Growth Without Adjustment: Thailand, 1973-82

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by
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and
Hector Sierra

Abstract

Despite the adverse external shocks of the 1970's, and seemingly little effort to adjust to them, the Thai economy grew at an average annual rate of 7.4% from 1973-82. This paper examines Thailand's curiously successful adjustment experience using a six-sector general equilibrium model which is calibrated to reproduce the actual behavior of the economy from 1973-82. Counterfactual experiments with the model reveal that: (i) the favorable shocks (like transfers from U.S. bases in Southeast Asia, a surge in export prices, etc.) that accompanied the adverse ones contributed little to Thailand's growth, and did not mitigate the need to adjust; (ii) the foreign borrowing that financed much of Thailand's ambitious investment program of the 1970's, while it enabled the country to achieve an impressive growth rate, was probably excessive, even if interest rates had remained at 1973 levels; (iii) sizeable gains in both equity and efficiency could have been achieved by changing the composition, rather than the volume, of investment.
GROWTH WITHOUT ADJUSTMENT:

THAILAND, 1973-1982

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# Table of Contents

I. INTRODUCTION ....................................................................................... 1

II. ADJUSTMENT EXPERIENCE OF THAILAND ........................................... 5  
   A. Antecedents and Institutional Framework ....................................... 5  
   B. External Shocks, 1973-81 ............................................................... 7  
   C. Modes of Adjustment ................................................................. 8

III. THE MODEL ......................................................................................... 25  
   A. Model Dimensions ................................................................. 26  
   B. Production and Factor Demand ................................................. 27  
   C. Employment and Wage Determination ...................................... 29  
   D. Income Generation and Final Demands ...................................... 32  
   E. Trade ......................................................................................... 33  
   F. Market Clearing ......................................................................... 34  
   G. Investment and Savings ............................................................ 34  
   H. Government .............................................................................. 35  
   I. Dynamics .................................................................................... 35

IV. EXPERIMENTS ..................................................................................... 36  
   A. Calibrating The Model and Tracking History ............................... 36  
   B. Alternative Patterns of Adjustment ............................................ 37

V. CONCLUSION ....................................................................................... 60

APPENDIX A ............................................................................................ 62

APPENDIX B ............................................................................................ 75

APPENDIX C ............................................................................................ 81

REFERENCES .......................................................................................... 82
I. INTRODUCTION

Like many other developing countries, Thailand was adversely affected by the increased oil prices and worldwide recession of the seventies. Nevertheless, from 1974 to 1981 the Thai economy grew at an annual rate of 7.3% while its population increased at about 2.4% per year. The implied per capita real income growth of 4.9% per year was among the highest of the middle income oil-importing countries.

Even more remarkable is the fact that this growth rate was achieved with seemingly little adjustment to the dramatic change in world market conditions. For example, the controlled domestic price of oil remained well below the world price and effectively unchanged until 1979. Moreover, some of the policies that were pursued appear with hindsight to have been imprudent. Thailand's export-promotion drive reached its peak in 1975-76 when prices for Thai exports were low and falling; the country borrowed lightly in world capital markets in the early seventies, when interest rates were low, and heavily in the latter half of the decade when rates were high.

Two hypotheses can be suggested to explain this pattern of development. One is that Thailand was effectively insulated from the oil shock of 1973-4 by a series of fortuitous circumstances. The U.S. military presence in southeast Asia enabled Thailand to run a surplus on its foreign transfer account. Thai export prices rose soon after the oil shock. In fact, the country's terms of trade reached an all-time high in 1974. Finally, Thailand was able to expand the area of land under cultivation without any bottlenecks during this period, enabling
agriculture—the most important sector in the economy—to continue its rapid growth rate.

The second hypothesis is that Thailand simply postponed the adjustment that was necessary after the oil shock by borrowing from abroad. Indeed, by the early 1980s it became clear that it would not be possible to maintain the high growth rates of the 1970s. The country's external deficits reached almost 8% of GDP in 1981, as compared with 4% in 1975. Commercial lenders were becoming increasingly reluctant to finance these deficits. Reflecting the deteriorating economic outlook, the private sector decreased total fixed capital investment between 1980 and 1982 by 6% on average. The GDP growth rate slowed to 5.5% during this period. In its Fifth Five-Year Plan (1982–86), the Thai government introduced a program of structural adjustment in agriculture, industry, energy, fiscal policy and public administration as well as the explicitly stated aim of reducing current account deficits.

Now, which of these two hypotheses explains Thailand's adjustment experience has important implications for how we view the country's impressive growth rate. If it is the first, then we can say that the Thais were blessed with a certain amount of good fortune and that it would be difficult to transfer the Thai experience to other situations. If, however, the second hypothesis dominates, then we will view Thailand's economic record with some caution as the growth enjoyed by the Thais in 1973–82 may have come at the expense of those saddled with debt-service payments today.
In this paper we present a quantitative framework with which the relative importance of the different hypotheses may be assessed. We develop a dynamic, multisector model of the Thai economy and use it, in the first instance, to "track" the actual path of various macroeconomic variables during the period 1973-82. Next, we perform counterfactual experiments with the model. We ask how the economy would have performed without the service payments from U.S. military bases, or with lower export prices or with limits to the availability of arable land. We also look at how the economy would have evolved had it been spared both the favorable shocks listed above and the unfavorable oil shocks. Turning to the second hypothesis, we look at the impact of a different profile of foreign borrowing than the one actually followed. We examine a trajectory of foreign borrowing that minimizes the post-1982 debt-service obligations. Alternatively, we determine the borrowing and investment paths that maximize the capital stock in 1982. As both of these differ from the actual trajectory, they strengthen the notion that the borrowing strategy adopted by Thailand was by no means optimal. Finally, we ask whether changing the composition of investment — as opposed to its level — over the ten-year period would have left the Thais with a stronger economy in 1982.

The plan of the paper is as follows. In Section 2, we describe the major developments in the Thai economy in the period 1973-82. Section 3 is an heuristic description of the model; the equations of the model are in the appendix. In Section 4, after showing how the model tracks the behavior of various macroeconomic variables, we present the
results of the counterfactual experiments. Section 5, the conclusion, draws together the lessons we have learned from this exercise for adjustment in oil-importing countries in general and for economic policy in Thailand in particular.
II. ADJUSTMENT EXPERIENCE OF THAILAND

A. Antecedents and Institutional Framework, 1960-73

Thailand's economic policy in the last quarter century has been characterized by a reliance on private economic activity and limited government intervention. The underlying philosophy was clearly expressed in the First National Development Plan (1961-1966):

"...[T]he key note of the public development program is...the encouragement of economic growth in the private sector, and the resources of government will be mainly directed to projects, both in the agricultural and non-agricultural sectors of the economy, which have this objective in view."

The emphasis on private sector growth, political stability, and a generally favorable investment climate, all may be included among the factors that contributed to the rapid economic growth of the postwar period. In the years from 1960 to 1973, Thailand's GDP increased at an average 7.8% per year. The growth rate of per-capita income, 4.6% per year, was one of the highest among developing countries.

Rapid growth in agriculture and rising exports supported the growth in the rest of the economy. Value added in agriculture grew at an annual rate of 5.2%, while the volume of exports grew at 7.2% per year during the period 1960-1973.

In agriculture, the availability of additional land allowed expansion of traditional subsistence production, and helped to absorb a growing labor force. It also facilitated a rapid diversification of new cash crops, which was the mainstay of the rapid growth of agricultural exports. Most of the growth of agricultural production in this period can be explained by the expansion of land under cultivation, which
occurred at a rate of about 4% p. a. until the early 1970s. The expansion of cultivated area included both increasing the size of existing holdings, and creating new farm units which facilitated the absorption of labor. Public investment was restricted to infrastructure and support facilities which aided the efficiency of the market. In the agricultural sector, this has led to a reduction in transportation and handling cost, and to a corresponding increase in the share accruing to the farmer. The market system traditionally provided credit, information and extension services to many farmers in the absence of such services from the public sector.¹/

The manufacturing sector also became an important source of growth and employment during this period, growing at an annual rate of 8.3%. The accelerating importance of this sector as a source of employment is reflected in the following figures: in 1960, the agricultural sector employed 82% of the labor force while the manufacturing sector (including mining) employed only 3.6%, less than commerce (5.76%), and services (4.8%). By early 1973, the agricultural sector employed 67.3% of the labor force, and the manufacturing sector was second with 10%.²/ A surge in domestic demand, together with import substitution were important factors contributing to growth in this sector.

¹/ See, for example, Thailand, Income Growth and Poverty Alleviation. World Bank, June 20, 1980.

B. External Shocks, 1973-81

Like many other developing countries in the 1970s, Thailand relied upon imported oil and petroleum products to meet most of its energy requirements. The quadrupling of the oil prices in 1973-74, therefore, sent Thailand's import bill climbing. The initial balance of payments effect was cushioned by high export prices (as compared to their 1971-73 levels.) In addition, the high transfer and service account earnings from U.S. bases continued throughout the period 1973-75. Inflation was also controlled successfully, having fallen from 24% in 1974 after the oil shock to about 4% in 1975.

The terms of trade were not so favorable after 1975. Export prices actually dropped 2.74% in the year 1975-76, and increased at an average 8.6% p.a. between 1977 and 1981. Meanwhile, import prices steadily increased reaching an average growth of 12.1% p.a. in the period 1977-81. The difference in the growth rates represented a 24% deterioration in the terms of trade between 1975 and 1981.

The reduced impact of the oil price shock allowed Thai authorities to focus on attaining historical growth rates of output. However, the continuous deterioration in the terms of trade after 1975 and an increase of real interest rates in 1979-81 implied a larger shock for Thailand. In the next sub-section we shall examine the direction of adjustment and growth followed in the period after the first oil shock.
C. Modes of Adjustment

That Thailand was spared the full impact of the oil-related shocks is reflected in the objectives of the Fourth Development Plan (1977-81). One of the main goals of the Plan was to "... revitalize the economy in order to ensure a higher and sustainable rate of output, investment and employment expansion during 1977 and 1978." After 1975 the main concern of the Thai authorities shifted towards restoring the high growth of the 1960s as a means of achieving the objectives of the Plan. The specific target set for GDP growth during this period (1977-81) was 7% per annum, which compares favorably with the level of the 1960s. The target growth rates of salient variables are given in Table 1.

Table 1: PROJECTED GROWTH RATES IN FOURTH DEVELOPMENT PLAN, 1977-1981

<table>
<thead>
<tr>
<th>Value Added In</th>
<th>Average Annual Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>5.0</td>
</tr>
<tr>
<td>Industry</td>
<td>9.6</td>
</tr>
<tr>
<td>Merchandise Exports</td>
<td>14.0</td>
</tr>
<tr>
<td>Volume</td>
<td>7.5</td>
</tr>
<tr>
<td>Price</td>
<td>6.1</td>
</tr>
<tr>
<td>Merchandise Imports</td>
<td>11.5</td>
</tr>
<tr>
<td>Volume</td>
<td>6.1</td>
</tr>
<tr>
<td>Price</td>
<td>5.0</td>
</tr>
<tr>
<td>Investment</td>
<td>7.2</td>
</tr>
<tr>
<td>Government Expenditures</td>
<td>11.2</td>
</tr>
</tbody>
</table>

We now consider the types of adjustment undertaken by Thailand in the 1970s, which can then be compared with the above-mentioned
projected targets. Most of the adjustment was carried out through additional foreign borrowing and export expansion.

