-1	-1	-1	-1	-1	-2	-3	-5	-6
3	Forestry	-6	-6	-6	-7	-7	-7	-7	-11	-16	-21
4	Fishery	-1	-1	-1	-1	-1	-1	-2	-3	-6	-10
5	Mining and quarrying	-103	-115	-126	-140	-159	-173	-190	-297	-444	-635
6	Food manufacturing	287	300	331	362	394	427	464	681	1009	1481
7	Beverages and tobacco products	-12	-12	-12	-11	-12	-13	-14	-29	-45	-59
8	Textile industry	151	162	181	199	213	227	243	346	515	777
9	Paper products and printing	-22	-24	-25	-28	-32	-36	-41	-75	-123	-188
10	Chemical industries	-177	-194	-219	-246	-281	-315	-357	-640	-1071	-1684
11	Petroleum refineries	-18	-18	-18	-19	-21	-21	-23	-30	-33	-27
12	Rubber and plastic products	31	31	34	36	36	38	39	46	61	93
13	Non-metallic products	17	17	18	17	17	17	18	26	40	65
14	Basic metal	-92	-111	-130	-155	-185	-209	-236	-422	-697	-1082
15	Fabricated metal products	-41	-49	-55	-65	-79	-89	-102	-188	-311	-473
16	Machinery	-31	-98	-131	-194	-282	-336	-391	-769	-1231	-1680
17	Other manufacturing	142	148	165	180	191	204	218	312	472	732
18	Electricity and water works	4	4	5	5	5	5	6	8	12	17
19	Construction	0	0	0	0	0	0	0	0	0	1
20	Trade	147	156	172	187	202	218	237	347	507	736
21	Restaurants and hotels	68	73	83	91	99	108	117	172	258	389
22	Transportation and communication	148	162	179	192	205	219	235	351	535	814
23	Banking and insurance	-1	-1	-1	-2	-3	-3	-4	-11	-20	-33
24	Real estate	3	3	5	7	7	8	7	8	11	18
25	Services	21	22	25	27	28	30	31	40	55	81
26	Unclassified	14	15	17	19	21	23	25	38	56	81

Table 10.11: Exports (Values in current prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	32	34	37	41	44	49	53	78	117	173	6.1	8.9	8.8	7.8	8.0	7.8	8.2
2	Livestock	2	3	3	3	3	4	4	6	9	13	8.1	8.3	8.5	7.8	7.9	7.6	8.0
3	Forestry	1	1	1	1	1	1	1	2	3	4	2.0	3.2	6.1	10.6	9.8	8.5	8.4
4	Fishery	1	1	1	1	1	1	1	2	2	3	1.1	7.2	8.6	8.6	8.4	7.8	7.7
5	Mining and quarrying	7	8	8	9	10	10	11	16	23	34	5.1	6.6	7.2	7.4	7.6	7.4	7.4
6	Food manufacturing	352	368	404	439	477	517	563	833	1232	1791	6.0	8.1	8.4	7.9	7.8	7.5	7.9
7	Beverages and tobacco products	4	4	4	5	5	6	6	10	16	26	6.1	9.8	10.5	10.0	9.4	8.9	9.5
8	Textile industry	190	201	223	244	263	283	304	443	654	962	6.7	7.0	7.4	7.5	7.8	7.7	7.8
9	Paper products and printing	20	21	23	25	28	31	35	57	93	146	5.0	10.3	10.8	10.1	9.6	9.1	9.7
10	Chemical industries	64	69	77	85	94	103	114	184	294	459	8.4	9.2	9.7	9.6	9.4	8.9	9.5
11	Petroleum refineries	20	20	22	23	25	27	30	45	67	100	2.2	7.9	8.3	8.1	8.2	8.0	8.1
12	Rubber and plastic products	81	87	98	108	118	129	142	223	348	534	8.0	9.0	9.4	9.0	8.9	8.5	9.1
13	Non-metallic products	30	31	34	36	39	41	45	68	104	157	7.2	6.7	7.5	8.4	8.5	8.3	8.1
14	Basic metal	45	47	53	58	63	69	75	118	185	286	5.5	8.2	9.0	9.1	9.0	8.7	9.0
15	Fabricated metal products	41	43	47	52	56	61	66	104	163	252	4.7	7.9	8.6	9.1	9.0	8.6	8.9
16	Machinery	847	914	1028	1139	1254	1376	1520	2551	4182	6626	8.5	9.3	9.9	10.4	9.9	9.2	9.9
17	Other manufacturing	235	249	274	298	321	345	373	549	812	1197	6.4	7.3	7.8	7.7	7.8	7.7	7.8
18	Electricity and water works	5	6	6	7	8	8	8	12	19	28	8.5	5.7	6.4	7.6	8.1	7.9	7.8
19	Construction	0	0	0	0	0	0	0	1	1	2	5.9	6.5	7.4	8.5	8.6	8.3	8.1
20	Trade	113	121	133	144	156	169	183	268	391	568	6.6	7.6	8.2	7.6	7.6	7.5	7.7
21	Restaurants and hotels	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
22	Transportation and communication	36	40	44	48	51	55	60	91	140	211	8.5	7.3	7.8	8.5	8.5	8.2	8.3
23	Banking and insurance	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
24	Real estate	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
25	Services	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
26	Unclassified	19	20	22	25	27	30	33	53	85	132	5.2	9.3	9.8	9.6	9.3	8.8	9.4

Table 10.12: Imports (Values in current prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	38	39	42	44	48	51	56	83	117	159	4.4	7.4	9.1	7.8	6.9	6.0	7.0
2	Livestock	3	4	4	4	5	5	5	9	13	19	8.4	8.7	10.7	9.7	8.2	7.1	8.5
3	Forestry	7	7	7	8	8	8	8	13	19	25	11.3	1.3	5.2	8.7	7.1	6.0	6.4
4	Fishery	1	2	2	2	2	2	3	5	9	13	11.2	12.0	14.6	13.2	10.5	8.6	10.7
5	Mining and quarrying	111	123	135	149	168	183	201	313	467	669	3.8	8.4	9.1	8.9	8.0	7.2	8.5
6	Food manufacturing	72	75	81	85	93	100	110	169	247	346	1.6	7.6	9.2	8.5	7.7	6.7	7.6
7	Beverages and tobacco products	29	30	32	32	35	38	43	76	121	176	2.8	8.6	11.7	11.4	9.2	7.6	8.9
8	Textile industry	74	77	83	90	98	107	117	178	259	361	3.4	8.2	9.3	8.4	7.4	6.7	7.8
9	Paper products and printing	44	47	51	56	63	71	80	139	227	351	7.5	11.3	12.0	11.1	9.8	8.7	10.0
10	Chemical industries	241	264	296	332	375	419	471	824	1367	2146	10.2	10.9	11.8	11.2	10.1	9.0	10.5
11	Petroleum refineries	61	61	65	69	75	80	87	126	177	242	14.0	6.8	7.8	7.4	6.8	6.2	6.8
12	Rubber and plastic products	52	57	65	73	83	93	105	180	292	448	7.9	11.1	11.7	10.8	9.7	8.5	10.3
13	Non-metallic products	12	15	16	19	22	24	26	42	64	92	7.8	9.4	9.2	9.4	8.3	7.3	9.2
14	Basic metal	138	159	183	213	248	278	312	540	883	1369	11.2	11.2	11.5	11.0	9.8	8.8	10.8
15	Fabricated metal products	83	92	103	118	136	151	169	294	478	730	5.6	10.3	11.2	11.1	9.7	8.5	10.3
16	Machinery	886	1021	1168	1344	1548	1725	1925	3344	5453	8369	13.2	10.9	11.0	11.0	9.8	8.6	10.5
17	Other manufacturing	133	143	156	168	185	200	218	330	478	668	4.1	7.9	8.7	8.2	7.4	6.7	7.7
18	Electricity and water works	2	2	2	2	3	3	3	5	8	12	1.9	7.2	8.5	9.4	8.8	7.9	8.8
19	Construction	0	0	0	0	0	0	0	0	1	1	-5.9	11.5	10.4	10.5	8.7	7.3	10.2
20	Trade	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
21	Restaurants and hotels	29	31	33	35	39	43	48	79	121	174	6.2	9.3	11.2	10.0	8.5	7.3	8.7
22	Transportation and communication	45	51	56	61	68	75	82	135	209	308	8.2	8.8	9.7	9.8	8.8	7.8	9.0
23	Banking and insurance	6	7	8	9	11	12	14	26	43	66	2.9	12.3	13.5	12.5	10.3	8.5	11.1
24	Real estate	16	17	17	16	17	17	19	32	51	74	-3.7	4.8	8.3	10.5	9.2	7.5	7.4
25	Services	57	64	72	79	86	93	101	151	220	310	6.6	7.2	8.2	8.1	7.5	6.9	7.9
26	Unclassified	5	5	6	6	7	8	9	17	31	55	21.8	12.5	13.0	12.8	12.3	11.4	11.8

10.2 POLICY OPTIMIZATION: A TIDY APPROACH TO POLICY DESIGN

Not only can optimization improve the historical simulation and forecasts, but it can also help to find the optimal path of policy variables specified within the model. In this section, optimization is used to find the optimal path of direct tax rates, in order to minimize a function of inflation and unemployment rates in the Thai economy.

Using the downhill simplex method, Almon (2001) provided an optimizing algorithm for Interdyme that minimizes an objective function by adjusting coefficients in a model. This capability produces an optimal '*path*' of policy variables that minimize a specified objective function. It offers a powerful instrument for economic model users. With optimization incorporated in the model, designing policy involves specifying the objective function and the policy instruments, and allowing the optimization to run its course. However, specifying the objective function is not always straightforward.

The Objective Function

In the present application, we try to find the optimal path of direct taxes that minimizes a function of the deviation of inflation and unemployment rates from their targeted values. The desired unemployment rate and inflation level are both set at 3.0 percent. The objective function we specify, '*misery*', is quadratic in these deviations. A quadratic objective function implies nonlinear substitution effects between the unemployment rate and inflation. For example, when unemployment is very high, we are willing to sacrifice more inflation to obtain a lower level of unemployment than when unemployment is low. Equation [10.1] displays the objective function, where *u* denotes the unemployment rate and π is the inflation. Parameters α and β are weights put on unemployment and inflation variables, respectively.

$$M = \alpha_1(u - 3) + \alpha_2(u - 3)^2 + (u - 3)(\pi - 3) + \beta_1(\pi - 3) + \beta_2(\pi - 3)^2 \qquad [10.1]$$

The optimal paths of direct tax rates were found for two different objective functions. In the first case, the tax authority is much concerned about the inflation level while in the second it is more concerned with the unemployment rates.

To deduce meaningful weighting parameters in the *misery* function, we may start by asking ourselves trade-off questions about inflation and unemployment rate. For example, at a given inflation level, we ask: How much increase in the unemployment rate we are willing to sacrifice in order to decrease inflation by 1 percent? In the present study, suppose the inflation-averse policymaker has the following trade-off in his mind:

Box 10.1: Inflation-unemployment trade-off for the inflation-averse policymaker

Inflation (%)	Unemp (%)	$-\Delta u/\Delta\pi$
4.0	3.0	5.0
3.5	3.3	3.0
3.3	3.7	1.9
3.1	4.5	1.0

The third column shows the increase in unemployment the authority would accept to get inflation down by 1 percent. The first row of Box 10.1, for example, says that when the unemployment rate equals 3 percent while inflation equals 4 percent, the inflation-averse policymaker is willing to accept a 5 percent higher unemployment rate in order to decrease inflation by 1 percent. On the other hand, line 4 says that when inflation rate equals to 3.1 percent and unemployment is 4.5 percent, he is willing to accept only a 1 percent increase in the unemployment rate to decrease in the inflation rate by 1 percent.

To solve for weighting parameters α_1, α_2, β_1, and β_2, we must first find the mathematical relationship of the inflation-unemployment trade-off. Total differentiating equation [10.1], we obtain:

$$dM = (\alpha_1 + 2\alpha_2(u - 3) + (\pi - 3))du + (\beta_1 + 2\beta_2(\pi - 3) + (u - 3))d\pi \qquad [10.2]$$

Therefore, the trade-off relation between inflation and unemployment rate along the constant *misery* curve ($dM = 0$) is:

$$(\alpha_1 + 2\alpha_2(u - 3) + (\pi - 3))du = -(\beta_1 + 2\beta_2(\pi - 3) + (u - 3))d\pi \qquad [10.3]$$

so,

$$-\frac{du}{d\pi} = \frac{(\beta_1 + 2\beta_2(\pi - 3) + (u - 3))}{(\alpha_1 + 2\alpha_2(u - 3) + (\pi - 3))} \qquad [10.4]$$

Rearranging terms, putting parameters on the left-hand-side and constant terms on the right-hand-side, equation [10.4] can be re-written in terms of:

$$-\frac{du}{d\pi}(\alpha_1 + 2\alpha_2(u-3)) - \beta_1 - 2\beta_2(\pi - 3) = (u-3) + \frac{du}{d\pi}(\pi - 3) \qquad [10.5]$$

By substituting numbers from Box 10.1, we have four linear equations with four unknown parameters as follows.

$$(5.00)\alpha_1 + (0.00)\alpha_2 - (1.00)\beta_1 - (2.00)\beta_2 = -5.00$$

$$(3.00)\alpha_1 + (1.80)\alpha_2 - (1.00)\beta_1 - (1.00)\beta_2 = -1.20$$

$$(1.89)\alpha_1 + (2.64)\alpha_2 - (1.00)\beta_1 - (0.60)\beta_2 = 0.13$$

$$(1.05)\alpha_1 + (3.15)\alpha_2 - (1.00)\beta_1 - (0.20)\beta_2 = 1.40$$

Solving above equations, weighting parameters in the *misery* function for the inflation-averse policymaker are: $\alpha_1 = 1$, $\alpha_2 = 1$, $\beta_1 = 2$, and $\beta_2 = 4$.

Similarly, we would ask the same question to the unemployment-averse policymaker. Box 10.2 displays his trade-off between inflation and unemployment.

Box 10.2: Inflation-unemployment trade-off for the unemployment-averse policymaker

Inflation (%)	Unemp (%)	$-\Delta\pi/\Delta u$
3.0	4.0	5.0
3.3	3.5	3.0
3.7	3.3	1.9
4.5	3.1	1.0

As before, substituting numbers from Box 10.2 to equation [10.5] gives us four linear equation with four unknown parameters. The solution of weighting parameters for the unemployment-averse policymaker are: $\alpha_1 = 2$, $\alpha_2 = 4$, $\beta_1 = 1$, and $\beta_2 = 1$.

The Optimal Paths of Direct Tax Policy

The tax policy is allowed to change every four years, corresponding to the future political terms from 2000 to 2020. Table 10.13 compares results from the base forecasts, the optimal tax for the inflation-averse policymaker, and the optimal tax for unemployment-averse policy planner.

In essence, optimization delivers desired results – the optimal paths of direct tax policy that provide desired values of inflation and unemployment rate for each case. Relative to the base forecasts, the optimal tax rates produce low inflation in the first case, while low unemployment rates are achieved in the second case. Certainly, in each case, this achievement comes with other associated costs.

Table 10.13: Comparison between the base and the optimal tax forecasts

	2000	2001	2002	2003	2004	2005	2010	2015	2020
Base Forecasts									
Direct tax rates (%)	3.9	4.0	4.2	4.3	4.5	4.6	5.2	5.8	6.4
Inflation (%)	4.8	5.8	4.2	3.5	3.0	3.6	4.0	4.0	3.9
Unemployment rates (%)	3.6	3.2	2.2	3.3	3.8	3.9	3.3	3.4	3.7
Real GDP growth (%)	5.1	2.6	4.3	6.0	4.3	5.4	4.8	3.8	3.5
Real private consumption growth (%)	1.0	-0.2	-0.4	5.0	4.6	6.8	5.1	3.9	3.2
Real disposable income (billions of 1990 baht)	1973	1922	1967	2040	2161	2304	3051	3746	4392
Net exports (billions of baht)	459	484	453	356	320	272	-105	-470	-592
Optimal Tax Forecasts for Low Inflation									
Direct tax rates (%)	3.9	4.3	4.7	5.2	5.6	6.1	8.0	9.2	10.3
Inflation (%)	4.8	5.8	4.2	3.4	3.0	3.4	3.5	3.3	3.1
Unemployment rates (%)	3.6	3.2	2.2	3.3	4.0	4.1	4.1	4.3	4.6
Real GDP growth (%)	5.1	2.6	4.3	5.6	4.0	5.0	4.7	3.8	3.5
Real private consumption growth (%)	1.0	-0.2	-0.5	4.2	3.8	6.0	4.8	3.8	3.2
Real disposable income (billions of 1990 baht)	1974	1916	1954	2011	2116	2239	2883	3513	4094
Net exports (billions of baht)	459	484	455	371	349	318	78	-149	-86
Optimal Tax Forecasts for Low Unemployment									
Direct tax rates (%)	3.9	3.8	3.7	3.6	3.4	3.3	3.0	3.0	2.6
Inflation (%)	4.8	5.8	4.2	3.5	3.1	3.7	4.4	4.4	4.5
Unemployment rates (%)	3.6	3.2	2.2	3.2	3.7	3.7	2.7	2.8	2.8
Real GDP growth (%)	5.1	2.6	4.4	6.3	4.7	5.7	5.0	3.9	3.7
Real private consumption growth (%)	1.0	-0.2	-0.3	5.6	5.3	7.4	5.4	4.0	3.7
Real disposable income (billions of 1990 baht)	1974	1927	1979	2066	2201	2361	3191	3939	4717
Net exports (billions of baht)	459	484	450	344	294	231	-264	-753	-1231

In the first case, greater concentration is placed on the inflation variable in the objective function. To achieve low levels of inflation, tax rates should be raised. The optimization suggests strong increases in the direct tax rates in order to deliver low inflation rates. Direct tax rates should be increased from 3.9 percent in the year 2000 to 10.3 percent in 2020. In return, inflation remains low at 3.1 percent in 2020.

The cost of such low inflation is evident – high unemployment rates. At the end of the forecasts, this case predicts unemployment rates at around 4.6 percent, fairly high relative to the base forecast of 3.7 percent.

Increasing personal taxes also comes with other adverse consequences. GDP growth in real terms exhibits a slower path than that in the base forecasts as do real disposable income and personal consumption expenditures. In the year 2020, real disposable income equals to 4,094 billion bahts – approximately 300 billion bahts less than the base forecasts. Private consumption clearly shows a slower growth path from 2000 to 2020.

On the bright side, the trade balance improves as a result of personal tax increases. Lower consumption leads to a decrease in imports. In addition, low inflation also provides relatively cheaper domestic products and, therefore, prompts export growth. Trade balance has its lowest value in year 2015 and will start to improve from then on.

In the second case, where more emphasis is placed upon unemployment rates, the optimization suggests indeed a tax cut policy. The tax rates should be cut continuously in order to induce unemployment rates to remain low throughout the forecasts[15]. As a result, unemployment rates are not greater than 3.7 percent and will remain approximately low at 2.8 percent.

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[15] It should be remarked that the continuous tax cut may be implausible in the real world because the government cannot run continuously a budget deficit. Currently, TIDY does not have a government

High inflation comes with a low level of employment. Inflation rates stand at around 3.7 to 4.5 percent, higher than that appear in the base forecasts. In addition to a higher level of inflation, trade balances are also deteriorating as a result of the tax cut.

Apart from higher inflation and deteriorating trade balances, a tax cut policy induces a healthy economy in general. When compared to the base case, real GDP, and especially private consumption expenditures, grow at more rapid rates. The tax cut also brings higher levels of real disposable income. In 2020, real disposable income should be equal to 4,717 billion bahts, approximately 300 billion bahts higher than the base case.

Figure 10.1 to 10.4 plot the optimal tax rates, inflation, unemployment rates, and real personal disposable income resulting from the analysis.

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balance within the model; therefore, this particular analysis can show only a hypothetical example of the optimal tax policy.

Figure 10.1: Direct tax rates

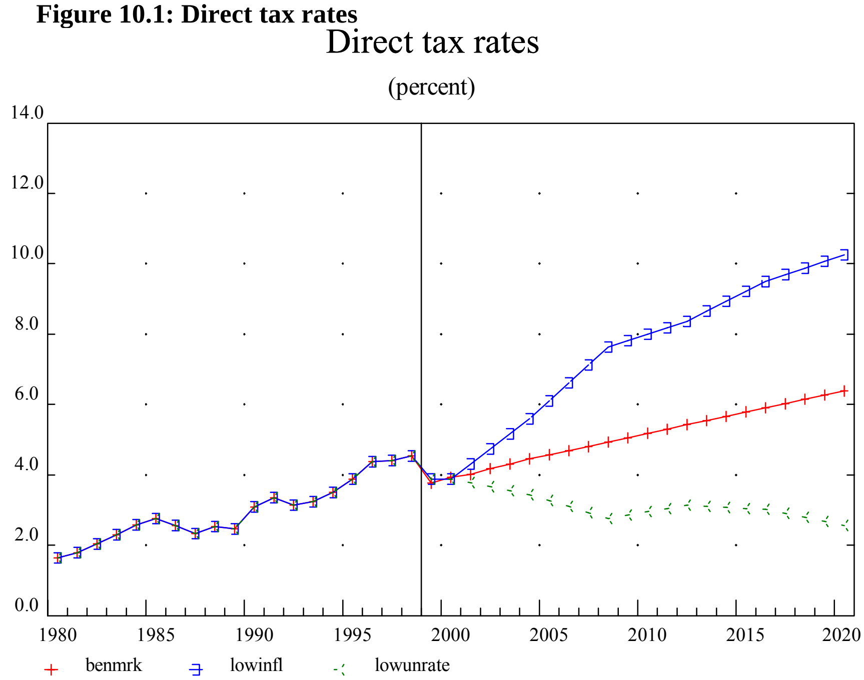


Figure 10.2: Real personal disposable income

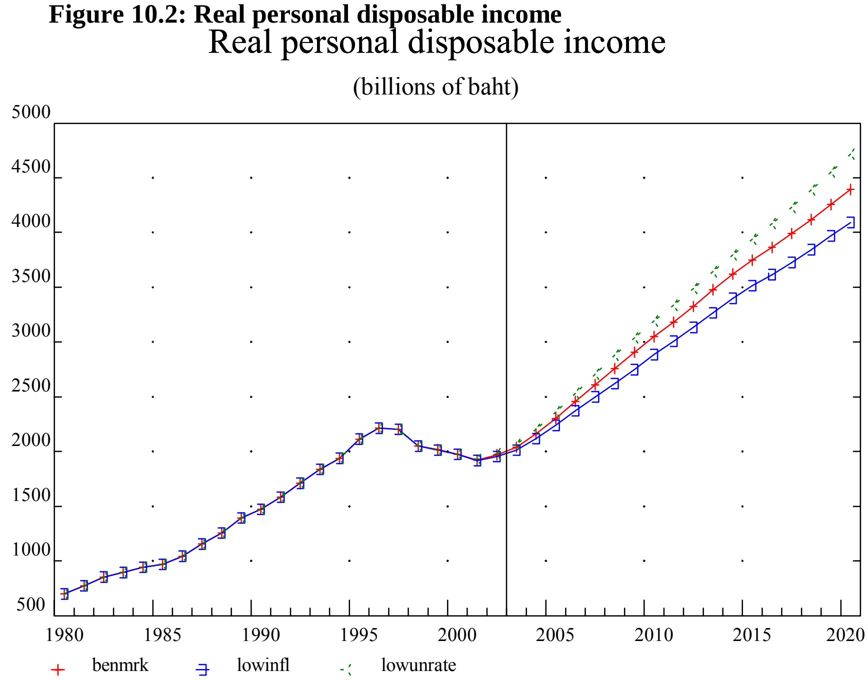


Figure 10.3: Inflation

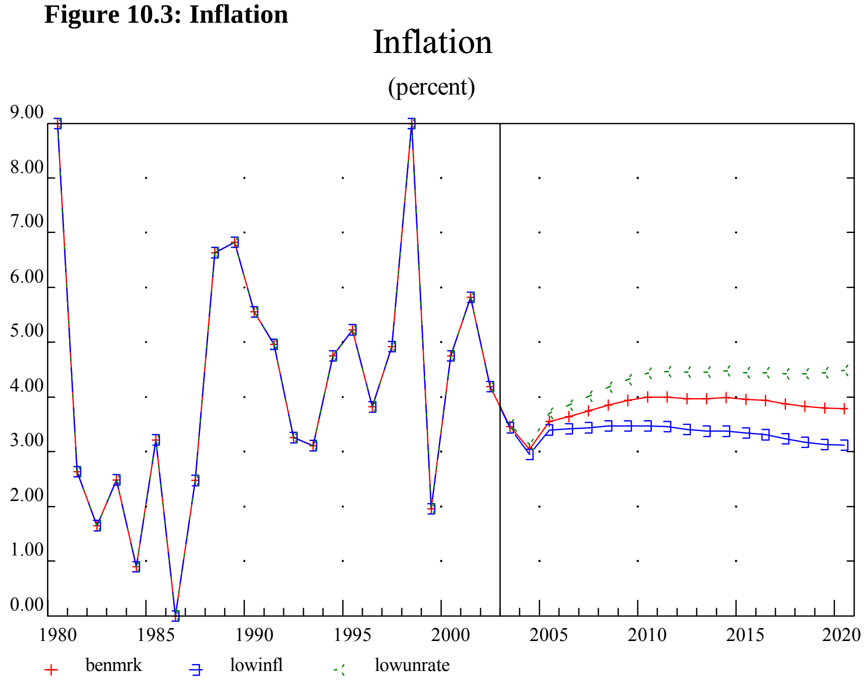
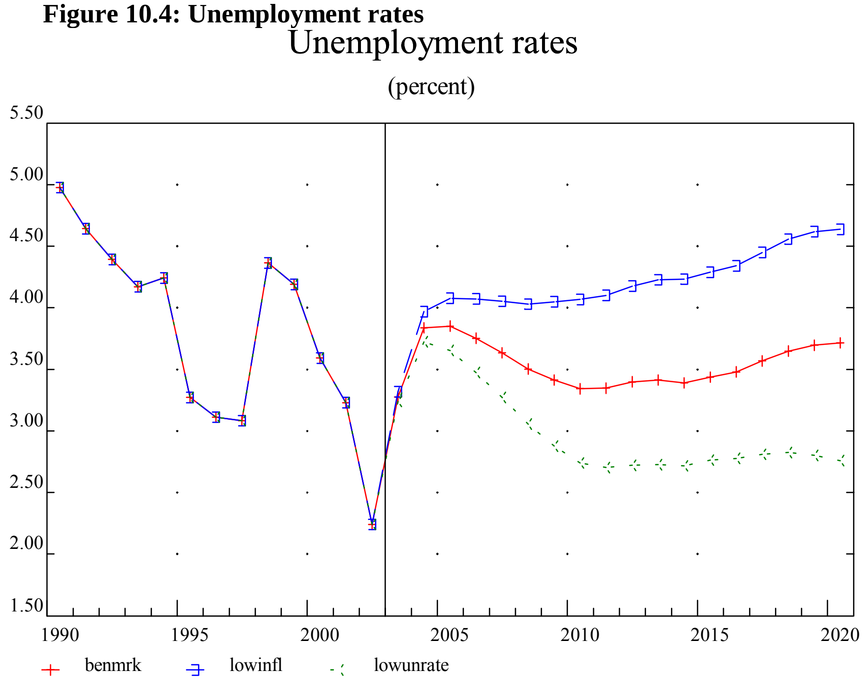


Figure 10.4: Unemployment rates



Sectoral Comparison

Table 10.14 displays the sectoral comparison of real personal consumption per capita in the base forecast, the inflation-averse policy forecast, and the unemployment-averse policy forecast. The sectoral output comparison is presented in table 10.15. For each sector, the first line displays the base forecast. The second line is the percent difference from the base forecast result from the inflation-averse tax policy. The third line shows the percent difference from the base forecast result from the unemployment-averse tax cut policy.

According to table 10.14, a tax increase policy for inflation-averse policymakers clearly cuts down real personal consumption expenditures in all consumption categories. Real gross output in all sectors also decline accordingly. In contrast, a tax decrease from the unemployment-averse policymaker induces more consumption expenditures and output growth in all sectors. Proportionally, larger decreases in real consumption are found in income-sensitive sectors such as Furniture, Household equipment, and Recreation.

Table 10.14: Personal consumption per capita
Line 1: TIDY base forecast
Line 2: Tax Increase - percent difference from base
Line 3: Tax Cut - percent difference from base
Alternatives are shown in deviations from base values.

