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Abstract

The paper presents an economywide framework for policy analysis focussing on structural adjustment in production and trade patterns. The framework, which is named SIAM2, is designed in order to allow the analyst to draw medium-run macroeconomic and distribution implications of alternative policies for structural adjustment. SIAM2 is a multi-sectoral, multi-household general equilibrium model of the Thai economy. It is used here to analyze the response of the economy to a drop in the world prices of oil and to compare two schemes of intervention on the rice market. The analysis shows that if one is concerned with external balance and foreign debt accumulation, it is preferable not to lower domestic energy prices with the drop in world prices. The adverse effect on income distribution is negligible. Comparing manipulations of the tax rate on exports of rice and a buying program in order to increase rice prices and farmers' incomes, the analysis points to the higher efficiency of reducing the export tax rate. The larger the elasticity of the world demand for Thai rice, the greater is the improvement in farmers' income.

Le cadre macroéconomique décrit dans cet ouvrage est destiné à l'analyse des politiques et plus particulièrement à l'étude de l'adaptation des structures de la production et du commerce; ce modèle, dénommé SIAM2, permet l'analyse des effets à moyen terme de diverses politiques d'ajustement structurel sur l'ensemble de l'économie et sur la répartition du revenu. Il s'agit d'un modèle d'équilibre général multisecteurs et multiménages de l'économie thaïlandaise, qui est utilisé dans le présent ouvrage pour étudier la réaction de l'économie à une baisse des cours mondiaux du pétrole et pour comparer deux programmes d'intervention sur le marché du riz. L'analyse montre que du point de vue des comptes extérieurs et du volume de la dette extérieure, il est préférable de ne pas répercuter la baisse des cours mondiaux sur les prix intérieurs de l'énergie. L'effet défavorable sur la répartition du revenu est négligeable. La comparaison des effets respectifs de modifications du taux d'imposition des exportations de riz et d'un programme d'achat, en vue d'augmenter les prix du riz et les revenus des agriculteurs, débouche sur la conclusion qu'il est plus efficace de réduire le taux d'imposition des exportations. L'amélioration du revenu des agriculteurs est d'autant plus grande que l'élasticité de la demande mondiale de riz thaïlandais est élevée.

Extracto

En este trabajo se presenta un sistema para el análisis de políticas en toda la economía, centrado en el ajuste estructural de las características de la producción y el comercio. El sistema, denominado SIAM2, está concebido para permitir al analista determinar las consecuencias macroeconómicas y de distribución, a mediano plazo, de otras políticas para el ajuste estructural. SIAM2 es un modelo de equilibrio general, multisectorial y multifamiliar, de la economía tailandesa. Se utiliza aquí para analizar la forma en que reacciona la economía ante una baja de los precios mundiales del petróleo y para comparar dos métodos de intervención en el mercado del arroz. El análisis demuestra que en el caso del equilibrio externo y la acumulación de la deuda exterior es preferible no reducir los precios internos de los productos energéticos cuando bajan los precios mundiales. El efecto adverso sobre la distribución del ingreso es mínimo. Al comparar la manipulación de la tasa tributaria sobre las exportaciones de arroz con un programa de compras para aumentar los precios del arroz y los ingresos de los agricultores, el análisis indica que la reducción de la tasa tributaria sobre las exportaciones es un recurso más eficaz. Mientras mayor sea la elasticidad de la demanda mundial de arroz tailandés más cuantioso será el aumento de los ingresos de los agricultores.

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Summary

This paper presents an economywide framework for policy analysis in Thailand. The framework is used here to analyze two sets of policies: energy pricing and rice pricing.

The framework which we have called SIAM2 is an economywide multisectoral, multi-household equilibrium model of the economy of Thailand. It allows an analyst to derive a path of the economy as a sequence of equilibria. Shifts between equilibria are due to changes in resource endowments, in the world environment, in policy interventions, in structural parameters and in expectations.

A distinctive feature of SIAM2 is dualism. The model separates production activities according to whether they take place in the formal or informal sectors, capturing the competition between these two sectors which supply similar commodities. Formal sector activities behave in a Keynesian manner. They are investment driven and facing fixed nominal wages. Informal sector activities are constrained financially. They invest whatever resources are available to them. They also face a flexible wage which clears the informal labor market.