(1) Foreign Borrowing

The particular time profile of financing which follow distinguishes Thailand from most other developing countries. While many developing countries borrowed heavily in the early 1970s — as real interest rates were low and global liquidity high — Thailand's growth in external debt was modest during the first half of the 1970s. This was due to several factors, including a commodity price boom which cushioned Thailand's balance of payments effects arising from the increase in oil prices. After 1975, however, many oil importing countries had undertaken major adjustment measures to offset the impact of the first oil shock, and responded to the substantial rise in interest rates—which began in 1978—by reducing the rate of increase in the growth of their external debt. By contrast, Thailand's external borrowing accelerated during this period, with nominal growth rates of medium and long-term debt at almost 50% in 1979 and 1980, coinciding with record high nominal and real interest rates. As a result, the ratio of debt to GDP more than doubled from less than 10% in 1974, to about 20% in 1981. Short-term debt also expanded rapidly since 1975, reaching US$2.78 billion at the end of 1981.

This rapid foreign borrowing financed the increased level of spending after 1975, which reflected the intention of the Thai government to attain higher growth rates of output, as expressed in the Fourth Development Plan. Consolidated public expenditures, a comprehensive
measure of government activity in Thailand, grew at a rapid pace between FY77 and FY82, tripling in terms of current prices, doubling in terms of constant (1976) prices. The average rate of growth of public expenditures was about 18% p. a. between FY77 and FY81, which is considerably larger than the minimum 11.2% projected in the Plan. The current account deficit, which averaged less than 2% of GDP for the period 1960-75, reached more than B (Bhat) 40 billion (8% of GDP) in 1979. The (total) public sector deficit surpassed B 30 billion (6% of GDP) in the same year. Inflation increased from 4% in 1975 and 1976, to 8% in 1977.

Adding to domestic expansionary policies were several factors that contributed to the deterioration of the current account. As we mentioned above, export price indices declined in nominal terms, while import prices continued to grow after 1975, yielding a considerable deterioration in terms of trade. At the same time, surpluses on the saving and transfer accounts suddenly diminished by a total of B 4.5 billion (US$200 million), largely as a result of the reduced U.S. military presence in the region. 2/

1/ Consolidated public expenditures in Thailand consist of recurrent and capital expenditures of general government and state enterprises, which differs from the conventional national accounts approach. The latter does not include the recurrent costs of state enterprises.

2/ A phased withdrawal of the American presence began in 1969, as conditions in Southeast Asia began to change. By late July 1976, the last of the American air and naval units had departed (see e.g. Bunge (1981)).
While there was a rapid increase in the budget deficit of the private and public sectors, no measures were taken to increase revenues: energy and other key goods, such as cement, remained underpriced. It was not until 1979 that a major oil price increase was effected (40%). Until then, the lower domestic price of energy implied only a relatively small reduction in energy use as a result of higher international oil prices. The demand for energy grew 1.8 times faster than GDP in the 1960s, and it slowed only to 1.3 times faster in the 1970s. Government taxes on energy products were in fact reduced, and subsidies were paid to refiners at various times. As a consequence, most of the impact of rising energy prices was absorbed in the current account and public sector deficits.

Government policies oriented towards maintaining historical growth rates of output implied larger expenditures in public investment in 1975. Growth in central government expenditures, however, was not matched by a similar growth in revenues, resulting in large budget deficits. Total government revenues as a share of GDP stagnated at about 13%, and taxes at a little more than 12%, both down marginally from their shares in 1970-75. Despite a rapid decline in the relative importance of taxes on international trade, indirect taxes remained the mainstay of Thailand’s tax system.

(ii) Export Expansion

The resurgence in the demand for exports—after the recession of 1973-1974 resulted in a substantial increase in the growth of agricultural and manufactured exports. In addition, several domestic poli-
cies were adopted to promote exports. Export taxes, which represented 3.7% of total exports in 1975, were reduced to an average 1.89% of total exports over the period 1976-81, and to 0.84% in 1982. A domestic sales quota on rice that was linked to the amount exported was suspended.\(^1\) Export industries, in particular those which were facing production problems such as textiles and sugar industries, received substantial assistance from the Bank of Thailand through lending through the commercial banks under concessionary terms. Also, the repayment period for concessionary export credits was extended to enable traditional exporters to expand markets by granting longer credit terms to buyers.

<table>
<thead>
<tr>
<th></th>
<th>1970</th>
<th>1982</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>71.0</td>
<td>64.0</td>
</tr>
<tr>
<td>Nonagriculture Primary</td>
<td>15.0</td>
<td>7.0</td>
</tr>
<tr>
<td>Total Primary</td>
<td>86.0</td>
<td>71.0</td>
</tr>
<tr>
<td>Manufactures</td>
<td>14.0</td>
<td>29.0</td>
</tr>
<tr>
<td>Total Merchandise Exports</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: NESDB and BOT.

\(^1\) This policy had to be replaced by some measures to slow down rice shipments abroad after the country had been badly hit by a widespread drought (see Bank of Thailand Annual Economic Report 1977).
The combined effect of these policies and the increased demand had a positive effect on Thailand's export performance. During the period 1974-81 merchandise exports substantially outperformed both GDP and import growth in real terms and thus reversed the pattern of the 1960s: exports of goods recorded 11.3% p.a. average volume increase, 1.6 times higher than GDP growth, 1.7 times higher than merchandise import growth, and well above the volume targets set in the Plan (7.5% p.a.). As a result of this growth, merchandise exports increased substantially as a share of GDP in the last decade (see Table A.1 in Appendix A); two-fifths of the change was due to traditional exports (agriculture and other primary commodities), and three-fifths to the expansion of manufactured exports. The structure of exports underwent considerable changes in the 1970s. While agricultural goods still played a mayor role in the late 1970s (64% of merchandise exports), manufactured exports have emerged as an important contributor (Table 2). In 1970, Thailand held a share of 0.4% of total manufactured exports by developing countries; in 1979, this share rose to 2%. These figures show Thailand's positive response to continuously strong demand for its traditional exports, and its effectiveness in penetrating new markets with manufactured exports.

In addition to increasing exports and borrowing from abroad, oil importing countries have pursued three other tools of adjustment: import substitution, investment slowdown and resource mobilization ([Mitra [1984]). In Thailand's case, use of these other modes was light and, in some instances, in the opposite direction.
(iii) Import Substitution

While the levels of protection in Thailand were substantially increased over the period 1974-78,\(^1\) these levels are relatively low compared with other developing countries. In the last decade, merchandise import volumes grew at 6.6% p.a., marginally lower than GDP and lower than exports. This figure compares favorably with the 6.1% volume growth projected in the Plan. The share of imports in GDP at current prices, however, increased considerably from 19.5% in 1970, to 27.7% in 1979 due to unfavorable developments in import prices, especially oil prices. The increased oil prices had an effect not only in the volume growth of imports, but also on its composition. Before the first oil price shock, oil imports accounted for only 10% of total import value. This proportion increased to about 20% after the price shock.

(iv) Investment Slowdown

While some countries adjusted to the oil shock by slowing down their investment program, Thailand actually accelerated hers. When it became evident in mid-1976 that Thailand's balance of payments had improved considerably, that domestic prices had not increased by much, and that public expenditures during the first half of 1976 could not be disbursed as rapidly as planned, the Bank of Thailand switched to an

\(^1\) Protection increased from an average nominal level of 35% in 1974, to 51% in 1978 for products with low import competition (less than 10% of domestic production) and from 25% to 36% for import competing goods. Effective tariff rates increased from 39.7% in 1974 to 99.6% in 1978 for non-import competing goods, and from 44.8% to 85.9% for import competing goods.

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easy money policy to induce credit expansion by financial institutions. The objective of the credit expansion was to encourage more investment by private enterprises, mainly through the reduction of short-term interest rates and the bank rate. Starting in mid-1976, the Bank of Thailand bought treasury bills on tender each week at increasingly higher prices. In addition, the Bank announced in 1976 a reduction in its basic interest rate charged on loans to commercial banks from 10% to 9% per annum.

This, coupled with the generally favorable environment brought about by the policies of the mid-1970s, led to an increase in investment activities in both the public and private sectors. In 1977 public and private fixed capital investment increased considerably, yielding a record 32.8% increase in real gross fixed investment. The share of fixed investment in GDP also increased from 21.7% to 25.3% between 1976, and 1977. The number of investment applications received by the Board of Investment increased from 111 in 1975, and 119 in 1976, to 264 in 1977.

However, investment activities fluctuated during the period 1977-81. In 1977 it increased 9.5% in real terms, but also declined as much as 2.3% in 1979-80, mainly due to a slowdown in the agro-processing industries as Thailand was affected by unfavorable weather. The average increase of fixed capital investment for the period 1977-81 was 4.2% p.a., which is lower than the one projected in the Plan (7.2% p.a. in real terms).
(v) Resource Mobilization

The majority of resource mobilization in Thailand occurs in the private sector, which has typically generated savings to the tune of about 19% of GDP, and has invested roughly comparable amounts. Private savings exceeded private investment demand throughout the period 1960-79, and were available to finance part of the investment in the public sector. By contrast, the public sector spent more resources than it generated during the 1970s, as public saving fell short of public investment. With the exception of the years 1974 and 1975 when the government pursued a restrictive fiscal policy in response to the first oil shock, the public sector saving-investment gap was close to, or above, 5% of GDP. Since 1978, this gap has rapidly increased.

The surpluses generated by the private sector were channeled to finance the public sector deficits via transfers through the banking system. However, between 1977 and 1979, public sector foreign borrowing increased substantially, substituting for the substantial drops in the public saving rate, while public investment remained approximately unchanged as a share of GDP. From the mid-1970s onward, public foreign borrowing rapidly increased from 0.5% of GDP in FY75 to almost 4% in FY80, and financing an increasing share of the growing public sector deficits.

This broad picture of the Thai economy from 1974 to 1982 would not be complete without a description of the distributional aspects of the adjustment experience. In the next subsection, we look at the
consequences of rapid economic growth for poverty alleviation and the
distribution between urban and rural incomes.

(d) Some Distributional Aspects

In the area of poverty alleviation too, Thailand has a good record. Household income data\(^1\) indicate that the benefits of rapid growth have been enjoyed by large segments of the population, and the incidence of poverty has been cut in half over the last two decades: the overall incidence of poverty was reduced from about 57% in the early 1960s, to about 31% by the middle 1970s, and from 61% to 35% in the rural sector.

Agricultural growth has had a profound influence on overall economic performance and therefore on rural and urban incomes. Although the structure of domestic production has changed over time, with manufacturing and financial services gaining in their share, agriculture has remained the single most important sector. In 1980, an estimated three-fourths of the labor force remained in agriculture, a share which was surpassed only by six other middle-income oil-importing countries (MIOIC), and virtually the same proportion as in 1960 (Table 3). Another indicator of the effect that a drought-induced slowdown in the rate of growth of agriculture in 1979 had on other

\(^1\) Some of the data in this section comes from WDR 1982, and the WB report Income Growth and Poverty Alleviation in Thailand, June 20, 1980.
Table 3  LABOR FORCE AND URBANIZATION

<table>
<thead>
<tr>
<th></th>
<th>Share of labor force in agriculture (%)</th>
<th>Growth of labor force (p.a.) 1970-80</th>
<th>Share of urban in total population (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thailand</td>
<td>84</td>
<td>76</td>
<td>2.9</td>
</tr>
<tr>
<td>Indonesia</td>
<td>75</td>
<td>58</td>
<td>2.1</td>
</tr>
<tr>
<td>Philippines</td>
<td>61</td>
<td>46</td>
<td>2.4</td>
</tr>
<tr>
<td>Korea</td>
<td>66</td>
<td>34</td>
<td>2.8</td>
</tr>
<tr>
<td>Malaysia</td>
<td>63</td>
<td>50</td>
<td>3.0</td>
</tr>
<tr>
<td>Middle income oil importing</td>
<td>59</td>
<td>42</td>
<td>2.2</td>
</tr>
</tbody>
</table>


sectors of the economy. In 1980, after an impressive growth of 10% during the seventies, the manufacturing sector saw the lowest growth for the past 15 years, mainly as a result of slow growth in agro-processing industries. ¹/ Additionally, agricultural incomes have been a major component in domestic demand, which we already established as an important source of industrial growth. In short, the good overall performance in poverty alleviation is mainly the reflection of a sustained rise in rural incomes experienced during the period 1963-79.