	Values in 1990 Prices, Bahts						Annual Growth Rates					
	2003	2004	2005	2010	2015	2020	03-04	04-05	05-10	10-15	15-20	00-20
1 Rice & cereals	1332	1338	1349	1418	1480	1535	0.4	0.8	1.0	0.8	0.7	0.8
	-0.1	-0.2	-0.3	-1.0	-1.3	-1.6	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
	0.1	0.1	0.3	0.8	1.0	1.6	0.1	0.1	0.1	0.0	0.1	0.1
2 Meat	1124	1140	1166	1316	1450	1568	1.3	2.3	2.4	1.9	1.6	1.7
	-0.3	-0.6	-0.9	-2.6	-3.2	-3.7	-0.3	-0.3	-0.4	-0.1	-0.1	-0.2
	0.3	0.5	0.8	2.2	2.6	3.9	0.3	0.3	0.3	0.1	0.3	0.2
3 Fish	402	421	449	603	740	860	4.4	6.7	5.9	4.1	3.0	4.1
	-1.0	-1.7	-2.4	-6.0	-6.8	-7.3	-0.8	-0.8	-0.7	-0.1	-0.1	-0.4
	0.7	1.4	2.2	5.0	5.4	7.6	0.7	0.7	0.5	0.1	0.4	0.4
4 Milk,cheese & eggs	509	509	532	707	876	1016	0.0	4.4	5.7	4.3	3.0	3.2
	0.4	-0.4	-1.1	-5.5	-6.3	-7.1	-0.8	-0.6	-0.9	-0.2	-0.2	-0.4
	-0.4	0.4	0.9	4.7	4.8	6.7	0.7	0.6	0.7	0.0	0.4	0.3
5 Oil & fat	272	279	295	399	499	588	2.4	5.6	6.0	4.5	3.3	3.9
	-0.4	-1.1	-1.7	-5.5	-6.2	-6.8	-0.8	-0.7	-0.8	-0.1	-0.1	-0.4
	0.4	1.1	1.7	4.8	4.8	6.8	0.7	0.6	0.6	0.0	0.4	0.3
6 Fruit & vegetables	1150	1147	1191	1515	1812	2046	-0.2	3.7	4.8	3.6	2.4	2.5
	0.0	-0.8	-1.4	-6.0	-7.0	-8.0	-0.8	-0.7	-0.9	-0.2	-0.2	-0.4
	0.0	0.7	1.3	5.1	5.4	7.8	0.7	0.7	0.7	0.1	0.5	0.4
7 Sugar & preserves	271	276	288	370	448	516	1.5	4.4	5.0	3.8	2.8	3.2
	0.0	-0.7	-1.4	-4.9	-5.6	-6.2	-0.7	-0.6	-0.7	-0.2	-0.1	-0.3
	0.0	0.7	1.0	4.1	4.2	6.0	0.6	0.5	0.6	0.1	0.3	0.3
8 Coffee,tea,cocoa,etc.	89	92	97	132	165	195	2.4	5.8	6.2	4.5	3.3	3.9
	0.0	-1.1	-2.1	-5.3	-6.1	-6.7	-0.8	-0.7	-0.8	-0.1	-0.1	-0.3
	0.0	1.1	1.0	4.5	4.8	6.7	0.7	0.6	0.6	0.0	0.4	0.3
9 Other food	438	434	438	486	533	570	-1.1	0.9	2.1	1.8	1.3	1.2
	0.5	0.2	0.0	-2.1	-2.6	-3.3	-0.3	-0.2	-0.4	-0.1	-0.1	-0.2
	-0.5	-0.2	0.0	1.6	1.9	2.8	0.2	0.2	0.3	0.0	0.2	0.1
10 Non-alcoholic beverages	1055	1089	1159	1553	1903	2192	3.3	6.2	5.8	4.1	2.8	3.7
	-0.7	-1.6	-2.3	-6.2	-6.9	-7.5	-0.9	-0.8	-0.8	-0.2	-0.1	-0.4
	0.6	1.4	2.1	5.2	5.5	7.7	0.8	0.7	0.6	0.1	0.4	0.4
11 Alcoholic beverages	1320	1302	1340	1669	1965	2165	-1.4	2.9	4.4	3.3	1.9	2.1
	0.3	-0.5	-1.1	-5.5	-6.4	-7.3	-0.8	-0.6	-0.9	-0.2	-0.2	-0.4
	-0.2	0.5	1.1	4.7	4.9	6.9	0.7	0.6	0.7	0.0	0.4	0.3
12 Tobacco	525	543	566	671	755	822	3.3	4.1	3.4	2.4	1.7	2.4
	-1.3	-2.0	-2.7	-5.5	-6.6	-7.4	-0.6	-0.7	-0.6	-0.2	-0.2	-0.4
	1.1	1.8	2.3	4.6	5.4	8.0	0.6	0.6	0.4	0.2	0.5	0.4
13 Footwear	224	224	235	311	383	440	0.2	4.6	5.6	4.1	2.8	3.1
	0.4	-0.4	-1.3	-5.8	-6.5	-7.3	-0.9	-0.7	-0.9	-0.2	-0.2	-0.4
	-0.4	0.4	1.3	4.8	5.0	7.0	0.7	0.7	0.7	0.0	0.4	0.3
14 Clothing	2877	3042	3254	4293	5207	6016	5.6	6.7	5.5	3.9	2.9	4.0
	-1.2	-1.9	-2.7	-5.6	-6.3	-6.7	-0.7	-0.7	-0.6	-0.1	-0.1	-0.3
	1.1	1.7	2.4	4.7	5.2	7.4	0.6	0.6	0.5	0.1	0.4	0.4
15 Other personal effects	329	364	402	572	718	852	10.1	10.0	7.0	4.6	3.4	5.5
	-2.7	-3.6	-4.7	-7.7	-8.2	-8.6	-0.9	-1.1	-0.6	-0.1	-0.1	-0.4
	2.4	3.3	4.0	6.5	7.0	9.6	0.8	0.8	0.4	0.1	0.5	0.5
16 Rent & water charges	1890	1931	2029	2552	3010	3388	2.1	5.0	4.6	3.3	2.4	2.9
	0.0	-0.7	-1.3	-5.0	-5.8	-6.6	-0.7	-0.6	-0.8	-0.2	-0.2	-0.3
	0.0	0.6	1.2	4.2	4.5	6.5	0.6	0.6	0.6	0.1	0.4	0.3
17 Fuel & light	600	617	653	841	1008	1147	2.9	5.6	5.1	3.6	2.6	3.2
	0.0	-0.8	-1.4	-5.0	-5.9	-6.5	-0.7	-0.6	-0.8	-0.2	-0.1	-0.3
	0.0	0.6	1.2	4.3	4.5	6.5	0.6	0.6	0.6	0.0	0.4	0.3

Table 10.14: Personal consumption per capita (cont.)
Line 1: TIDY base forecast
Line 2: Tax Increase - percent difference from base
Line 3: Tax Cut - percent difference from base
Alternatives are shown in deviations from base values.

	Values in 1990 Prices, Bahts						Annual Growth Rates					
	2003	2004	2005	2010	2015	2020	03-04	04-05	05-10	10-15	15-20	00-20
18 Furniture & furnishings	594	655	724	1032	1300	1546	9.8	10.0	7.1	4.6	3.5	5.5
	-2.5	-3.4	-4.4	-7.6	-8.2	-8.5	-0.9	-1.1	-0.7	-0.1	-0.1	-0.4
	2.2	3.1	3.9	6.3	6.8	9.5	0.8	0.8	0.5	0.1	0.5	0.5
19 Households equipment	2010	2087	2241	3089	3812	4382	3.7	7.1	6.4	4.2	2.8	3.9
	-0.7	-1.8	-2.7	-7.0	-7.6	-8.0	-1.1	-0.9	-0.9	-0.1	-0.1	-0.4
	0.7	1.6	2.5	5.9	6.0	8.3	0.9	0.8	0.7	0.0	0.4	0.4
20 Domestic services of hh	51	54	57	79	100	122	4.6	7.1	6.3	4.9	3.8	4.2
	0.0	-1.9	-1.8	-5.1	-6.0	-7.4	-0.7	-0.6	-0.7	-0.2	-0.2	-0.4
	0.0	1.9	1.8	3.8	5.0	7.4	0.6	0.6	0.5	0.1	0.4	0.3
21 Other expenditures of hh	451	456	480	644	804	945	1.1	5.2	5.9	4.4	3.2	3.4
	0.2	-0.7	-1.3	-5.4	-6.1	-6.9	-0.8	-0.6	-0.8	-0.2	-0.2	-0.4
	-0.2	0.7	1.3	4.5	4.6	6.6	0.7	0.6	0.6	0.0	0.4	0.3
22 Personal care	568	590	619	772	913	1040	3.7	4.9	4.4	3.3	2.6	3.2
	-0.5	-1.0	-1.5	-3.8	-4.4	-4.9	-0.5	-0.5	-0.5	-0.1	-0.1	-0.2
	0.5	0.8	1.3	3.2	3.5	5.1	0.4	0.4	0.4	0.1	0.3	0.2
23 Health expenses	1966	2099	2246	2904	3510	4090	6.6	6.8	5.1	3.8	3.1	4.1
	-1.4	-2.0	-2.5	-4.6	-5.2	-5.6	-0.5	-0.6	-0.4	-0.1	-0.1	-0.3
	1.3	1.8	2.2	3.8	4.3	6.2	0.5	0.5	0.3	0.1	0.4	0.3
24 Personal transportation	1492	1704	1885	2469	2900	3302	13.3	10.1	5.4	3.2	2.6	5.3
	-4.2	-4.8	-5.7	-7.7	-8.1	-8.3	-0.5	-1.0	-0.4	-0.1	0.0	-0.4
	3.8	4.3	5.0	6.4	7.2	10.1	0.5	0.7	0.3	0.2	0.5	0.5
25 Operation of private trans	1269	1311	1401	1938	2424	2831	3.2	6.7	6.5	4.5	3.1	4.0
	-0.6	-1.6	-2.4	-6.4	-7.1	-7.7	-1.0	-0.8	-0.8	-0.1	-0.1	-0.4
	0.6	1.4	2.2	5.4	5.6	7.8	0.9	0.7	0.6	0.0	0.4	0.4
26 Purchased transportation	1251	1270	1310	1495	1647	1770	1.5	3.1	2.6	1.9	1.4	1.7
	-0.4	-0.9	-1.3	-3.9	-4.7	-5.3	-0.5	-0.5	-0.5	-0.2	-0.1	-0.3
	0.3	0.8	1.2	3.3	3.7	5.4	0.4	0.4	0.4	0.1	0.3	0.3
27 Communication	612	627	656	789	891	962	2.4	4.5	3.7	2.4	1.5	2.4
	-0.2	-0.8	-1.2	-4.1	-4.2	-4.4	-0.6	-0.5	-0.6	0.0	0.0	-0.2
	0.2	0.6	1.2	3.4	3.1	4.4	0.6	0.5	0.4	0.0	0.2	0.2
28 Entertainment	91	95	101	127	155	184	4.8	5.2	4.7	4.0	3.4	4.0
	0.0	0.0	0.0	-0.8	-1.3	-1.1	-0.1	-0.1	-0.1	-0.1	0.0	-0.1
	0.0	0.0	0.0	0.8	0.6	1.1	0.1	0.1	0.1	0.0	0.1	0.1
29 Hotels,restaurants & cafes	2626	2738	2918	3928	4818	5577	4.2	6.4	5.9	4.1	2.9	3.9
	-1.2	-2.0	-2.8	-6.4	-7.2	-7.9	-0.8	-0.8	-0.8	-0.2	-0.1	-0.4
	1.0	1.8	2.5	5.3	5.9	8.2	0.7	0.7	0.5	0.1	0.4	0.4
30 Books & newspapers	433	447	468	575	664	735	3.1	4.6	4.1	2.9	2.0	2.8
	-1.2	-1.8	-2.6	-5.6	-6.3	-6.9	-0.7	-0.7	-0.6	-0.2	-0.1	-0.4
	0.9	1.6	2.1	4.7	5.3	7.5	0.6	0.6	0.5	0.1	0.4	0.4
31 Other recreation	755	809	902	1441	1970	2444	7.0	10.9	9.4	6.2	4.3	5.9
	-1.6	-3.1	-4.2	-9.2	-9.6	-10.1	-1.5	-1.2	-1.0	-0.1	-0.1	-0.5
	1.5	2.7	3.8	7.6	7.7	10.6	1.2	1.0	0.7	0.0	0.5	0.5
32 Financial services	381	410	446	617	770	913	7.2	8.5	6.5	4.4	3.4	4.8
	-1.8	-2.7	-3.6	-6.6	-7.1	-7.7	-0.9	-0.9	-0.6	-0.1	-0.1	-0.4
	1.6	2.4	3.1	5.5	5.8	8.3	0.8	0.7	0.5	0.1	0.4	0.4
33 Other services	250	258	273	359	440	512	3.2	5.8	5.5	4.1	3.0	3.5
	-0.4	-1.2	-1.8	-5.3	-6.1	-6.6	-0.7	-0.6	-0.7	-0.2	-0.1	-0.3
	0.4	1.2	1.5	4.5	4.8	6.8	0.6	0.6	0.5	0.1	0.4	0.3

Table 10.15: Gross Output

Line 1: TIDY base forecast

Line 2: Tax Increase - percent difference from base

Line 3: Tax Cut - percent difference from base

Alternatives are shown in deviations from base values.

	Values in 1990 prices, millions of baht						Annual Growth Rates					
	2003	2004	2005	2010	2015	2020	03-04	04-05	05-10	10-15	15-20	00-20
1 Crops	272046	276387	283882	323590	358361	387851	1.6	2.7	2.6	2.0	1.6	1.9
	-0.2	-0.5	-0.7	-2.2	-2.6	-2.8	-0.3	-0.3	-0.3	-0.1	-0.1	-0.1
	0.2	0.4	0.7	1.9	2.1	2.9	0.2	0.2	0.2	0.0	0.2	0.1
2 Livestock	79053	81224	84438	102907	120473	137593	2.7	3.9	4.0	3.2	2.7	3.1
	-0.2	-0.5	-0.8	-2.4	-2.7	-3.0	-0.3	-0.3	-0.3	-0.1	-0.1	-0.2
	0.2	0.4	0.7	2.0	2.1	3.2	0.3	0.3	0.3	0.0	0.2	0.2
3 Forestry	7076	7062	7062	7042	7054	7158	-0.2	0.0	-0.1	0.0	0.3	0.0
	-0.3	-0.4	-0.6	-1.2	-1.4	-1.6	-0.2	-0.2	-0.1	0.0	0.0	-0.1
	0.3	0.4	0.5	1.0	1.2	1.8	0.1	0.1	0.1	0.0	0.1	0.1
4 Fishery	85476	91290	98680	140274	183923	228098	6.6	7.8	7.0	5.4	4.3	5.7
	-0.4	-0.8	-1.2	-3.2	-3.7	-3.9	-0.4	-0.4	-0.4	-0.1	-0.1	-0.2
	0.4	0.7	1.1	2.7	2.9	4.1	0.4	0.4	0.3	0.0	0.2	0.2
5 Mining	149144	160393	172936	244760	325631	414886	7.3	7.5	6.9	5.7	4.8	6.3
	-0.4	-0.9	-1.2	-3.0	-3.2	-3.4	-0.4	-0.4	-0.4	0.0	0.0	-0.2
	0.4	0.8	1.1	2.5	2.6	3.8	0.4	0.3	0.3	0.0	0.2	0.2
6 Food manuf	562362	581649	607979	761772	930255	1111859	3.4	4.4	4.5	4.0	3.6	3.8
	-0.1	-0.4	-0.6	-1.9	-2.2	-2.4	-0.2	-0.2	-0.3	-0.1	0.0	-0.1
	0.1	0.3	0.5	1.6	1.8	2.4	0.2	0.2	0.2	0.0	0.1	0.1
7 Bevg & tobac	162562	167892	176958	234113	290622	342311	3.2	5.3	5.6	4.3	3.3	3.9
	-0.3	-1.0	-1.6	-4.9	-5.6	-6.2	-0.7	-0.6	-0.7	-0.2	-0.1	-0.3
	0.3	0.9	1.5	4.1	4.5	6.3	0.6	0.6	0.5	0.1	0.3	0.3
8 Textile	578190	611272	651021	854800	1062590	1276923	5.6	6.3	5.4	4.4	3.7	4.5
	-0.7	-1.1	-1.6	-3.4	-3.8	-4.0	-0.4	-0.5	-0.4	-0.1	0.0	-0.2
	0.6	1.0	1.4	2.8	3.1	4.4	0.4	0.4	0.3	0.1	0.2	0.2
9 Paper & prin	116067	123091	131052	177616	231616	293223	5.9	6.3	6.1	5.3	4.7	5.4
	-0.4	-0.8	-1.1	-2.7	-3.0	-3.2	-0.3	-0.3	-0.3	-0.1	0.0	-0.2
	0.4	0.7	1.0	2.2	2.4	3.4	0.3	0.3	0.2	0.0	0.2	0.2
10 Chemical	214912	231833	251257	365207	504335	669014	7.6	8.0	7.5	6.5	5.7	6.7
	-0.4	-0.8	-1.1	-2.5	-2.8	-3.0	-0.3	-0.3	-0.3	-0.1	0.0	-0.1
	0.4	0.7	1.0	2.1	2.3	3.2	0.3	0.3	0.2	0.0	0.2	0.2
11 Petroleum	238138	250819	266321	352010	440688	530810	5.2	6.0	5.6	4.5	3.7	4.7
	-0.4	-0.8	-1.2	-3.0	-3.3	-3.5	-0.4	-0.4	-0.4	-0.1	0.0	-0.2
	0.4	0.7	1.1	2.5	2.6	3.7	0.4	0.3	0.3	0.0	0.2	0.2
12 Rubber & plastic	177497	190047	204121	285955	381762	489907	6.8	7.1	6.7	5.8	5.0	6.1
	-0.3	-0.6	-0.9	-2.2	-2.4	-2.6	-0.3	-0.3	-0.3	0.0	0.0	-0.1
	0.3	0.5	0.8	1.8	1.9	2.8	0.3	0.2	0.2	0.0	0.2	0.1
13 Non-metallic	189242	205702	221426	307560	396974	487994	8.3	7.4	6.6	5.1	4.1	6.6
	-0.5	-1.0	-1.4	-2.9	-3.0	-3.1	-0.4	-0.4	-0.3	0.0	0.0	-0.2
	0.5	0.9	1.2	2.4	2.4	3.7	0.4	0.3	0.2	0.0	0.3	0.2
14 Basic metal	154006	166661	180008	259340	355960	470135	7.9	7.7	7.3	6.3	5.6	7.0
	-0.4	-0.7	-1.0	-2.2	-2.4	-2.5	-0.3	-0.3	-0.3	0.0	0.0	-0.1
	0.3	0.6	0.9	1.9	1.9	2.9	0.3	0.3	0.2	0.0	0.2	0.1
15 Fabricated metal	138118	148742	160737	229757	308406	395086	7.4	7.8	7.1	5.9	5.0	6.5
	-0.4	-0.8	-1.1	-2.7	-2.9	-3.1	-0.4	-0.4	-0.3	0.0	0.0	-0.2
	0.4	0.7	1.0	2.3	2.3	3.4	0.3	0.3	0.2	0.0	0.2	0.2

Table 10.15: Gross Output
Line 1: TIDY base forecast
Line 2: Tax Increase - percent difference from base
Line 3: Tax Cut - percent difference from base
Alternatives are shown in deviations from base values.

	Values in 1990 prices, millions of baht						Annual Growth Rates					
	2003	2004	2005	2010	2015	2020	03-04	04-05	05-10	10-15	15-20	00-20
16 Machinery	1512993	1621988	1732665	2357586	3063133	3850680	7.0	6.6	6.2	5.2	4.6	6.0
	-0.4	-0.7	-1.0	-2.1	-2.2	-2.3	-0.3	-0.3	-0.2	0.0	0.0	-0.1
	0.3	0.6	0.9	1.8	1.8	2.7	0.3	0.2	0.2	0.0	0.2	0.1
17 Other manuf	465527	492160	522482	689043	865465	1047679	5.6	6.0	5.5	4.6	3.8	4.8
	-0.5	-0.9	-1.3	-3.0	-3.3	-3.5	-0.4	-0.4	-0.4	-0.1	0.0	-0.2
	0.4	0.8	1.1	2.5	2.7	3.8	0.4	0.3	0.3	0.0	0.2	0.2
18 Utilities	253305	271184	292834	416380	554941	705652	6.8	7.7	7.0	5.7	4.8	6.0
	-0.4	-0.8	-1.2	-3.2	-3.6	-3.9	-0.4	-0.4	-0.4	-0.1	-0.1	-0.2
	0.3	0.7	1.1	2.7	2.9	4.1	0.4	0.4	0.3	0.0	0.2	0.2
19 Construction	655004	710678	760881	1031974	1297958	1556525	8.2	6.8	6.1	4.6	3.6	6.4
	-0.6	-1.1	-1.6	-3.3	-3.3	-3.5	-0.5	-0.4	-0.4	0.0	0.0	-0.2
	0.6	1.0	1.4	2.8	2.6	4.2	0.5	0.4	0.3	0.0	0.3	0.2
20 Trade	1085328	1160871	1245146	1720338	2231137	2770156	6.7	7.0	6.5	5.2	4.3	5.7
	-0.6	-1.1	-1.5	-3.5	-3.8	-4.1	-0.5	-0.5	-0.4	-0.1	-0.1	-0.2
	0.5	0.9	1.4	2.9	3.1	4.4	0.4	0.4	0.3	0.0	0.3	0.2
21 Restrnt & hotel	277452	290479	308428	408289	505241	597960	4.6	6.0	5.6	4.3	3.4	4.2
	-0.8	-1.3	-1.9	-4.5	-5.1	-5.5	-0.6	-0.6	-0.5	-0.1	-0.1	-0.3
	0.7	1.2	1.7	3.7	4.1	5.8	0.5	0.5	0.4	0.1	0.3	0.3
22 Trans & comm	582474	614982	652390	858467	1077947	1310294	5.4	5.9	5.5	4.6	3.9	4.8
	-0.5	-0.9	-1.2	-2.9	-3.2	-3.4	-0.4	-0.4	-0.3	-0.1	0.0	-0.2
	0.4	0.8	1.1	2.4	2.6	3.7	0.4	0.3	0.3	0.0	0.2	0.2
23 Bank & insur	336882	368504	405199	624416	882810	1171040	9.0	9.5	8.6	6.9	5.7	7.5
	-0.5	-1.0	-1.4	-3.4	-3.6	-3.9	-0.5	-0.4	-0.4	-0.1	0.0	-0.2
	0.4	0.9	1.2	2.8	2.9	4.2	0.4	0.4	0.3	0.0	0.2	0.2
24 Real estate	125800	131304	139581	185589	233655	282320	4.3	6.1	5.7	4.6	3.8	4.5
	-0.1	-0.7	-1.2	-3.9	-4.4	-4.8	-0.6	-0.5	-0.6	-0.1	-0.1	-0.2
	0.1	0.6	1.1	3.3	3.4	4.9	0.5	0.5	0.4	0.0	0.3	0.2
25 Services	548838	570381	595160	731752	884355	1052735	3.9	4.3	4.1	3.8	3.5	3.7
	-0.2	-0.4	-0.6	-1.5	-1.9	-2.1	-0.2	-0.2	-0.2	-0.1	0.0	-0.1
	0.2	0.3	0.5	1.3	1.5	2.2	0.2	0.2	0.2	0.0	0.1	0.1
26 Unclassified	70100	76742	84344	132700	195853	271084	9.1	9.4	9.1	7.8	6.5	8.1
	-0.3	-0.6	-0.9	-2.5	-2.9	-3.2	-0.3	-0.3	-0.3	-0.1	-0.1	-0.2
	0.3	0.6	0.8	2.1	2.3	3.4	0.3	0.3	0.2	0.0	0.2	0.2

CHAPTER 11: THE CONCLUSION

The objective of this study is to construct a dynamic interindustry model for Thailand that is able to provide a policy design, given a specific objective, such as to maximize social welfare of the economy.

The Thailand Interindustry Dynamic model (TIDY) was constructed from the bottom-up; where hundreds of estimations are conducted at sectoral level and aggregate variables are simply the sum of these sectoral variables. Indeed, this characteristic is analogous to how real economy works.

The core of TIDY is the series of 26x26 input-output tables of Thailand that connect economic activities in various parts of the economy, including intermediate transactions between producers from different industries, final transactions to end-users, and return payments to factor inputs. Implementation requires estimating annual input-output relationships. A model explaining final demands in all sectors is also developed, that includes sectoral forecasts of demand, prices, employment, and the distribution of income. This includes gross output, prices, personal consumption, fixed investment, capital stock, employment, labor productivity, wages, and operating surpluses. Since Thailand's available statistics are defined at different levels of data aggregation, a consistent method is devised to translate outcomes at each level of aggregation into sectors describing productive activity.

Not only can the model provide sectoral forecasts, but also it can find the optimal policy '*path*' that leads to a specified stage of the economy. The present study employs optimization to design a path of personal direct taxes to minimize the sum of squared deviation of inflation and unemployment rates from their desired value of 3.0 percent.

In all, the dissertation has achieved its research goal: to create a model that may be used as an effective tool in the planning of a national development strategy. TIDY is a detailed dynamic interindustry model, referencing 26 producing sectors and is, to our knowledge, the most disaggregate dynamic interindustry model for Thailand that is currently available. It is also the first dynamic interindustry model to offer the optimization capability. Quite simply, the benefits from TIDY are significant. The model is able to conduct sectoral forecasts and policy designs in various applications beneficial to both government and corporate business.

Still, TIDY has weaknesses. Several extensions of this research should be undertaken to improve the model.

First, in order to gain a better understanding of consumer behavior, certain improvements need to be made in the estimation for private consumption expenditure. Particularly, the use of total income series and nation-wide consumption series could be misleading if income is not well-distributed among the Thai population. In addition, consumers in different age groups could also unevenly allocate their expenditure shares. Poor consumers place greater emphasis with basic necessities, while wealthy consumers spend more money on luxury items. Young consumers spend more money on education, while elder consumer spends more on their health. It is of particular interest to conduct estimations regarding different ranges of income class and age. Incorporating the demographic effects in the demand system helps the model capture the effects from various policy changes more accurately. Bardazzi and Barnabani (2001) show an example of such benefits in a work of the Italian model.

Second, the investment function can also be improved. The current investment equation relies on an accelerator model where the cost of capital does not enter into business investment decisions. The benefit from such an extension is obvious - it takes into account the effect from supply side in investment decisions. Meade (1990) has shown that various investment models that include cost of capital in the function form did not perform well in the U.S. interindustry model. Therefore, finding a more appropriate model of the investment equations is not an easy task.

Further study to examine negative trends in sectoral labor productivity is required. There is also room to improve the productivity function. When the data is available, labor productivity may be redefined into average output per hour. This redefinition is much more helpful as numbers of working hours significantly change over time. In fact, this is actually happening in Thai labor market. Aggregate data suggests that the average working hours per week have been decreasing in recent years.

In addition, the functional form for productivity could be less restrictive. Labor productivity is mainly explained by the business cycle; however, effects from economic upturn and economic downturn can be different. Such specification is proved to be beneficial in the U.S. and the Spanish models. These extensions may also be applied to the TIDY when more data is available for Thailand.

Lastly, international trade, that consists of exports and imports, should be modeled properly. This is currently the weakest part of the TIDY and is a top priority on the extension lists. Currently, imports are simple linear functions of gross output. Exports are completely exogenous and are assumed to grow at 4.0 to 4.5 percent per year in real terms.

Although net exports account for only the small part of GDP, their importance has grown in recent years. Since the inception of the ASEAN Free Trade Agreement (AFTA) in Southeast Asian countries, international trade has become an important part of Thai economic growth. Its role could be more significant in the future as Thailand is now aiming to establish free trade agreements with the U.S. and China. International trade should become a major contribution to economic growth in the future.

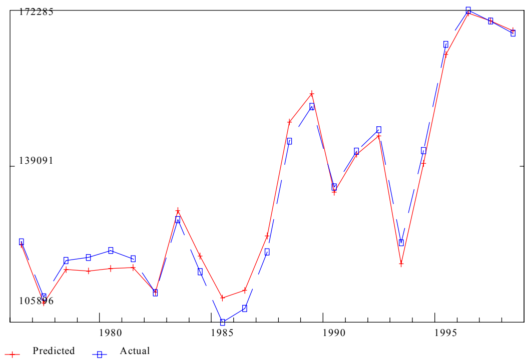
In spite of its importance, modeling the international part of a model is nontrivial. Imports and exports of a country relate to several external factors, such as foreign demands and relative prices. A construction of the international trade model may involve extensive works and is certainly beyond the objective of the present study. Having said that, we have left it for a near future extension. The promising way is to connect TIDY with the *INFORUM* Bilateral Trade Model (BTM) constructed by Ma (1996).

It seems that there are plenty of room to improve and complete TIDY. Not complete but sufficient, TIDY is the first interindustry dynamic model for Thailand, and it is also the first model that incorporates optimization. In all, I shall close with observation from Margaret B. McCarthy, one of the most experienced interindustry model builders, “There is no completely built economic model”. It appears that building an empirical economic model is an unfinished job.