Within the broad disaggregation between formal and informal sectors, SIAM2 captures various articulations of the economy. There are 22 production activities, while 20 commodities are traded in the economy. Seven groups of households supply labor, save, consume and are taxed. Companies are classified into public and private. The government collects taxes and transfers, spends on consumption, saves and invests. The public sector deficit can be dirived from SIAM2. Investors in SIAM2, correspond to the 22

production activities; they also include government. The rest of the world interacts with the domestic economy through trade, transfers and borrowing.

Contrary to most other economywide equilibrium frameworks, SIAM2 does not treat all sectors similarly in terms of the market clearing mechanisms. Some markets clear via quantity adjustments, others clear via prices. In the former case the price is fixed through trade or regulation. In SIAM2, rubber, traded crops, fertilizers and crude oil have their prices fixed through trade by the world price. Gas, petroleum products, electricity and non-market services have regulated prices. This treatment of prices is particularly useful when addressing the issue of the domestic effects of a change in the world prices of energy.

Another particular feature of SIAM2 is the macroeconomic interaction between the public and private sectors. The public sector is assumed to decide on its investments (in constant prices) and on its net borrowing from abroad. This leaves an imbalance which needs to be financed by the own savings of the public sector and by borrowing from domestic sources. The larger the public sector borrowing from domestic sources the more private investment is crowded out. The reduced resources left to the private sector, on the one hand force the formal sector to borrow from abroad to finance its investment needs,[1/] and on the other hand constrain informal sector investment. Thus the size of the public sector deficit matters. The larger it is, the less is informal sector investment and the more borrowing from abroad by the formal sector.

1/ In SIAM2, the nominal exchange rate is fixed and the current account deficit adjusts through private formal borrowing from abroad.

Agriculture is still the largest sector of the Thai economy. Its performance and that of the whole economy are intimately linked. For this reason, special attention is given in SIAM2 to the production process of crops. At the beginning of a period farmers use past prices to anticipate the prices which would prevail the following period. Knowing their production possibilities, they maximize expected revenues. This provides marginal revenues corresponding to various levels of activity. Given their endowments in land and fixed capital, technology and factor prices, cost minimization provides the marginal cost associated with each level of activity. Because some factors are fixed, marginal costs increase with the level of activity. Farmers then compare the discounted present value of expected marginal revenues with marginal cost, choosing the activity levels which equalize the two.

Because domestic energy prices are captured as policy variables in SIAM2, the framework is well designed to address issues of energy pricing. SIAM2 is used to analyze aternative paths of the domestic prices of energy when the world prices of oil decline. A "liberal" policy where domestic prices follow the world prices is compared with a "centrist" policy where domestic prices are maintained at their nominal level. The long run growth implications do not seem substantially different; the macroeconomic resource balance is however sensitive to the policy adopted. The "centrist" policy allows a much more rapid improvement in the current account deficit than the "liberal" one. Employment growth does not vary much between the two policies. The "liberal" policy benefits however more initially to the formal sector. This latter policy seems however more equitable in terms of distribution of real incomes per capita though differences are not marked.

The policy conclusion to draw will vary among analysts. However, if one is concerned about the accumulation of foreign debt and if accelerating sustained growth is preferred, then the "centrist" policy seems preferable.

Rice, in the beginning of the eighties, still dominates the economy of Thailand. It contributes heavily to employment, income generation, exports and government revenues. Rice farmers remain however one of the poorest segments of agricultural households. In order to help them, the Thai government has had a standing policy of supporting the price of paddy. Interventions in the market are either through a buying program or through manipulations of export tax rates. The SIAM2 is used to compare these two types of interventions. The results indicate that the export tax is a more effective way of raising the domestic price of rice than the support buying program. It leads to a higher level of rice production and an improvement in rice farmers' income. However the latter effect would disappear if the price elasticity of the world demand for Thai rice is small.