¹/ See e.g., Thailand: Managing Resources for Structural Adjustment, August 31, 1981, for support of this claim. Manufacturing production growth recovered in 1981 (6.4%) but remained below historical levels.
The rise in rural incomes, in turn, was due to several interrelated factors, the most important of which was the continuous expansion of land under cultivation. Land expanded at about 3% p.a. during the period 1960-79, absorbing the increase in rural population (3% p.a. in the 1960s, and 2.5% p.a. in the 1970s), and allowing average holdings size to increase. The expansion of land was facilitated by, first, the availability of land, and by the expansion of transport and communication infrastructure which provided farmers access to new land, and—through the market structure—to national and international markets. The expansion of land was also facilitated by the control of malaria in the North and North-East parts of the country, which permitted sedentary cultivation of large tracts of land.

Other important factors that contributed to higher rural incomes were diversification into higher-value crops, and rising crop prices. A key factor in promoting diversification were improved linkages with external markets, and increasing the share of wholesale prices received by producers. By providing seeds, information, and outlets, merchants and traders were able to introduce new crops with profitable external markets, such as sugar, cassava, and maize in the Center, maize in the North, and kenaf, maize, and cassava in the North-East.

The rise in the relative price of most agricultural products (except rubber), also explains part of the growth in rural incomes. The increases occurred at different sites for different crops, but the
agriculture-non-agriculture terms of trade stood at 113 in 1976, compared to 100 in 1962. 1/

A final factor explaining the rapid rise in rural incomes has been the increasing participation of rural households in the modern sector, where incomes tend to be higher. A significant proportion of rural incomes derived from money wages rather than self-employment. Agricultural households diversified their sources of income and by 1975 22% of agricultural households' income was earned from non-agricultural activities such as agro-industries, trade, commerce, construction, and public service. 2/

Despite all this, at least one quarter of the population did not share sufficiently in the benefits of growth to rise above the absolute poverty level. Poverty remains largely a rural phenomenon and it is unevenly distributed around the country. Most people below the poverty line are farmers engaged in rainfed agriculture, living in the North and North-East parts of the country. 3/ These regions account for 56% of Thailand's population in 1980, and 45% of regional GDP is derived from agriculture, compared with a national average of 26%.

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1/ See e.g., Income Growth and Poverty in Thailand, p.13. The accessibility of external markets for several crops, however, allowed farmers to switch among upland crops in response to relative price changes, and they probably did better than indicated by the terms of trade index.

2/ See e.g. ibid., p.13

3/ See e.g. ibid., p.19

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Rural workers in the South present another exception to the general trend in rising rural incomes. Unlike other regions, the South was (and still is) heavily dependent on a single cash crop, rubber. Despite relatively large areas of unexploited land, agricultural expansion and diversification have been slow. The South is physically distant from the rest of the country, and the communications network has been much slower in developing. In addition, rubber prices declined in the late 1960s and early 1970s, and the region was less able to diversify production away from reliance on rubber as a cash crop.

Not surprisingly, there is a concentration of wealth in the Center part of Thailand, and the capital city of Bangkok, which expanded rapidly in the 1970s. 1/

These diverse regional and agricultural development patterns occurred in response to differences in the comparative advantage of each region, which have in turn been influenced by factors such as government policies in the rural sector, and the particular economic and social system in Thailand.

Among these factors, the emphasis on the private sector has been a leading contributor to the rates of growth experienced by the different rural areas and, as a result, to the raising of large numbers

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1/ In 1970, Bangkok had a population of 3.2 million, which increased to 4 million in 1978. Migration into Bangkok was 70,000 in 1973; 60,000 in 1974; 67,000 in 1975; and 92,000 in 1976. The 1970 census indicates that some 35% of Bangkok's population was born outside Bangkok (National Statistical Office, Survey of Migration in Bangkok Metropolis, annual publication, 1974-77).
of the rural population above the poverty line. The market economy encouraged farmers to change their production patterns to profitable cash crops, and the marketing system absorbed and disposed of large agricultural surpluses to domestic and export markets, while returning to the farmers a large percentage of wholesale prices. The market system also provided credit, information, and extension services to many farmers in the absence of such services from public institutions.

The main contribution of public policies was in increasing the efficiency of the market system through the provision and maintenance of economic infrastructure, such as communications and roads. Definite poverty-alleviation programs were not considered until the Fourth Development Plan (1977–81), which included explicit anti-poverty objectives as part of its development strategy. The anti-poverty program set out in that plan, however, recognized the leading role of the private sector in reducing poverty, and reinforced the government's role of providing support and an appropriate economic framework.

Other government policies had mixed results in terms of their impact on growth and poverty alleviation. It has been argued, for example, that the policy of maintaining low rice prices for urban consumers through export taxes, reserve requirements and the export premium has acted to the detriment of most rural areas.1/ These policies lowered incomes received by farmers producing and selling rice, and reduced the incentive for subsistence farmers to produce marketable

1/ See e.g. op.cit., p.30-31

Chpt-2/SD-7/12-13-85:jo
surpluses of rice. Since rice is essentially the wage good, maintaining low rice prices has kept modern sector wage rates low, and reduced the real earnings of rural laborers in alternative employment. It has also been argued\(^1\) that public policies promoted regional disparities. The Center and Bangkok were the main beneficiaries of public investment, irrigation works, and the availability of subsidized agricultural credit.

Significant shifts took place in the functional distribution of public spending between FY77 and FY82. Expenditure on industry, mining, energy, transportation and communications, which in FY77 accounted for 38.5% of the total, increased its share to 46.4% in FY82. In contrast, the share of public spending on agriculture, education, and other services dropped from 33.3% of total public expenditure in FY77, to 26.9% in FY82. Health expenditure, in particular, expanded at a very low rate (2.3%) in real terms during the Fourth Plan period. However, a normative conclusion without further analysis is precluded by the fact that these shifts were the consequence of a number of exogenous factors (especially in the energy sector), as well as explicit domestic policies. \(^2\)

\(^1\) See e.g., WB report No. 4085-TH, Thailand: Perspectives for Financial Reform.

\(^2\) See report Managing Public Resources for Structural Adjustment, Table 4.5, for data on the growth and structure of consolidated public expenditure, as well as for a description of influential factors on expenditure decisions.
In general, then, Thailand's track record in poverty alleviation and income distribution has been impressive, all the more so given the emphasis on the private sector and economic growth in the government's policies. That agriculture was the engine of growth in the Thai economy certainly contributed to removing the gap between urban and rural incomes. Migration patterns and rural households' participation in urban employment also helped in countering any urban bias in public investment. Just as with adjustment to oil shocks, therefore, Thailand's performance in improving the distribution of income appears to have been achieved without an explicitly stated set of policies aimed in that direction. Rather, the particular development strategy pursued seems to have contributed to the twin goals of equity and growth—during a period when other countries were having difficulty making progress with either objective.

The question of how this curiously successful pattern of development was achieved, however, remains unanswered. We turn therefore to a description of the multisector model of the Thai economy that will be used to assess the importance—in quantitative terms—of the various factors that we have in this section suggested as having contributed to Thailand's economic performance in the period 1973-82.
III. THE MODEL

A variant of the model developed by Mitra and Tendulkar [1985] for their study of the Indian economy, the model to be presented here is a reflection of (i) the issues we wish to address; (ii) characteristics of the Thai economy; and (iii) the data available. As for (i), we are concerned with an entire economy's adjustment. Hence, ours is a general equilibrium model which takes explicit account of the equality between a country's income and expenditure. The model is disaggregated into six sectors so that changes in the structure of production may be simulated. With four categories of labor and six household types in the model, the impact of policies on distribution can be observed. Finally, as investment and foreign borrowing feature heavily in our discussion of Thailand's response to the oil shocks, the model is dynamic. Different periods are linked through investment, which augments the capital stock, and foreign borrowing, which adds to external debt and hence to future debt-service payments.

Turning to aspects of the model that reflect the Thai economy, we note two in particular. First, in the agricultural sector, we include land as a separate factor of production. This enables us to perform counterfactual experiments on the availability of land which, as we noted earlier, is said to have played a major role in Thailand's economic growth.

Secondly, we model labor markets such that for two categories of labor—urban white collar and rural workers—the wage is parametrically fixed. Thus, there can be unemployment in these categories. When
there is unemployment in rural labor, it "spills over" into the informal urban labor market where a flexible wage equates supply and demand. In this way, we attempt to capture the phenomenon of rural households competing for jobs in the urban sector. Similarly, we allow unemployed white collar workers to cascade downwards to the urban blue collar market which also is cleared by a flexible wage.

Concerning (iii), as there are fairly good data on income distribution in Thailand, our model is specified so that we can account for the variations in incomes of six different categories of households.

We turn now to an heuristic description of the model. A complete list of the model's equations is given in Appendix A. Appendix B is an account of the data sources used to estimate the model's parameters.

A. Model Dimensions

The production side of the model distinguishes six different product markets: (1) Agriculture, (2) Consumer goods, (3) Capital goods (including construction), (4) Intermediate Goods, (5) Public Infrastructure, and (6) Services. The disaggregation follows agriculture-industry-services lines. Industry is disaggregated by sources of demand, (2), (3) and (4), to capture the differential impact of policies on different parts of the industrial sector. Infrastructure (e.g. irrigation, roads) is singled out to isolate possible bottlenecks to expansion of traded goods sectors necessary for adjustment. There is an investment producing sector, referred to as the Capital-goods sector, whose output is used as investment goods in all the sectors.
There are four basic factors of production: labor, capital, infrastructure and land. The Agriculture sector is the only one using land. Labor is further disaggregated into four categories: informal rural, informal urban, blue collar and white collar. Capital and infrastructure are sector-specific and immobile across sectors.

Households are classified into six categories: own account rural and urban households, informal urban and rural households, blue collar, and white collar. (Table A.5 shows how factor incomes are allocated to each of these categories). Households demand the output of the six production sectors.

There are four sources of savings: households, firms, government and foreign savings. The total savings from all sources adjust to the given levels of investment. Firms are distinguished from other institutions, but grouped all into one account. Government represents one agent in the economy as does the rest of the world.

B. Production and Factor Demand

In all sectors, the production structure is represented by a nested CES tree as follows:

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Output $X$ is a function of $L_T$ (informal rural labor), $L_U$ (informal urban labor), $L_b$ (blue-collar labor), $L_w$ (white-collar labor), land $H$ (in the Agriculture sector only), capital $K$, $N_D$ (domestically produced intermediate goods from all sectors other than 5), $N_M$ (imported intermediate goods from all sectors other than 5) and $G$ (the flow of infrastructure, i.e., output of sector 5 going into the sector in question).

Four types of labor combine with capital and land to produce value added. $N_D$ is a fixed-proportions bundle of non-sector 5 domestically produced intermediates; similarly, $N_M$ is a fixed-proportions bundle of non-sector 5 imported intermediates. There is substitution between $N_D$ and $N_M$; their aggregate, $N$ combines with value added to produce $Z$. Infrastructural services which are publicly provided are identified separately and combine with $Z$ to produce output, $X$.

In Sector 3 (capital goods), there is an extra layer at the top of the tree as follows:
Thus imported final goods (M) are less than perfect substitutes for the domestically produced variety (X); final output (CX) is considered to be a CES aggregate of the two.

The CES equations implied by the structure above plus the assumption of cost minimization behaviour permit the derivation of implicit demand equations for Z, G, M, D, K, L2, N. The list of demand equations for these variables is given by equations in Appendix A.