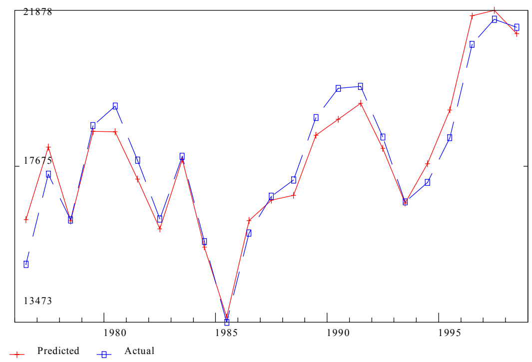
APPENDIX A: REGRESSION FITS FOR THE VALUE-ADDED

1. PROFIT

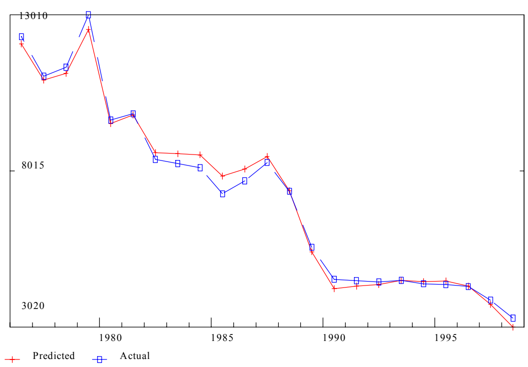
1.Crops



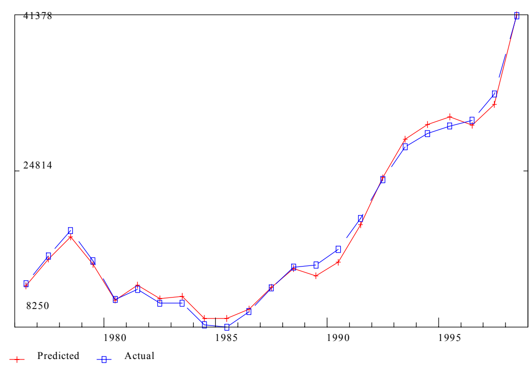
2.Livestock



3.Forestry

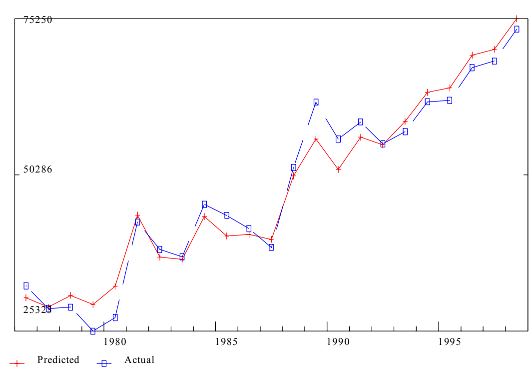


4.Fishery

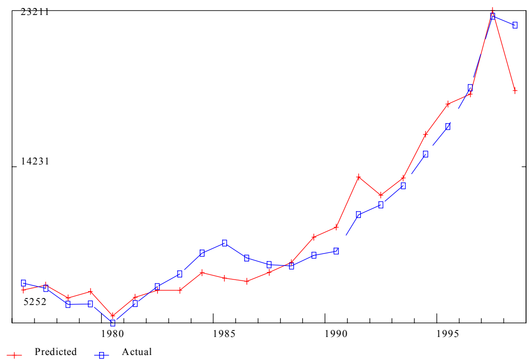


5.Mining and Quarrying

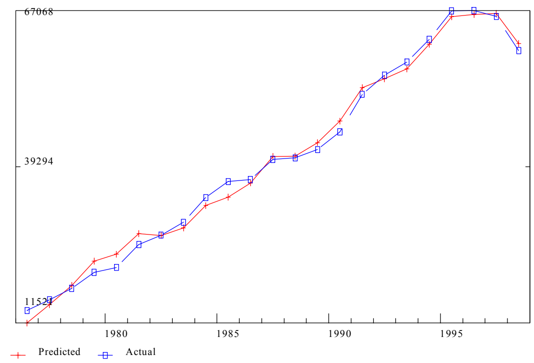
6.Food Manufacturing



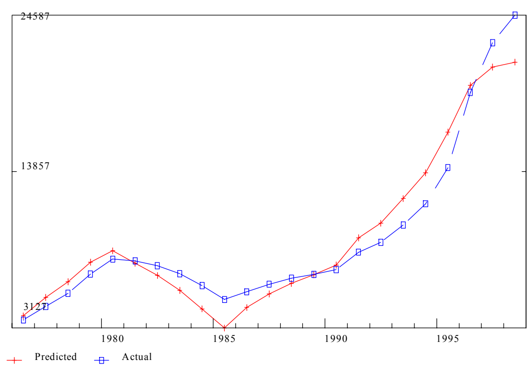
7.Beverages and Tobacco Products



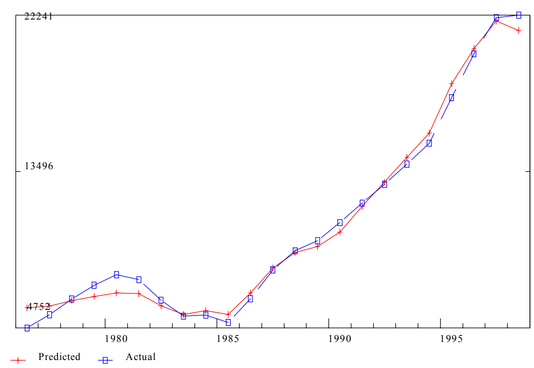
8.Textile Industry



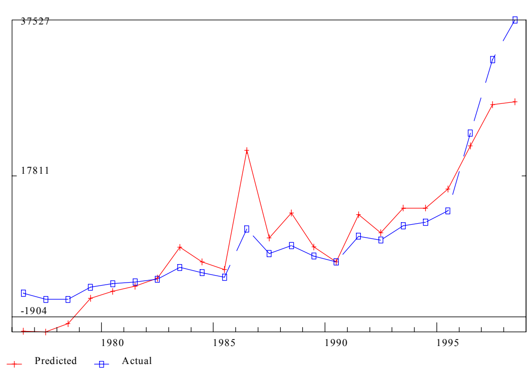
9.Paper Products and Printing



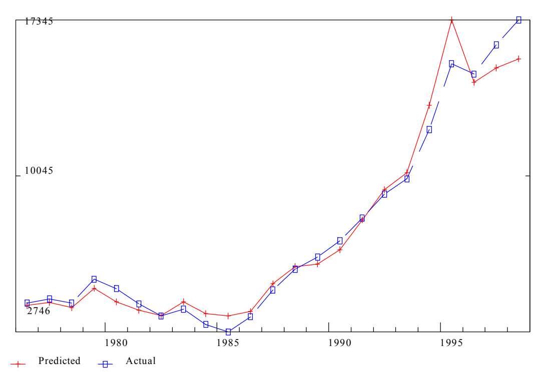
10.Chemical Industries

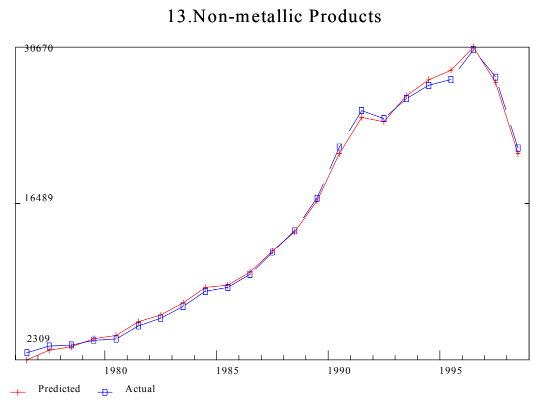


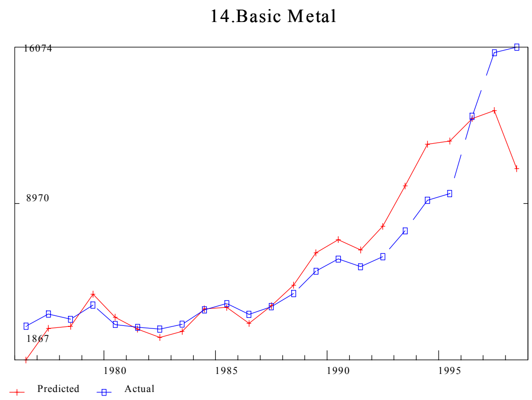
11.Petroleum Refineries

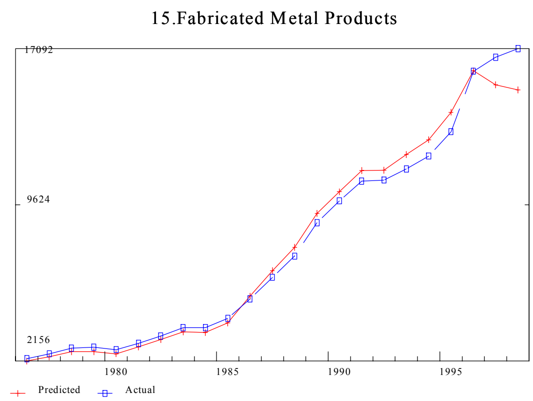


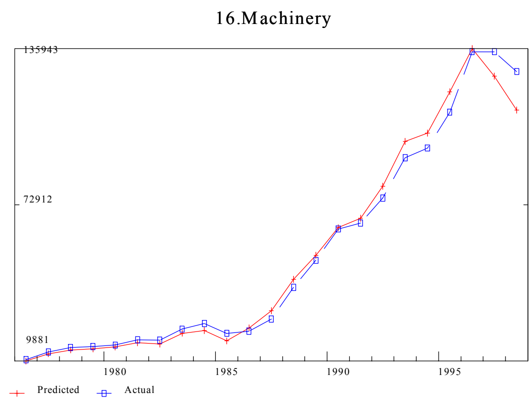
12.Rubber and Plastic Products

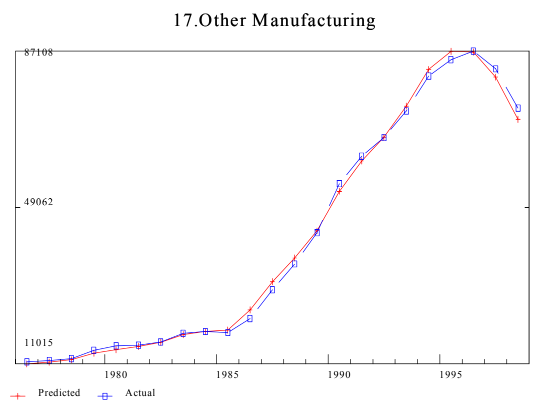


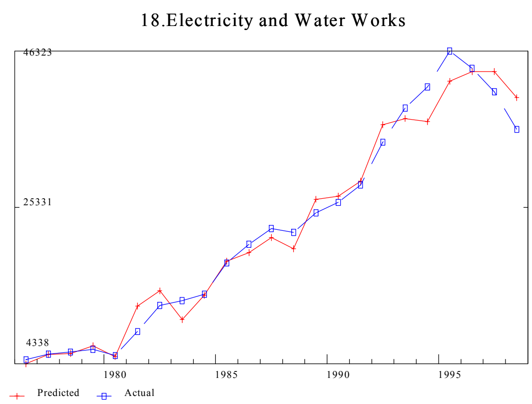

13.Non-metallic Products
30670
16489
2309
1980
1985
1990
1995
Predicted
Actual


14.Basic Metal
16074
8970
1867
1980
1985
1990
1995
Predicted
Actual

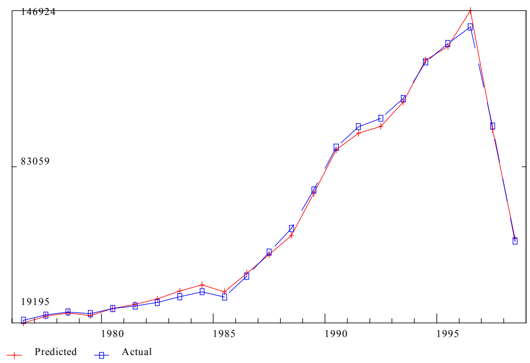

15.Fabricated Metal Products
17092
9624
2156
1980
1985
1990
1995
Predicted
Actual


16.Machinery
135943
72912
9881
1980
1985
1990
1995
Predicted
Actual

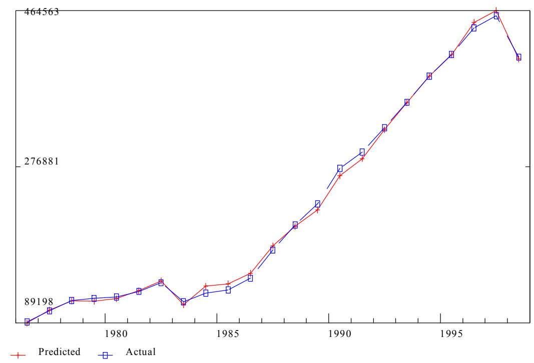

17.Other Manufacturing
87108
49062
11015
1980
1985
1990
1995
Predicted
Actual


18.Electricity and Water Works
46323
25331
4338
1980
1985
1990
1995
Predicted
Actual