CONTENTS

Chapter 1: Introduction

The beginning of the eighties is a period of economic upheavals. In 1979/1980, the world witnesses a second oil price shock and the world economy is thrown into a recession. Thailand, with a small open economy, needs to absorb the shock and pursue its development strategy. Given its resource endowments, the question for Thailand is how to adjust to the shambles of the world economy while preserving, in the medium run, its long-run growth objective. For the policy-maker the issue is how best to use the policy instruments available to him in order to gear the economy on a sound and safe path. One way of helping the decision-maker is to inform him about likely consequences of alternative policies. It is to give him an assessment of what would be the consequences of alternative actions he might take. Should domestic energy prices in Thailand follow closely the path of world prices and without delay, what would then be the likely macroeconomic and distributional consequences? This is only one among many questions a policy-maker is faced with in day-to-day life. The work presented in this paper proposes an economy-wide framework to analyze the medium-run consequences of alternative policy interventions and changes in the world environment. Its purpose is to simulate the consequences of policy interventions and changes in the world environment of the Thai economy in order to provide additional information in the decision-making process.

The policy framework proposed focuses on three issues of relevance to Thailand in the eighties: (i) the role of the agricultural sector in employment, income generation, and trade; (ii) the contribution of the industrial sector to the transformation of the economy from a mainly

agricultural-based one to a more diversified one and (iii) the potential of the energy sector to make Thailand less dependent on foreign energy sources. The fate of the agricultural, industrial and energy sectors bears heavily on growth, distribution and macroeconomic equilibrium. This fate depends on both trends in the world environment of the Thai economy and on policy interventions. The policy-framework presented in the following attempts to capture the effects of trends in the world environment and of policy changes on the performances of the agriculture, industry and energy sectors. It draws macroeconomic, growth and income distribution implications of these performances.

The framework for policy analysis, which we have called SIAM2, is used here to analyze two sets of issues: (i) the response of domestic energy prices to a large change in the world prices of oil and (ii) the role of the price support programme for rice. Differing from most works on energy prices, the analysis presented deals with a drop and not a surge in world oil prices. After the two first oil price shocks, economists, policy makers and the public got used to increases in energy prices and they expected them to continue. In 1982, when the oil prices dropped, all expectations needed to be revised and adjustments to the new conditions needed to be thought of. Using the SIAM2, we analyze the growth, macroeconomic, employment and income distribution implications of a drop in oil prices. Alternative policies with respect to domestic energy prices are simulated. The outcome of the analysis is that growth is not much affected by changes in energy prices. The macroeconomic resource balance is however sensitive. Dropping the domestic prices of energy with the world prices helps more employment in the formal sector. Real incomes per capita of all categories of households benefit in various degrees from a drop in domestic prices. Income distribution is not

much affected. If one is concerned about foreign debt accumulation and if sustained and accelerating growth is desired, it would seem preferable not to drop the domestic price with the world price.

Rice, in the beginning of the eighties, still dominates the economic scene in Thailand. It contributes heavily to employment, income generation, exports and government revenues. Rice farmers remain however one of the poorest segments of agricultural households. In order to help them, the Thai government has had a standing policy of supporting the price of paddy. Interventions in the market are either through a buying program or through manipulations of export tax rates. The SIAM2 is used to compare these two types of interventions. The results indicate that the export tax is a more effective way of raising the domestic price of rice than the support buying programme. It leads to a higher level of rice production and an improvement in rice farmers' income. However the latter effect would disappear if the price elasticity of the world demand for Thai rice is small.

The following of the paper is organized into two parts. Part I deals with the framework and presents the SIAM2 model; in part II the energy and rice pricing policies are discussed. If the reader is mainly interested in the two policy issues analyzed in the paper, he can directly go to part II which is self contained. Part II also gives a good illustration of the usefulness for policy analysis of economywide frameworks like the SIAM2.

PART I. A FRAMEWORK FOR POLICY ANALYSIS

In the following we present the SIAM2 framework for policy analysis. It is focussed on adjustments in production and trade patterns. It allows the user to draw income distribution and macroeconomic consequences of such adjustments. Chapter 2 presents the configuration of the accounts of SIAM2. It describes all the flows captured by the model. Although it may be tedious to go through all the accounts of SIAM2, their description is essential for a thorough and complete understanding of all details of the model. It also conveys well the richness of SIAM2. Chapter 3 discusses the behavior of all the agents identified in SIAM2. The chapter presents also the systems constraints which characterize the within-period equilibrium in the economy. These constraints ensure the consistency of the decisions of the various agents. Whereas chapter three deals with the within-period equilibrium of SIAM2, chapter 4 describes the inter-period linkages. These linkages provide the explanation of the shifts of equilibrium between period.