C. Employment and Wage Determination

While detailed examination of wage levels and structures in Thailand is hampered by the scarcity of wage surveys data, some important features of the labor market can be characterized. The government is a major employer in the economy, particularly of better-educated employees in higher-status jobs, accounting in 1981 for approximately 70% of all white collar workers. By comparison, it employed only 19% of blue collar labor in the same year. It is therefore not surprising to find government wage and employment policies to have a substantial impact on the labor market, with the government white collar wage being the prime determinant of the average white collar wage.

Another important characteristic is the substantial difference between formal and informal sector wages, suggesting that formal labor markets do not operate competitively. Rather, job rationing may be
If this view is correct, the expansion of the labor force can be absorbed in the informal sector with the wage adjusting to clear the market.

At the same time, as we discussed before, there is evidence of high seasonal elasticities of labor supply in rural areas, which may be interpreted to reflect an abundant reserve of "underemployed" labor. We have also discussed the large seasonal fluctuations in agricultural employment, which are in turn caused by changes in the demand of labor over the year.

Taking all these considerations into account, we distinguish in the model four different labor types:

(i) Rural Labor
(ii) Informal Urban Labor
(iii) Blue Collar Labor
(iv) White Collar Labor

The rural category — which includes all rural workers — is only employed by the Agricultural sector. We assume that the rural real wage is fixed and that there is job rationing for this type of labor. The informal urban wage is perfectly flexible and moves to clear the market. This type of labor is employed by all sectors with all informal urban workers getting the same wage rate. The blue and white collar workers are employed by all sectors and by the government. It is

---

1/ This view is supported by several studies. See e.g., Sussangkarn [1983] from which many of the observations in this sub-section are taken.
assumed that the blue collar wage is flexible and moves to clear the market. The government and the private sector pay the same wage rate to blue collar workers. The real wages of white collar workers, however, are assumed to be fixed, with job rationing characterizing this type of labor. The government and the private sector also pay the same wage rates to white collar workers.

The following "spillover" mechanism is assumed for the labor market:

\[
\begin{align*}
L_r - U_r &= \sum L_{r,i} \\
L_u + \lambda_r U_r &= \sum L_{u,i} \\
L_b + \lambda_w U_w &= \sum L_{b,i} + L_b^G \\
L_w - U_w &= \sum L_{w,i} + L_w^G
\end{align*}
\]

where \((L_r, L_u, L_b, L_w)\) represent the (exogenously given) available supply of rural informal, urban, blue collar and white collar labor, respectively. The variables \((L_{r,i}, L_{u,i}, L_{b,i}, L_{w,i})\) represent the demand for the different labor types by the \(i\)-th sector, and \((L_b^G, L_w^G)\) the government demand for blue collar and white collar labor, respectively. The variables \((U_r, U_w)\) denote the amount of unemployed rural and white collar labor, respectively. The parameters \((\lambda_r, \lambda_w)\) represent the percentage of unemployed rural and white collar labor who find jobs as informal urban and blue collar workers, respectively. The informal urban and blue collar wages move to clear the corresponding labor markets.

Chpt-3/SD-7/12-13-85:jo
The absorption of migrant workers into the Bangkok economy is supported by a complex of formal and informal networks to provide job information and placement. According to a labor survey,\(^1\) about 60% of those migrant who came to work either had a job or a promise of a job before moving. Relatives, friends and acquaintances were the principal sources of job information, with employment agencies a much smaller but still significant factor. In the model, therefore, we assume that \( \lambda_r \) is responsive to differentials between the cost-adjusted informal urban real wage, and the the rural real wage.

For white collar labor we fix \( \lambda_w \) at 0.4, which means we assume that 40% of the unemployed white collar workers find jobs as blue collar workers, independently of the wage differentials between the two labor categories. The value represents an arbitrary, but we think reasonable, estimate as there are no data to corroborate this figure.

D. Income Generation and Final Demands

The production system distinguishes four categories of income, viz., (1) income from labor (2) land income, (3) capital income, and (4) income from implicit government subsidies on publicly provided infrastructure. To this must be added unearned income, comprising such items as (a) interest on national debt, (b) domestic current transfers, (c)

\(^1\) See Apichot Chamratrithirong, Recent Migrants in Bangkok Metropolis: A Follow-Up Study of Migrants Adjustment, Assimilation and Integration. Mahidol University, Institute for Population and Social Research, November 1979.
net factor income from abroad and (d) net current transfers from the rest of the world.

Final demands comprise private consumption, public consumption, exports and investment. Household incomes are mapped into private consumption via a savings function. Private consumption demand for the output of the six production sectors is generated by a linear expenditure system for each of the rural and urban households, and are functions of prices and incomes. Public consumption of each sector's output is exogenous. Export demand is a function of world demand as well as the ratio of export prices to those of substitutes in international markets. Investment demand is almost entirely directed at Sector 3 (capital goods, including construction).

Thailand had significant final good imports in sectors 1, 2 and 3 during the period of analysis. For these sectors domestic production feeds all sources of final demand except consumption. It is assumed that domestic production and final good imports are imperfect substitutes in consumption and combine in a CES fashion to satisfy consumer demand in Sectors 1, 2 and 3.

E. Trade

The trade side incorporates price-responsive export and import relationships. The derived demand for both intermediate and final imports depends on the level of output and the import price to the user relative to that of the domestically produced variety, where appropriate. Similarly, exports depend on the state of demand in the rest of the world (world income) and export prices relative to that of
substitutes. Import prices are given, so that the country is small in the relevant market. By contrast, the country is assumed to be able to vary its export sales by changing its export prices. In any event, the model is equipped to simulate the effects of tariffs and subsidies.

F. Market Clearing

Gross output in each of the six sectors must equal the sum of final demand, intermediate demand and changes in stocks. Since each of these components is either exogenous or price-responsive, the market clearing conditions determine prices.

The allocation of public infrastructures for intermediate use in each of the production sectors is fixed by policy, while production and final demand are price-responsive. Intermediate users are typically not charged the market price for infrastructure. This allows an exploration of the effects of changing the rates of implicit subsidy on public infrastructure as well as of the policy-determined allocations to intermediate users.

G. Investment and Savings

Investment is equal to the sum of household, government and foreign savings. The relation between household incomes and consumption determines household savings. Government savings are the difference between government income and expenditure. Foreign savings are exogenously specified in most runs of the model. However, in some experiments, we fix investment exogenously and allow foreign savings to

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adjunct. The “tracking” experiments described in the next section are all “investment driven.”

H. Government

The sum of tax and tariff revenue, the return on public infrastructure and other income, less the value of government consumption equals government saving. This is the government’s budget constraint but it does not need separate formulation, since, by Walras’ Law, it follows from the other equations of the system.

I. Dynamics

The model system solves for an equilibrium in each time period, taken to be a year. The solutions in future periods depend on past policies through their impact on investment and foreign savings, and hence on future capital stocks and external debt.

The model is thus solved year by year. Capital and debt accumulate according to the exogenous investment and net foreign borrowing, there is technological progress, and the exogenous variables are updated. In updating the capital stock, the first step is to determine the allocation of investment output among the capital stocks of the six different sectors. The second is to update the private capital stocks based on this allocation and allowing for depreciation. The third is to allocate the output of new infrastructure.

The breakdown of investment by sector of origin is given by base year input output data; it typically comes entirely from Sector 3. Its breakdown by sector of destination is taken from national accounts data for the base year. These proportions are maintained for all periods.
IV. EXPERIMENTS

A. Calibrating the Model and Tracking History

The model described in the last section will be used later to examine alternative patterns of adjustment for Thailand for the years 1974 to 1982. For this reason, it is important to get the model to reproduce what is already known for the Thai economy for this period. In addition, it will serve as a test of how reasonable our model is as an application to Thailand. Here we follow the standard procedure for computable general equilibrium models by first "calibrating" the model so that the base year is reproduced exactly, and then, by updating some exogenous parameters, getting the model to track what is known for the years following the base. In our case, the base period is 1973.

It is clear that a perfect matching of historical data is almost impossible since, in the first place, we are not sure that the real world behaves in the same way as the model predicts, and, second, independent estimates for many of the parameters and variables in our model do not exist. For example, we do not have values for the elasticities of substitution in the CES functions, nor values for the year-to-year variation of sector-specific tax rates.

Instead, we follow the common practice among modellers of selecting the value of some of the parameters for which data are not available on the basis of how well they improve the tracking of the system. This is similar to how parameters are estimated by econometric techniques to minimize the sum of squared errors although in our case, there are many more degrees of freedom.

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The official historical figures of Thailand for some key variables are presented in Table 4. The solution path obtained by the updating of parameters is shown in Table 5. The model reproduces quite well what happened in Thailand during the period 1974 to 1982. The model's estimate for GDP and investment growth shows basically the same trend as in the national account estimates. The model-generated path of private consumption was consistently below the actual one, although the discrepancy is small.

The model had difficulty reproducing the export boom of 1977, when the volume of exports grew 40% with respect to 1973 levels. As we mentioned before, the boom was mainly due to an increase in demand for Thailand's primary exports, such as rice, and the implementation of several export promotion policies by the government, such as the reduction in the quotas imposed on rice exporters. These policies are difficult to replicate given the structure of the model. Consequently, exports in the model after 1977 are considerably lower than the actual figures. The path, nevertheless, follows the basic trend as the historical figures. The amount of imports in the model was adjusted in such a way so as to have the trade balance follow historical estimates.

B. Alternative Patterns of Adjustment

Having ascertained that the model reproduces Thailand's actual pattern of development, we now turn to some counterfactual experiments. As stated in Section 1, we will attempt to assess quantitatively two hypotheses about Thailand's rapid growth without
THAILAND - EXPORTS
(MILLIONS OF 1973 BHTS)

- - HISTORICAL VALUE
--- --- TRACKING VALUE

Years: 73, 74, 75, 76, 77, 78, 79, 80, 81, 82
Values: 30000, 40000, 50000, 60000, 70000, 80000, 90000, 100000
adjustment to the external shocks of the 1970s. The first is that Thailand was insulated from the shocks by a series of fortuitous circumstances and therefore did not need to adjust; the second is that Thailand borrowed in world capital markets and thereby deferred adjustment.

Evidence for the first view is offered by the facts that (i) Thailand continued to receive service payments from U.S. military bases until 1976; (ii) export prices peaked in 1974; and (iii) farmers were able to expand the area of land under cultivation without any constraints during the entire period. We measure the contribution of each of these phenomena to Thai economic growth in the 1970s. Specifically, we ask the following questions: What would Thailand's performance have been if:

(i) There had been no transfers from U.S. bases?
(ii) Export prices had not peaked in 1974 but instead had followed their historical trend?
(iii) There had been no increase in the amount of land under cultivation?

We consider each of these questions seriatim.

The transfers from U.S. military bases in southeast Asia represented a significant, although declining, contribution to foreign inflows into Thailand during the period 1973-76 (Table 4).

We simulate the effects of eliminating these transfers by reducing foreign transfers and, hence, the current account deficit sustained in the years 1973-76. This means that exports increase and
Table 4

<table>
<thead>
<tr>
<th>Year</th>
<th>Transfers from U.S. military bases (in millions of 1973 bahts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>4223</td>
</tr>
<tr>
<td>1974</td>
<td>2884</td>
</tr>
<tr>
<td>1975</td>
<td>2165</td>
</tr>
<tr>
<td>1976</td>
<td>600</td>
</tr>
</tbody>
</table>

Source: Bank of Thailand.