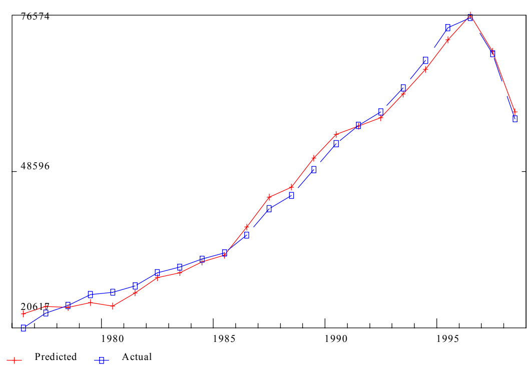
19.Construction



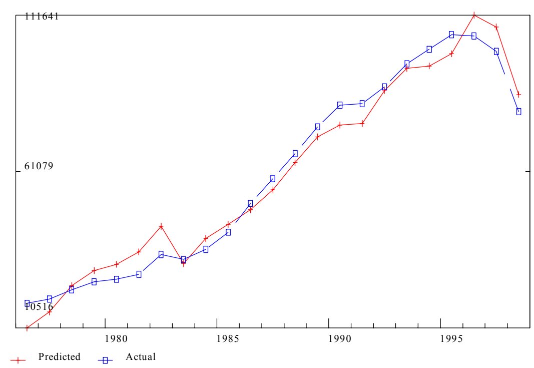
20.Trade



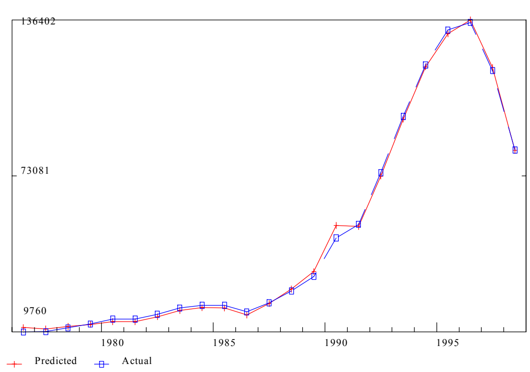
21.Restaurants and Hotels



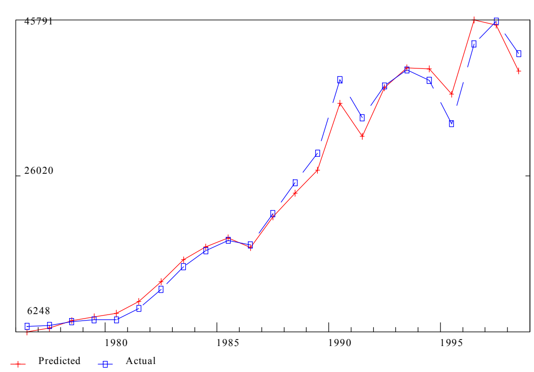
22.Transportation and Communication



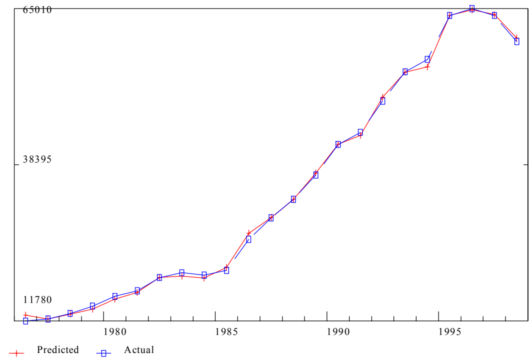
23.Banking and Insurance



24.Real Estate

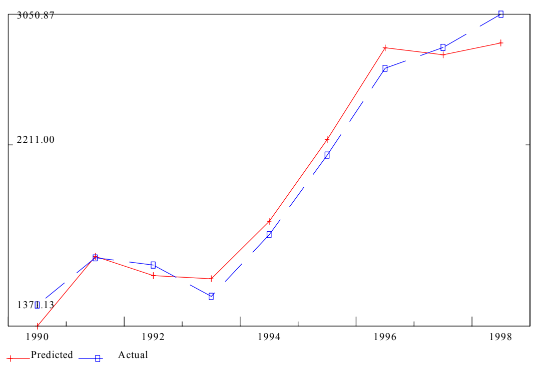


25.Services



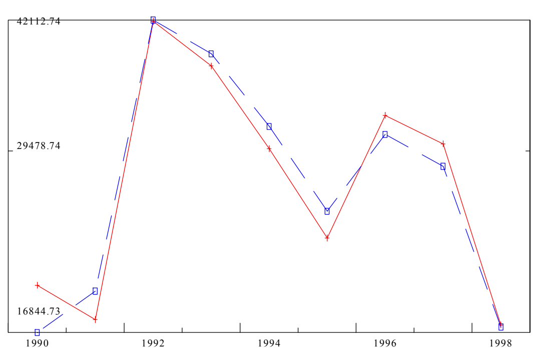
2. WAGE

1.Crops

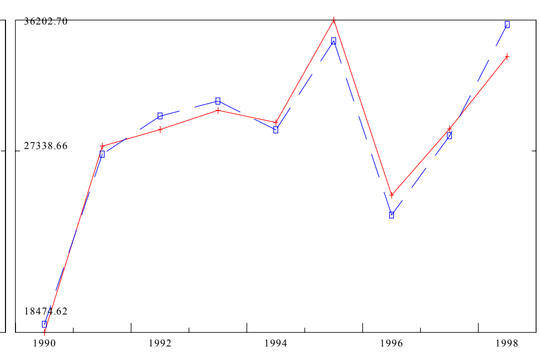


2.Livestock

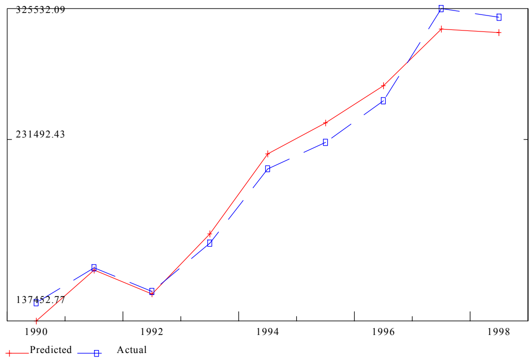
3.Forestry



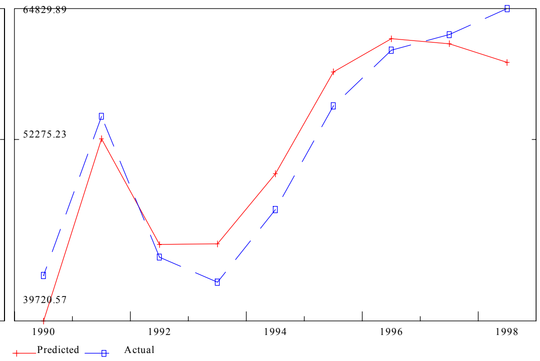
4.Fishery



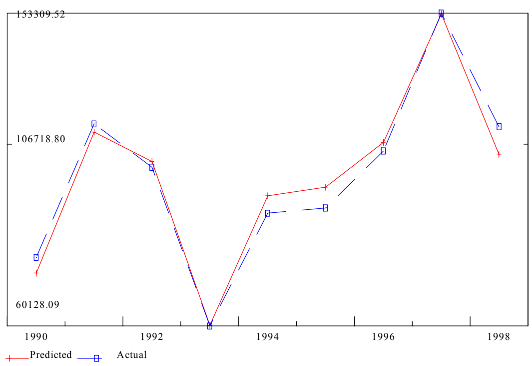
5.Mining and Quarrying



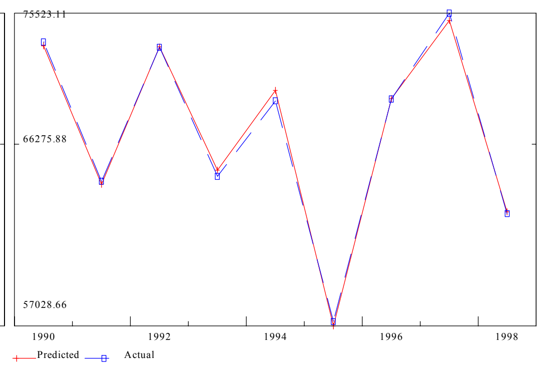
6.Food Manufacturing



7.Beverages and Tobacco Products

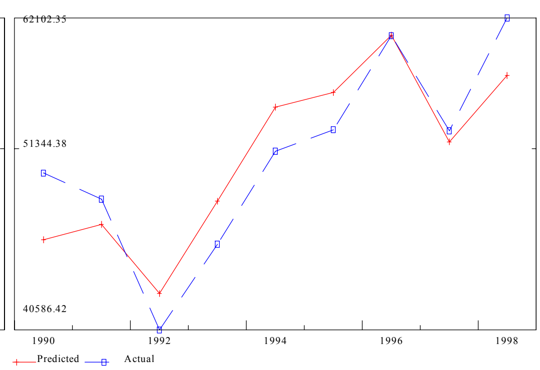


8.Textile Industry



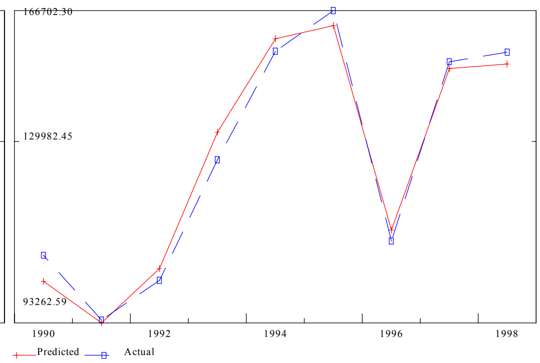
9.Paper Products and Printing

10.Chemical Industries

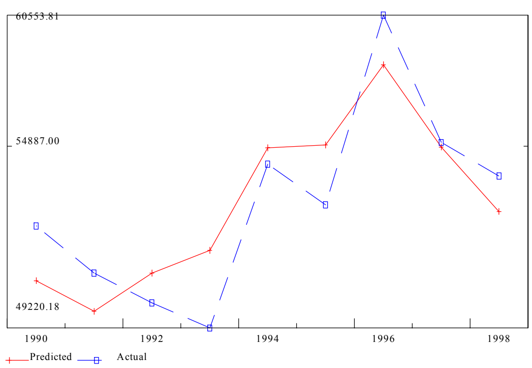


11.Petroleum Refineries

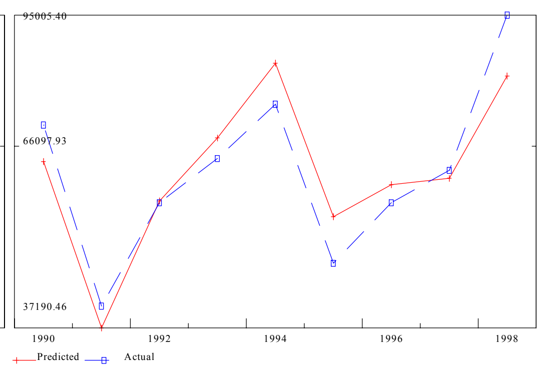
12.Rubber and Plastic Products



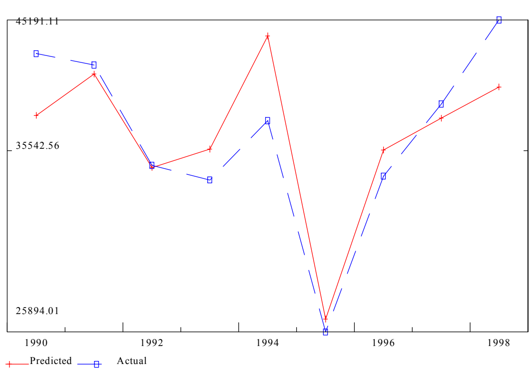
13.Non-metallic Products



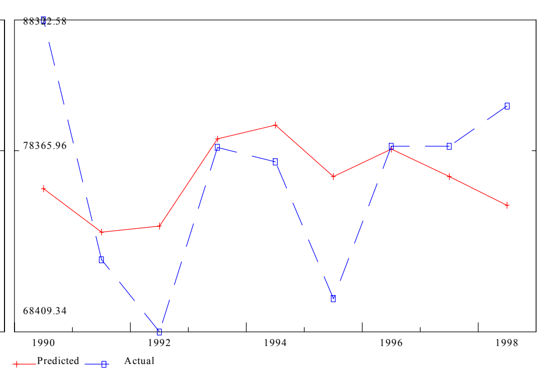
14.Basic Metal



15.Fabricated Metal Products

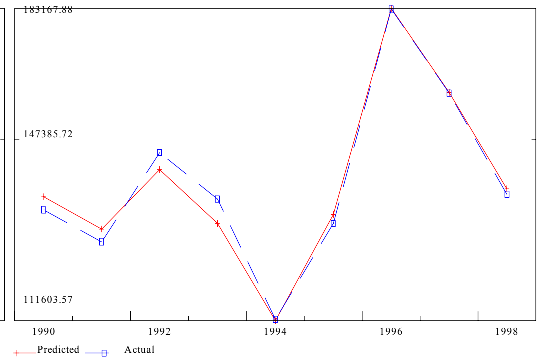


16.Machinery

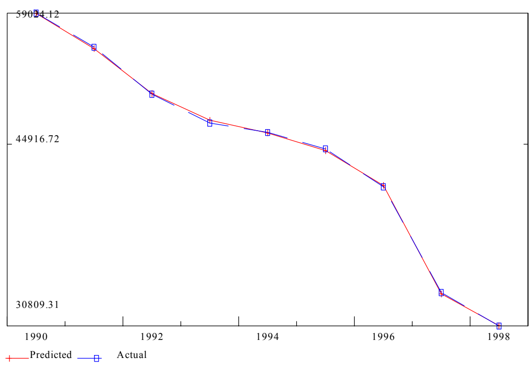


17.Other Manufacturing

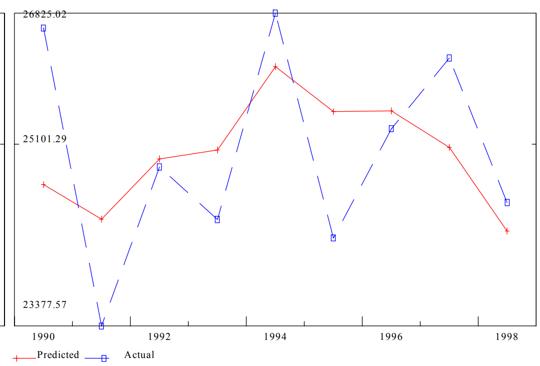
18.Electricity and Water Works



19.Construction

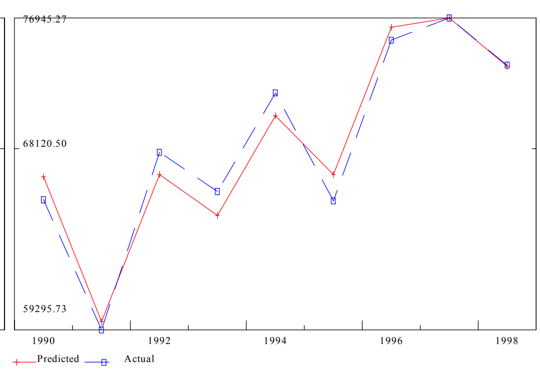


20.Trade

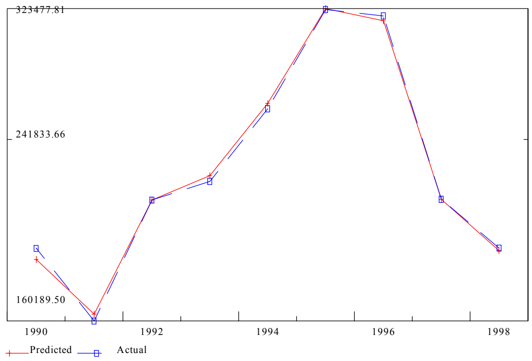


21.Restaurants and Hotels

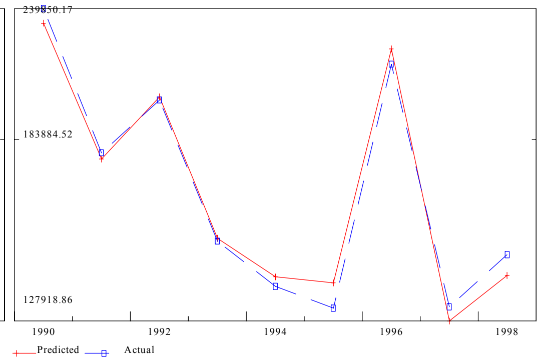
22.Transportation and Communication



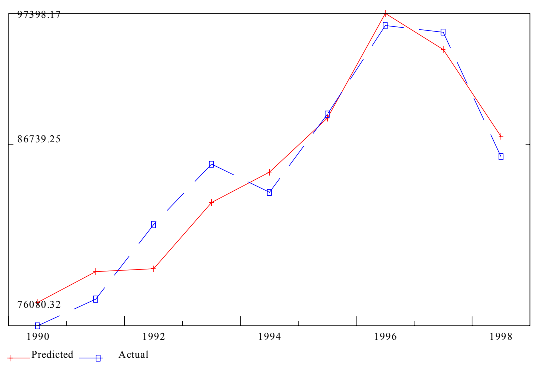
23.Banking and Insurance



24.Real Estate

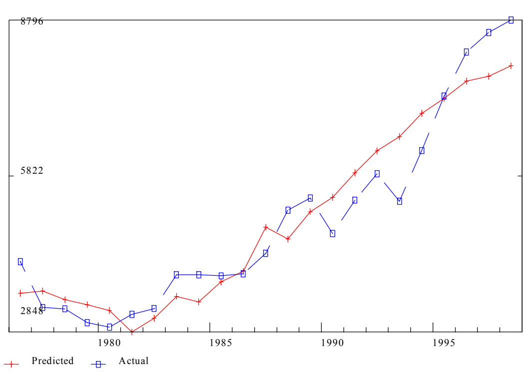


25.Services

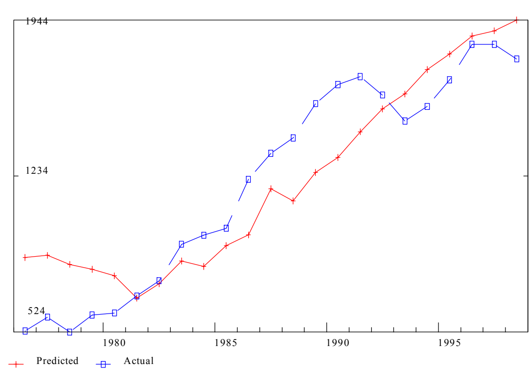


3. DEPRECIATION

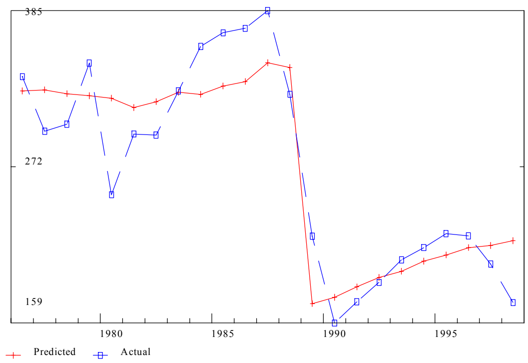
1.Crops



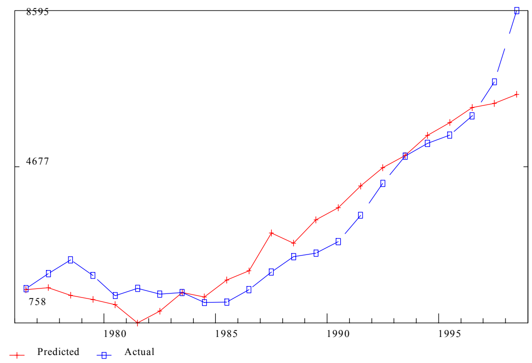
2.Livestock



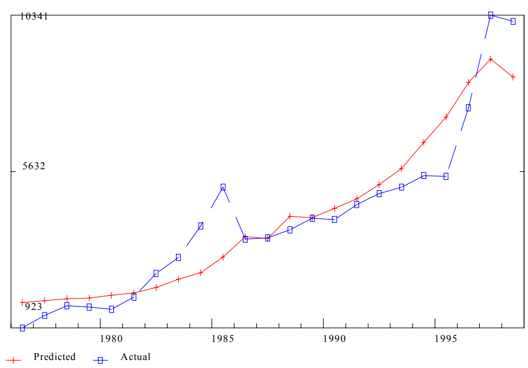
3.Forestry



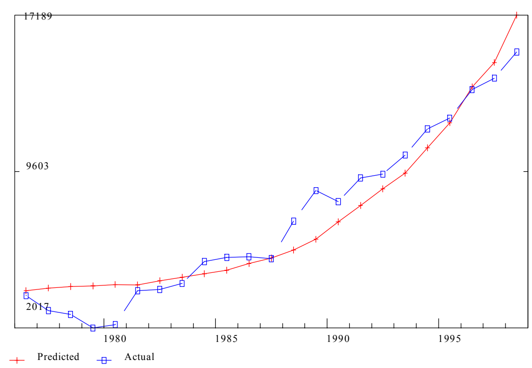
4.Fishery



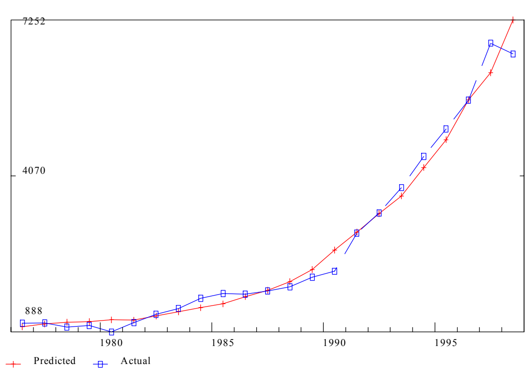
5.Mining and Quarrying



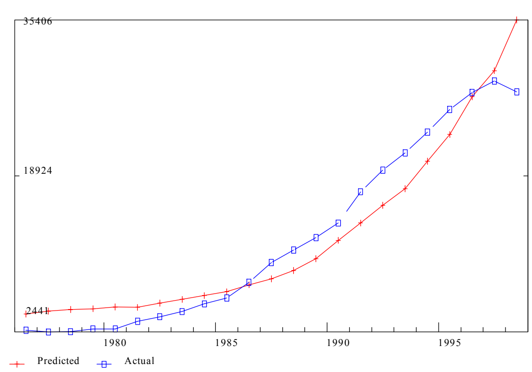
6.Food Manufacturing



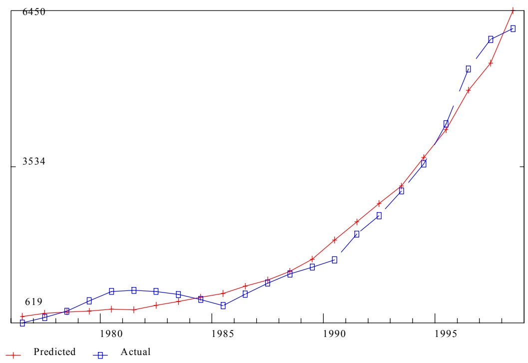
7.Beverages and Tobacco Products



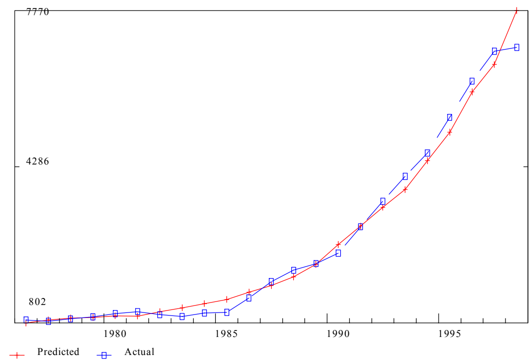
8.Textile Industry



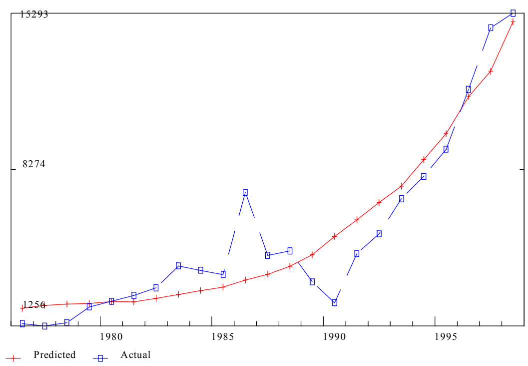
9.Paper Products and Printing



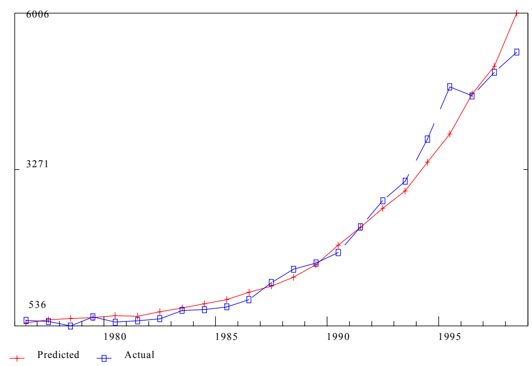
10.Chemical Industries



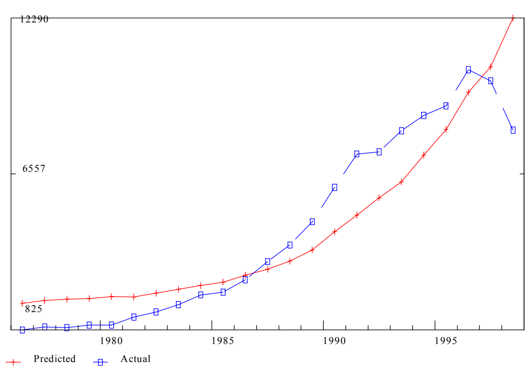
11.Petroleum Refineries



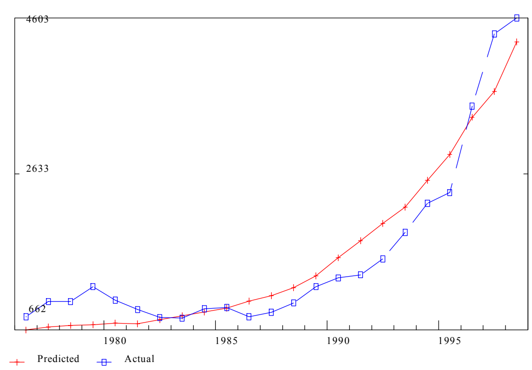
12.Rubber and Plastic Products



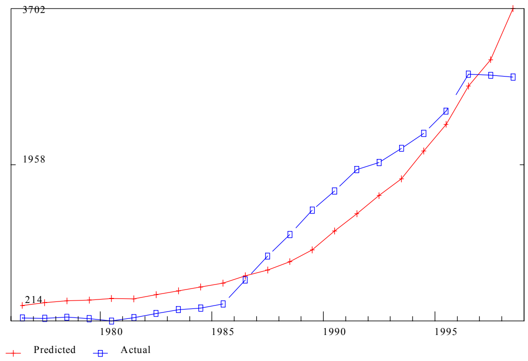
13.Non-metallic Products



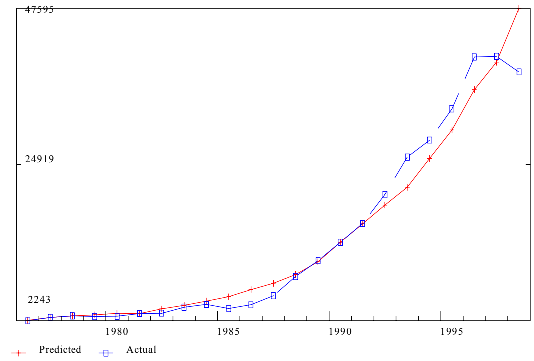
14.Basic Metal



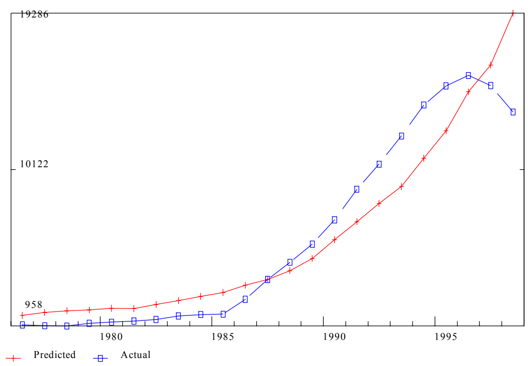
15.Fabricated Metal Products



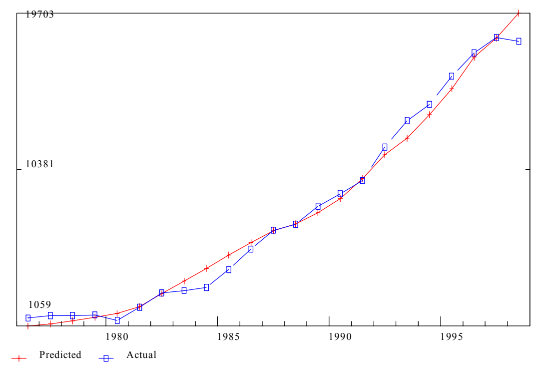
16.Machinery



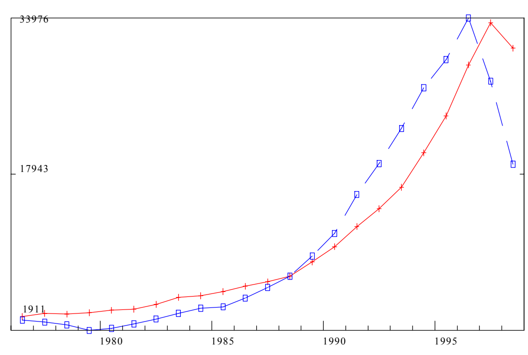
17.Other Manufacturing



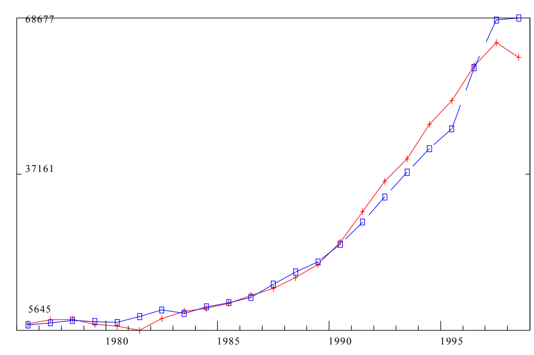
18.Electricity and Water Works



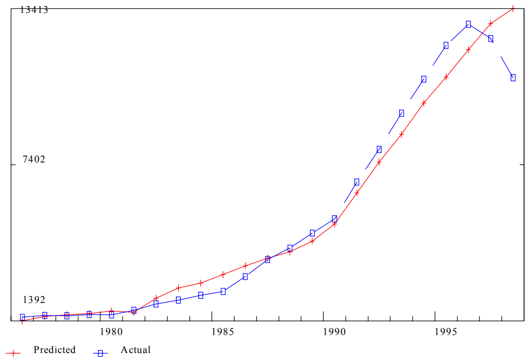
19.Construction



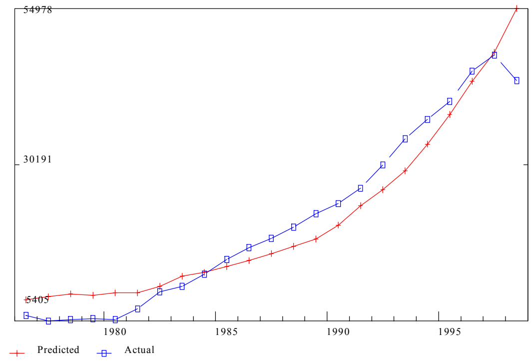
20.Trade



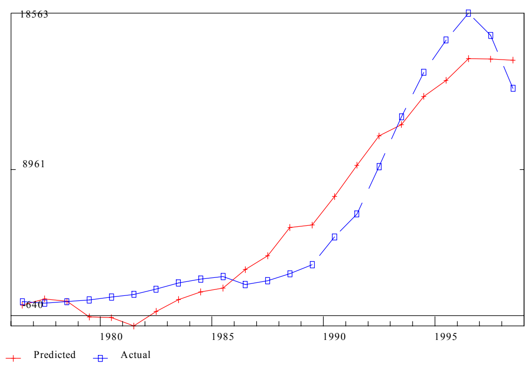
21.Restaurants and Hotels



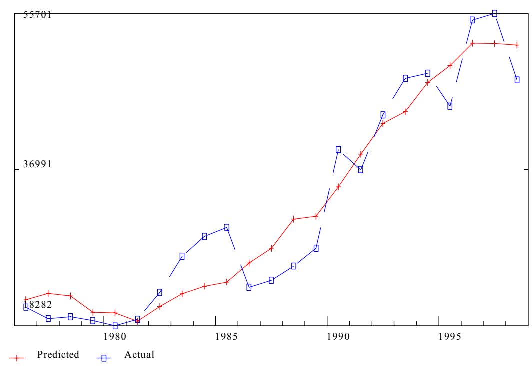
22.Transportation and Communication



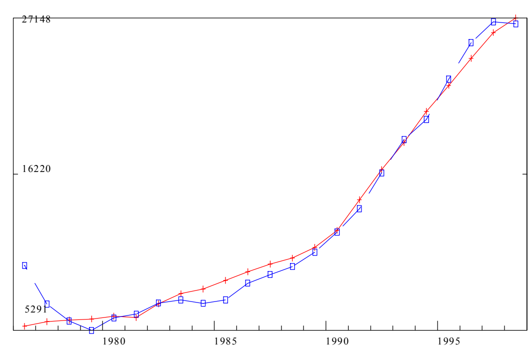
23.Banking and Insurance



24.Real Estate



25.Services



APPENDIX B: THE BASE FORECASTS OF THAILAND TO 2020

Table B-1: Personal consumption Per Capita (Values in 1990 prices, bahts)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Rice & cereals	1306	1318	1324	1325	1332	1338	1349	1418	1480	1535	-0.5	0.4	0.8	1.0	0.8	0.7	0.8
2	Meat	1108	1112	1112	1107	1124	1140	1166	1316	1450	1568	-0.7	1.3	2.3	2.4	1.9	1.6	1.7
3	Fish	373	381	383	382	402	421	449	603	740	860	-0.2	4.4	6.7	5.9	4.1	3.0	4.1
4	Milk,cheese & eggs	524	536	540	498	509	509	532	707	876	1016	-5.0	0.0	4.4	5.7	4.3	3.0	3.2
5	Oil & fat	263	270	273	262	272	279	295	399	499	588	-1.9	2.4	5.6	6.0	4.5	3.3	3.9
6	Fruit & vegetables	1224	1231	1220	1132	1150	1147	1191	1515	1812	2046	-3.7	-0.2	3.7	4.8	3.6	2.4	2.5
7	Sugar,preserves & confectionery	267	273	275	264	271	276	288	370	448	516	-2.2	1.5	4.4	5.0	3.8	2.8	3.2
8	Coffee,tea,cocoa,etc.	87	89	90	86	89	92	97	132	165	195	-2.4	2.4	5.8	6.2	4.5	3.3	3.9
9	Other food	445	453	456	438	438	434	438	486	533	570	-2.8	-1.1	0.9	2.1	1.8	1.3	1.2
10	Non-alcoholic beverages	1041	1049	1043	1011	1055	1089	1159	1553	1903	2192	0.4	3.3	6.2	5.8	4.1	2.8	3.7
11	Alcoholic beverages	1386	1421	1423	1306	1320	1302	1340	1669	1965	2165	-3.3	-1.4	2.9	4.4	3.3	1.9	2.1
12	Tobacco	514	510	500	510	525	543	566	671	755	822	3.6	3.3	4.1	3.4	2.4	1.7	2.4
13	Footwear	235	237	237	219	224	224	235	311	383	440	-2.8	0.2	4.6	5.6	4.1	2.8	3.1
14	Clothing	2699	2704	2676	2731	2877	3042	3254	4293	5207	6016	2.7	5.6	6.7	5.5	3.9	2.9	4.0
15	Other personal effects	290	283	275	301	329	364	402	572	718	852	11.6	10.1	10.0	7.0	4.6	3.4	5.5
16	Rent & water charges	1927	1915	1912	1827	1890	1931	2029	2552	3010	3388	-4.0	2.1	5.0	4.6	3.3	2.4	2.9
17	Fuel & light	612	602	600	577	600	617	653	841	1008	1147	-3.9	2.9	5.6	5.1	3.6	2.6	3.2
18	Furniture & furnishings	520	515	504	545	594	655	724	1032	1300	1546	10.1	9.8	10.0	7.1	4.6	3.5	5.5
19	Households equipment	2003	2018	1998	1917	2010	2087	2241	3089	3812	4382	-0.8	3.7	7.1	6.4	4.2	2.8	3.9
20	Domestic services of household	56	53	51	49	51	54	57	79	100	122	-4.1	4.6	7.1	6.3	4.9	3.8	4.2
21	Other expenditures of household	477	476	473	437	451	456	480	644	804	945	-3.4	1.1	5.2	5.9	4.4	3.2	3.4
22	Personal care	542	544	545	547	568	590	619	772	913	1040	0.7	3.7	4.9	4.4	3.3	2.6	3.2
23	Health expenses	1863	1811	1777	1859	1966	2099	2246	2904	3510	4090	3.8	6.6	6.8	5.1	3.8	3.1	4.1
24	Personal transportation equipment	1237	1154	1087	1348	1492	1704	1885	2469	2900	3302	17.5	13.3	10.1	5.4	3.2	2.6	5.3
25	Operation of private transportation	1215	1269	1272	1217	1269	1311	1401	1938	2424	2831	0.6	3.2	6.7	6.5	4.5	3.1	4.0
26	Purchased transportation	1280	1265	1250	1225	1251	1270	1310	1495	1647	1770	-1.7	1.5	3.1	2.6	1.9	1.4	1.7
27	Communication	594	599	606	590	612	627	656	789	891	962	0.3	2.4	4.5	3.7	2.4	1.5	2.4
28	Entertainment	82	83	85	87	91	95	101	127	155	184	1.6	4.8	5.2	4.7	4.0	3.4	4.0
29	Hotels,restaurants & cafes	2606	2572	2522	2515	2626	2738	2918	3928	4818	5577	-0.1	4.2	6.4	5.9	4.1	2.9	3.9
30	Books,newspapers & magazines	420	424	419	420	433	447	468	575	664	735	3.2	3.1	4.6	4.1	2.9	2.0	2.8
31	Other recreation	785	757	729	700	755	809	902	1441	1970	2444	-2.1	7.0	10.9	9.4	6.2	4.3	5.9
32	Financial services	352	350	344	355	381	410	446	617	770	913	3.7	7.2	8.5	6.5	4.4	3.4	4.8
33	Other services	257	253	249	240	250	258	273	359	440	512	-1.2	3.2	5.8	5.5	4.1	3.0	3.5

Table B-2: Personal consumption Per Capita (Values in current prices, bahts)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Rice & cereals	2075	2166	2296	2399	2512	2616	2741	3413	4247	5225	3.0	4.1	4.7	4.4	4.4	4.1	4.4
2	Meat	1751	1826	1926	2001	2112	2218	2357	3152	4143	5307	3.1	4.9	6.1	5.8	5.5	5.0	5.3
3	Fish	667	678	698	710	770	830	923	1502	2235	3103	0.3	7.5	10.6	9.7	8.0	6.6	7.6
4	Milk,cheese & eggs	829	881	936	899	957	990	1075	1695	2502	3438	-1.2	3.5	8.2	9.1	7.8	6.4	6.8
5	Oil & fat	415	442	471	472	510	540	593	951	1416	1975	1.6	5.8	9.3	9.4	8.0	6.7	7.5
6	Fruit & vegetables	1944	2023	2116	2050	2168	2243	2420	3645	5199	6964	-0.2	3.4	7.6	8.2	7.1	5.8	6.2
7	Sugar,preserves & confectionery	422	447	474	475	508	534	579	882	1272	1732	1.4	4.9	8.2	8.4	7.3	6.2	6.8
8	Coffee,tea,cocoa,etc.	138	146	156	156	169	179	197	318	475	664	1.1	6.0	9.6	9.6	8.0	6.7	7.6
9	Other food	705	743	790	791	825	847	888	1168	1529	1941	0.7	2.6	4.8	5.5	5.4	4.8	4.8
10	Non-alcoholic beverages	1497	1561	1641	1661	1818	1966	2201	3717	5693	8127	4.0	7.8	11.3	10.5	8.5	7.1	8.2
11	Alcoholic beverages	1951	2074	2196	2104	2230	2303	2497	3963	5868	8043	0.3	3.2	8.1	9.2	7.8	6.3	6.8
12	Tobacco	739	759	786	839	906	980	1074	1605	2260	3050	7.1	7.9	9.2	8.0	6.8	6.0	7.0
13	Footwear	342	361	382	367	389	402	436	685	1009	1387	1.2	3.3	8.0	9.0	7.7	6.4	6.7
14	Clothing	4124	4312	4539	4845	5284	5743	6338	9798	14162	19506	6.7	8.3	9.9	8.7	7.4	6.4	7.5
15	Other personal effects	421	429	440	503	569	648	742	1248	1872	2650	15.4	13.1	13.5	10.4	8.1	6.9	9.1
16	Rent & water charges	3021	3218	3387	3328	3485	3583	3821	5736	8265	11200	0.6	2.8	6.4	8.1	7.3	6.1	6.2
17	Fuel & light	892	943	1005	1004	1077	1134	1234	1876	2697	3673	1.0	5.2	8.4	8.4	7.3	6.2	6.8
18	Furniture & furnishings	776	800	829	933	1051	1189	1356	2288	3457	4920	13.8	12.4	13.1	10.5	8.3	7.1	9.1
19	Households equipment	2795	2940	3093	3107	3391	3646	4073	6894	10501	14796	3.2	7.2	11.1	10.5	8.4	6.9	8.1
20	Domestic services of household	91	93	96	98	106	113	125	199	295	412	1.4	6.8	9.9	9.3	7.9	6.7	7.5
21	Other expenditures of household	718	759	806	784	842	882	967	1577	2380	3341	1.4	4.6	9.2	9.8	8.2	6.8	7.4
22	Personal care	820	876	939	991	1073	1150	1255	1888	2692	3668	5.7	7.0	8.7	8.2	7.1	6.2	7.2
23	Health expenses	2816	2914	3062	3368	3711	4096	4553	7101	10353	14431	8.8	9.9	10.6	8.9	7.5	6.6	8.0
24	Personal transportation equipment	1733	1708	1716	2234	2582	3066	3543	5825	8575	12089	22.3	17.2	14.5	9.9	7.7	6.9	9.8
25	Operation of private transportation	1711	1842	1953	1958	2132	2288	2554	4385	6797	9724	3.7	7.1	11.0	10.8	8.8	7.2	8.3
26	Purchased transportation	1730	1819	1931	1996	2135	2263	2450	3670	5267	7209	3.9	5.9	7.9	8.1	7.2	6.3	6.9
27	Communication	832	887	957	978	1060	1128	1233	1861	2633	3520	5.1	6.3	8.9	8.2	6.9	5.8	6.9
28	Entertainment	134	147	162	174	189	202	219	322	456	624	7.1	7.0	7.9	7.7	7.0	6.2	7.2
29	Hotels,restaurants & cafes	4138	4299	4489	4701	5153	5603	6249	10245	15307	21416	4.5	8.4	10.9	9.9	8.0	6.7	8.0
30	Books,newspapers & magazines	596	614	641	678	737	800	885	1397	2051	2853	6.0	8.2	10.1	9.1	7.7	6.6	7.7
31	Other recreation	1169	1189	1217	1220	1361	1501	1730	3254	5275	7754	2.2	9.8	14.2	12.6	9.7	7.7	9.4
32	Financial services	524	543	568	616	691	773	881	1522	2312	3251	7.9	11.2	13.1	10.9	8.4	6.8	8.9
33	Other services	414	441	468	477	513	543	592	906	1292	1737	4.2	5.5	8.7	8.5	7.1	5.9	6.9

Table B-3: Personal consumption (Values in 1990 prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Rice & cereals	81	82	83	84	85	86	87	95	102	109	0.2	1.3	1.7	1.7	1.4	1.2	1.4
2	Meat	68	69	70	70	72	73	76	88	100	111	0.0	2.2	3.2	3.1	2.5	2.1	2.4
3	Fish	23	24	24	24	26	27	29	40	51	61	0.5	5.3	7.5	6.6	4.7	3.5	4.7
4	Milk,cheese & eggs	32	33	34	31	32	33	34	47	60	72	-4.3	0.8	5.3	6.4	4.9	3.5	3.8
5	Oil & fat	16	17	17	17	17	18	19	27	34	42	-1.2	3.2	6.5	6.7	5.1	3.8	4.5
6	Fruit & vegetables	75	77	76	71	73	74	77	102	125	145	-3.0	0.6	4.6	5.5	4.2	2.9	3.2
7	Sugar,preserves & confectionery	16	17	17	17	17	18	19	25	31	37	-1.5	2.4	5.3	5.7	4.4	3.3	3.8
8	Coffee,tea,cocoa,etc.	5	6	6	5	6	6	6	9	11	14	-1.7	3.2	6.6	6.9	5.1	3.8	4.6
9	Other food	27	28	29	28	28	28	28	33	37	40	-2.1	-0.2	1.8	2.8	2.4	1.8	1.8
10	Non-alcoholic beverages	64	65	65	64	67	70	75	104	131	155	1.1	4.1	7.1	6.5	4.7	3.3	4.3
11	Alcoholic beverages	85	88	89	82	84	84	87	112	136	153	-2.6	-0.6	3.8	5.1	3.9	2.4	2.8
12	Tobacco	32	32	31	32	33	35	37	45	52	58	4.3	4.1	5.0	4.1	3.0	2.2	3.0
13	Footwear	15	15	15	14	14	14	15	21	26	31	-2.1	1.1	5.4	6.3	4.7	3.3	3.7
14	Clothing	166	168	168	172	183	195	211	288	360	426	3.4	6.4	7.6	6.2	4.5	3.4	4.6
15	Other personal effects	18	18	17	19	21	23	26	38	50	60	12.3	10.9	10.9	7.7	5.2	3.9	6.2
16	Rent & water charges	119	119	120	115	120	124	131	171	208	240	-3.3	3.0	5.9	5.3	3.9	2.9	3.5
17	Fuel & light	38	37	38	36	38	40	42	56	70	81	-3.2	3.7	6.5	5.8	4.2	3.1	3.9
18	Furniture & furnishings	32	32	32	34	38	42	47	69	90	109	10.8	10.6	10.9	7.8	5.2	4.0	6.1
19	Households equipment	123	126	125	121	128	134	145	207	263	310	-0.1	4.6	8.0	7.1	4.8	3.3	4.5
20	Domestic services of household	3	3	3	3	3	3	4	5	7	9	-3.4	5.5	8.0	7.0	5.5	4.3	4.8
21	Other expenditures of household	29	30	30	28	29	29	31	43	56	67	-2.7	1.9	6.1	6.6	5.0	3.7	4.1
22	Personal care	33	34	34	35	36	38	40	52	63	74	1.4	4.5	5.8	5.1	3.9	3.1	3.9
23	Health expenses	115	113	111	117	125	135	145	195	242	290	4.5	7.4	7.6	5.8	4.4	3.6	4.7
24	Personal transportation equipment	76	72	68	85	95	109	122	166	200	234	18.2	14.1	11.0	6.1	3.8	3.1	5.9
25	Operation of private transportation	75	79	80	77	81	84	91	130	167	200	1.3	4.0	7.5	7.2	5.1	3.6	4.7
26	Purchased transportation	79	79	78	77	80	82	85	100	114	125	-1.0	2.4	4.0	3.3	2.5	1.9	2.3
27	Communication	37	37	38	37	39	40	42	53	62	68	1.0	3.2	5.4	4.4	3.0	2.0	3.0
28	Entertainment	5	5	5	5	6	6	7	9	11	13	2.3	5.6	6.1	5.4	4.6	3.9	4.6
29	Hotels,restaurants & cafes	161	160	158	159	167	176	189	263	333	395	0.6	5.0	7.2	6.6	4.7	3.4	4.5
30	Books,newspapers & magazines	26	26	26	27	28	29	30	39	46	52	3.9	4.0	5.5	4.8	3.5	2.5	3.4
31	Other recreation	48	47	46	44	48	52	58	97	136	173	-1.4	7.8	11.8	10.1	6.8	4.8	6.5
32	Financial services	22	22	22	22	24	26	29	41	53	65	4.4	8.1	9.4	7.2	5.0	3.9	5.4
33	Other services	16	16	16	15	16	17	18	24	30	36	-0.5	4.1	6.7	6.1	4.7	3.5	4.2