Chapter 2: The Configuration of the Accounts of SIAM2

Every year, in an economy, agents organize production and supply goods. Their activity generates incomes to labor and capital, it also creates demands for intermediate inputs. These agents supply goods to domestic markets and for exports. The goods supplied to domestic markets compete with imports in the satisfaction of consumers', government and investors' demands. Consumers get the labor and part of the capital income generated by producers. They use this income to save, pay taxes and spend. Similarly, the government collects taxes from consumers, producers and from the exchange of commodities. It uses its income for transfer and consumption expenditures and eventually saves. Consumers' and government savings as well as retained earnings of producers are used to finance capital accumulation. If there is an excess of savings, the country runs a current account surplus with the rest of the world and (or) accumulates foreign reserves. Otherwise, it runs a current account deficit and (or) runs down its foreign reserves.

All this activity takes place within each year and is reflected by flows of incomes and expenditures between the various agents in the economy and between them and the rest of the world. The purpose of an economy-wide general equilibrium framework is on the one hand to provide an explanation of the behavior of all these flows and on the other hand to analyse their response to various changes in the environment of the economy. In order to meet this purpose, an essential prerequisite is to clearly identify the flows the analyst is concerned with and their interaction. This is most usefully done by defining an appropriate accounting framework for the economy under consideration. Therefore a first step in an effort to develop an economy-wide

general equilibrium model is to define and explicit the accounting framework which will underly it. 1/

The SIAM2 model is a multi-sector, multi-household economy-wide general equilibrium model. It is designed to address issues of adjustments in production and trade patterns, and to monitor their distributional, fiscal and macroeconomic implications. The disaggregation of the model reflects these concerns. One can easily understand that the wide-scope of these issues does not allow us to contain the model at a simple and limited level of aggregation. Consequently a brief compact presentation of the accounts underlying SIAM2, in its full disaggregation, is not possible. The choice is then either to give a short but partial and impressionistic view of these accounts or to be thorough and give a lengthier but complete description of the disaggregations of the model. This chapter adopts the second approach and sacrifices brevity for comprehension. Its purpose is to present and explain the accounting structure on which SIAM2 is based. The first section of the chapter presents the accounting framework and an overview of the accounts. Sections two to six review in more details the outlays of the various sub-accounts of the model. In section 2, the cost structures of production activities are considered. Section 3 deals with the domestic and foreign suppliers of commodities and their channels of distributions until they reach final users. The distribution of incomes from factors of production to institutions and the structure of the intermediate costs of activities are taken up in section 4. Section 5 deals with the way institutions allocate

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1/ This approach is similar to the one suggested by Tobin for financial modeling, see, e.g., Tobin [1969].

their resources on their current accounts. Finally, investment expenditures and the flows of funds are treated in section 6.

Section 1 - An Overview of the Accounts of SIAM2

The disaggregation and accounting of SIAM2 are developed within the framework of a Social Accounting Matrix (SAM). The first historically known "SAM" was constructed for England for 1688 by Gregory King.[2/] Unfortunately, this was a short-lived attempt to gather and provide national accounting information. King's basic accounting ideas were taken up in the United Nations System of National Accounts (UNSO (1968)). However, the United Nations System falls short of incorporating distributional features of economic activity. The modern generation of SAMs was developed with a view to remedy to this drawback of the United Nations System and incorporates the flows of incomes and expenditures between all relevant agents in the economy. The big thrust in the construction of modern SAMs for developing countries was given by G. Pyatt, A. Roe and associates (1977) with their 1970 SAM of Sri-Lanka. Subsequently, a number of SAMs for developing countries have been constructed. The Thailand SAM of the SIAM2 model is in this tradition; it expands the number of SAMs built for developing countries and widens their scope.

1.1 - The Framework of a SAM

But what is a SAM? A brief explanation [3/] would say the following. It is a matrix where each identified agent in the economy is assigned a row and a column. The natural implication is that a SAM is always

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2/ See Pyatt and Thorbecke [1976].

3/ For an introduction to SAM's, see B. King [1981].

square. The row assigned to an agent records all his receipts and is thus his income account. The column records all outlays of the agent. Following accounting conventions, the total receipts have to be equal to the total of outlays. Therefore each row sum in the matrix is equal to the corresponding column sum. An entry in the matrix, at the intersection of a column and a row represents a payment from the agent to which is assigned the column account to the agent to which the row is assigned. An additional convention is that all entries in a row be valued at the same price. The implications of such a convention is that each time a commodity is traded at a different price, a new account is needed.