Imports decrease with respect to the historical base run (Table 5). The extra exports came at the expense of consumption and investment; GDP is only slightly affected by this loss in foreign transfers. The reason for this is that, with fixed capital stocks and full employment in two categories of labor, gross output is essentially supply-determined in the model. The effect of a drop in foreign transfers leads mainly to a reallocation of demand from foreign to domestic sources. Moreover, consumption is hurt more than investment because it was assumed that the service payments accrued directly to households. However, the lower household income implies lower savings and therefore less investment in this "savings-driven" model. It is interesting to note that, despite the short-term reduction in investment, the economy's long-term health is not badly affected: by 1977, GDP recovers to its historical level.

Concerning changes in the pattern of output, we note that consumer goods output is actually higher than in the base run in the first year of the shortfall in foreign transfers. Declining demand for
Table 5: EXPERIMENT - NO SERVICE PAYMENTS FROM U.S. MILITARY BASES  
(Percentage change from base run)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Exports</td>
<td>8.0</td>
<td>3.2</td>
<td>2.4</td>
<td>0.6</td>
</tr>
<tr>
<td>Imports</td>
<td>-7.3</td>
<td>-3.2</td>
<td>-2.3</td>
<td>-0.6</td>
</tr>
<tr>
<td>Consumption</td>
<td>-4.1</td>
<td>-2.1</td>
<td>-1.9</td>
<td>-0.6</td>
</tr>
<tr>
<td>Investment</td>
<td>-4.1</td>
<td>-1.5</td>
<td>-1.5</td>
<td>-0.4</td>
</tr>
<tr>
<td>GDP</td>
<td>-1.0</td>
<td>-0.6</td>
<td>-0.6</td>
<td>-0.2</td>
</tr>
</tbody>
</table>

<table>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>-1.2</td>
<td>-1.0</td>
<td>-0.8</td>
<td>-0.3</td>
</tr>
<tr>
<td>Cons. goods</td>
<td>0.5</td>
<td>-0.4</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Capital goods</td>
<td>-3.7</td>
<td>-1.7</td>
<td>-1.3</td>
<td>-0.3</td>
</tr>
<tr>
<td>Intern. goods</td>
<td>-0.6</td>
<td>-0.5</td>
<td>-0.5</td>
<td>-0.2</td>
</tr>
<tr>
<td>Pub. Infrastr.</td>
<td>-3.0</td>
<td>-1.4</td>
<td>-1.0</td>
<td>-0.3</td>
</tr>
<tr>
<td>Services</td>
<td>-1.4</td>
<td>-1.1</td>
<td>-0.9</td>
<td>-0.3</td>
</tr>
</tbody>
</table>

capital goods and infrastructure releases resources (labor) which is now put to other uses. This leads to an increase in exports, most of which were consumer goods in 1973. Evidently, this export boom is sufficient to counteract the loss in domestic demand and results in a net increase in output. Similarly, the intermediate goods sector suffers less than other sectors because it produces an import substitute. In the wake of declining imports, this sector registers an increase in demand that dampens the effect of an overall decline in economic activity brought about by the elimination of transfers from the military bases.1/

1/ In fact, the good N0 that compete with imports as intermediate inputs are in fact an aggregate of several sectors' output, but sector 4's (intermediate goods) weight is by far the greatest.
It is interesting to note that although output in each sector (except consumer goods) is lower than in the base run, value added is actually higher in the first year and more or less keeps pace with historical levels subsequently. With a decline in the real wages of two labor groups, all sectors increase employment thereby increasing value added. However, the reduction in imports—which are mainly intermediate goods—is sufficiently acute that despite the higher value added the net result is a decline in gross output.

Changes in relative prices mirror the changes in the sectoral pattern of output described above. While the level of domestic prices is lower, the price of nontradeables falls more than those of tradeables signalling the real exchange rate depreciation that is required to sustain a smaller current account deficit.

Finally, the distributional impact of the loss of foreign transfers can also be explained by the changes in the production mix. Households that rely on employment in the services and capital goods sectors for their income (mainly blue collar and casual urban workers) are hurt more than those that depend on the agriculture, consumer goods and intermediate goods sectors (rural and white collar workers).

To summarize this experiment, the transfers from U.S. military bases permitted Thailand to sustain a slightly higher growth rate in the early years. They enabled the economy to purchase more imports which, given their complementary role in production, resulted in a higher level of output. Nevertheless, the lasting effects of this “windfall” appear to be minimal. Although the lower investment levels without transfers
would have led to lower levels of capital stock, the reduced real wage would have resulted in higher employment (given pools of unemployed labor). Thus value added would have been maintained and the post-1976 economy would have been the same.

We now address the second question, namely, the impact of the surge in export prices in 1974-75. The international price of Thailand's agricultural exports rose by 30% in 1974, by another 6.2% in 1975 and fell by 6.2% in 1976 before embarking on a trajectory of steady growth thereafter. We simulate the effects on the economy if the world price followed instead a smooth growth path in the 1973-76 period of 8.6% annual growth (the geometric average of the 1973 and 1976 levels). The results indicate that the lower agricultural export prices have only a slight effect on the economy's performance in 1974 and 1975, and virtually no effect on the long-run path (Table 6). Not surprisingly, the largest impact is on the volume of exports. Imports are also lower in order to maintain the same current account as in the base year. Reflecting the small drop in overall economic activity, domestic savings and hence investment is lower. Finally, the fall in agricultural prices lowers domestic food prices. This, in turn, permits a decline in wages, making other exports more competitive. Thus, while agricultural exports suffer badly in this experiment, all other exports are higher than in the base run.

The last experiment in this sequence is the one in which the growth of arable land is halted. Recall that land is a factor of production in the agricultural sector. In the base run, the supply of this
Table 6: EXPERIMENT - SLOWER GROWTH IN AGRICULTURAL EXPORT PRICES, 1974-75
(Percentage change from the base run)

<table>
<thead>
<tr>
<th></th>
<th>1974</th>
<th>1975</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exports</td>
<td>-1.4</td>
<td>-5.0</td>
</tr>
<tr>
<td>Imports</td>
<td>-1.4</td>
<td>-3.1</td>
</tr>
<tr>
<td>Consumption</td>
<td>-0.5</td>
<td>-1.0</td>
</tr>
<tr>
<td>Investment</td>
<td>-0.9</td>
<td>-2.5</td>
</tr>
<tr>
<td>GDP</td>
<td>-0.4</td>
<td>-1.8</td>
</tr>
</tbody>
</table>

Exports of: (share of exports in output in parentheses)

<table>
<thead>
<tr>
<th></th>
<th>1974</th>
<th>1975</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>-20.7</td>
<td>-16.3</td>
</tr>
<tr>
<td>Cons. goods</td>
<td>2.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Capital goods</td>
<td>1.0</td>
<td>1.9</td>
</tr>
<tr>
<td>Intern. goods</td>
<td>1.3</td>
<td>2.8</td>
</tr>
<tr>
<td>Services</td>
<td>1.1</td>
<td>2.6</td>
</tr>
</tbody>
</table>

factor is assumed to grow at 4% per annum; in the present experiment this figure drops to zero. Despite its draconian feature, this counterfactual yields very little difference from the base run. GDP is perceptibly lower in the first few years. In 1982, the final year, when the cumulative effect of the reduction in land would be most noticeable, GDP is only 1.6% lower than in the base run. The reason for this is that land is but one factor in agriculture, accounting for less than 6% of value added in that sector. As its supply shrinks and price rises, farmers substitute away from land to labor and capital. Although we assume an elasticity of substitution between land and other factors of 0.9, the ready availability of agricultural labor at a parametrically
fixed wage induces a fair amount of substitution.\(^1\) In the terminal year, the price of land is 48% higher than in the base run; yet, the price of agricultural output is only 2.9% higher.

In sum, the three "positive" shocks that accompanied the large negative shock of oil price increases made only a minor contribution to Thailand's economic performance in the 1973-82 period. Of the three, the service payments from U.S. military bases seem to have been the most important, with the 1973-74 export price boom second and the expansion of arable land the least significant. It is reasonable to ask, however, whether the negative shocks had an equally mild impact. That is, was the effect of the oil price rise on Thailand also so slight that it was, in fact, counteracted by these positive shocks? The answer is no. An experiment in which import prices grew at pre-1973 rates (9% instead of 15% per annum) and all three favorable events were eliminated, reveals that the net effect on Thailand was negative.\(^2\) In the absence of both types of shocks, the Thai economy would have grown considerably faster with real GDP in the terminal year being almost 14% higher than its actual value (Table 7). The lower import prices permitted more imports to enter the economy which, given their complementary role in

---

1/ This elasticity of substitution is a prime candidate for sensitivity analysis with the model.

2/ Except for the elimination of transfers from U.S. bases, we assume the foreign capital inflow remains unchanged in this counterfactual. Hence, we are assuming that Thailand's foreign borrowing would have been the same in the absence of the two oil shocks. Since Thailand did not borrow from special oil facilities, this is not an unreasonable assumption.
production, enhanced output. In addition, higher imports raised tariff revenues which, in turn, gave a boost to government savings and investment. Thus, it cannot be concluded that Thailand's combination of positive and negative shocks cancelled each other, making adjustment unnecessary. We consider, therefore, the second explanation for Thailand's adjustment-free growth path namely, that Thailand borrowed in world capital markets and postponed the necessary adjustment.

There are many ways to test the hypothesis that Thailand deferred adjustment by borrowing abroad. It is plain that lower levels of borrowing would have led to lower growth rates in the 1973-82 period, and a lower terminal debt in 1982. However, this does not mean that the borrowing was imprudent. The Thais may simply have been exploiting intertemporal arbitrage possibilities offered by international capital markets. The optimal level of borrowing would depend, inter alia, on the rate of return to capital in Thailand, world market interest rates and the social rate of time preference. Here, we attempt a particular test of the proposition that Thailand "overborrowed" in the 1973-82 period. We ask\textsuperscript{1/}: could the actual capital stock in 1982 have been achieved with a lower debt? Specifically, we adjust the time profile of investment and borrowing to minimize the post-1982 debt-service obligations, keeping the terminal capital stock fixed at its 1982 level.

\textsuperscript{1/} For an alternative test, which reaches the same conclusion, see Kharas and Shishido [1985].
Table 7: EXPERIMENT: NO SHOCKS  
(Percentage Change from the Base Run)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Exports</td>
<td>16.0</td>
<td>4.0</td>
<td>1.5</td>
<td>3.0</td>
<td>5.6</td>
<td>8.9</td>
</tr>
<tr>
<td>Imports</td>
<td>47.0</td>
<td>41.3</td>
<td>41.5</td>
<td>41.5</td>
<td>40.4</td>
<td>49.7</td>
</tr>
<tr>
<td>Consumption</td>
<td>9.5</td>
<td>9.5</td>
<td>4.5</td>
<td>7.9</td>
<td>10.6</td>
<td>14.1</td>
</tr>
<tr>
<td>Investment</td>
<td>23.4</td>
<td>19.8</td>
<td>12.1</td>
<td>13.5</td>
<td>18.3</td>
<td>24.6</td>
</tr>
<tr>
<td>GDP</td>
<td>3.0</td>
<td>5.2</td>
<td>0.9</td>
<td>4.1</td>
<td>6.9</td>
<td>9.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>1980</th>
<th>1981</th>
<th>1982</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exports</td>
<td>13.2</td>
<td>13.8</td>
<td>13.4</td>
</tr>
<tr>
<td>Imports</td>
<td>68.0</td>
<td>70.1</td>
<td>55.6</td>
</tr>
<tr>
<td>Consumption</td>
<td>17.7</td>
<td>20.5</td>
<td>17.9</td>
</tr>
<tr>
<td>Investment</td>
<td>31.8</td>
<td>34.4</td>
<td>29.9</td>
</tr>
<tr>
<td>GDP</td>
<td>12.1</td>
<td>15.1</td>
<td>17.9</td>
</tr>
</tbody>
</table>

The computational costs of optimizing our six-sector nonlinear model over nine time periods would be prohibitive. Therefore, we employ an approximation technique developed by Sierra (for details, see Sierra and Condon [1985]). This technique begins with the observation that the two variables that drive an optimal borrowing strategy are investment and foreign savings. Of course, these two variables are connected, their connection being expressed by the CGE model. Thus, for a given external and policy environment, there exists a unique relationship between different levels of investment and levels of foreign savings. Sierra and Condon [1985] estimate this relationship using a polynomial approximation. They "shock" the CGE model with different values of...
foreign savings and fit a fourth order polynomial to the resulting values of investment. This equation is then grafted onto the debt module. This smaller model can be optimized over nine years at very low cost. Moreover, as Sierra and Condon show, the approximation is a good one and the resulting optimal path does not deviate significantly from the "true" optimum.