Table B-4: Personal consumption (Values in current prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Rice & cereals	128	135	144	151	160	168	178	229	293	370	3.7	4.9	5.5	5.1	5.0	4.6	5.0
2	Meat	108	114	121	126	134	142	153	211	286	376	3.8	5.7	7.0	6.5	6.1	5.5	6.0
3	Fish	41	42	44	45	49	53	60	101	154	220	1.0	8.4	11.5	10.4	8.5	7.1	8.2
4	Milk,cheese & eggs	51	55	59	57	61	64	70	114	173	244	-0.5	4.3	9.1	9.8	8.4	6.9	7.5
5	Oil & fat	26	28	30	30	32	35	38	64	98	140	2.3	6.6	10.2	10.1	8.6	7.2	8.1
6	Fruit & vegetables	120	126	133	129	138	144	157	244	359	493	0.5	4.3	8.5	8.9	7.7	6.3	6.8
7	Sugar,preserves & confectionery	26	28	30	30	32	34	38	59	88	123	2.1	5.8	9.0	9.1	7.9	6.7	7.4
8	Coffee,tea,cocoa,etc.	8	9	10	10	11	11	13	21	33	47	1.8	6.9	10.5	10.2	8.6	7.2	8.2
9	Other food	43	46	49	50	53	54	57	78	106	137	1.4	3.4	5.6	6.2	6.0	5.3	5.4
10	Non-alcoholic beverages	92	97	103	105	116	126	143	249	393	576	4.7	8.7	12.1	11.2	9.1	7.6	8.9
11	Alcoholic beverages	120	129	138	133	142	148	162	266	405	570	1.0	4.0	9.0	9.9	8.4	6.8	7.4
12	Tobacco	46	47	49	53	58	63	70	108	156	216	7.8	8.7	10.0	8.7	7.4	6.5	7.6
13	Footwear	21	22	24	23	25	26	28	46	70	98	1.9	4.1	8.9	9.7	8.3	6.9	7.4
14	Clothing	254	268	284	306	336	369	410	657	978	1381	7.4	9.2	10.7	9.4	8.0	6.9	8.2
15	Other personal effects	26	27	28	32	36	42	48	84	129	188	16.1	13.9	14.4	11.1	8.7	7.5	9.8
16	Rent & water charges	186	200	212	210	222	230	247	385	571	793	1.3	3.6	7.3	8.8	7.9	6.6	6.9
17	Fuel & light	55	59	63	63	69	73	80	126	186	260	1.7	6.0	9.3	9.1	7.9	6.7	7.4
18	Furniture & furnishings	48	50	52	59	67	76	88	153	239	348	14.5	13.2	14.0	11.2	8.8	7.6	9.7
19	Households equipment	172	183	194	196	216	234	264	462	725	1048	3.9	8.1	12.0	11.2	9.0	7.4	8.7
20	Domestic services of household	6	6	6	6	7	7	8	13	20	29	2.1	7.7	10.8	10.0	8.5	7.2	8.1
21	Other expenditures of household	44	47	51	50	54	57	63	106	164	237	2.1	5.4	10.1	10.5	8.8	7.3	8.1
22	Personal care	51	54	59	63	68	74	81	127	186	260	6.4	7.9	9.6	8.9	7.7	6.7	7.8
23	Health expenses	174	181	192	213	236	263	295	476	715	1022	9.5	10.7	11.4	9.6	8.1	7.1	8.6
24	Personal transportation equipment	107	106	108	141	164	197	229	391	592	856	23.0	18.0	15.3	10.6	8.3	7.4	10.4
25	Operation of private transportation	105	115	122	124	136	147	165	294	469	689	4.4	7.9	11.9	11.5	9.4	7.7	9.0
26	Purchased transportation	107	113	121	126	136	145	159	246	364	511	4.6	6.7	8.8	8.8	7.8	6.8	7.5
27	Communication	51	55	60	62	67	72	80	125	182	249	5.8	7.1	9.7	8.9	7.5	6.3	7.5
28	Entertainment	8	9	10	11	12	13	14	22	32	44	7.8	7.8	8.8	8.4	7.6	6.7	7.9
29	Hotels,restaurants & cafes	255	268	281	297	328	360	405	687	1057	1517	5.2	9.2	11.8	10.6	8.6	7.2	8.7
30	Books,newspapers & magazines	37	38	40	43	47	51	57	94	142	202	6.7	9.1	10.9	9.8	8.3	7.1	8.3
31	Other recreation	72	74	76	77	87	96	112	218	364	549	2.9	10.6	15.0	13.3	10.3	8.2	10.0
32	Financial services	32	34	36	39	44	50	57	102	160	230	8.6	12.1	14.0	11.6	9.0	7.3	9.6
33	Other services	26	27	29	30	33	35	38	61	89	123	4.9	6.4	9.5	9.2	7.7	6.4	7.5

Table B-5: Gross fixed investment (Values in 1990 prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Agriculture	24	25	29	38	49	55	60	91	109	130	28.9	11.7	8.5	8.5	3.6	3.4	8.2
2	Mining & quarrying	8	10	12	14	16	18	20	30	36	42	34.6	9.3	8.1	8.8	3.5	2.9	7.3
3	Manufacturing	237	276	291	327	362	401	425	561	711	874	8.3	10.2	5.8	5.6	4.7	4.1	5.8
4	Construction	7	17	19	27	36	39	46	79	105	126	20.9	5.9	17.5	10.9	5.6	3.7	10.2
5	Electricity & water supply	69	74	79	85	94	102	112	171	217	263	0.4	8.6	9.5	8.4	4.8	3.8	6.3
6	Transportation & communication	152	208	230	277	342	358	378	489	607	733	12.6	4.7	5.3	5.1	4.3	3.8	6.3
7	Wholesale & retail trade	27	49	67	97	123	130	139	190	246	304	35.1	5.7	6.5	6.3	5.1	4.3	9.2
8	Banking,insurance & real estate	5	6	6	7	7	10	13	19	24	28	21.2	27.5	31.0	7.3	4.1	3.5	7.8
9	Ownership of dwellings	85	95	104	114	124	134	145	208	287	339	15.8	8.0	7.7	7.3	6.4	3.3	6.4
10	Public administration & defense	14	16	19	20	23	25	27	28	36	41	6.5	10.2	6.1	0.6	5.3	2.4	4.6
11	Services	38	58	75	92	112	129	138	187	225	263	23.9	14.1	7.1	6.1	3.7	3.1	7.5

Table B-6: Gross fixed investment (Values in current prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Agriculture	40	43	52	70	95	111	126	230	333	475	31.5	15.8	12.7	12.1	7.4	7.1	12.0
2	Mining & quarrying	11	13	16	20	25	28	31	56	79	107	36.8	11.7	10.9	11.8	6.9	6.2	10.6
3	Manufacturing	337	406	455	538	621	716	793	1320	2112	3240	12.0	14.2	10.3	10.2	9.4	8.6	10.4
4	Construction	11	25	31	45	61	66	81	172	282	416	23.9	8.0	20.4	15.0	9.9	7.8	14.0
5	Electricity & water supply	99	116	134	149	170	188	210	377	579	844	6.0	10.0	11.4	11.7	8.6	7.5	9.9
6	Transportation & communication	224	331	388	483	617	666	726	1150	1766	2612	18.2	7.6	8.7	9.2	8.6	7.8	10.3
7	Wholesale & retail trade	39	75	109	165	216	237	262	423	643	939	38.8	9.0	10.3	9.5	8.4	7.6	12.6
8	Banking,insurance & real estate	8	9	11	12	14	18	26	46	70	99	25.3	30.3	34.7	11.6	8.2	7.0	11.8
9	Ownership of dwellings	123	143	165	186	207	229	255	451	772	1120	18.8	10.2	10.7	11.4	10.8	7.4	10.3
10	Public administration & defense	23	28	34	39	46	53	58	70	109	145	11.6	13.1	9.5	3.9	8.8	5.7	8.2
11	Services	61	100	139	179	227	269	298	479	680	934	29.1	17.0	10.4	9.5	7.0	6.3	11.1

Table B-7: Inventory change (Values in 1990 prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	3.95	4.53	4.51	4.32	4.77	4.75	5.01	5.38	5.72	6.03	6.2	-0.3	5.2	1.4	1.2	1.1	1.4
2	Livestock	-0.47	-0.26	-0.23	-0.23	-0.03	-0.04	0.07	0.55	0.91	1.32	-50.7	12.7	-0.0	40.4	10.2	7.4	-0.0
3	Forestry	-0.29	-0.31	-0.30	-0.25	-0.20	-0.15	-0.10	0.06	0.14	0.18	-43.6	-29.9	-42.5	-0.0	17.3	4.6	-0.0
4	Fishery	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
5	Mining and quarrying	-1.26	0.60	0.56	0.50	0.58	0.66	0.74	0.95	1.21	1.33	-0.0	12.5	10.9	5.0	4.9	1.8	4.0
6	Food manufacturing	5.21	2.91	0.26	0.49	0.35	-0.20	-0.26	0.06	0.61	1.04	-0.0	-0.0	23.7	-0.0	45.3	10.5	-5.2
7	Beverages and tobacco products	0.73	0.45	0.90	1.19	0.28	0.79	0.43	0.80	1.01	1.22	-33.5	103.1	-61.5	12.4	4.7	3.7	4.9
8	Textile industry	2.25	-1.93	-0.04	0.43	-0.03	-0.39	-0.26	0.20	0.62	0.92	-95.1	241.9	-38.8	-0.0	22.7	8.1	-0.0
9	Paper products and printing	-1.04	0.34	-0.05	-0.20	-0.28	-0.12	-0.19	0.15	0.42	0.62	-0.0	-84.0	47.4	-0.0	20.0	7.9	3.0
10	Chemical industries	1.88	0.09	0.79	0.69	0.54	0.21	0.23	0.16	0.22	0.34	-0.0	-93.0	6.0	-7.3	6.7	8.7	6.9
11	Petroleum refineries	1.55	1.43	1.27	1.39	1.40	1.19	1.18	1.15	1.25	1.35	4.7	-16.3	-1.1	-0.4	1.7	1.5	-0.3
12	Rubber and plastic products	2.61	1.92	1.65	1.59	1.52	1.45	1.44	1.26	1.34	1.31	-23.9	-5.1	-0.8	-2.6	1.1	-0.3	-1.9
13	Non-metallic products	1.39	1.21	1.16	0.92	0.78	0.88	0.94	0.93	1.04	0.98	-31.6	12.5	6.4	-0.2	2.1	-1.2	-1.1
14	Basic metal	0.88	2.72	2.69	2.51	2.53	2.53	2.59	2.71	2.82	2.89	29.1	0.1	2.1	0.9	0.8	0.5	0.3
15	Fabricated metal products	2.71	2.18	1.00	1.47	1.39	1.03	1.41	1.33	1.44	1.41	-13.9	-29.6	31.1	-1.2	1.6	-0.5	-2.2
16	Machinery	3.50	12.63	15.02	15.13	16.56	16.59	15.60	13.53	13.51	12.44	-0.0	0.2	-6.2	-2.8	0.0	-1.6	-0.1
17	Other manufacturing	12.38	14.06	14.43	14.00	13.80	14.54	14.24	13.47	14.27	13.73	-18.5	5.3	-2.1	-1.1	1.2	-0.8	-0.1
18	Electricity and water works	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
19	Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
20	Trade	1.03	3.95	5.69	4.83	5.48	6.80	6.16	7.03	7.20	6.87	5.1	21.6	-9.9	2.6	0.5	-0.9	2.8
21	Restaurants and hotels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
22	Transportation and communication	0.00	0.07	0.10	0.09	0.06	0.10	0.09	0.14	0.18	0.20	-24.2	49.6	-15.1	8.7	5.0	2.8	5.4
23	Banking and insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
24	Real estate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
25	Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
26	Unclassified	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0

Table B-8: Inventory change (Values in current prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	6.45	7.58	7.99	8.05	9.34	9.75	10.72	13.60	17.39	22.04	9.4	4.2	9.5	4.8	4.9	4.7	5.3
2	Livestock	-0.75	-0.43	-0.40	-0.42	-0.06	-0.07	0.15	1.35	2.69	4.62	-45.5	16.6	-0.0	43.8	13.8	10.8	-0.0
3	Forestry	-0.41	-0.43	-0.43	-0.35	-0.29	-0.21	-0.14	0.12	0.37	0.58	-44.5	-31.1	-40.9	-0.0	22.8	8.9	-0.0
4	Fishery	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
5	Mining and quarrying	-1.67	0.80	0.79	0.72	0.88	1.02	1.16	1.73	2.60	3.35	-0.0	14.8	13.5	7.9	8.2	5.0	7.2
6	Food manufacturing	8.62	4.93	0.47	0.92	0.67	-0.41	-0.54	0.16	1.82	3.63	-0.0	-0.0	27.6	-0.0	48.8	13.8	-1.5
7	Beverages and tobacco products	1.00	0.64	1.34	1.85	0.46	1.38	0.79	1.94	3.17	4.84	-30.3	108.5	-55.4	18.0	9.8	8.5	10.1
8	Textile industry	3.48	-3.11	-0.07	0.77	-0.06	-0.74	-0.51	0.45	1.68	3.01	-91.3	244.6	-35.9	-0.0	26.2	11.6	-0.0
9	Paper products and printing	-1.45	0.47	-0.07	-0.32	-0.46	-0.21	-0.36	0.38	1.36	2.58	-0.0	-78.1	53.7	-0.0	25.3	12.8	8.5
10	Chemical industries	2.73	0.13	1.31	1.22	1.00	0.42	0.46	0.42	0.75	1.48	-0.0	-88.1	11.2	-2.2	11.8	13.5	12.1
11	Petroleum refineries	2.11	1.91	1.75	1.99	2.09	1.84	1.89	2.22	2.92	3.81	4.0	-12.7	2.7	3.2	5.5	5.3	3.5
12	Rubber and plastic products	3.87	2.99	2.76	2.81	2.84	2.82	2.94	3.26	4.33	5.31	-18.7	-0.5	4.1	2.0	5.7	4.1	2.9
13	Non-metallic products	1.94	1.74	1.76	1.42	1.23	1.43	1.57	1.89	2.60	3.00	-27.2	14.8	9.4	3.8	6.4	2.9	2.7
14	Basic metal	1.00	3.17	3.35	3.31	3.49	3.63	3.88	5.12	6.74	8.66	31.7	3.9	6.5	5.6	5.5	5.0	5.0
15	Fabricated metal products	3.38	2.75	1.34	2.07	2.03	1.56	2.22	2.65	3.62	4.43	-12.1	-26.1	35.2	3.5	6.3	4.0	2.4
16	Machinery	4.55	17.39	22.34	23.93	27.63	29.10	28.89	33.70	44.49	52.70	-0.0	5.2	-0.7	3.1	5.6	3.4	5.5
17	Other manufacturing	17.77	20.97	22.75	22.98	23.42	25.41	25.72	28.66	36.27	41.72	-15.0	8.2	1.2	2.2	4.7	2.8	3.4
18	Electricity and water works	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
19	Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
20	Trade	1.51	6.10	9.27	8.21	9.68	12.41	11.67	15.62	18.83	21.18	8.9	24.8	-6.2	5.8	3.7	2.3	6.2
21	Restaurants and hotels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
22	Transportation and communication	0.00	0.11	0.17	0.15	0.11	0.19	0.17	0.33	0.52	0.73	-18.6	52.5	-11.8	12.7	9.2	6.9	9.4
23	Banking and insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
24	Real estate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
25	Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
26	Unclassified	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0

Table B-9: Government expenditure (Values in 1990 prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	0.18	0.19	0.19	0.20	0.20	0.21	0.21	0.24	0.28	0.31	2.5	2.5	2.5	2.5	2.5	2.5	2.5
2	Livestock	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.09	0.11	0.12	2.5	2.5	2.5	2.5	2.5	2.5	2.5
3	Forestry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
4	Fishery	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	2.5	2.5	2.5	2.5	2.5	2.5	2.5
5	Mining and quarrying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
6	Food manufacturing	4.17	4.28	4.38	4.50	4.61	4.73	4.85	5.49	6.22	7.05	2.5	2.5	2.5	2.5	2.5	2.5	2.5
7	Beverages and tobacco products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.5	2.5	2.5	2.5	2.5	2.5	2.5
8	Textile industry	0.10	0.10	0.10	0.11	0.11	0.11	0.12	0.13	0.15	0.17	2.5	2.5	2.5	2.5	2.5	2.5	2.5
9	Paper products and printing	4.21	4.31	4.42	4.53	4.65	4.77	4.89	5.54	6.28	7.11	2.5	2.5	2.5	2.5	2.5	2.5	2.5
10	Chemical industries	0.60	0.61	0.63	0.64	0.66	0.68	0.69	0.79	0.89	1.01	2.5	2.5	2.5	2.5	2.5	2.5	2.5
11	Petroleum refineries	6.77	6.94	7.11	7.29	7.48	7.67	7.86	8.91	10.10	11.44	2.5	2.5	2.5	2.5	2.5	2.5	2.5
12	Rubber and plastic products	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13	Non-metallic products	0.68	0.70	0.72	0.74	0.76	0.78	0.80	0.90	1.02	1.16	2.5	2.5	2.5	2.5	2.5	2.5	2.5
14	Basic metal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.5	2.5	2.5	2.5	2.5	2.5	2.5
15	Fabricated metal products	0.19	0.19	0.20	0.20	0.21	0.21	0.22	0.24	0.28	0.31	2.5	2.5	2.5	2.5	2.5	2.5	2.5
16	Machinery	7.37	7.56	7.75	7.94	8.15	8.35	8.56	9.70	11.00	12.46	2.5	2.5	2.5	2.5	2.5	2.5	2.5
17	Other manufacturing	2.15	2.20	2.26	2.32	2.38	2.44	2.50	2.83	3.21	3.63	2.5	2.5	2.5	2.5	2.5	2.5	2.5
18	Electricity and water works	6.29	6.45	6.61	6.78	6.95	7.12	7.30	8.28	9.38	10.63	2.5	2.5	2.5	2.5	2.5	2.5	2.5
19	Construction	0.30	0.31	0.32	0.33	0.34	0.34	0.35	0.40	0.45	0.51	2.5	2.5	2.5	2.5	2.5	2.5	2.5
20	Trade	5.29	5.43	5.56	5.70	5.85	6.00	6.15	6.97	7.90	8.95	2.5	2.5	2.5	2.5	2.5	2.5	2.5
21	Restaurants and hotels	3.23	3.31	3.40	3.48	3.57	3.66	3.76	4.26	4.82	5.47	2.5	2.5	2.5	2.5	2.5	2.5	2.5
22	Transportation and communication	7.27	7.45	7.64	7.84	8.03	8.24	8.45	9.57	10.84	12.29	2.5	2.5	2.5	2.5	2.5	2.5	2.5
23	Banking and insurance	0.60	0.62	0.64	0.65	0.67	0.69	0.70	0.80	0.90	1.02	2.5	2.5	2.5	2.5	2.5	2.5	2.5
24	Real estate	0.68	0.70	0.72	0.73	0.75	0.77	0.79	0.90	1.02	1.15	2.5	2.5	2.5	2.5	2.5	2.5	2.5
25	Services	303	311	319	327	335	344	352	399	452	512	2.5	2.5	2.5	2.5	2.5	2.5	2.5
26	Unclassified	7.74	7.93	8.13	8.34	8.55	8.77	8.99	10.19	11.54	13.08	2.5	2.5	2.5	2.5	2.5	2.5	2.5

Table B-10: Government expenditure (Values in current prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	0.30	0.32	0.34	0.37	0.40	0.43	0.46	0.62	0.84	1.14	5.7	7.1	6.8	5.8	6.2	6.2	6.4
2	Livestock	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.23	0.32	0.43	7.7	6.4	6.5	5.9	6.1	6.0	6.2
3	Forestry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
4	Fishery	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.04	0.05	0.07	0.8	5.3	6.6	6.7	6.6	6.2	6.0
5	Mining and quarrying	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
6	Food manufacturing	6.90	7.25	7.83	8.38	8.95	9.52	10.15	13.65	18.45	24.67	5.6	6.2	6.4	5.9	6.0	5.8	6.1
7	Beverages and tobacco products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.8	7.9	8.5	8.1	7.6	7.3	7.7
8	Textile industry	0.15	0.16	0.18	0.19	0.21	0.22	0.23	0.30	0.41	0.55	6.4	5.1	5.4	5.6	6.0	6.0	6.0
9	Paper products and printing	5.88	6.06	6.56	7.12	7.76	8.45	9.22	13.85	20.42	29.60	4.6	8.4	8.8	8.1	7.8	7.4	7.9
10	Chemical industries	0.87	0.94	1.04	1.13	1.23	1.32	1.43	2.09	3.06	4.40	8.1	7.4	7.7	7.6	7.6	7.3	7.7
11	Petroleum refineries	9.21	9.24	9.81	10.45	11.16	11.86	12.63	17.16	23.58	32.37	1.9	6.1	6.3	6.1	6.4	6.3	6.3
12	Rubber and plastic products	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.04	0.06	0.08	7.6	7.1	7.4	7.1	7.1	6.9	7.3
13	Non-metallic products	0.95	1.01	1.09	1.14	1.20	1.26	1.33	1.83	2.56	3.56	6.9	4.8	5.5	6.4	6.7	6.6	6.3
14	Basic metal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.1	6.4	7.0	7.1	7.2	7.0	7.2
15	Fabricated metal products	0.23	0.24	0.26	0.28	0.30	0.32	0.34	0.49	0.70	0.99	4.3	6.0	6.6	7.2	7.2	7.0	7.1
16	Machinery	9.59	10.41	11.53	12.57	13.59	14.65	15.85	24.17	36.21	52.76	8.1	7.5	7.9	8.4	8.1	7.5	8.1
17	Other manufacturing	3.09	3.29	3.56	3.81	4.03	4.26	4.51	6.02	8.15	11.04	6.1	5.4	5.8	5.8	6.0	6.1	6.1
18	Electricity and water works	9.02	10.17	11.29	11.99	12.62	13.11	13.70	18.23	24.95	34.02	8.1	3.9	4.4	5.7	6.3	6.2	6.0
19	Construction	0.45	0.48	0.51	0.54	0.56	0.59	0.62	0.86	1.21	1.69	5.5	4.6	5.4	6.5	6.8	6.6	6.3
20	Trade	7.81	8.38	9.07	9.70	10.33	10.94	11.65	15.47	20.65	27.58	6.2	5.8	6.2	5.7	5.8	5.8	6.0
21	Restaurants and hotels	5.13	5.54	6.05	6.51	7.01	7.50	8.04	11.10	15.32	20.99	7.1	6.7	7.0	6.4	6.4	6.3	6.7
22	Transportation and communication	10.72	11.87	12.91	13.72	14.51	15.32	16.23	22.54	31.57	43.81	8.1	5.4	5.8	6.6	6.7	6.6	6.5
23	Banking and insurance	0.90	0.96	1.05	1.13	1.21	1.29	1.39	1.96	2.71	3.64	6.6	6.5	7.1	7.0	6.4	5.9	6.7
24	Real estate	1.10	1.19	1.27	1.32	1.35	1.38	1.42	1.95	2.75	3.80	6.4	2.0	3.0	6.3	6.9	6.4	5.8
25	Services	493	547	605	655	695	728	768	1011	1329	1738	8.0	4.7	5.3	5.5	5.5	5.4	5.8
26	Unclassified	9.43	10.09	11.12	12.10	13.10	14.11	15.26	22.38	32.56	46.46	4.8	7.4	7.8	7.7	7.5	7.1	7.6

Table B-11: Exports (Values in current prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	32	34	37	41	44	49	53	78	117	173	6.1	8.9	8.8	7.8	8.0	7.8	8.2
2	Livestock	2	3	3	3	3	4	4	6	9	13	8.1	8.3	8.5	7.8	7.9	7.6	8.0
3	Forestry	1	1	1	1	1	1	1	2	3	4	2.0	3.2	6.1	10.6	9.8	8.5	8.4
4	Fishery	1	1	1	1	1	1	1	2	2	3	1.1	7.2	8.6	8.6	8.4	7.8	7.7
5	Mining and quarrying	7	8	8	9	10	10	11	16	23	34	5.1	6.6	7.2	7.4	7.6	7.4	7.4
6	Food manufacturing	352	368	404	439	477	517	563	833	1232	1791	6.0	8.1	8.4	7.9	7.8	7.5	7.9
7	Beverages and tobacco products	4	4	4	5	5	6	6	10	16	26	6.1	9.8	10.5	10.0	9.4	8.9	9.5
8	Textile industry	190	201	223	244	263	283	304	443	654	962	6.7	7.0	7.4	7.5	7.8	7.7	7.8
9	Paper products and printing	20	21	23	25	28	31	35	57	93	146	5.0	10.3	10.8	10.1	9.6	9.1	9.7
10	Chemical industries	64	69	77	85	94	103	114	184	294	459	8.4	9.2	9.7	9.6	9.4	8.9	9.5
11	Petroleum refineries	20	20	22	23	25	27	30	45	67	100	2.2	7.9	8.3	8.1	8.2	8.0	8.1
12	Rubber and plastic products	81	87	98	108	118	129	142	223	348	534	8.0	9.0	9.4	9.0	8.9	8.5	9.1
13	Non-metallic products	30	31	34	36	39	41	45	68	104	157	7.2	6.7	7.5	8.4	8.5	8.3	8.1
14	Basic metal	45	47	53	58	63	69	75	118	185	286	5.5	8.2	9.0	9.1	9.0	8.7	9.0
15	Fabricated metal products	41	43	47	52	56	61	66	104	163	252	4.7	7.9	8.6	9.1	9.0	8.6	8.9
16	Machinery	847	914	1028	1139	1254	1376	1520	2551	4182	6626	8.5	9.3	9.9	10.4	9.9	9.2	9.9
17	Other manufacturing	235	249	274	298	321	345	373	549	812	1197	6.4	7.3	7.8	7.7	7.8	7.7	7.8
18	Electricity and water works	5	6	6	7	8	8	8	12	19	28	8.5	5.7	6.4	7.6	8.1	7.9	7.8
19	Construction	0	0	0	0	0	0	0	1	1	2	5.9	6.5	7.4	8.5	8.6	8.3	8.1
20	Trade	113	121	133	144	156	169	183	268	391	568	6.6	7.6	8.2	7.6	7.6	7.5	7.7
21	Restaurants and hotels	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
22	Transportation and communication	36	40	44	48	51	55	60	91	140	211	8.5	7.3	7.8	8.5	8.5	8.2	8.3
23	Banking and insurance	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
24	Real estate	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
25	Services	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
26	Unclassified	19	20	22	25	27	30	33	53	85	132	5.2	9.3	9.8	9.6	9.3	8.8	9.4

Table B-12: Special exports (Values in current prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	1	1	1	2	2	2	2	3	4	7	6.1	8.9	8.8	7.8	8.0	7.8	8.2
2	Livestock	0	0	0	0	0	0	0	0	0	0	8.1	8.3	8.5	7.8	7.9	7.6	8.0
3	Forestry	0	0	0	0	0	0	0	0	0	0	2.0	3.2	6.1	10.6	9.8	8.5	8.4
4	Fishery	0	0	0	0	0	0	0	0	0	0	1.1	7.2	8.6	8.6	8.4	7.8	7.7
5	Mining and quarrying	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
6	Food manufacturing	7	7	8	9	9	10	11	16	24	35	6.0	8.1	8.4	7.9	7.8	7.5	7.9
7	Beverages and tobacco products	13	14	15	17	18	20	22	37	59	92	6.1	9.8	10.5	10.0	9.4	8.9	9.5
8	Textile industry	35	37	41	45	48	52	56	81	120	176	6.7	7.0	7.4	7.5	7.8	7.7	7.8
9	Paper products and printing	2	3	3	3	3	4	4	7	11	17	5.0	10.3	10.8	10.1	9.6	9.1	9.7
10	Chemical industries	0	0	0	1	1	1	1	1	2	3	8.4	9.2	9.7	9.6	9.4	8.9	9.5
11	Petroleum refineries	23	23	25	27	29	31	34	51	77	115	2.2	7.9	8.3	8.1	8.2	8.0	8.1
12	Rubber and plastic products	1	1	1	1	2	2	2	3	5	7	8.0	9.0	9.4	9.0	8.9	8.5	9.1
13	Non-metallic products	0	0	0	0	0	0	0	0	0	1	7.2	6.7	7.5	8.4	8.5	8.3	8.1
14	Basic metal	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
15	Fabricated metal products	1	1	1	1	1	1	1	2	3	5	4.7	7.9	8.6	9.1	9.0	8.6	8.9
16	Machinery	8	9	10	11	12	13	14	24	40	63	8.5	9.3	9.9	10.4	9.9	9.2	9.9
17	Other manufacturing	40	42	47	51	55	59	63	93	138	203	6.4	7.3	7.8	7.7	7.8	7.7	7.8
18	Electricity and water works	0	0	0	0	0	0	0	1	1	1	8.5	5.7	6.4	7.6	8.1	7.9	7.8
19	Construction	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
20	Trade	33	36	39	42	46	50	54	79	115	167	6.6	7.6	8.2	7.6	7.6	7.5	7.7
21	Restaurants and hotels	97	104	115	126	138	151	165	250	378	563	7.5	8.6	9.0	8.4	8.2	8.0	8.4
22	Transportation and communication	157	173	191	206	222	238	258	394	604	911	8.5	7.3	7.8	8.5	8.5	8.2	8.3
23	Banking and insurance	6	6	7	7	8	9	10	15	23	33	7.0	8.4	9.1	8.9	8.2	7.6	8.4
24	Real estate	19	20	22	23	24	25	26	40	62	93	6.8	3.9	5.0	8.2	8.7	8.1	7.6
25	Services	78	86	97	106	115	123	132	191	275	391	8.4	6.6	7.3	7.4	7.3	7.0	7.6
26	Unclassified	1	1	1	1	1	1	1	1	2	4	5.2	9.3	9.8	9.6	9.3	8.8	9.4