An aggregated SAM is presented in table 1. It articulates the economy in eight basic accounts: (i) factors; (ii) households; (iii) companies; (iv) government; (v) consolidated capital; (vi) commodities, (vii) activities and (viii) the rest of the world. This macroeconomic SAM of Thailand for the year 1975 presents the aggregate income and expenditures flows between the eight categories of accounts.[4/] Consider column 7. It shows a figure of 267697 million bahts in its intersection with the first row. This is a payment from activities to factors of production and is GDP at factor cost. Column 8 pays to the first row account, factors, -78 million bahts; this is net factor income from abroad. The sum of the two entries in row 1 is that of GDP at factor cost and of net factor income from abroad. It defines GNP at factor cost or national income. This income, is distributed in column 1 to the various institutions who have contributed services of factors

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4/ The SAM of Table 1 differs slightly from the National Accounts figures, see Chewakrengkai and Lamsam [1982].

TABLE 1

Aggregated Social Accounting Matrix for Thailand 1975

			FACTORS	INST. CURRENT ACCOUNT			COMBINED CAPITAL	COMMO-DITIES	ACTIVI-TIES	REST OF THE WLD.	TOTAL
				Household.	Comp.	Gov't.					
			1	2	3	4	5	6	7	8	9
FACTORS		1							267697	-78	267619
INST. CURRENT ACCOUNT	Households	2	219147		21449	210				1323	242129
	Companies	3	47785	1972		3452					53209
	Government	4	687	3639	5444			31119		647	41536
COMBINED CAPITAL		5		30301	26316	6877				12253	75747
COMMODITIES		6		206028		30963	75747			56639	369377
ACTIVITIES		7						267697			267697
REST OF THE WORLD		8		189		34		70561			70784
TOTAL		9	267619	242129	53209	41536	75747	369377	267697	70784	

to the economy: households, companies and government. Consider row 7, it intersects the column of commodities, 6. The cell at this intersection is a payment from comodities to activities, it defines the latter's income and the value of their supplies. It is again GDP at factor cost. Commodities, in column 6, add to this GDP at factor costs, imports from the rest of the world (70561 million bahts) and net indirect taxes (31119 million bahts). This defines total supplies of commodities at market prices which is also the sum of the outlays of the account of commodities. This sum is equal to that of row 6. There, all receipts of the account of commodities are recorded. These receipts include the value of the commodities purchased by households, government, investors and the rest of the world in cells (6,2) (6,4), (6,5) and (6,8) respectively. Row and column 6 thus give the standard national accounts identity:

$$\underset{\text{row 6}}{C + G + I + X} = \underset{\text{column 6}}{Y + M + T} \quad ,$$

where Y is GDP at factor cost, M imports, T net indirect taxes, X exports, I, investment, G government consumption and C private consumption.

1.2 An Intermediate Disaggregation of Activities and Commodities

The SAM in table 1 is the most aggregated version of the SAM which underlies SIAM2. In the latter, each of the accounts of table 1 is disaggregated in order to capture the issues the model is designed to address.[5/] Considering first questions of production and trade patterns, the