Our experiment reveals that the investment path that minimizes post-1982 debt-service obligations differs substantially from the historical one, as shown by a comparison between the dashed and solid lines in Figure 6. The optimal profile also squares with intuition: Thailand should have invested and borrowed more than it did in the early years, when interest rates were low, and much less in the later years, when rates were at an all-time high. The terminal debt is 28% lower than its historical value. Clearly, the 1982 capital stock could have been achieved with a much lower debt-burden by shifting the profile of investment and borrowing.

The above experiment determines the optimal borrowing path when there is perfect foresight of the trajectory of interest rates. Now, few people in 1973 could have predicted the erratic behavior of interest rates in the second half of the 1970s. Hence, the deviation of the investment path from the optimal one could have been due to poor prediction of interest rates as well as sub-optimal borrowing. To distinguish between these two, we also compute the optimal path if interest rates had stayed at their 1973 levels. This myopic path, given by the dotted
line in Figure 6, also differs substantially from the historical one. Thus, even if Thai policymakers had expected the low interest rates of 1973 to persist, they should have been following a different path from the one followed. Indeed, the myopic path more closely resembles the perfect foresight one. This gives rise to the conjecture that to achieve a given capital stock, if minimizing debt-service obligations is the objective, then a period of rapid borrowing should be followed by one of lower borrowing. It has been shown that foreign borrowing is associated with appreciation of the real exchange rate in developing countries (Ghanem and Kharas [1985]). A higher real exchange rate makes it more difficult to meet debt-service obligations. Thus, the slowdown in borrowing is needed to enable relative prices to adjust to meet debt-service payments.

An alternative question to ask is, "given its debt in 1982, could Thailand have altered its profile of borrowing and investment to achieve a higher capital stock in 1982?" As Figure 7 shows, the optimal borrowing path would differ from the historical one. The resulting pattern reflects the optimizing model's attempt to trade-off depreciation (which try to push investment into the later years) with high interest rates in 1979-1982 (which would push it to the early years). The resulting terminal capital stock, however, is only slightly higher. Thus, for a given volume of terminal debt, Thailand could not have done much better by adjusting its profile of foreign borrowing. This strengthens the notion that it was the country's investment and
THAILAND - OPTIMAL INVESTMENT
(MILLIONS OF 1973 BAHTS)

- BASE RUN VALUE
- HISTORICAL INTEREST RATES
- INTEREST RATES AT 1973 LEVELS

Year: 73, 74, 75, 76, 77, 78, 79, 80, 81, 82
Y-axis: 30000, 40000, 50000, 60000, 70000, 80000, 90000, 100000
Figure 7

THAILAND - NET FOREIGN BORROWING
(MILLIONS OF 1973 BAHTS)

--- LINECHART ---

- BASE RUN VALUE
- OPTIMAL (MAX. CAPITAL STOCK)

73 74 75 76 77 78 79 80 81 82
borrowing strategies taken together, rather than its investment strategy given it debt strategy, that was suboptimal.

In the class of experiments just discussed, we have attempted to alter the intertemporal allocation of borrowing and investment. We have kept the intersectoral allocation of investment resources constant at their 1974 levels. That is, while the volume of investment may vary, we assume the share going to each sector is the same in every year as it was in 1974. We now relax this assumption. We allow investment by sector of destination to vary according to the profitability of capital in the sector. This profitability is defined as the return to capital services in a sector (i.e., value added less payments to labor and land) divided by the capital stock. If $x_i$ is the profitability in sector $i$ in relation to the economy-wide average, then $y_i$, the share of investment going to sector $i$, is given by

$$y_i = 1 - e^{-\lambda x_i}$$  \hspace{1cm} (1)

Where $\lambda$ is a damping parameter reflecting how rapidly investment responds to rate of return differentials. ($\lambda$ is defined so that $\sum y_i = 1$).

We perform the following experiment. For the same volume of investment in each year, we allow its intersectoral allocation to be determined by (1). Thus, we are asking: "how would the economy have

---

1/ With fixed, sector-specific capital stocks within a period, this value will in general not be equal across sectors. Moreover, it would signal the scarcity of capital resources in a sector.
behaved if investible resources were allowed to flow to where capital
was scarce?"[1]

The results of this experiment are quite dramatic. There is a
clear and significant shift of resources towards the tradeables sector,
particularly agriculture and consumer goods. As a result, exports are
higher and imports lower than in the base run (Table 8). The need for
foreign borrowing is correspondingly reduced, and the economy's terminal
year debt is only 25% of its historical level.

Table 8: EXPERIMENT - CHANGE IN ALLOCATION OF INVESTMENT
(Percentage changes from base run)

<table>
<thead>
<tr>
<th>Year</th>
<th>Exports</th>
<th>Imports</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1975</td>
<td>0.6</td>
<td>-0.4</td>
</tr>
<tr>
<td>1976</td>
<td>0.8</td>
<td>-0.5</td>
</tr>
<tr>
<td>1977</td>
<td>1.7</td>
<td>-1.5</td>
</tr>
<tr>
<td>1978</td>
<td>2.8</td>
<td>-2.5</td>
</tr>
<tr>
<td>1979</td>
<td>3.4</td>
<td>-2.8</td>
</tr>
<tr>
<td>1980</td>
<td>3.6</td>
<td>-2.9</td>
</tr>
<tr>
<td>1981</td>
<td>3.8</td>
<td>-2.9</td>
</tr>
<tr>
<td>1982</td>
<td>7.4</td>
<td>-6.2</td>
</tr>
</tbody>
</table>

The structure of output reflects this shift towards
tradeables. While all output is higher in the terminal year, that of
agriculture and consumer goods exceeds base run values by twice as much
as the others (Table 9).

[1] Note that the "closure rule" in this experiment is different from
that in all other experiments reported in this paper. By fixing
total investment, we allow foreign savings to be endogenous.
Table 9: EXPERIMENT: CHANGE IN ALLOCATION OF INVESTMENT  
(Percentage change from base run)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Output in Terminal Year (1982)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>10.3</td>
</tr>
<tr>
<td>Consumer Goods</td>
<td>8.7</td>
</tr>
<tr>
<td>Capital Goods</td>
<td>4.0</td>
</tr>
<tr>
<td>Intermediate Goods</td>
<td>4.1</td>
</tr>
<tr>
<td>Public Infrastructure</td>
<td>3.1</td>
</tr>
<tr>
<td>Services</td>
<td>3.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Household Group</th>
<th>Utility in Terminal Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own Account Rural</td>
<td>4.5</td>
</tr>
<tr>
<td>Own Account Urban</td>
<td>1.8</td>
</tr>
<tr>
<td>Casual Rural</td>
<td>6.2</td>
</tr>
<tr>
<td>Casual Urban</td>
<td>2.8</td>
</tr>
<tr>
<td>Blue Collar</td>
<td>2.9</td>
</tr>
<tr>
<td>White Collar</td>
<td>0.3</td>
</tr>
</tbody>
</table>

As for equity considerations, since consumer demand in our model is based on static utility-maximizing behavior, we can calculate the impact of this (or any) experiment on the utility of each of the six consumer groups. The outcome in this particular case is that while everybody's utility is increased, the rural and poor households benefit proportionately more. This is of course due to the fact that their welfare is closely tied to the faster growing tradeables sector, while white collar workers, for example, are linked with the production of nontradeables.

Thus, by changing the mix of investments, Thailand could have significantly lowered its foreign debt, without affecting the overall volume of investment. This would have increased welfare and improved
the distribution of income in the country. The direction in which the mix should have been altered was not determined by some complicated intertemporal optimizing problem. Rather, it was signalled by the current return to capital services in the various sectors.¹ To be sure, these results should be treated with some caution. The assumption made in the base run that the mix of investments remained what it was in 1973 is clearly a strong one, although a necessary one given the lack of data for any other year. It is not surprising, therefore, that allowing this mix to change will have dramatic effects. If the mix had changed in reality towards tradeables, then some of the gains registered by our experiment would already have been captured by Thailand. Nevertheless the magnitude of the change elicited by allowing the intersectoral allocation of investment to respond to differentials in profitability indicates that some gains were likely.

¹ This approach assumes investors are myopic insofar as they look at the current return to capital rather than the future profitability of their investments.
V. CONCLUSION

Thailand's adjustment experience has been characterized by rapid economic growth without much adjustment to the 1973 oil price increase and ensuing worldwide recession. Looking more closely, we find that the country benefitted from several favorable "shocks" and borrowed heavily in world capital markets during the 1973-82 period. In this paper we have attempted to assess that experience in a quantitative framework. Using a six-sector general equilibrium model of the Thai economy (which tracked the behavior of several key variables reasonably well), we showed that the favorable external circumstances contributed little to Thailand's economic growth in the 1973-82 period. Moreover, they did not mitigate the need for adjustment. The harm done by higher import prices in the 1970's outweighed the beneficial effects of these favorable shocks. Turning to the foreign borrowing, we find considerable evidence that Thailand's borrowing strategy was not optimal. We showed that Thailand could have achieved the same 1982 capital stock with less debt had it adjusted its profile of borrowing over the decade. Finally, taking the level of investment as given, we showed that significant gains could have been achieved had the composition of investment been allowed to respond to the profitability of capital in each sector. This would have resulted in a shift of resources towards the tradeables sector, a much lower foreign debt and a more equitable distribution.

What lessons can be drawn from this exercise for adjustment in other oil-importing countries? First, it is likely that favorable,
temporary shocks do little to counteract the need for adjustment to a permanent change in the external environment. Second, while borrowing abroad does postpone adjustment, the tendency to overborrow can be quite costly. In general, it appears as if a period of rapid increase in foreign debt should be followed by a period of decreased borrowing to facilitate debt-service payments. Third, an ambitious investment program may not be inconsistent with adjustment. As we demonstrated, the mix of investments, rather than the volume, can play a crucial role in determining the outcome for the economy.