Table B-13: Imports (Values in current prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	38	39	42	44	48	51	56	83	117	159	4.4	7.4	9.1	7.8	6.9	6.0	7.0
2	Livestock	3	4	4	4	5	5	5	9	13	19	8.4	8.7	10.7	9.7	8.2	7.1	8.5
3	Forestry	7	7	7	8	8	8	8	13	19	25	11.3	1.3	5.2	8.7	7.1	6.0	6.4
4	Fishery	1	2	2	2	2	2	3	5	9	13	11.2	12.0	14.6	13.2	10.5	8.6	10.7
5	Mining and quarrying	111	123	135	149	168	183	201	313	467	669	3.8	8.4	9.1	8.9	8.0	7.2	8.5
6	Food manufacturing	72	75	81	85	93	100	110	169	247	346	1.6	7.6	9.2	8.5	7.7	6.7	7.6
7	Beverages and tobacco products	29	30	32	32	35	38	43	76	121	176	2.8	8.6	11.7	11.4	9.2	7.6	8.9
8	Textile industry	74	77	83	90	98	107	117	178	259	361	3.4	8.2	9.3	8.4	7.4	6.7	7.8
9	Paper products and printing	44	47	51	56	63	71	80	139	227	351	7.5	11.3	12.0	11.1	9.8	8.7	10.0
10	Chemical industries	241	264	296	332	375	419	471	824	1367	2146	10.2	10.9	11.8	11.2	10.1	9.0	10.5
11	Petroleum refineries	61	61	65	69	75	80	87	126	177	242	14.0	6.8	7.8	7.4	6.8	6.2	6.8
12	Rubber and plastic products	52	57	65	73	83	93	105	180	292	448	7.9	11.1	11.7	10.8	9.7	8.5	10.3
13	Non-metallic products	12	15	16	19	22	24	26	42	64	92	7.8	9.4	9.2	9.4	8.3	7.3	9.2
14	Basic metal	138	159	183	213	248	278	312	540	883	1369	11.2	11.2	11.5	11.0	9.8	8.8	10.8
15	Fabricated metal products	83	92	103	118	136	151	169	294	478	730	5.6	10.3	11.2	11.1	9.7	8.5	10.3
16	Machinery	886	1021	1168	1344	1548	1725	1925	3344	5453	8369	13.2	10.9	11.0	11.0	9.8	8.6	10.5
17	Other manufacturing	133	143	156	168	185	200	218	330	478	668	4.1	7.9	8.7	8.2	7.4	6.7	7.7
18	Electricity and water works	2	2	2	2	3	3	3	5	8	12	1.9	7.2	8.5	9.4	8.8	7.9	8.8
19	Construction	0	0	0	0	0	0	0	0	1	1	-5.9	11.5	10.4	10.5	8.7	7.3	10.2
20	Trade	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
21	Restaurants and hotels	29	31	33	35	39	43	48	79	121	174	6.2	9.3	11.2	10.0	8.5	7.3	8.7
22	Transportation and communication	45	51	56	61	68	75	82	135	209	308	8.2	8.8	9.7	9.8	8.8	7.8	9.0
23	Banking and insurance	6	7	8	9	11	12	14	26	43	66	2.9	12.3	13.5	12.5	10.3	8.5	11.1
24	Real estate	16	17	17	16	17	17	19	32	51	74	-3.7	4.8	8.3	10.5	9.2	7.5	7.4
25	Services	57	64	72	79	86	93	101	151	220	310	6.6	7.2	8.2	8.1	7.5	6.9	7.9
26	Unclassified	5	5	6	6	7	8	9	17	31	55	21.8	12.5	13.0	12.8	12.3	11.4	11.8

Table B-14: Net exports (Values in current prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
1	Crops	-5	-5	-3	-2	-2	-1	-1	-2	4	21
2	Livestock	-1	-1	-1	-1	-1	-1	-2	-3	-5	-6
3	Forestry	-6	-6	-6	-7	-7	-7	-7	-11	-16	-21
4	Fishery	-1	-1	-1	-1	-1	-1	-2	-3	-6	-10
5	Mining and quarrying	-103	-115	-126	-140	-159	-173	-190	-297	-444	-635
6	Food manufacturing	287	300	331	362	394	427	464	681	1009	1481
7	Beverages and tobacco products	-12	-12	-12	-11	-12	-13	-14	-29	-45	-59
8	Textile industry	151	162	181	199	213	227	243	346	515	777
9	Paper products and printing	-22	-24	-25	-28	-32	-36	-41	-75	-123	-188
10	Chemical industries	-177	-194	-219	-246	-281	-315	-357	-640	-1071	-1684
11	Petroleum refineries	-18	-18	-18	-19	-21	-21	-23	-30	-33	-27
12	Rubber and plastic products	31	31	34	36	36	38	39	46	61	93
13	Non-metallic products	17	17	18	17	17	17	18	26	40	65
14	Basic metal	-92	-111	-130	-155	-185	-209	-236	-422	-697	-1082
15	Fabricated metal products	-41	-49	-55	-65	-79	-89	-102	-188	-311	-473
16	Machinery	-31	-98	-131	-194	-282	-336	-391	-769	-1231	-1680
17	Other manufacturing	142	148	165	180	191	204	218	312	472	732
18	Electricity and water works	4	4	5	5	5	5	6	8	12	17
19	Construction	0	0	0	0	0	0	0	0	0	1
20	Trade	147	156	172	187	202	218	237	347	507	736
21	Restaurants and hotels	68	73	83	91	99	108	117	172	258	389
22	Transportation and communication	148	162	179	192	205	219	235	351	535	814
23	Banking and insurance	-1	-1	-1	-2	-3	-3	-4	-11	-20	-33
24	Real estate	3	3	5	7	7	8	7	8	11	18
25	Services	21	22	25	27	28	30	31	40	55	81
26	Unclassified	14	15	17	19	21	23	25	38	56	81

Table B-15: Gross Output (Values in 1990 prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	266	267	267	266	272	276	284	324	358	388	0.4	1.6	2.7	2.6	2.0	1.6	1.9
2	Livestock	74	74	75	76	79	81	84	103	120	138	1.2	2.7	3.9	4.0	3.2	2.7	3.1
3	Forestry	7	7	7	7	7	7	7	7	7	7	-0.2	-0.2	0.0	-0.1	0.0	0.3	0.0
4	Fishery	69	73	76	79	85	91	99	140	184	228	4.5	6.6	7.8	7.0	5.4	4.3	5.7
5	Mining and quarrying	106	117	125	135	149	160	173	245	326	415	9.3	7.3	7.5	6.9	5.7	4.8	6.3
6	Food manufacturing	515	523	533	542	562	582	608	762	930	1112	1.9	3.4	4.4	4.5	4.0	3.6	3.8
7	Beverages and tobacco products	155	158	160	157	163	168	177	234	291	342	0.7	3.2	5.3	5.6	4.3	3.3	3.9
8	Textile industry	513	516	527	548	578	611	651	855	1063	1277	4.6	5.6	6.3	5.4	4.4	3.7	4.5
9	Paper products and printing	95	101	104	109	116	123	131	178	232	293	4.0	5.9	6.3	6.1	5.3	4.7	5.4
10	Chemical industries	166	174	184	197	215	232	251	365	504	669	7.9	7.6	8.0	7.5	6.5	5.7	6.7
11	Petroleum refineries	196	206	214	223	238	251	266	352	441	531	2.1	5.2	6.0	5.6	4.5	3.7	4.7
12	Rubber and plastic products	136	145	153	164	177	190	204	286	382	490	6.0	6.8	7.1	6.7	5.8	5.0	6.1
13	Non-metallic products	112	131	144	165	189	206	221	308	397	488	10.9	8.3	7.4	6.6	5.1	4.1	6.6
14	Basic metal	104	116	125	138	154	167	180	259	356	470	10.7	7.9	7.7	7.3	6.3	5.6	7.0
15	Fabricated metal products	97	107	114	124	138	149	161	230	308	395	10.6	7.4	7.8	7.1	5.9	5.0	6.5
16	Machinery	1062	1170	1253	1371	1513	1622	1733	2358	3063	3851	8.5	7.0	6.6	6.2	5.2	4.6	6.0
17	Other manufacturing	387	404	418	436	466	492	522	689	865	1048	4.3	5.6	6.0	5.5	4.6	3.8	4.8
18	Electricity and water works	200	211	222	233	253	271	293	416	555	706	4.9	6.8	7.7	7.0	5.7	4.8	6.0
19	Construction	344	429	477	559	655	711	761	1032	1298	1557	12.7	8.2	6.8	6.1	4.6	3.6	6.4
20	Trade	828	889	933	993	1085	1161	1245	1720	2231	2770	5.9	6.7	7.0	6.5	5.2	4.3	5.7
21	Restaurants and hotels	256	258	259	264	277	290	308	408	505	598	1.6	4.6	6.0	5.6	4.3	3.4	4.2
22	Transportation and communication	476	500	517	543	582	615	652	858	1078	1310	4.3	5.4	5.9	5.5	4.6	3.9	4.8
23	Banking and insurance	236	259	279	302	337	369	405	624	883	1171	8.3	9.0	9.5	8.6	6.9	5.7	7.5
24	Real estate	112	115	118	118	126	131	140	186	234	282	0.0	4.3	6.1	5.7	4.6	3.8	4.5
25	Services	484	498	511	526	549	570	595	732	884	1053	3.0	3.9	4.3	4.1	3.8	3.5	3.7
26	Unclassified	49	54	58	63	70	77	84	133	196	271	7.2	9.1	9.4	9.1	7.8	6.5	8.1

Table B-16: Gross Output (Values in current prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	435	446	473	496	533	567	608	818	1090	1417	3.6	6.1	7.0	5.9	5.7	5.3	5.8
2	Livestock	117	124	133	140	152	162	175	253	355	483	6.4	6.6	7.9	7.4	6.8	6.1	6.8
3	Forestry	10	10	10	10	10	10	10	14	18	23	-1.1	-1.4	1.6	6.2	5.5	4.7	4.2
4	Fishery	136	138	145	152	167	183	206	362	582	867	2.8	9.4	11.8	11.2	9.5	8.0	9.2
5	Mining and quarrying	140	158	175	196	224	247	273	448	701	1048	11.5	9.5	10.2	9.9	9.0	8.0	9.5
6	Food manufacturing	851	886	951	1010	1092	1172	1274	1894	2759	3891	5.0	7.1	8.3	7.9	7.5	6.9	7.4
7	Beverages and tobacco products	212	223	238	245	267	292	326	570	911	1362	4.0	8.6	11.3	11.2	9.4	8.0	9.1
8	Textile industry	793	829	903	984	1074	1166	1279	1959	2901	4159	8.5	8.2	9.2	8.5	7.8	7.2	8.1
9	Paper products and printing	133	141	154	171	194	218	247	444	754	1221	6.1	11.8	12.5	11.7	10.6	9.6	10.8
10	Chemical industries	241	267	305	348	400	453	517	973	1732	2917	13.4	12.4	13.3	12.6	11.5	10.4	11.9
11	Petroleum refineries	267	275	295	319	355	388	428	678	1030	1502	1.4	8.8	9.8	9.2	8.4	7.6	8.5
12	Rubber and plastic products	202	225	256	289	331	371	418	737	1239	1978	11.2	11.4	12.0	11.3	10.4	9.4	10.9
13	Non-metallic products	156	189	218	255	299	333	369	625	995	1501	15.2	10.7	10.4	10.5	9.3	8.2	10.4
14	Basic metal	119	136	156	182	212	239	270	490	851	1408	13.3	11.8	12.2	11.9	11.0	10.1	11.7
15	Fabricated metal products	121	135	152	175	202	226	254	458	777	1244	12.4	10.9	11.8	11.8	10.6	9.4	11.1
16	Machinery	1382	1611	1864	2168	2525	2845	3208	5872	10088	16307	14.1	11.9	12.0	12.1	10.8	9.6	11.6
17	Other manufacturing	556	603	659	716	790	860	943	1466	2199	3183	7.8	8.5	9.3	8.8	8.1	7.4	8.3
18	Electricity and water works	287	333	379	413	460	499	549	917	1476	2258	10.5	8.2	9.5	10.3	9.5	8.5	9.6
19	Construction	509	656	761	918	1100	1219	1343	2231	3477	5122	15.7	10.3	9.7	10.1	8.9	7.7	10.3
20	Trade	1222	1373	1521	1688	1917	2119	2359	3820	5837	8540	9.7	10.0	10.7	9.6	8.5	7.6	9.1
21	Restaurants and hotels	406	431	461	493	544	594	661	1065	1605	2296	6.2	8.8	10.5	9.5	8.2	7.2	8.4
22	Transportation and communication	703	795	874	950	1052	1144	1254	2022	3138	4671	9.9	8.3	9.2	9.6	8.8	8.0	8.9
23	Banking and insurance	352	402	461	524	610	695	800	1541	2652	4169	12.5	13.0	14.1	13.1	10.9	9.1	11.7
24	Real estate	180	196	209	213	226	234	250	403	633	932	3.9	3.8	6.6	9.5	9.0	7.7	7.8
25	Services	788	876	971	1056	1138	1209	1297	1854	2599	3570	8.5	6.1	7.0	7.1	6.8	6.3	7.0
26	Unclassified	60	68	79	92	107	124	143	292	553	963	9.5	14.0	14.7	14.2	12.8	11.1	13.2

Table B-17: Gross output in aggregate sector (Values in 1990 prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Agriculture	420	426	431	435	450	463	482	586	688	785	1.3	2.8	4.0	3.9	3.2	2.7	3.1
2	Mining & quarrying	110	122	130	141	156	167	181	257	343	440	9.2	7.3	7.6	7.0	5.8	4.9	6.4
3	Manufacturing	3543	3755	3934	4179	4516	4799	5114	6887	8850	10990	5.9	6.1	6.4	6.0	5.0	4.3	5.4
4	Construction	293	362	400	466	541	583	621	815	991	1148	12.0	7.5	6.2	5.4	3.9	2.9	5.8
5	Electricity & water supply	204	216	227	239	260	278	301	428	573	730	5.0	6.9	7.7	7.1	5.8	4.9	6.1
6	Transportation & communication	481	504	523	548	589	622	660	871	1096	1335	4.3	5.5	5.9	5.5	4.6	3.9	4.9
7	Wholesale & retail trade	832	894	938	999	1092	1168	1253	1732	2249	2795	5.9	6.7	7.0	6.5	5.2	4.3	5.7
8	Banking,insurance & real estate	353	379	402	426	469	507	552	822	1134	1478	5.7	7.7	8.6	7.9	6.4	5.3	6.8
9	Ownership of dwellings	60	76	87	105	126	141	156	241	342	457	15.0	11.0	9.7	8.8	7.0	5.8	9.0
10	Public administration & defense	121	124	127	130	136	142	150	177	218	263	2.6	4.3	5.0	3.3	4.2	3.7	3.8
11	Services	628	641	654	672	703	732	769	988	1207	1437	2.6	4.2	4.9	5.0	4.0	3.5	4.0

Table B-18: Gross output in aggregate sector (Values in current prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Agriculture	704	724	768	807	871	933	1013	1474	2096	2878	3.9	6.9	8.1	7.5	7.0	6.3	6.9
2	Mining & quarrying	145	164	182	204	234	258	286	474	751	1136	11.4	9.7	10.4	10.1	9.2	8.3	9.7
3	Manufacturing	5039	5526	6158	6870	7753	8573	9547	16192	26285	40760	9.6	10.1	10.8	10.6	9.7	8.8	10.0
4	Construction	432	553	637	763	909	1000	1095	1761	2657	3785	15.0	9.6	9.1	9.5	8.2	7.1	9.6
5	Electricity & water supply	292	339	386	421	470	510	562	943	1526	2346	10.5	8.3	9.7	10.4	9.6	8.6	9.7
6	Transportation & communication	708	801	881	958	1062	1155	1267	2048	3188	4759	9.9	8.4	9.3	9.6	8.8	8.0	8.9
7	Wholesale & retail trade	1228	1379	1529	1697	1927	2130	2372	3847	5887	8628	9.7	10.0	10.8	9.7	8.5	7.6	9.2
8	Banking,insurance & real estate	538	605	677	745	846	940	1063	1971	3335	5189	9.7	10.6	12.3	12.3	10.5	8.8	10.7
9	Ownership of dwellings	87	115	138	172	211	242	274	522	920	1511	18.0	13.3	12.7	12.9	11.3	9.9	12.9
10	Public administration & defense	194	213	233	252	275	295	321	448	657	934	7.7	7.1	8.4	6.7	7.7	7.0	7.4
11	Services	1011	1107	1213	1313	1428	1531	1663	2524	3648	5108	7.7	7.0	8.3	8.3	7.4	6.7	7.6

Table B-19: Labor productivity - Real output per worker (Values in 1990 prices, Thousand bahts)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	17	17	17	17	18	19	20	24	29	34	1.1	7.5	4.4	3.7	3.5	3.3	3.5
2	Livestock	149	155	156	157	163	163	167	174	182	190	3.3	-0.1	2.1	0.9	0.8	0.9	1.0
3	Forestry	60	58	56	55	53	51	50	43	37	32	-1.8	-3.2	-2.9	-3.1	-3.1	-3.0	-3.0
4	Fishery	187	201	206	212	225	231	241	276	317	365	3.0	2.4	4.3	2.8	2.8	2.8	3.0
5	Mining and quarrying	2479	2609	2745	2888	3040	3197	3363	4323	5542	7089	6.2	5.0	5.1	5.0	5.0	4.9	5.0
6	Food manufacturing	847	871	891	909	941	959	985	1092	1205	1327	2.6	1.9	2.7	2.1	2.0	1.9	2.1
7	Beverages and tobacco products	2013	2110	2128	2112	2245	2279	2359	2561	2766	2989	4.0	1.5	3.4	1.6	1.5	1.5	1.7
8	Textile industry	510	514	527	541	554	565	578	634	688	741	1.9	2.1	2.1	1.8	1.6	1.5	1.8
9	Paper products and printing	734	787	799	831	867	891	921	1065	1228	1417	4.2	2.7	3.3	2.9	2.8	2.9	2.9
10	Chemical industries	712	730	755	780	807	831	857	988	1126	1273	3.1	3.0	3.1	2.8	2.6	2.5	2.8
11	Petroleum refineries	31047	40570	47757	54119	59852	64157	68046	77671	77150	71377	23.3	6.9	5.9	2.6	-0.1	-1.6	2.8
12	Rubber and plastic products	1713	1811	1870	1955	2057	2100	2180	2552	2964	3446	4.6	2.1	3.7	3.2	3.0	3.0	3.2
13	Non-metallic products	680	749	758	800	833	846	875	1044	1236	1467	7.8	1.6	3.4	3.5	3.4	3.4	3.4
14	Basic metal	946	967	988	1040	1087	1112	1154	1375	1618	1898	7.4	2.3	3.6	3.5	3.3	3.2	3.4
15	Fabricated metal products	426	435	446	459	472	483	496	559	622	687	2.7	2.3	2.6	2.4	2.1	2.0	2.3
16	Machinery	1544	1605	1644	1706	1765	1807	1863	2172	2528	2947	4.9	2.4	3.0	3.1	3.0	3.1	3.0
17	Other manufacturing	541	490	506	531	564	581	607	732	883	1070	-0.1	3.0	4.3	3.7	3.7	3.8	3.9
18	Electricity and water works	1437	1557	1601	1658	1768	1803	1879	2186	2540	2961	5.5	1.9	4.2	3.0	3.0	3.1	3.2
19	Construction	331	385	369	388	396	387	391	424	452	485	8.5	-2.4	1.1	1.6	1.3	1.4	1.2
20	Trade	207	208	222	232	244	260	271	326	389	467	2.5	6.5	4.2	3.7	3.5	3.7	4.0
21	Restaurants and hotels	212	220	225	233	245	250	259	283	306	330	1.1	1.9	3.4	1.8	1.6	1.5	2.0
22	Transportation and communication	530	558	572	594	620	634	655	757	868	995	4.8	2.3	3.3	2.9	2.7	2.7	2.9
23	Banking and insurance	979	968	907	952	1021	1056	1119	1432	1826	2345	0.9	3.4	5.8	4.9	4.9	5.0	4.4
24	Real estate	2320	2673	2695	2667	2841	2816	2888	2969	3042	3104	4.0	-0.9	2.5	0.5	0.5	0.4	0.7
25	Services	134	128	130	131	134	136	140	156	174	193	-1.7	2.1	2.6	2.2	2.1	2.1	2.0
26	Unclassified	12315	13305	14036	14857	15773	16586	17535	22957	30003	39280	8.0	5.0	5.6	5.4	5.4	5.4	5.4

Table B-20: Employment (Thousand persons)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	15698	15615	15726	15467	15067	14207	13966	13225	12307	11285	-0.7	-5.9	-1.7	-1.1	-1.4	-1.7	-1.6
2	Livestock	492	481	483	484	484	498	507	590	663	723	-2.1	2.8	1.8	3.0	2.3	1.7	2.0
3	Forestry	119	123	126	129	134	138	142	165	193	227	1.6	3.0	2.9	3.0	3.1	3.3	3.1
4	Fishery	369	361	369	375	380	396	410	508	580	625	1.5	4.2	3.5	4.3	2.7	1.5	2.7
5	Mining and quarrying	43	45	45	47	49	50	51	57	59	59	3.1	2.2	2.5	1.9	0.7	-0.1	1.3
6	Food manufacturing	608	601	598	596	598	607	617	698	772	838	-0.7	1.5	1.7	2.5	2.0	1.6	1.7
7	Beverages and tobacco products	77	75	75	74	72	74	75	91	105	115	-3.3	1.7	1.8	4.0	2.8	1.7	2.1
8	Textile industry	1005	1003	999	1014	1045	1081	1127	1349	1545	1724	2.7	3.4	4.2	3.6	2.7	2.2	2.7
9	Paper products and printing	130	128	130	131	134	138	142	167	189	207	-0.2	3.2	3.0	3.2	2.5	1.9	2.4
10	Chemical industries	232	238	244	253	266	279	293	370	448	525	4.7	4.6	5.0	4.6	3.8	3.2	4.0
11	Petroleum refineries	6	5	4	4	4	4	4	5	6	7	-21.2	-1.8	0.1	2.9	4.6	5.3	1.9
12	Rubber and plastic products	80	80	82	84	86	90	94	112	129	142	1.5	4.7	3.4	3.6	2.8	2.0	2.9
13	Non-metallic products	164	175	190	206	227	243	253	295	321	333	3.1	6.7	4.0	3.0	1.7	0.7	3.2
14	Basic metal	110	120	127	133	142	150	156	189	220	248	3.4	5.6	4.1	3.8	3.1	2.4	3.6
15	Fabricated metal products	228	246	255	270	292	308	324	411	496	575	7.9	5.1	5.2	4.8	3.7	3.0	4.2
16	Machinery	688	729	762	804	857	898	930	1085	1212	1306	3.6	4.6	3.6	3.1	2.2	1.5	2.9
17	Other manufacturing	716	824	826	821	825	846	861	941	980	979	4.4	2.6	1.7	1.8	0.8	0.0	0.9
18	Electricity and water works	139	136	139	141	143	150	156	190	219	238	-0.6	4.9	3.5	4.0	2.7	1.7	2.8
19	Construction	1041	1113	1292	1441	1655	1839	1946	2436	2872	3211	4.1	10.5	5.7	4.5	3.3	2.2	5.3
20	Trade	4007	4274	4194	4290	4455	4465	4591	5283	5738	5928	3.4	0.2	2.8	2.8	1.7	0.7	1.6
21	Restaurants and hotels	1206	1173	1154	1133	1132	1163	1193	1441	1649	1813	0.5	2.7	2.6	3.8	2.7	1.9	2.2
22	Transportation and communication	898	896	904	913	940	970	995	1134	1241	1317	-0.6	3.2	2.6	2.6	1.8	1.2	1.9
23	Banking and insurance	242	268	307	317	330	349	362	436	483	499	7.5	5.6	3.7	3.7	2.1	0.7	3.1
24	Real estate	48	43	44	44	44	47	48	63	77	91	-4.0	5.2	3.6	5.1	4.1	3.4	3.7
25	Services	3606	3877	3943	4012	4106	4180	4250	4677	5080	5446	4.7	1.8	1.7	1.9	1.7	1.4	1.7
26	Unclassified	4	4	4	4	4	5	5	6	7	7	-0.8	4.0	3.9	3.7	2.4	1.1	2.7

Table B-21: Capital stock (Values in 1990 prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Agriculture	584	564	549	544	550	562	578	723	920	1127	-2.0	2.2	2.8	4.5	4.8	4.0	3.5
2	Mining & quarrying	96	97	99	104	110	118	126	185	254	316	2.5	6.7	6.9	7.7	6.3	4.4	5.9
3	Manufacturing	2043	2141	2245	2377	2532	2713	2902	3986	5282	6758	4.9	6.9	6.7	6.4	5.6	4.9	5.7
4	Construction	267	259	255	259	271	285	305	470	690	915	-1.1	4.9	6.7	8.7	7.7	5.6	6.3
5	Electricity & water supply	798	832	869	911	959	1013	1075	1503	2066	2706	4.5	5.5	5.9	6.7	6.4	5.4	5.9
6	Transportation & communication	1978	2002	2046	2132	2276	2423	2576	3441	4450	5574	2.5	6.3	6.1	5.8	5.1	4.5	5.1
7	Wholesale & retail trade	737	729	741	782	845	910	980	1394	1904	2488	1.9	7.5	7.3	7.0	6.2	5.4	6.1
8	Banking,insurance & real estate	112	106	102	98	95	96	99	130	165	203	-4.4	0.0	3.7	5.4	4.8	4.1	3.2
9	Ownership of dwellings	2534	2532	2540	2558	2584	2620	2665	3041	3706	4515	0.3	1.4	1.7	2.6	4.0	3.9	2.9
10	Public administration & defense	182	183	187	191	199	208	218	258	312	368	1.7	4.5	4.7	3.4	3.8	3.3	3.5
11	Services	1070	1060	1069	1093	1136	1193	1256	1655	2125	2626	0.6	4.9	5.1	5.5	5.0	4.2	4.5

Table B-22: Capital stock (Values in current prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Agriculture	978	959	978	1010	1066	1134	1216	1820	2805	4129	0.6	6.2	7.0	8.1	8.6	7.7	7.3
2	Mining & quarrying	127	130	139	151	166	182	200	342	555	816	4.7	9.1	9.7	10.7	9.7	7.7	9.2
3	Manufacturing	2906	3151	3515	3909	4347	4846	5417	9372	15690	25065	8.7	10.9	11.1	11.0	10.3	9.4	10.4
4	Construction	394	396	406	424	455	488	538	1017	1851	3016	1.9	7.0	9.6	12.7	12.0	9.8	10.2
5	Electricity & water supply	1141	1306	1478	1604	1734	1859	2011	3309	5507	8693	10.0	6.9	7.9	10.0	10.2	9.1	9.5
6	Transportation & communication	2913	3181	3451	3726	4105	4498	4944	8097	12949	19868	8.1	9.2	9.4	9.9	9.4	8.6	9.2
7	Wholesale & retail trade	1087	1125	1207	1327	1491	1660	1855	3095	4984	7682	5.6	10.7	11.1	10.2	9.5	8.7	9.6
8	Banking,insurance & real estate	170	169	171	171	172	177	191	311	486	713	-0.4	2.9	7.4	9.8	8.9	7.7	7.2
9	Ownership of dwellings	3697	3834	4017	4171	4322	4482	4696	6579	9955	14919	3.3	3.6	4.7	6.7	8.3	8.1	6.8
10	Public administration & defense	291	314	343	371	400	430	466	653	939	1308	6.8	7.3	8.0	6.7	7.3	6.6	7.1
11	Services	1722	1831	1983	2138	2308	2494	2715	4230	6423	9334	5.8	7.8	8.5	8.9	8.4	7.5	8.1