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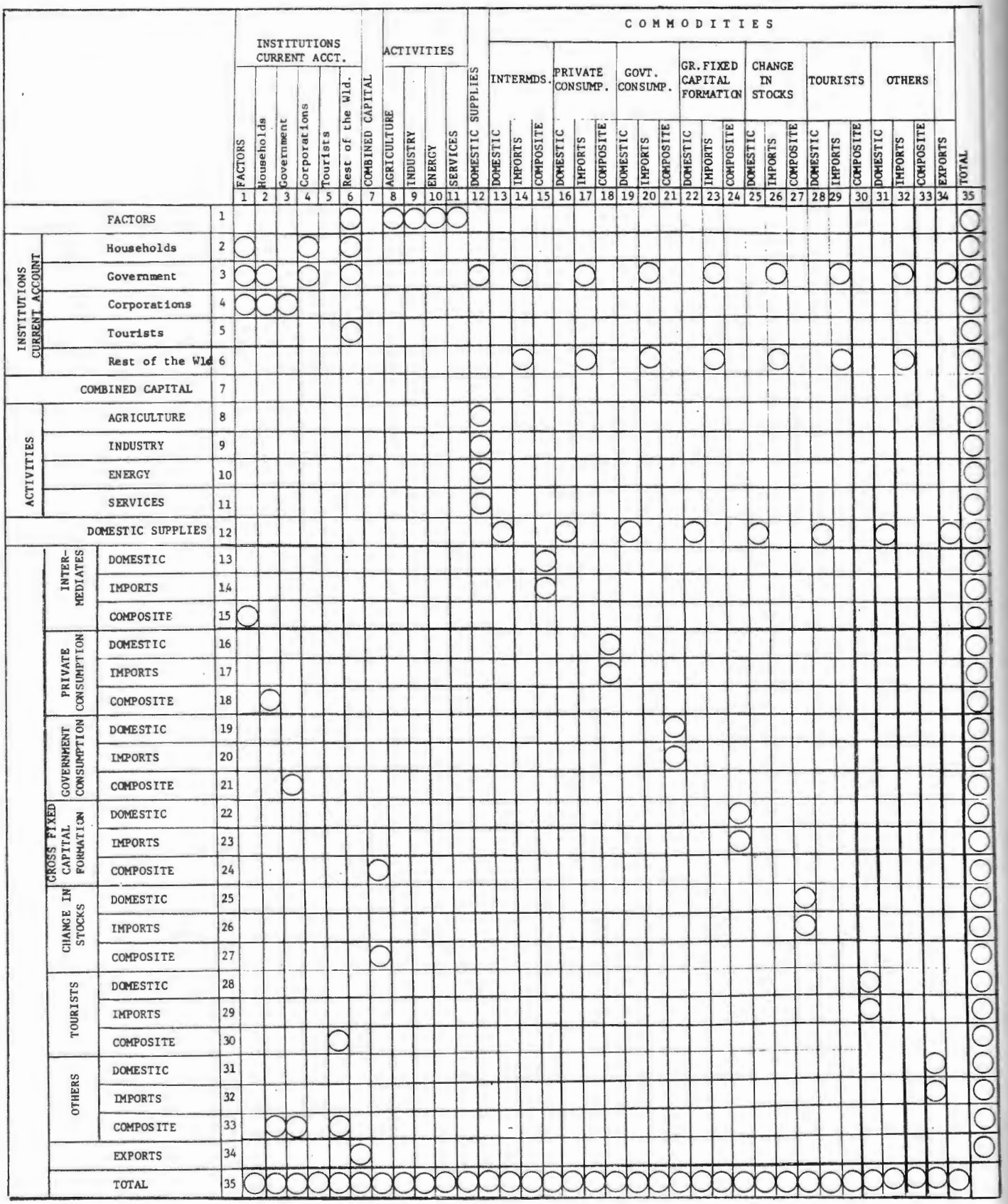
5/ A full and detailed description of the 1975 SAM underlying SIAM2 is given

natural focus is on the activities and commodities accounts. Table 1A presents an intermediate level of disaggregation of the commodities and activities accounts of table 1. It also introduces an account for Toursits, considering them as a separate institution. Otherwise, table 1A keeps the same disaggregation as table 1. Its purpose is to present the main articulations of the commodities and activities accounts of the SAM underlying the SIAM2 model.

In table 1A, activities are disaggregated into four sectors: agriculture, industry, energy and services. This is the most basic distinction between production activities. It also reflects the views, prevailing in the early eighties in Thailand, that structural adjustment means (i) the transformation of agriculture to respond to a tighter land constraint; (ii) the promotion of export oriented industries in order to maintain growth and contain the trade deficit and (iii) the development of the energy sector and the containment of energy demand in order to protect the growth and equilibrium of the domestic economy from erratic developments on the world energy markets. Columns 8 to 11 of table 1A show the cost payments of activities to factors. There are no other entries in these columns because of the convention adopted in SIAM2 to classify all inputs as factors. Thus payments from activities to factors include the costs of intermediate inputs. This becomes clearer when one looks at the first column of table 1A. That column allocates payments to factors between institutions and composite intermediates. Intermediate costs appear at the intersection of row 15 and column 1. The convention to classify all inputs as factors is adopted

TABLE 1A

Disaggregation of Activities and Commodities



for convenience. In some cases the distinction between intermediates and primary factors into two clearly separate categories is not appropriate. For example the use of fertilizers enhances land productivity. Therefore, there is a case for presuming that the relation between these two inputs, in terms of complementarity or substitution, is different from that between either of them and other variables contributing to production. Classifying all inputs under the same heading of factors provides a flexibility in the accounting system which allows to take into consideration particular behaviors.