As for implications for Thai economic policy, there is no question that the economy turned in an impressive performance during the 1970s. However, this was at a cost of sizeable debt-service payments and slower growth in the following decade. We showed that the economy would have been better off with a different time profile of foreign borrowing and a different sectoral allocation of investment. In the latter case, moreover, the signals for a better investment allocation were given by the intersectoral returns to capital. Thus, policy makers in Thailand may wish to promote an environment where investible resources can flow easily to where their current profitability is highest. This leads not just to faster growth but — because it is the tradeables sector that will attract this investment — also to lower borrowing and improved income distribution.
Appendix A

Equations of the Thailand Model

Table A.1: Production Equations

\[ \begin{align*}
\text{Sectors } 1, 2, 4, 5, 6 & \quad \frac{\sigma_X}{\sigma_X - 1} G \left( \frac{P_X}{P_X (1 + t_X)} \right) = \frac{\alpha_X P_X}{\alpha_X (1 - \alpha_X) (1 - \alpha_X)} X \\
(1) & \quad X = (\alpha_{G,G})^X G P_X^{-\alpha_X} A^{1 - \alpha_X} (A_{P_X}^{1 - \alpha_X} - \alpha_X P_Z^{1 - \alpha_X})^{-1} \\
(2) & \quad Z = X \left( \frac{\sigma_X - 1}{\sigma_X} \right) \frac{\alpha_X P_X}{P_Z (1 + t_X)} \sigma_X \\
(3) & \quad P_G = A \left( \frac{X}{\alpha_X P_G} \right) \frac{1}{\sigma_X (1 + t_X)} \\
(4) & \quad V = Z \left( \frac{\alpha_V P_Z}{P_V} \right) \sigma_V \\
(5) & \quad N = Z \left( \frac{\alpha_N P_Z}{P_N} \right) \sigma_N \\
(6) & \quad P_Z = (\frac{\sigma_Z}{\sigma_V} P_V^{1 - \alpha_Z} + \frac{\sigma_Z}{\sigma_N} P_N^{1 - \alpha_Z}) \left( \frac{1}{1 - \alpha_Z} \right) 
\end{align*} \]
(9) \[ P_{N} = \left[ \frac{\alpha_{N} \sigma_{N}}{P_{N}} + \alpha_{N} \frac{\sigma_{N}}{P_{N}} \right] \]

(7) \[ N_{D} = N \left( \frac{\alpha_{D} P_{N}}{P_{N} \sigma_{N}} \right) \]

(8) \[ N_{M} = N \left( \frac{\alpha_{M} P_{N}}{P_{N} \sigma_{N}} \right) \]

(10) \[ P_{N} = \sum_{j \neq i} a_{j} P_{Xj} (1 + \frac{\sigma_{N}}{P_{N}}) \text{ where } i \text{ is the using sector} \]

(11) \[ P_{N} = \sum_{j \neq i} m_{j} P_{Mj} (1 + \frac{\sigma_{N}}{P_{N}}) \text{ where } i \text{ is the using sector} \]

(12) \[ K = V B_{K} - 1 \left( \frac{\alpha_{K} P_{V}}{P_{K}} \right) \sigma_{V} \]

(13) \[ L_{L} = V B_{L} \sigma_{V} - 1 \left( \frac{\alpha_{L} P_{V}}{P_{L}} \sigma_{V} \right) \]

(14) \[ H = V B_{H} \sigma_{V} - 1 \left( \frac{\alpha_{H} P_{V}}{P_{H}} \sigma_{V} \right) \]

(15) \[ P_{V} = P_{K} K + P_{H} H + \sum_{L} P_{L} L_{L} \]
Sector 3

Since Sector 3 has significant quantities of almost-finished imports, M, it is necessary to add the following equations:

\[
X = (CX) \left( \frac{\alpha_X P_{CX}}{P_X} \right)^\sigma_C
\]

\[
M = (CX) \left( \frac{\alpha_M P_{CX}}{P_M (1 + \tau_{FM})} \right)^\sigma_C
\]

\[
P_{CX} = \left[ \sigma_C \left( 1 - \sigma_C + \sigma_C \left( \frac{P_M (1 + \tau_{FM})}{1 - \sigma_C} \right) \right) \right]^{\frac{1}{1 - \sigma_C}}
\]

The supply of infrastructure, G, fixed, supply of output X is given by (1) as a function of the output price, \( P_X \), input price, \( P_Z \) and G,

where

\[ A : \text{ rate of Hicks-neutral technical progress} \]
\[ B_j : \text{ rate of factor } j\text{-augmenting technical progress} \]
\[ \sigma_X : \text{ elasticity of substitution between } Z \text{ and } G. \]

Equation (2) expresses the demand for \( Z\), while equation (3) calculates the shadow price of \( G \) to the sector. Equations (4) and (5) are the demand equations for \( V \) and \( N \), while (6) expresses \( P_Z \) in terms of the prices of its constituent inputs, \( P_V \) and \( P_N \), where \( \sigma_Z = \text{ elasticity of substitution between } V \text{ and } N. \)

Equations (7) and (8) are demand
functions for $N_D$ and $N_M$, while (9) expresses $P_N$ in terms of the prices of $N_D$ and $N_M$. Equations (10) and (11) define $P_{N_D}$ and $P_{N_M}$ as weighted averages of their component prices, with the weights being the input-output coefficients making up these aggregates. Equations (12) and (14) are the demands for $K$ and $H$, while (13) is the demand for labor type $i$ (informal rural and urban, blue collar and white collar). Equation (15) determines the price of value added.

Table A.2: Income Generation and Household Consumption

The following types of income are identified by the model:

(1) $y^L = \sum l^L p^L L^\ell$ : labor (private)

(2) $y^G = \sum l^G p^G L^G$ : labor (government)

(3) $y^K = \sum (p_G G^\ell + p_K K^\ell)(1 - t^P)$ : profit

(4) $y^H = (1 - t^P) P_{H^\ell}$ : land

(5) $\overline{y}_R = \overline{y}_R$ : transfers
Household Incomes and Consumption

(6) \[ R^W = \frac{R^W}{R} \]

(7) \[ y^H_L = \frac{6}{5} y^L_i + \epsilon_R^W + y^L_R + y^L_G + \mu_i^H_T \]

\[ (\mu_i^H = 1 \text{ for Own Account rural households and zero otherwise}) \]

(8) \[ y^P_K = \frac{6}{5} y^K_i (1 - t^P_i) \]

(9) \[ T^H_L = t^H_L y^H_L \]

(10) \[ T^H_K = t^H_K y^H_K \]

(11) \[ P^C_i = P^C_i y^C_L + \beta^C L \left(C^H_L - \sum_j P^C_j y^C_j \right) \]

Table A.3: System Constraints

Material Balances

Final demand equals the sum of private and public consumption and gross fixed investment:

(1) \[ FD_i = C_i + PI_i + GOV_i \]

The sum of domestic production and imports must equal the sum of final and intermediate demands, export demand and changes in stocks.
(2) \[ X_i = FD_i + \sum_{j=1}^{6} a_{ij} ND_j + E_i + \Delta S_i \quad (i = 1, 2, 4, 6) \]

\[ CX_i = FD_i + \sum_{j=1}^{6} a_{ij} ND_j + E_i + \Delta S_i \quad (i = 3) \]

\[ X_i = FD_i + \sum_{i=1}^{6} G_i + \Delta S_i \quad (i = 5) \]

Exports are a downward sloping function of export prices relative to prices of international competitors, as well as incomes in the rest of the world.

\[ e^{P*}_{i} = X_{i} VOL_{i} \left( \frac{\varepsilon_i}{P_{E_i}} \right) \quad (i = 1, 2, 3, 4) \]

where \( e \) is the base year nominal exchange rate and asterisks signify international export prices. Export prices differ from output prices by export taxes:

\[ P_{E_i} = P_X (1 + \tau_{E_i}) \quad (i = 1, 2, 3, 4) \]

The flow of infrastructural services to intermediate users is controlled by the government:

\[ G_i = \bar{G}_i \quad (i = 1, \ldots, 6) \]

Changes in stocks are given:
(6) \[ \Delta s_i = \Delta s_i \quad (i = 1,..,6) \]

Public consumption demand for each sector is given:

(7) \[ \text{GOV}_i = \text{GOV}_i \quad (i = 1,..,6) \]

Fixed investment demand for each sector is a fixed proportion of total fixed investment:

(8) \[ \text{FI}_i = \gamma_i \sum_{i=1}^{6} \text{FI}_i \quad (\sum_{i=1}^{6} \gamma_i = 1) \]

The amount of land is fixed

(9) \[ H = \bar{H} \]

The stock of capital in each sector, employment in each sector \( i \) are given in each period.

(10) \[ K_i = \bar{K}_i \quad (i = 2,..,6) \]

Wages of informal rural labor and white collar labor are indexed to a CPI:

(11) \[ \frac{\bar{w}_i}{\text{CPI}} = \lambda \alpha_1 \quad (i = r, w) \]
where \( \lambda (\leq 1) \) capture the degree of indexation and \( a_t \) is the real wage in the base period.

The CPI is an average of consumer price indexes weighted by total private consumption by sector \( (C_i) \):

\[
(12) \text{CPI} = \frac{\sum_i p_{C_i} c_i}{C_i}
\]

Import prices are internationally given:

\[
(13) p_{M_j} = e^{*}_{M_j}
\]

where asterisks signify international import prices.

The economy's balance of payments constraint is given by

\[
(14) eF = \sum_{i=1}^{6} \left[ p_{M_j} M_i + \sum_{j} p_{M_j} N_{M_i} \right] - p_{O_i} (1 + \tau_{E_i}) \cdot E_i - \text{NCT} - \text{NFI}
\]

NCT : net current transfers from the rest of the world

NFI : net factor income from the rest of the world

The savings investment equality is

\[
(15) S + Fe + S_G = \sum_i p_{O_i} AS_i + \sum_{i} p_{C_i} PI_i
\]
where $S_G$ is government savings, the difference between government revenue (REV) and expenditure (PUBEXP).

\[
(16) \text{REV} = \sum_{i=1}^{6} \left( \sum_{j=1}^{6} a_{ji} p_{oj} t_{ND_j} n_{D_i} + \sum_{j=1}^{6} m_{ji} p_{mj} t_{NM_j} n_{M_i} + t_{E_i} E_i \right) + \frac{tx_i}{1+tx_i} p_{x_i} x_i + \left( p_{G_i} - p_{c_5} \right) g_i \\
+ t_p p_H H + t_p \sum_k p_{k_i} k_i + t_f M_3 p_{M_3} M_3 + t_L L
\]

Thus, government revenue is the sum of tax revenue on intermediates and final goods, tariff revenue on intermediates and, where applicable, exports and final imports, revenue from excise taxes, wage and capital income, and income from infrastructure.

\[
(17) \text{PUBEXP} = \frac{\gamma L}{R} + R^G + \sum_k p_{G_k} G_k + \sum_{i=1}^{6} p_{c_i} \text{GOV}_i
\]

the sum of interest on the national debt, transfers to households, payments to government labor, and the value of government consumption.

Thus, government savings

\[
(18) S_G = \text{REV} - \text{PUBEXP}
\]
Finally, total investment is determined in exogenously.

Table A.4: Labor Market Structure

(1) \( L_t - U_t = \sum_i L_{t,i} \)

(2) \( L_u + \lambda U_t = \sum_i L_{u,i} \)

(3) \( L_b + \lambda U_w = \sum_i L_{b,i} + L^G \)

(4) \( L_w - U_w = \sum_i L_{w,i} + L^G \)

(5) \( \lambda = 1 - \exp(w - \phi w_u) \)

(6) \( \lambda = 0.4 \)

Table A.5: The Debt Module

Let \( D_t \) be the (total) stock of debt in period \( t \), and \( NFB_t \) net foreign borrowing. Then:

\[
D_t = D_{t-1} + NFB_t
\]

where we have:

\[ NFB_t = CA_t + I_t + \Delta R_t - DFI_t \]

CA = current account deficit

I = interest payments

\( \Delta R \) = change in reserves
DPI = direct foreign investment

Given $CA_t$ (from base run path), $I_t$, and $\Delta R_t$ (obtained from data), the value of $DPI_t$ (direct foreign investment) is residually obtained so that $NFB_t$ reproduces historical data.

All data have to be expressed in base year local currency. Therefore, historical debt data (given in current dollars) were deflated by the U.S. GDP deflator and multiplied by the dollar exchange rate in the base year (obtained from International Financial Statistics, IMF).

There is a different maturity structure for official and private medium-term debt as well as for short-term debt. It is assumed in the experiments that additional borrowing is split between medium- (official and private), and short-term debt according to the proportions in the base run path.