Table B-23: Average wage per worker (Values in 1990 prices, bahts/person/year)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1 Crops	2799	2796	2731	2776	2933	3250	3445	4363	5305	6217	0.6	10.3	5.8	4.7	3.9	3.2	4.0
2 Livestock	10522	10746	10723	10737	10792	10419	10419	9902	9250	8636	1.8	-3.5	0.0	-1.0	-1.4	-1.4	-1.1
3 Forestry	26246	26565	26804	28139	27771	27602	27777	27956	26482	23480	3.4	-0.6	0.6	0.1	-1.1	-2.4	-0.6
4 Fishery	39413	42725	43962	45403	47460	47528	49228	54404	58912	62594	3.1	0.1	3.5	2.0	1.6	1.2	1.9
5 Mining and quarrying	340494	350739	362057	374865	378349	381106	389086	437990	489221	544155	3.7	0.7	2.1	2.4	2.2	2.1	2.2
6 Food manufacturing	68707	70967	73131	75222	76532	76503	78150	84729	89684	92749	3.0	0.0	2.1	1.6	1.1	0.7	1.3
7 Beverages and tobacco products	118967	124967	125997	125030	130704	129533	132915	138679	142540	145567	4.0	-0.9	2.6	0.8	0.5	0.4	0.8
8 Textile industry	70561	71490	73933	76893	77654	78198	79761	87842	94828	101143	2.3	0.7	2.0	1.9	1.5	1.3	1.7
9 Paper products and printing	52905	55081	54599	55880	55648	54635	54576	53775	51995	49986	1.3	-1.8	-0.1	-0.3	-0.7	-0.8	-0.5
10 Chemical industries	57900	58782	60211	61811	61860	61670	62345	66390	69763	72711	1.6	-0.3	1.1	1.3	1.0	0.8	1.1
11 Petroleum refineries	931409	1234546	1469455	1684102	1834466	1930920	2036832	2282266	2199278	1963494	24.1	5.1	5.3	2.3	-0.7	-2.3	2.3
12 Rubber and plastic products	159210	168409	174722	183988	189879	190394	196347	226752	258242	293686	4.4	0.3	3.1	2.9	2.6	2.6	2.8
13 Non-metallic products	61014	63476	63552	65110	64583	63238	63281	64856	65855	66815	2.7	-2.1	0.1	0.5	0.3	0.3	0.3
14 Basic metal	84887	88338	92229	99447	103851	105913	111020	141944	178155	222559	9.1	2.0	4.7	4.9	4.5	4.5	4.6
15 Fabricated metal products	37248	37679	38415	39559	39629	39344	39746	41941	43381	44326	1.6	-0.7	1.0	1.1	0.7	0.4	0.8
16 Machinery	87169	87916	88346	89485	88244	86530	86232	86276	85834	85318	0.9	-2.0	-0.3	0.0	-0.1	-0.1	-0.2
17 Other manufacturing	59583	55482	56411	58290	59102	58677	59507	63469	67035	70744	-1.0	-0.7	1.4	1.3	1.1	1.1	1.2
18 Electricity and water works	165671	177069	180651	185964	191920	189604	193804	208413	222677	238254	3.9	-1.2	2.2	1.5	1.3	1.4	1.5
19 Construction	36488	39941	37279	37848	36373	33726	32595	28337	24044	20385	3.2	-7.6	-3.4	-2.8	-3.3	-3.3	-3.4
20 Trade	25563	25413	25818	26094	25781	25562	25489	25305	24925	24545	-0.4	-0.9	-0.3	-0.1	-0.3	-0.3	-0.2
21 Restaurants and hotels	23729	24125	24250	24972	25294	24843	25061	24388	23068	21572	-0.9	-1.8	0.9	-0.5	-1.1	-1.3	-0.6
22 Transportation and communication	78994	81649	82946	85405	85981	85090	86028	90826	94784	98571	2.8	-1.0	1.1	1.1	0.9	0.8	0.9
23 Banking and insurance	253089	251791	238941	252900	265576	269645	283572	355036	439262	544698	1.0	1.5	5.0	4.5	4.3	4.3	3.9
24 Real estate	126167	144991	145091	142811	148032	142048	143183	136417	128803	120799	2.9	-4.1	0.8	-1.0	-1.1	-1.3	-0.9
25 Services	91473	89661	90548	92873	92291	91955	92846	96866	98701	99492	-0.5	-0.4	1.0	0.8	0.4	0.2	0.5
26 Unclassified	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0

Table B-24: Average wage per worker (Values in current prices, bahts/person/year

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	4244	4447	4603	4880	5336	6097	6696	10272	15233	21635	4.6	13.3	9.4	8.6	7.9	7.0	7.9
2	Livestock	15957	17089	18076	18872	19636	19545	20251	23310	26563	30054	5.8	-0.5	3.6	2.8	2.6	2.5	2.8
3	Forestry	39803	42247	45182	49459	50532	51777	53992	65810	76047	81712	7.5	2.4	4.2	4.0	2.9	1.4	3.3
4	Fishery	59770	67946	74104	79803	86358	89156	95687	128074	169173	217833	7.2	3.2	7.1	5.8	5.6	5.1	5.8
5	Mining and quarrying	516363	557784	610298	658891	688438	714901	756290	1031077	1404863	1893693	7.8	3.8	5.6	6.2	6.2	6.0	6.1
6	Food manufacturing	104195	112859	123273	132217	139256	143508	151906	199461	257541	322773	7.1	3.0	5.7	5.4	5.1	4.5	5.3
7	Beverages and tobacco products	180415	198736	212387	219762	237828	242985	258354	326465	409324	506583	8.0	2.1	6.1	4.7	4.5	4.3	4.7
8	Textile industry	107006	113691	124625	135153	141299	146688	155036	206791	272312	351984	6.3	3.7	5.5	5.8	5.5	5.1	5.7
9	Paper products and printing	80232	87596	92034	98218	101256	102487	106082	126593	149310	173955	5.4	1.2	3.4	3.5	3.3	3.1	3.4
10	Chemical industries	87805	93482	101494	108643	112560	115684	121184	156291	200335	253038	5.7	2.7	4.6	5.1	5.0	4.7	5.0
11	Petroleum refineries	1412492	1963311	2476978	2960108	3337966	3622128	3959111	5372710	6315522	6833084	28.2	8.2	8.9	6.1	3.2	1.6	6.2
12	Rubber and plastic products	241444	267823	294519	323391	345501	357152	381652	533800	741577	1022044	8.4	3.3	6.6	6.7	6.6	6.4	6.7
13	Non-metallic products	92529	100946	107126	114443	117514	118626	123002	152678	189111	232520	6.8	0.9	3.6	4.3	4.3	4.1	4.2
14	Basic metal	128732	140485	155466	174796	188966	198677	215795	334153	511597	774518	13.1	5.0	8.3	8.7	8.5	8.3	8.5
15	Fabricated metal products	56487	59921	64754	69531	72108	73803	77257	98735	124574	154259	5.6	2.3	4.6	4.9	4.6	4.3	4.7
16	Machinery	132193	139814	148920	157285	160568	162318	167614	203103	246483	296911	5.0	1.1	3.2	3.8	3.9	3.7	3.8
17	Other manufacturing	90358	88234	95090	102454	107541	110070	115668	149412	192500	246195	3.0	2.3	5.0	5.1	5.1	4.9	5.1
18	Electricity and water works	251242	281594	304514	326865	349214	355670	376708	490629	639446	829139	8.0	1.8	5.7	5.3	5.3	5.2	5.4
19	Construction	55334	63518	62839	66524	66184	63265	63357	66708	69046	70942	7.3	-4.5	0.1	1.0	0.7	0.5	0.6
20	Trade	38766	40414	43519	45865	46911	47950	49545	59570	71577	85418	3.7	2.2	3.3	3.7	3.7	3.5	3.7
21	Restaurants and hotels	35985	38366	40877	43892	46024	46602	48712	57412	66242	75072	3.1	1.2	4.4	3.3	2.9	2.5	3.4
22	Transportation and communication	119795	129847	139818	150115	156450	159616	167217	213815	272185	343032	6.9	2.0	4.7	4.9	4.8	4.6	4.9
23	Banking and insurance	383813	400425	402770	444516	483238	505815	551196	835796	1261399	1895583	5.0	4.6	8.6	8.3	8.2	8.1	7.8
24	Real estate	191333	230580	244571	251016	269358	266462	278313	321140	369874	420388	6.9	-1.1	4.4	2.9	2.8	2.6	3.0
25	Services	138720	142589	152632	163240	167932	172495	180470	228034	283433	346237	3.6	2.7	4.5	4.7	4.3	4.0	4.4
26	Unclassified	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0

Table B-25: Total wage (Values in 1990 prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	44	44	43	43	44	46	48	58	65	70	-0.1	4.4	4.1	3.6	2.5	1.4	2.4
2	Livestock	5	5	5	5	5	5	5	6	6	6	-0.4	-0.7	1.8	2.0	1.0	0.4	0.9
3	Forestry	3	3	3	4	4	4	4	5	5	5	5.0	2.4	3.6	3.2	2.0	0.9	2.5
4	Fishery	15	15	16	17	18	19	20	28	34	39	4.6	4.3	7.0	6.3	4.3	2.7	4.7
5	Mining and quarrying	15	16	16	17	19	19	20	25	29	32	6.9	3.0	4.5	4.3	3.0	2.0	3.5
6	Food manufacturing	42	43	44	45	46	46	48	59	69	78	2.3	1.5	3.8	4.1	3.2	2.3	3.0
7	Beverages and tobacco products	9	9	9	9	9	10	10	13	15	17	0.7	0.8	4.4	4.8	3.3	2.1	2.9
8	Textile industry	71	72	74	78	81	85	90	119	147	174	5.0	4.1	6.1	5.5	4.2	3.5	4.4
9	Paper products and printing	7	7	7	7	7	8	8	9	10	10	1.1	1.3	2.9	2.9	1.8	1.1	1.9
10	Chemical industries	13	14	15	16	16	17	18	25	31	38	6.4	4.3	6.1	5.9	4.8	4.0	5.0
11	Petroleum refineries	6	6	7	7	7	8	8	10	13	15	2.9	3.4	5.5	5.2	3.9	3.0	4.2
12	Rubber and plastic products	13	13	14	15	16	17	18	25	33	42	5.8	5.0	6.5	6.5	5.4	4.5	5.7
13	Non-metallic products	10	11	12	13	15	15	16	19	21	22	5.8	4.6	4.1	3.5	2.0	1.0	3.5
14	Basic metal	9	11	12	13	15	16	17	27	39	55	12.5	7.5	8.8	8.7	7.6	6.8	8.2
15	Fabricated metal products	9	9	10	11	12	12	13	17	22	25	9.5	4.4	6.2	5.8	4.4	3.4	5.1
16	Machinery	60	64	67	72	76	78	80	94	104	111	4.5	2.6	3.2	3.1	2.1	1.4	2.8
17	Other manufacturing	43	46	47	48	49	50	51	60	66	69	3.4	1.8	3.1	3.1	1.9	1.1	2.1
18	Electricity and water works	23	24	25	26	27	29	30	40	49	57	3.3	3.7	5.7	5.5	4.1	3.1	4.3
19	Construction	38	44	48	55	60	62	63	69	69	65	7.4	3.0	2.3	1.7	0.0	-1.1	1.9
20	Trade	102	109	108	112	115	114	117	134	143	145	3.1	-0.6	2.5	2.7	1.3	0.3	1.5
21	Restaurants and hotels	29	28	28	28	29	29	30	35	38	39	-0.4	0.9	3.4	3.2	1.6	0.6	1.6
22	Transportation and communication	71	73	75	78	81	83	86	103	118	130	2.3	2.1	3.7	3.7	2.7	2.0	2.9
23	Banking and insurance	61	67	73	80	88	94	103	155	212	272	8.5	7.1	8.7	8.2	6.3	5.0	7.0
24	Real estate	6	6	6	6	7	7	7	9	10	11	-1.2	1.1	4.4	4.2	3.0	2.1	2.8
25	Services	330	348	357	373	379	384	395	453	501	542	4.2	1.4	2.6	2.8	2.0	1.5	2.2
26	Unclassified	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0

Table B-26: Total wage (Values in current prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	67	69	72	75	80	87	94	136	187	244	3.9	7.5	7.7	7.5	6.4	5.3	6.3
2	Livestock	8	8	9	9	10	10	10	14	18	22	3.7	2.3	5.3	5.8	4.9	4.2	4.9
3	Forestry	5	5	6	6	7	7	8	11	15	19	9.0	5.4	7.1	7.0	6.0	4.7	6.4
4	Fishery	22	25	27	30	33	35	39	65	98	136	8.7	7.4	10.6	10.1	8.2	6.6	8.6
5	Mining and quarrying	22	25	28	31	34	36	39	58	83	111	10.9	6.0	8.1	8.1	6.9	5.9	7.4
6	Food manufacturing	63	68	74	79	83	87	94	139	199	270	6.3	4.5	7.4	7.9	7.1	6.2	6.9
7	Beverages and tobacco products	14	15	16	16	17	18	19	30	43	58	4.7	3.9	8.0	8.6	7.3	6.0	6.8
8	Textile industry	108	114	124	137	148	159	175	279	421	607	9.0	7.2	9.7	9.4	8.2	7.3	8.4
9	Paper products and printing	10	11	12	13	14	14	15	21	28	36	5.1	4.4	6.4	6.7	5.8	4.9	5.8
10	Chemical industries	20	22	25	27	30	32	36	58	90	133	10.4	7.3	9.6	9.7	8.8	7.9	8.9
11	Petroleum refineries	9	10	11	12	13	14	15	24	36	51	6.9	6.4	9.0	9.0	7.9	6.9	8.1
12	Rubber and plastic products	19	21	24	27	30	32	36	60	96	145	9.9	8.1	10.1	10.3	9.4	8.4	9.6
13	Non-metallic products	15	18	20	24	27	29	31	45	61	77	9.8	7.7	7.6	7.4	6.0	4.8	7.4
14	Basic metal	14	17	20	23	27	30	34	63	113	192	16.5	10.6	12.3	12.5	11.6	10.7	12.1
15	Fabricated metal products	13	15	17	19	21	23	25	41	62	89	13.5	7.4	9.7	9.7	8.4	7.2	9.0
16	Machinery	91	102	114	126	138	146	156	220	299	388	8.5	5.7	6.8	6.9	6.1	5.2	6.7
17	Other manufacturing	65	73	79	84	89	93	100	141	189	241	7.4	4.9	6.6	6.9	5.9	4.9	6.0
18	Electricity and water works	35	38	42	46	50	54	59	93	140	198	7.4	6.7	9.3	9.3	8.0	6.9	8.2
19	Construction	58	71	81	96	110	116	123	163	198	228	11.4	6.0	5.8	5.5	4.0	2.8	5.9
20	Trade	155	173	183	197	209	214	227	315	411	506	7.1	2.4	6.1	6.5	5.3	4.2	5.4
21	Restaurants and hotels	43	45	47	50	52	54	58	83	109	136	3.6	3.9	7.0	7.1	5.6	4.4	5.5
22	Transportation and communication	108	116	126	137	147	155	166	242	338	452	6.3	5.2	7.3	7.5	6.6	5.8	6.8
23	Banking and insurance	93	107	124	141	159	177	200	364	610	947	12.5	10.2	12.3	12.0	10.3	8.8	10.9
24	Real estate	9	10	11	11	12	12	13	20	28	38	2.8	4.1	7.9	8.0	6.9	5.9	6.7
25	Services	500	553	602	655	690	721	767	1067	1440	1886	8.2	4.5	6.2	6.6	6.0	5.4	6.1
26	Unclassified	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0

Table B-27: Total profits (Values in 1990 prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	165	161	160	162	167	171	176	190	203	215	0.1	2.1	3.2	1.5	1.3	1.1	1.4
2	Livestock	20	22	22	22	23	23	24	28	30	33	2.4	3.0	3.5	2.5	2.1	1.8	2.1
3	Forestry	2	2	1	1	1	0	0	0	0	0	-30.0	-90.0	-0.0	-0.0	-0.0	-0.0	-0.0
4	Fishery	43	39	37	36	37	39	43	66	91	114	-0.8	5.8	9.1	8.6	6.2	4.6	5.3
5	Mining and quarrying	32	34	34	36	40	42	45	58	72	86	6.6	5.0	5.7	5.2	4.2	3.6	4.7
6	Food manufacturing	76	75	76	77	80	83	87	103	119	136	2.0	3.5	4.4	3.4	3.0	2.6	3.0
7	Beverages and tobacco products	17	16	16	15	16	17	19	32	44	56	-3.9	7.1	12.1	10.1	6.6	4.8	6.2
8	Textile industry	70	69	71	75	79	83	86	101	116	132	4.3	4.0	4.2	3.1	2.8	2.6	3.2
9	Paper products and printing	19	18	18	19	21	23	26	41	58	78	-0.7	11.2	11.4	9.2	7.0	5.8	7.3
10	Chemical industries	24	25	27	29	32	35	38	57	79	103	8.3	8.7	9.2	8.0	6.5	5.4	7.0
11	Petroleum refineries	23	21	21	22	24	26	28	38	48	59	-2.5	6.9	8.0	6.3	4.8	4.0	5.1
12	Rubber and plastic products	15	17	17	19	21	23	25	35	45	55	5.7	8.1	8.5	7.0	5.2	3.9	6.0
13	Non-metallic products	22	26	27	29	31	32	32	41	50	57	7.6	2.3	2.1	4.8	3.6	2.7	3.9
14	Basic metal	13	13	13	15	16	17	18	25	32	39	9.9	6.0	6.3	5.9	4.9	4.2	5.6
15	Fabricated metal products	18	17	17	18	19	20	21	28	36	43	5.5	3.2	3.6	6.1	4.9	3.9	4.7
16	Machinery	120	130	134	144	156	162	169	237	309	383	6.9	4.2	4.1	6.7	5.4	4.3	5.4
17	Other manufacturing	71	73	75	78	85	90	96	124	154	187	3.4	5.9	6.2	5.2	4.4	3.9	4.7
18	Electricity and water works	37	48	52	52	54	53	54	66	78	90	6.1	-0.9	1.2	4.0	3.4	2.8	3.2
19	Construction	61	81	84	95	106	108	110	142	170	194	13.1	1.6	1.8	5.1	3.6	2.6	4.4
20	Trade	424	460	479	509	558	594	636	820	988	1154	5.6	6.3	6.8	5.1	3.7	3.1	4.6
21	Restaurants and hotels	56	60	60	62	67	72	78	104	128	151	2.4	6.4	8.2	5.8	4.2	3.3	4.6
22	Transportation and communication	96	118	119	119	124	126	129	160	191	222	6.6	1.3	2.3	4.3	3.6	3.0	3.2
23	Banking and insurance	86	94	101	110	126	141	158	252	346	430	7.8	11.1	11.7	9.3	6.4	4.3	7.6
24	Real estate	36	42	43	42	44	45	46	58	73	87	2.0	1.1	3.4	4.6	4.4	3.5	3.7
25	Services	50	60	67	69	75	77	80	95	112	129	3.2	2.9	3.5	3.5	3.1	2.9	3.8
26	Unclassified	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0

Table B-28: Total profits (Values in current prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	251	256	270	284	304	320	343	448	583	748	4.1	5.2	6.7	5.4	5.3	5.0	5.4
2	Livestock	31	35	37	39	41	44	47	65	88	116	6.4	6.0	7.1	6.3	6.0	5.6	6.1
3	Forestry	4	3	2	2	1	0	0	0	0	0	-26.0	-86.9	-0.0	-0.0	-0.0	-0.0	-0.0
4	Fishery	65	63	62	63	67	74	84	156	260	396	3.3	8.8	12.7	12.5	10.2	8.4	9.2
5	Mining and quarrying	48	53	57	64	73	80	87	137	206	299	10.6	8.1	9.3	9.0	8.2	7.4	8.6
6	Food manufacturing	115	119	127	135	146	156	169	242	343	474	6.0	6.5	7.9	7.2	7.0	6.5	6.9
7	Beverages and tobacco products	26	26	27	26	29	32	37	74	126	195	0.1	10.1	15.6	13.9	10.6	8.7	10.1
8	Textile industry	107	110	120	132	144	155	168	237	333	460	8.3	7.1	7.8	7.0	6.8	6.4	7.1
9	Paper products and printing	29	29	30	33	38	43	50	97	168	271	3.4	14.2	15.0	13.0	11.0	9.6	11.2
10	Chemical industries	37	40	45	51	58	66	75	134	227	359	12.3	11.7	12.8	11.8	10.5	9.2	11.0
11	Petroleum refineries	35	33	35	38	43	48	54	89	138	205	1.6	10.0	11.5	10.1	8.8	7.9	9.1
12	Rubber and plastic products	23	26	29	33	38	43	48	82	131	193	9.7	11.2	12.0	10.8	9.2	7.8	9.9
13	Non-metallic products	34	42	45	51	57	60	63	97	142	198	11.7	5.3	5.7	8.6	7.6	6.6	7.8
14	Basic metal	20	20	23	26	30	32	36	58	91	137	13.9	9.1	9.9	9.8	8.9	8.1	9.5
15	Fabricated metal products	27	27	29	31	35	37	40	66	103	151	9.5	6.2	7.2	10.0	8.9	7.8	8.6
16	Machinery	182	206	226	254	283	305	329	557	889	1332	11.0	7.2	7.7	10.5	9.3	8.1	9.3
17	Other manufacturing	108	117	127	138	154	169	186	292	443	651	7.4	9.0	9.8	9.0	8.4	7.7	8.6
18	Electricity and water works	56	76	88	91	98	100	105	155	225	314	10.2	2.2	4.7	7.9	7.4	6.7	7.1
19	Construction	92	128	141	166	193	203	214	334	489	675	17.1	4.7	5.3	8.9	7.6	6.5	8.3
20	Trade	644	732	807	895	1015	1114	1236	1929	2837	4015	9.7	9.3	10.4	8.9	7.7	6.9	8.5
21	Restaurants and hotels	85	95	101	109	122	134	151	244	367	526	6.5	9.5	11.8	9.6	8.2	7.2	8.6
22	Transportation and communication	145	187	200	209	226	236	250	376	549	774	10.7	4.3	5.8	8.1	7.6	6.9	7.1
23	Banking and insurance	130	149	169	194	229	264	308	593	994	1497	11.8	14.2	15.3	13.1	10.3	8.2	11.5
24	Real estate	55	66	72	74	81	84	90	137	209	301	6.1	4.1	7.0	8.4	8.4	7.4	7.6
25	Services	75	96	113	121	137	145	156	225	321	450	7.3	6.0	7.1	7.3	7.1	6.8	7.7
26	Unclassified	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0

Table B-29: Total depreciation (Values in 1990 prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	11	10	9	9	9	9	9	12	15	19	1.8	2.3	3.7	4.5	5.4	4.4	3.2
2	Livestock	3	2	2	2	2	2	2	3	4	5	1.8	2.3	3.8	4.6	5.5	4.4	3.2
3	Forestry	0	0	0	0	0	0	0	0	0	0	1.1	1.5	2.4	3.0	3.9	3.3	2.3
4	Fishery	10	9	8	8	7	8	8	11	15	19	2.4	3.1	4.9	5.7	6.5	5.0	3.8
5	Mining and quarrying	7	6	6	6	6	7	7	10	13	15	-5.8	5.3	5.3	5.9	5.7	3.8	4.5
6	Food manufacturing	17	17	17	18	19	20	22	30	41	53	1.9	6.2	6.8	6.5	6.0	5.4	5.8
7	Beverages and tobacco products	7	7	7	8	8	9	9	13	18	24	2.1	6.8	7.4	7.0	6.3	5.6	6.1
8	Textile industry	34	35	36	37	40	43	46	65	90	119	2.1	6.9	7.5	7.1	6.4	5.6	6.2
9	Paper products and printing	6	6	6	7	7	8	8	12	17	22	2.2	7.0	7.6	7.1	6.4	5.6	6.2
10	Chemical industries	7	8	8	8	9	9	10	15	20	27	2.2	7.0	7.7	7.2	6.4	5.6	6.3
11	Petroleum refineries	14	15	15	16	17	18	19	27	38	50	2.1	6.8	7.4	7.0	6.3	5.6	6.1
12	Rubber and plastic products	6	6	6	6	7	7	8	11	16	21	2.2	7.1	7.7	7.2	6.4	5.6	6.3
13	Non-metallic products	12	12	12	13	14	15	16	22	31	41	2.1	6.7	7.4	6.9	6.3	5.5	6.1
14	Basic metal	4	4	4	5	5	5	6	8	11	14	2.1	6.7	7.3	6.9	6.3	5.5	6.1
15	Fabricated metal products	4	4	4	4	4	4	5	7	10	13	2.2	7.0	7.7	7.2	6.4	5.6	6.3
16	Machinery	46	46	48	51	54	58	63	91	127	170	2.3	7.4	8.0	7.5	6.6	5.7	6.5
17	Other manufacturing	19	19	19	20	22	23	25	36	50	67	2.2	7.2	7.8	7.3	6.5	5.7	6.4
18	Electricity and water works	22	23	25	27	28	30	31	41	57	75	7.1	4.4	4.0	5.7	6.5	5.5	5.8
19	Construction	27	25	24	23	23	24	25	37	56	76	-5.8	3.5	3.8	8.0	8.2	6.2	5.6
20	Trade	59	55	54	55	59	65	72	108	149	196	-0.9	10.6	9.7	8.1	6.5	5.5	6.4
21	Restaurants and hotels	15	15	15	16	16	17	18	24	30	37	3.5	4.7	5.3	5.6	4.9	4.0	4.5
22	Transportation and communication	53	55	58	59	61	65	69	94	124	159	1.9	6.3	6.2	6.1	5.6	4.9	5.3
23	Banking and insurance	16	14	13	11	10	9	9	18	27	37	-8.8	-8.1	-0.4	12.5	9.0	5.9	4.8
24	Real estate	52	49	46	43	41	39	39	56	76	95	-5.0	-4.0	-0.2	7.0	6.2	4.5	3.3
25	Services	31	30	30	31	32	34	35	46	57	69	3.2	4.3	4.8	5.2	4.6	3.8	4.2
26	Unclassified	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0

Table B-30: Total depreciation (Values in current prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	17	16	16	16	16	17	18	27	44	66	5.8	5.4	7.3	8.4	9.4	8.2	7.1
2	Livestock	4	4	4	4	4	4	4	7	11	16	5.8	5.4	7.3	8.4	9.5	8.2	7.1
3	Forestry	0	0	0	0	0	0	0	1	1	1	5.1	4.5	5.9	6.8	7.9	7.2	6.2
4	Fishery	15	14	13	13	13	14	16	25	42	66	6.4	6.1	8.5	9.6	10.5	8.8	7.7
5	Mining and quarrying	10	10	10	11	12	13	14	23	37	54	-1.8	8.4	8.8	9.8	9.7	7.6	8.4
6	Food manufacturing	25	27	29	32	35	38	42	71	117	185	5.9	9.3	10.4	10.4	10.0	9.2	9.7
7	Beverages and tobacco products	11	11	12	13	15	16	18	31	53	84	6.1	9.9	11.0	10.8	10.3	9.4	10.1
8	Textile industry	52	55	60	66	72	80	89	154	259	414	6.2	10.0	11.1	10.9	10.3	9.4	10.1
9	Paper products and printing	9	10	11	12	13	15	16	28	47	76	6.2	10.0	11.2	11.0	10.4	9.4	10.1
10	Chemical industries	11	12	13	14	16	18	20	34	58	92	6.2	10.1	11.2	11.0	10.4	9.5	10.2
11	Petroleum refineries	22	23	25	28	30	34	38	65	108	173	6.1	9.9	11.0	10.8	10.3	9.4	10.1
12	Rubber and plastic products	9	9	10	11	12	14	15	27	45	72	6.2	10.1	11.3	11.0	10.4	9.5	10.2
13	Non-metallic products	18	19	21	23	25	28	31	53	88	141	6.1	9.8	10.9	10.8	10.3	9.4	10.0
14	Basic metal	6	7	7	8	9	10	11	18	31	49	6.1	9.7	10.9	10.7	10.2	9.4	10.0
15	Fabricated metal products	5	6	6	7	8	8	9	16	27	44	6.2	10.1	11.2	11.0	10.4	9.5	10.2
16	Machinery	69	74	81	89	98	109	122	215	365	590	6.3	10.5	11.6	11.3	10.6	9.6	10.4
17	Other manufacturing	28	30	33	36	40	44	49	86	145	233	6.3	10.2	11.4	11.1	10.5	9.5	10.3
18	Electricity and water works	33	37	43	48	52	56	60	97	163	259	11.1	7.5	7.5	9.6	10.4	9.3	9.7
19	Construction	40	40	40	41	42	45	49	88	161	266	-1.8	6.5	7.4	11.8	12.2	10.0	9.5
20	Trade	89	87	91	96	107	122	140	254	429	682	3.1	13.6	13.3	11.9	10.5	9.3	10.3
21	Restaurants and hotels	23	24	26	27	29	32	35	56	87	128	7.6	7.8	8.9	9.4	8.9	7.8	8.4
22	Transportation and communication	81	88	97	104	111	122	135	221	357	552	6.0	9.3	9.7	9.9	9.6	8.7	9.2
23	Banking and insurance	24	23	21	20	19	18	18	41	79	128	-4.8	-5.0	3.2	16.3	12.9	9.8	8.7
24	Real estate	79	78	77	76	75	74	76	131	218	332	-0.9	-1.0	3.4	10.9	10.1	8.4	7.2
25	Services	46	48	51	55	59	63	68	107	165	242	7.2	7.3	8.4	9.0	8.6	7.6	8.1
26	Unclassified	0	0	0	0	0	0	0	0	0	0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0

Table B-31: Total net indirect taxes (Values in 1990 prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	0	0	0	0	0	0	0	0	0	0	-1.0	3.1	4.2	2.4	1.7	1.4	1.7
2	Livestock	0	0	0	0	0	0	0	0	0	0	2.2	3.3	4.7	3.7	2.8	2.3	2.9
3	Forestry	0	0	0	0	0	0	0	0	0	0	-5.3	-3.8	-4.2	1.5	1.8	1.0	0.0
4	Fishery	0	0	0	0	0	0	0	0	0	0	0.8	5.1	7.6	7.5	5.6	4.2	4.9
5	Mining and quarrying	10	10	11	11	12	13	14	19	25	30	6.2	7.1	6.8	6.0	5.0	4.2	5.4
6	Food manufacturing	4	4	4	4	4	4	4	5	6	7	1.6	4.0	5.1	4.3	3.5	3.0	3.4
7	Beverages and tobacco products	54	53	53	52	54	57	61	89	117	145	-1.3	5.1	7.6	7.6	5.5	4.2	5.0
8	Textile industry	8	8	8	8	9	10	10	13	15	18	3.4	5.5	5.9	4.7	3.8	3.3	4.1
9	Paper products and printing	1	1	1	1	1	1	2	2	3	4	0.5	8.6	9.1	8.1	6.7	5.8	6.6
10	Chemical industries	2	2	2	2	3	3	3	5	8	10	8.5	9.6	9.9	8.9	7.6	6.6	8.0
11	Petroleum refineries	41	38	36	37	40	42	45	59	73	88	-2.9	5.8	6.5	5.5	4.4	3.7	4.2
12	Rubber and plastic products	1	2	2	2	2	2	2	3	5	6	6.1	8.6	8.7	7.6	6.4	5.5	6.9
13	Non-metallic products	2	2	2	3	3	3	3	5	6	8	11.3	6.9	6.7	6.5	5.3	4.4	6.4
14	Basic metal	1	1	1	1	1	2	2	3	4	5	9.6	8.9	8.5	8.1	7.1	6.2	7.6
15	Fabricated metal products	1	1	1	1	1	1	2	2	3	4	8.5	8.0	8.2	7.9	6.6	5.6	7.0
16	Machinery	17	19	20	23	25	28	30	46	65	86	9.2	8.9	8.5	8.3	6.9	5.8	7.7
17	Other manufacturing	4	4	4	5	5	5	5	7	9	10	3.0	5.4	5.8	5.0	4.1	3.5	4.4
18	Electricity and water works	3	4	4	4	5	5	5	7	9	12	5.8	5.9	6.0	6.2	5.5	4.6	5.9
19	Construction	12	15	17	20	23	24	26	35	45	54	10.9	7.0	5.9	6.1	4.9	3.9	6.3
20	Trade	38	40	42	45	49	52	56	76	95	114	4.8	7.1	7.2	6.0	4.5	3.7	5.2
21	Restaurants and hotels	19	19	19	19	21	22	24	32	39	46	0.5	6.0	7.2	5.9	4.2	3.3	4.5
22	Transportation and communication	2	2	2	2	3	3	3	4	5	6	5.1	5.1	5.7	5.6	4.8	4.1	5.1
23	Banking and insurance	16	17	19	20	23	25	28	45	63	82	7.2	9.8	10.4	9.4	7.0	5.3	7.8
24	Real estate	14	15	15	15	16	16	16	21	27	33	-0.4	0.6	2.6	4.9	5.2	3.9	3.9
25	Services	8	8	9	9	10	10	10	12	14	16	2.7	3.7	3.4	3.3	2.8	2.5	3.3
26	Unclassified	4	4	4	5	5	6	7	11	17	25	3.7	11.0	11.3	10.5	8.9	7.3	9.3

Table B-32: Total net indirect taxes (Values in current prices, billions of baht)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	0	1	1	1	1	1	1	1	1	2	3.1	6.2	7.7	6.2	5.7	5.2	5.7
2	Livestock	0	0	0	0	0	0	0	0	0	0	6.3	6.4	8.3	7.5	6.7	6.1	6.8
3	Forestry	0	0	0	0	0	0	0	0	0	0	-1.2	-0.7	-0.7	5.4	5.7	4.8	3.9
4	Fishery	0	0	0	0	0	0	0	0	0	0	4.8	8.1	11.1	11.3	9.6	8.0	8.8
5	Mining and quarrying	15	16	18	20	22	25	27	45	70	105	10.2	10.2	10.3	9.9	9.0	8.0	9.4
6	Food manufacturing	5	6	6	6	7	7	8	12	17	24	5.6	7.0	8.6	8.1	7.5	6.9	7.3
7	Beverages and tobacco products	82	85	89	91	98	106	119	210	337	503	2.8	8.1	11.2	11.4	9.4	8.0	8.9
8	Textile industry	12	13	14	15	16	18	20	30	44	64	7.4	8.6	9.4	8.5	7.8	7.2	8.0
9	Paper products and printing	2	2	2	2	2	3	3	6	10	16	4.6	11.6	12.7	12.0	10.6	9.7	10.5
10	Chemical industries	3	3	4	4	5	6	6	12	22	36	12.6	12.6	13.4	12.7	11.6	10.5	11.9
11	Petroleum refineries	63	60	61	65	72	79	87	138	210	306	1.1	8.8	10.1	9.3	8.3	7.5	8.1
12	Rubber and plastic products	2	2	3	3	3	4	4	8	13	21	10.1	11.6	12.2	11.5	10.4	9.4	10.8
13	Non-metallic products	3	3	4	5	5	6	7	11	18	27	15.3	10.0	10.2	10.4	9.3	8.2	10.3
14	Basic metal	2	2	2	2	3	3	3	6	11	18	13.6	12.0	12.1	12.0	11.0	10.1	11.5
15	Fabricated metal products	2	2	2	2	2	3	3	5	9	15	12.6	11.1	11.8	11.7	10.6	9.4	10.9
16	Machinery	25	30	34	40	46	52	59	107	185	301	13.2	11.9	12.1	12.1	10.9	9.7	11.6
17	Other manufacturing	6	7	7	8	9	10	11	17	25	36	7.0	8.5	9.4	8.9	8.1	7.4	8.3
18	Electricity and water works	5	6	7	8	8	9	10	17	27	41	9.8	9.0	9.6	10.0	9.5	8.5	9.8
19	Construction	19	25	29	34	41	45	50	82	128	189	14.9	10.1	9.4	9.9	8.9	7.8	10.2
20	Trade	57	64	71	78	89	98	109	179	272	398	8.8	10.2	10.8	9.8	8.5	7.6	9.2
21	Restaurants and hotels	28	30	32	34	38	41	46	74	112	160	4.5	9.0	10.7	9.8	8.2	7.1	8.4
22	Transportation and communication	3	3	4	4	5	5	5	9	14	20	9.2	8.2	9.3	9.5	8.8	8.0	9.0
23	Banking and insurance	24	28	31	36	41	47	54	105	182	286	11.2	12.9	14.0	13.3	11.0	9.1	11.7
24	Real estate	21	24	26	27	28	30	31	49	77	113	3.6	3.6	6.1	8.7	9.2	7.8	7.8
25	Services	12	13	15	16	18	19	20	29	41	56	6.7	6.8	7.0	7.2	6.8	6.3	7.2
26	Unclassified	6	6	7	8	10	11	13	26	50	87	7.7	14.1	14.9	14.3	12.8	11.2	13.2

Table B-33: Output price index (1990=100)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Crops	163.3	167.2	177.0	186.3	195.9	205.1	214.1	252.9	304.1	365.4	3.2	4.6	4.3	3.3	3.7	3.7	3.9
2	Livestock	158.7	166.6	176.2	184.2	191.8	199.5	207.6	246.2	295.1	351.1	5.2	3.9	4.0	3.4	3.6	3.5	3.7
3	Forestry	142.8	140.6	142.0	144.2	144.0	142.3	144.6	197.4	259.8	323.1	-0.9	-1.2	1.6	6.2	5.5	4.4	4.2
4	Fishery	197.7	190.3	190.3	191.3	195.1	200.7	209.0	258.0	316.7	380.3	-1.7	2.8	4.1	4.2	4.1	3.7	3.5
5	Mining and quarrying	132.1	134.6	140.2	145.4	150.3	153.7	157.9	182.9	215.3	252.6	2.2	2.3	2.7	2.9	3.3	3.2	3.1
6	Food manufacturing	165.4	169.5	178.6	186.5	194.2	201.5	209.5	248.7	296.6	350.0	3.1	3.7	3.9	3.4	3.5	3.3	3.6
7	Beverages and tobacco products	137.4	141.1	149.0	156.0	164.5	173.6	184.4	243.5	313.6	397.8	3.3	5.4	6.0	5.6	5.1	4.8	5.2
8	Textile industry	154.7	160.8	171.4	179.6	185.8	190.8	196.5	229.2	273.0	325.7	3.9	2.6	2.9	3.1	3.5	3.5	3.5
9	Paper products and printing	139.7	140.6	148.3	157.0	167.0	177.2	188.6	250.0	325.4	416.3	2.1	5.9	6.3	5.6	5.3	4.9	5.4
10	Chemical industries	145.4	153.7	165.8	176.2	186.1	195.4	205.9	266.3	343.4	436.0	5.6	4.9	5.2	5.1	5.1	4.8	5.2
11	Petroleum refineries	136.1	133.2	137.9	143.3	149.2	154.6	160.6	192.6	233.6	282.9	-0.6	3.6	3.8	3.6	3.9	3.8	3.8
12	Rubber and plastic products	148.0	155.7	167.0	176.8	186.3	195.0	204.8	257.6	324.4	403.8	5.1	4.6	4.9	4.6	4.6	4.4	4.8
13	Non-metallic products	139.4	143.9	150.9	154.9	158.1	161.9	166.8	203.1	250.7	307.6	4.4	2.3	3.0	3.9	4.2	4.1	3.8
14	Basic metal	114.0	116.6	124.8	131.8	137.9	143.3	149.9	188.9	238.9	299.5	2.6	3.9	4.5	4.6	4.7	4.5	4.7
15	Fabricated metal products	124.8	126.1	133.8	140.6	146.4	151.6	157.9	199.3	251.8	314.9	1.8	3.5	4.1	4.7	4.7	4.5	4.6
16	Machinery	130.2	137.7	148.8	158.2	166.9	175.4	185.1	249.1	329.3	423.5	5.6	5.0	5.4	5.9	5.6	5.0	5.6
17	Other manufacturing	143.6	149.2	157.6	164.2	169.7	174.7	180.6	212.8	254.1	303.8	3.6	2.9	3.3	3.3	3.5	3.6	3.6
18	Electricity and water works	143.5	157.7	170.7	176.9	181.5	184.0	187.5	220.2	266.0	320.0	5.6	1.4	1.9	3.2	3.8	3.7	3.5
19	Construction	147.9	153.0	159.5	164.1	168.0	171.6	176.5	216.1	267.9	329.0	3.0	2.1	2.9	4.0	4.3	4.1	3.8
20	Trade	147.6	154.4	163.1	170.0	176.7	182.5	189.4	222.1	261.6	308.3	3.7	3.3	3.7	3.2	3.3	3.3	3.5
21	Restaurants and hotels	158.8	167.2	178.0	186.9	196.2	204.7	214.2	260.8	317.7	384.0	4.6	4.2	4.5	3.9	3.9	3.8	4.2
22	Transportation and communication	147.5	159.2	169.0	175.1	180.7	185.9	192.2	235.5	291.1	356.5	5.6	2.9	3.3	4.1	4.2	4.1	4.0
23	Banking and insurance	148.9	155.2	165.2	173.4	181.1	188.5	197.4	246.8	300.4	356.0	4.1	4.0	4.6	4.5	3.9	3.4	4.2
24	Real estate	160.9	170.7	177.1	179.8	179.5	178.5	179.4	217.0	270.9	330.0	3.9	-0.5	0.5	3.8	4.4	3.9	3.3
25	Services	162.7	176.1	189.9	200.6	207.4	212.0	218.0	253.3	293.9	339.1	5.5	2.2	2.8	3.0	3.0	2.9	3.3
26	Unclassified	121.9	127.2	136.7	145.1	153.2	161.0	169.8	219.8	282.1	355.2	2.3	4.9	5.3	5.2	5.0	4.6	5.1

Table B-34: Output price index in aggregate sector (1990=100)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Agriculture	167.4	170.1	178.2	185.6	193.6	201.6	210.2	251.6	304.9	366.5	2.6	4.0	4.2	3.6	3.8	3.7	3.8
2	Mining & quarrying	131.7	134.3	140.0	145.3	150.4	154.0	158.4	184.6	218.7	258.4	2.2	2.4	2.8	3.1	3.4	3.3	3.3
3	Manufacturing	142.2	147.2	156.6	164.4	171.7	178.6	186.7	235.1	297.0	370.9	3.8	4.0	4.4	4.6	4.7	4.4	4.6
4	Construction	147.5	152.7	159.2	163.9	167.8	171.5	176.5	216.2	268.1	329.6	3.0	2.1	2.9	4.1	4.3	4.1	3.8
5	Electricity & water supply	143.0	157.0	170.0	176.2	180.9	183.5	187.0	220.2	266.5	321.2	5.5	1.4	1.9	3.3	3.8	3.7	3.6
6	Transportation & communication	147.3	158.9	168.7	174.7	180.4	185.7	191.9	235.3	291.0	356.5	5.6	2.9	3.3	4.1	4.2	4.1	4.0
7	Wholesale & retail trade	147.5	154.2	162.9	169.8	176.5	182.4	189.3	222.1	261.8	308.7	3.7	3.3	3.7	3.2	3.3	3.3	3.5
8	Banking,insurance & real estate	152.4	159.6	168.3	174.8	180.3	185.5	192.5	239.7	294.0	351.1	4.0	2.9	3.7	4.4	4.1	3.5	3.9
9	Ownership of dwellings	145.9	151.4	158.1	163.1	167.3	171.1	176.2	216.3	268.6	330.5	3.0	2.2	3.0	4.1	4.3	4.1	3.9
10	Public administration & defense	159.9	171.2	183.9	193.8	201.3	207.2	214.3	253.5	300.9	355.4	5.1	2.9	3.4	3.4	3.4	3.3	3.7
11	Services	161.0	172.7	185.5	195.6	203.2	209.1	216.2	255.6	302.3	355.4	5.2	2.9	3.4	3.3	3.4	3.2	3.6

Table B-35: Consumption price index (1990=100)

		1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
1	Rice & cereals	158.9	164.3	173.5	181.1	188.6	195.5	203.2	240.6	287.0	340.4	3.5	3.6	3.8	3.4	3.5	3.4	3.6
2	Meat	158.1	164.2	173.3	180.7	187.9	194.6	202.1	239.6	285.7	338.4	3.8	3.5	3.8	3.4	3.5	3.4	3.6
3	Fish	178.9	177.8	182.1	186.1	191.4	197.5	205.4	249.1	302.0	360.7	0.6	3.1	3.9	3.9	3.9	3.5	3.5
4	Milk,cheese & eggs	158.1	164.2	173.3	180.7	187.9	194.6	202.1	239.6	285.7	338.4	3.8	3.5	3.8	3.4	3.5	3.4	3.6
5	Oil & fat	158.0	163.8	172.8	180.1	187.2	193.7	201.1	238.4	283.9	336.0	3.5	3.4	3.8	3.4	3.5	3.4	3.6
6	Fruit & vegetables	158.9	164.3	173.5	181.1	188.6	195.5	203.2	240.6	287.0	340.4	3.5	3.6	3.8	3.4	3.5	3.4	3.6
7	Sugar,preserves & confectionery	158.0	163.8	172.8	180.1	187.2	193.7	201.1	238.4	283.9	336.0	3.5	3.4	3.8	3.4	3.5	3.4	3.6
8	Coffee,tea,cocoa,etc.	158.9	164.3	173.5	181.1	188.6	195.5	203.2	240.6	287.0	340.4	3.5	3.6	3.8	3.4	3.5	3.4	3.6
9	Other food	158.5	164.0	173.1	180.8	188.3	195.2	202.9	240.4	286.9	340.5	3.5	3.6	3.9	3.4	3.5	3.4	3.7
10	Non-alcoholic beverages	143.8	148.8	157.3	164.4	172.4	180.5	189.8	239.3	299.2	370.8	3.5	4.6	5.1	4.6	4.5	4.3	4.6
11	Alcoholic beverages	140.8	146.0	154.3	161.1	168.9	176.9	186.4	237.5	298.6	371.5	3.6	4.6	5.2	4.8	4.6	4.4	4.7
12	Tobacco	143.8	148.8	157.3	164.4	172.4	180.5	189.8	239.3	299.2	370.8	3.5	4.6	5.1	4.6	4.5	4.3	4.6
13	Footwear	145.4	152.2	161.0	167.7	173.8	179.3	185.7	220.2	263.7	315.4	4.0	3.1	3.5	3.4	3.6	3.6	3.6
14	Clothing	152.8	159.4	169.6	177.4	183.7	188.8	194.8	228.2	272.0	324.2	4.0	2.8	3.1	3.2	3.5	3.5	3.5
15	Other personal effects	145.0	151.7	160.4	167.0	172.9	178.2	184.4	218.1	260.6	311.1	3.9	3.0	3.4	3.4	3.6	3.5	3.6
16	Rent & water charges	156.8	168.1	177.2	182.1	184.4	185.6	188.3	224.8	274.5	330.5	4.6	0.6	1.4	3.5	4.0	3.7	3.4
17	Fuel & light	145.8	156.7	167.6	174.0	179.6	183.8	188.9	223.0	267.6	320.3	4.9	2.3	2.8	3.3	3.7	3.6	3.6
18	Furniture & furnishings	149.3	155.1	164.3	171.3	176.9	181.6	187.4	221.7	265.9	318.2	3.7	2.6	3.1	3.4	3.6	3.6	3.6
19	Households equipment	139.5	145.7	154.8	162.1	168.7	174.7	181.8	223.2	275.4	337.6	4.0	3.5	4.0	4.1	4.2	4.1	4.2
20	Domestic services of household	162.7	176.1	189.9	200.6	207.4	212.0	218.0	253.3	293.9	339.1	5.5	2.2	2.8	3.0	3.0	2.9	3.3
21	Other expenditures of household	150.4	159.5	170.5	179.3	186.9	193.5	201.4	244.8	295.9	353.5	4.9	3.5	4.0	3.9	3.8	3.6	4.0
22	Personal care	151.2	160.9	172.3	181.2	188.7	195.1	202.7	244.5	294.9	352.9	5.1	3.3	3.8	3.8	3.7	3.6	3.9
23	Health expenses	151.2	160.9	172.3	181.2	188.7	195.1	202.7	244.5	294.9	352.9	5.1	3.3	3.8	3.8	3.7	3.6	3.9
24	Personal transportation equipment	140.1	148.0	157.9	165.7	173.1	180.0	188.0	235.9	295.7	366.1	4.8	3.9	4.4	4.5	4.5	4.3	4.5
25	Operation of private transportation	140.8	145.1	153.6	160.8	167.9	174.6	182.3	226.3	280.4	343.5	3.1	3.9	4.3	4.3	4.3	4.1	4.3
26	Purchased transportation	135.2	143.8	154.5	162.9	170.7	178.3	187.1	245.6	319.7	407.2	5.6	4.4	4.8	5.4	5.3	4.8	5.2
27	Communication	140.1	148.0	157.9	165.7	173.1	180.0	188.0	235.9	295.7	366.1	4.8	3.9	4.4	4.5	4.5	4.3	4.5
28	Entertainment	162.7	176.1	189.9	200.6	207.4	212.0	218.0	253.3	293.9	339.1	5.5	2.2	2.8	3.0	3.0	2.9	3.3
29	Hotels,restaurants & cafes	158.8	167.2	178.0	186.9	196.2	204.7	214.2	260.8	317.7	384.0	4.6	4.2	4.5	3.9	3.9	3.8	4.2
30	Books,newspapers & magazines	142.0	145.0	153.1	161.2	170.1	179.0	189.1	243.0	309.0	388.1	2.8	5.1	5.5	5.0	4.8	4.6	4.9
31	Other recreation	148.9	157.1	166.9	174.3	180.4	185.5	191.7	225.7	267.8	317.2	4.3	2.8	3.3	3.3	3.4	3.4	3.5
32	Financial services	148.9	155.2	165.2	173.4	181.1	188.5	197.4	246.8	300.4	356.0	4.1	4.0	4.6	4.5	3.9	3.4	4.2
33	Other services	161.2	174.4	188.1	198.7	205.6	210.3	216.4	252.3	293.6	339.6	5.4	2.3	2.8	3.1	3.0	2.9	3.3

APPENDIX C: THE OPTIMAL TAX POLICY FORECASTS

Table C-1: Main Account of the Low Inflation Optimal Tax Forecasts

Real Activity (Values in 1990 prices, billions of baht)	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
Gross Domestic Product	3372	3550	3644	3803	4024	4186	4400	5618	6923	8224	3.7	4.0	5.0	4.9	4.2	3.4	4.2
Private consumption	1761	1778	1774	1765	1841	1913	2032	2649	3269	3818	0.7	3.8	6.0	5.3	4.2	3.1	3.8
Government expenditure	361	370	380	389	399	409	419	475	539	610	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Gross fixed investment	832	1041	1162	1366	1596	1727	1844	2480	3143	3784	12.9	7.9	6.6	5.9	4.7	3.7	6.5
Inventory change	37	47	49	49	49	50	49	48	52	52	-0.0	1.8	-3.1	-0.1	1.5	0.0	0.6
Net exports	291	219	215	181	120	101	80	-9	-31	74							
Exports	1868	1906	1984	2068	2157	2254	2357	2941	3647	4493	2.9	4.4	4.5	4.4	4.3	4.2	4.3
Imports	1578	1687	1769	1886	2038	2153	2277	2950	3678	4419	5.2	5.5	5.6	5.2	4.4	3.7	4.8
Statistical discrepancy	91	96	65	53	18	-15	-25	-26	-48	-115							
Real personal income	2094	2054	2002	2051	2121	2241	2385	3133	3869	4563	-0.2	5.5	6.2	5.5	4.2	3.3	4.0
Real personal disposable income	2013	1974	1916	1954	2011	2116	2239	2883	3513	4094	-0.3	5.1	5.7	5.0	4.0	3.1	3.6
Nominal Activity (Values in current prices, billions of baht)	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
Gross Domestic Product	5114	5646	6142	6684	7319	7843	8529	12941	18892	26328	7.7	6.9	8.4	8.3	7.6	6.6	7.7
Private consumption	2656	2804	2966	3081	3338	3583	3946	6107	8901	12154	4.7	7.1	9.6	8.7	7.5	6.2	7.3
Government expenditure	575	635	701	758	804	842	887	1151	1486	1900	7.7	4.7	5.2	5.2	5.1	4.9	5.5
Gross fixed investment	1169	1528	1806	2217	2690	3007	3337	5557	8646	12562	16.9	11.2	10.4	10.2	8.8	7.5	10.5
Inventory change	54	68	76	79	84	89	90	108	141	167	-0.0	5.5	0.9	3.8	5.3	3.5	4.5
Net exports	523	459	484	455	371	349	318	78	-149	-86							
Exports	2669	2851	3165	3469	3780	4103	4473	6857	10345	15259	7.3	8.2	8.7	8.5	8.2	7.8	8.4
Imports	2146	2392	2681	3014	3409	3754	4155	6779	10494	15345	9.4	9.6	10.2	9.8	8.7	7.6	9.3
Statistical discrepancy	138	153	109	93	33	-27	-48	-60	-132	-369							
Personal income	3176	3266	3375	3605	3858	4199	4623	7217	10559	14607	3.8	8.5	9.6	8.9	7.6	6.5	7.5
Direct tax rates (percent)	3.9	3.9	4.3	4.7	5.2	5.6	6.1	8.0	9.2	10.3							
Personal disposable income	3052	3139	3229	3434	3658	3964	4341	6640	9585	13108	3.7	8.0	9.1	8.5	7.3	6.3	7.1
Saving rates (percent)	13.4	11.0	8.8	10.2	8.6	9.3	8.8	8.0	7.4	7.7							

Table C-1: Main Account of the Low Inflation Optimal Tax Forecasts (cont.)

Value added (Values in current prices, billions of baht)																	
	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
Wages	1566	1731	1892	2071	2218	2330	2497	3536	4836	6337	8.1	5.0	6.9	7.0	6.3	5.4	6.5
Operating surpluses	2423	2735	2983	3255	3623	3902	4258	6492	9453	13109	8.7	7.4	8.7	8.4	7.5	6.5	7.8
Depreciation	728	750	799	849	911	990	1088	1801	2891	4393	4.3	8.3	9.4	10.1	9.5	8.4	8.8
Net indirect taxes	398	430	468	509	567	620	685	1111	1711	2490	6.6	8.9	10.0	9.7	8.6	7.5	8.8
Price Indexes, 1990=100																	
GDP deflator	151.7	159.0	168.6	175.8	181.9	187.4	193.8	230.3	272.9	320.1	4.0	3.0	3.4	3.5	3.4	3.2	3.5
PCE deflator	150.2	157.3	167.0	174.5	181.4	187.6	194.6	231.7	274.2	320.7	4.1	3.3	3.7	3.5	3.4	3.1	3.6
Employment and Population																	
	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
Unemployment rate	4.2	3.6	3.2	2.2	3.3	4.0	4.1	4.1	4.3	4.6							
Labor productivity																	
(real output/worker, thou. bahts)	220.9	228.4	237.8	251.1	269.2	288.5	304.4	383.0	470.0	567.8	4.6	6.9	5.4	4.6	4.1	3.8	4.6
Labor force	32.7	33.2	33.9	34.2	34.7	35.1	35.3	36.7	37.9	39.0	1.4	1.2	0.5	0.8	0.7	0.6	0.8
Population	61.7	62.2	62.7	63.1	63.7	64.2	64.8	67.0	69.1	70.8	0.7	0.8	0.9	0.7	0.6	0.5	0.6
Financial Variables																	
Nominal interest rate (1-yr dep rate)	4.7	3.3	3.0	2.6	1.4	1.5	1.6	2.5	3.0	3.5							
Money supply growth (M2)	2.1	3.6	4.1	2.5	3.0	3.3	3.6	5.0	5.7	6.3							
Exchange rate (bahts/US dollar)	37.8	40.2	44.5	43.0	41.5	40.0	39.8	38.6	37.4	36.2							

Table C-2: Main Account of the Low Unemployment Optimal Tax Forecasts

Real Activity (Values in 1990 prices, billions of baht)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
Gross Domestic Product	3372	3550	3644	3807	4056	4250	4499	5935	7364	8877	3.9	4.7	5.7	5.5	4.3	3.7	4.6
Private consumption	1761	1778	1774	1768	1870	1972	2124	2946	3678	4414	1.0	5.3	7.4	6.5	4.4	3.6	4.5
Government expenditure	361	370	380	389	399	409	419	475	539	610	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Gross fixed investment	832	1041	1162	1369	1616	1765	1901	2635	3334	4082	13.1	8.9	7.4	6.5	4.7	4.0	6.8
Inventory change	37	47	49	49	50	51	50	51	55	56	-0.0	2.8	-2.3	0.5	1.5	0.3	0.9
Net exports	291	219	215	179	104	70	33	-150	-217	-202							
Exports	1868	1906	1984	2068	2157	2254	2357	2941	3647	4493	2.9	4.4	4.5	4.4	4.3	4.2	4.3
Imports	1578	1687	1769	1889	2054	2184	2325	3091	3863	4695	5.4	6.2	6.2	5.7	4.5	3.9	5.1
Statistical discrepancy	91	96	65	53	18	-17	-28	-22	-25	-84							
Real personal income	2094	2054	2002	2054	2142	2280	2441	3288	4063	4841	0.0	6.2	6.8	6.0	4.2	3.5	4.3
Real personal disposable income	2013	1974	1927	1979	2066	2201	2361	3191	3939	4717	0.2	6.3	7.0	6.0	4.2	3.6	4.4

Nominal Activity (Values in current prices, billions of baht)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
Gross Domestic Product	5114	5646	6142	6692	7382	7982	8767	14236	22073	33223	7.9	7.8	9.4	9.7	8.8	8.2	8.9
Private consumption	2656	2804	2966	3088	3393	3702	4145	7067	10998	16430	5.0	8.7	11.3	10.7	8.8	8.0	8.8
Government expenditure	575	635	701	758	805	847	897	1216	1655	2258	7.8	5.1	5.7	6.1	6.2	6.2	6.3
Gross fixed investment	1169	1528	1806	2222	2723	3080	3457	6149	10085	15871	17.2	12.3	11.5	11.5	9.9	9.1	11.7
Inventory change	54	68	76	79	84	90	92	118	162	209	-0.0	6.6	2.0	5.1	6.3	5.0	5.6
Net exports	523	459	484	450	344	294	231	-264	-753	-1231							
Exports	2669	2851	3165	3468	3781	4111	4495	7134	11358	17844	7.3	8.4	8.9	9.2	9.3	9.0	9.2
Imports	2146	2392	2681	3018	3437	3817	4265	7398	12111	19076	9.6	10.5	11.1	11.0	9.9	9.1	10.4
Statistical discrepancy	138	153	109	94	33	-31	-54	-52	-74	-314							
Personal income	3176	3266	3375	3610	3898	4281	4756	7886	12178	18117	4.0	9.4	10.5	10.1	8.7	7.9	8.6
Direct tax rates (percent)	3.9	3.9	3.8	3.7	3.6	3.4	3.3	3.0	3.0	2.6							
Personal disposable income	3052	3139	3248	3478	3760	4133	4601	7654	11807	17653	4.2	9.5	10.7	10.2	8.7	8.0	8.6
Saving rates (percent)	13.4	11.0	8.8	11.1	9.5	10.1	9.6	7.8	7.3	7.5							

Table C-2: Main Account of the Low Unemployment Optimal Tax Forecasts (cont.)

Value added (Values in current prices, billions of baht)	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
Wages	1566	1731	1892	2073	2236	2375	2576	3941	5726	8127	8.3	6.0	8.1	8.5	7.5	7.0	7.7
Operating surpluses	2423	2735	2983	3261	3662	3979	4383	7116	10975	16430	8.9	8.3	9.7	9.7	8.7	8.1	9.0
Depreciation	728	750	799	849	912	995	1100	1942	3352	5490	4.3	8.7	10.1	11.4	10.9	9.9	9.9
Net indirect taxes	398	430	468	509	573	633	708	1237	2020	3176	6.8	10.0	11.2	11.2	9.8	9.1	10.0
Price Indexes, 1990=100																	
GDP deflator	151.7	159.0	168.6	175.8	182.0	187.8	194.9	239.8	299.7	374.3	4.0	3.1	3.7	4.2	4.5	4.4	4.3
PCE deflator	150.2	157.3	167.0	174.5	181.6	188.0	195.6	241.3	301.2	375.3	4.1	3.5	4.0	4.2	4.4	4.4	4.3
Employment and Population	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020	98-03	03-04	04-05	05-10	10-15	15-20	00-20
Unemployment rate	4.2	3.6	3.2	2.2	3.2	3.7	3.7	2.7	2.8	2.8							
Labor productivity																	
(real output/worker, thou. bahts)	220.9	228.4	237.8	251.4	270.7	290.4	306.6	385.2	471.4	569.8	4.7	7.0	5.4	4.6	4.0	3.8	4.6
Labor force	32.7	33.2	33.9	34.2	34.7	35.1	35.3	36.7	37.9	39.0	1.4	1.2	0.5	0.8	0.7	0.6	0.8
Population	61.7	62.2	62.7	63.1	63.7	64.2	64.8	67.0	69.1	70.8	0.7	0.8	0.9	0.7	0.6	0.5	0.6
Financial Variables																	
Nominal interest rate (1-yr dep rate)	4.7	3.3	3.0	2.6	1.4	1.5	1.6	2.5	3.0	3.5							
Money supply growth (M2)	2.1	3.6	4.1	2.5	3.0	3.3	3.6	5.0	5.7	6.3							
Exchange rate (bahts/US dollar)	37.8	40.2	44.5	43.0	41.5	40.0	39.8	38.6	37.4	36.2							

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