For experiments, we need to know how additional borrowing in year $t$ affects the stream of service payments (and hence the current account deficit) in future years. We assume that the interest rate, grace period and maturity period for additional borrowing in any year are the same as those the country faced for actual borrowing in that year. Moreover, we assume that the stream of service payments to repay a given loan is constant across the years in which the payments are made. Thus, if the country borrows NFB in year 0 at an interest rate $r$, with a grace period $g$ and a maturity period $m$, then it pays $rNFB$ during years $(1, 2, \ldots, g)$. For the remaining $m-g$ years, $\frac{1}{r}$ the

---

1/ Note that we assume the maturity period of a loan includes the grace period.
country pays a constant service payment \( S \) per year. The present value of this stream should equal NFB (the outstanding debt at year \( g \)):

\[
\sum_{t=g+1}^{m} \frac{S_t}{(1+r)^{t}} = NFB
\]

or,

\[
S = \frac{r(1+r)^{m-g}}{(1+r)^{m-g-1}} NFB
\]

To compute the allocation of \( S \) between interest and amortization, we note that the indebtedness follows the difference equation:

\[
D_t = (1+r)D_{t-1} - S
\]

or,

\[
D_t = (1+r)^t D_0 - \sum_{t=0}^{t-1} (1+r)^t S
\]

Thus the interest payment on this additional debt at time \( t \) is

\[
I_t = rD_t = r(1+r)^t D_0 - [(1+r)^t - 1]S.
\]

The amortization payment at time \( t \), \( A_t \), then is the difference between \( S \) and \( I_t \).

Now, the actual service payment at \( t \), \( S_t \), is the sum of service payments on debt contracted at different years in the past. Hence,

\[
S_t = \sum_{k=0}^{t-1} a_k NFB_k + S_t
\]
where

\[
a_k^c = \begin{cases} 
  r_k & \text{if } t - k < g_k \\
  \frac{r_k (1 + r_k)^{m_k} - g_k}{(1 + r_k)^m_k - g_k} & \text{if } m_k > t - k > g_k + 1 \\
  0 & \text{if } t - k > m_k 
\end{cases}
\]

Similarly, the interest payment at \( t \), \( I_t \), is given by the sum of the interest payments on debt contracted earlier:

\[
I_t = \sum_{k=0}^{t-1} \left( \gamma_k^c NFB_k (1 + \gamma_k^c)^{t-1-k} - S_k ((1 + \gamma_k^c)^{t-1-k} - 1) \right) + \hat{I}_t
\]

where

\[
\gamma_k^c = \begin{cases} 
  r_k & \text{if } t - k < m_k \\
  0 & \text{if } t - k > m_k 
\end{cases}
\]

The elements \( S_t, \hat{I}_t \) are parameters that are obtained residually so that the values of \( S_t, \hat{I}_t \) are equal to historical values.
Appendix B

Organization of the Data and Data Sources

This Appendix discusses the basic data requirements underlying the sequential CGE model for Thailand presented in this paper. The data is organized in the form of a Social Accounting Matrix (SAM), which essentially describes the principal flows in an economy at a particular point in time.\(^1\) The matrix for 1973, at its most aggregate level, is shown in Table A.1.

The figures in each column of the matrix in Table A.1 represent payments to the row, and those in each row receipts from columns. Thus, for example, column 1 pays the total cost of production to factors (GDP at factor cost: 180,920 m. baht) which, added to indirect taxes paid to the government (21,986 m. baht), and to supply of imports (46,069 m. baht) gives the total supply of commodities on the domestic market (248,975 m. baht). This sum is in turn equal to the total demand of commodities in row 1 from households (private consumption: 147,134 m. baht), the government (8,342 m. baht), the consolidated capital account (total investment: 51,711 m. baht), and from the rest of the world (exports: 41,788 m. baht).

The data used in building the SAM were taken from the National Accounts and all other data were adjusted to its magnitudes. The main

---

data sources for disaggregating the National Account figures are the following:

1) National Accounts of Thailand (NA), 1973–82. Published by the office of the Prime Minister.

2) The Basic Input-Output Matrix of Thailand (I-O), 1975. Published by National Economic and Social Development Board (NESDB).

3) The Labor Force Survey (LFS), 1973–82. Published by the National Statistical Office of Thailand (NSO).


5) A Social Accounting Matrix for Thailand (SAMT), 1975. Published by NESDB–IBRD.

A more disaggregated SAM was constructed for Thailand, within the confines of the totals given by the summary SAM in Table A.1. In the fully disaggregated SAM the following sub-accounts are distinguished:

(1) Activities

1.1) Agriculture
1.2) Consumer Goods
1.3) Capital Goods
1.4) Intermediate Goods
1.5) Public Infrastructure
1.6) Services
(2) Factors

2.1) Informal Rural Labor
2.2) Informal Urban Labor
2.3) Blue Collar Labor
2.4) White Collar Labor
2.5) Capital
2.6) Infrastructure
2.7) Land

(3) Households

3.1) Own Account Rural
3.2) Own Account Urban
3.3) Casual Rural
3.4) Casual Urban
3.5) Blue Collar
3.6) White Collar

(4) Consolidated Capital

4.1) Gross Fixed Investment
4.2) Investment in Infrastructure
4.3) Changes in Stocks

1. Activity Accounts

The activity accounts show the value added generated in 6 production sectors, listed in 1.1)-1.6) above. The correspondence of these sectors with the items listed in the Input-Output (I-O) Table of Thailand is presented in Appendix C. The value added generated by the model's 6 producing sectors is then to be distributed to the factors of

Appendix-B/SD-11/11-11-85:j0
production accounts. The basic factor disaggregation is listed in 2.1)-2.7) above.

Table A.2 shows the payments of the producing sectors to the primary factors (value added), to the government (indirect taxes), to domestic intermediates, and to the rest of the world (intermediate and final imports). First, the vector of value added was calculated, using the information in (SAMT) and (I-O), and then wages and salaries, obtained from (LFS) and (SAMT), were subtracted, leaving the operating surplus of firms as a residual. Rents accruing to land and infrastructure were then extracted from the operating surplus.

The calculations to obtain the rent paid on the primary factor land were made using the criterion in (SAMT); where the total amount of land rent was calculated as the product of rent per unit area and the total agricultural land holding. Total figures for employment and wage data were obtained from (LFS). The employment and industry breakdown required for the level of disaggregation in the SAM were obtained from (SAMT) for 1975, and then adjusted proportionately to be consistent with the 1973 estimates.

Table A.2 shows the total payments of the producing sectors for the use of domestic and import intermediates. For example, agriculture pays a total of 18559.6 m. baht for the use of domestic intermediates, and 1253.2 m. baht for imported intermediates. These total were obtained by adding over the columns of the input-output domestic and import matrices shown in Tables A.3 and A.4 respectively. The 1975 (I-O) Table (at producer’s prices) provided the raw data for these
matrices, which were then RAS'ed to obtain the totals consistent with 1973 (NA) figures.

2. Household Income and Expenditure Accounts

The household current accounts in the SAM show the sources of income and expenditure of the 6 household types described in 3.1)-3.6) above. The number and type of household categories correspond more or less to the ones in (SAMT), except that we do not distinguish between crops and rubber own account households. The payments to households from different sources is shown in Table A.5. As we may observe, households derive income from labor, dividends, land rent (all accruing to own account rural households), and transfers from government and the rest of the world.

The households outlays are shown in Table A.6. On the expenditure side, each household distributes its income over consumption, taxes and savings. Total savings was calculated as the difference between total income and the expenditure on consumption and taxes. Total household consumption was divided into 6 commodities using the (I-O) structure, and then distributed proportionately amongst households using the structure in (SAMT). Saving rates for the different households were also obtained from (SAMT).

3. Consolidated Capital Accounts

Two types of investment activities are distinguished in the model: private investment, and public infrastructure investment. The latter represents government investment in areas such as transport and communications (eg. roads), electricity, public water works (eg. dams,
irrigation projects), which are provided to the private sector at no cost.

The investment flow matrix in Table A.7 essentially shows the purchase of investment goods by the different producing sectors for the year 1973. Thus, for example, the agricultural sector in column 1 (sector of destination), paid 3351.5 m. baht to the capital goods sector in row 3 (sector of origin) for the purchase of investment goods.

There is no disaggregated investment data for Thailand, hence it was necessary to compute figures by using (I-O) structure, aggregate (NA) data, and available capital/output ratios from the industrial Census 1976. The original matrix was constructed for 1975 and then RAS'ed to adjust to (NA) data. Total gross fixed investment in 1973 amounted to 44,244 m. baht.
Appendix C

<table>
<thead>
<tr>
<th>Sector No.</th>
<th>Sector</th>
<th>Correspondence with Codes in I-O Table of Thailand</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Agriculture</td>
<td>Paddy 001, Maize 002, Cassava 003, Beans and Nuts 004, Vegetable and Fruits 005, Sugar Cane 006, Rubber (Latex) 007, Other Saps 008, Livestock 009, Forestry 010, Iskary 011</td>
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<tr>
<td>2</td>
<td>Consumer Goods</td>
<td>Slaughtering 015, Processing and Preserving of Foods 016, Rice and Other Grain Milling 017, Sugar Refineries 018, Other Foods 019, Beverages 021, Tobacco Processing and Products 022, Textile Products 024, Leather Products 042, Other Manufacturing Products 044</td>
</tr>
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<td>3</td>
<td>Capital Goods</td>
<td>Industrial Machinery 038, Electrical Machinery and Apparatus 039, Motor Vehicles and Repair 040, Other Transportation Equipment 041, Building Construction 047</td>
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<tr>
<td>4</td>
<td>Intermediate Goods</td>
<td>Animal Feed 020, Spinning, Weaving and Bleaching 023, Paper and Paper Products 025, Printing and Publishing 026, Basic Chemical Products 027, Fertilizer, Pesticides 028, Other Chemical Products 029, Petroleum References 030, Rubber Products 031, Plastic Ware 032, Cement and Concrete Products 033, Other Non-Metallic Products 034, Iron and Steel 035, Non-Ferrous Metal 036, Fabricated Metal Products 037, Saw Mills and Wood Products 038, Unclassified 058</td>
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<td>5</td>
<td>Public Infrastructure</td>
<td>Electricity 045, Water Works and Supply 046, Public Works and Other Construction 048, Transportation 051, Communication 052</td>
</tr>
<tr>
<td>6</td>
<td>Services</td>
<td>Trade 049, Restaurants and Hotels 050, Banking, Insurance 053, Real Estate 054, Business Services 055, Public Services 056 Other Services 057</td>
</tr>
</tbody>
</table>

06/26/85
References


## Table A.1

### MACROECONOMIC INDICATORS FOR THAILAND 1973-1982

### Historical Data

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### II. GDP Deflators

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### III. GDP Shares

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1/ As ratios of 1973 data. Base year = 1973

Source: National Income of Thailand, years 1973 to 1982. Published by the NESDB
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<th>Factors</th>
<th>Households</th>
<th>Firms</th>
<th>Government</th>
<th>Consolidated Capital</th>
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<th>Total</th>
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### TABLE A.2

**Activity Accounts**  
(Million Baht)

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<th>Capital Goods</th>
<th>Intermediate Goods</th>
<th>Public Infrastructure</th>
<th>Service</th>
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SIERRATABS/bh/06.07.85
TABLE A.3

Domestic Input-Output Matrix (million baht)

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<th></th>
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<th>Capital Goods</th>
<th>Intermediate Goods</th>
<th>Public Infrastructure</th>
<th>Service</th>
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### TABLE A.4

Import Input-Output Matrix
(million baht)

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### TABLE A.6

**Matrix for Household Expenditures**  
(million baht)

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<th>WC</th>
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TABLE A.7

**Investment Matrix**

(million baht)

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<th>Capital Goods</th>
<th>Intermediate Goods</th>
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<th>Service</th>
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