Let us go back to columns 8 to 11 of table 1A. The sums of these columns represent the aggregate production of each activity. In rows 8 to 11, these productions are supplied to an account named "domestic supplies" in column 12. The introduction of this account is due to the difference between the number of commodities and activities in SIAM2. In order to capture particular features of the Thai economy some activities are assumed to produce several commodities and some commodities are produced by different activities. The intersection of rows 8 to 11 with column 12 introduces the mapping between activities and commodities. Account 12 thus buys the outputs of the various activities and pays the commodity taxes to government (in row 3). It defines, as its column sum, the supplies of domestic goods and services.

The SAM in table 1A separates all agents who buy commodities in the economy into six categories: (i) the fictitious agent "Factors" which buys intermediate goods and services; (ii) households who express a demand for private consumption; (iii) government which spends for public consumption; (iv) tourists who bring money into the country and spend on commodities; (v) the rest of the world which expresses a demand for exports and finally (vi)

investors who buy capital goods and accumulate inventories. A standard assumption in most accounting and modeling works is that all these agents buy the same goods at the same prices. This assumption overlooks a certain number of features which have their importance especially when one is interested in adjustments in production and trade patterns. One first feature is that the commodities purchased by the various agents differ in their import content. In a country like Thailand, import intensities are higher for capital goods than for intermediates, and in turn, those for intermediates are higher than for consumer goods. Another feature is that trade margins and transportation costs may differ. One should also mention, as an additional feature, that import protection is often user-oriented and differs according to whether the imported goods are intermediate inputs, capital or consumer goods.

The foregoing reasons lead to treat commodities purchased by different users as different commodities. Accounts 13 to 34 of table 1A show the channels of distribution of the various commodities exchanged and how they are related to the rest of the world account and to that of the supplies of domestic goods considered previously. Commodities are classified into eight groups: (i) intermediates; (ii) consumer goods; (iii) government consumption; (iv) capital goods; (v) changes in stocks; (vi) goods purchased by tourists; (vii) other goods not differentiated by destination and, (viii) exports. Each of the first seven categories distinguishes between goods produced domestically, imported goods and composites. The latter are aggregates of imports and domestic goods. We shall now illustrate how the accounts are tied together using the category of intermediate inputs. The configuration of the accounts of the other categories of goods, except exports, is identical and will not be commented on. At the intersection of row 15 and column 1 appear

the purchases of intermediate inputs by the fictitious agent: "Factors". This is a demand for composite commodities which is matched by their supply shown in column 15. This supply is composed of domestic (cell (13, 15)) and imported (cell (14, 15)) goods at purchasers prices. Column 14 shows the decomposition of the landed value of imports between c.i.f. value and tariffs. Cell (6,14) gives the value of imports which enters the trade balance and cell (3,14) contains the tariffs paid to government. In a similar way, the entry in column 13 defines the purchasers value of domestically produced goods. With the present configuration an increased demand of intermediate goods will find its way to imports and to domestic supplies in a way which is specific to intermediates.

Consider now exports. Their f.o.b. value is shown in cell (34,6). This is the value of exports which enters the trade balance. Column 34 decomposes this value between what is paid to producers and for trade and transportation margins (cell (12,34)) and the export taxes (cell (3,34)). An increase in the world demand would first show in an increase in the sum of row 34 and then, in the demand for domestic goods and in taxes paid to the government. Going back to the domestic supplies of domestic goods shown in column 12, it becomes clear they are matched by the demands, distinguished by user, shown in row 12.

1.3 An Intermediate Disaggregation of Factors and Institutions

The main focus of the SIAM2 model is the analysis of adjustments in production and trade patterns. These issues underly the disaggregation of activities and commodities discussed in the foregoing. The model is also designed on the one hand to monitor the distributional implications of the adjustments and on the other hand to draw their macroeconomic implications.

This second set of issues motivates the adopted disaggregation of factors and institutions. Table 1B shows the major articulations of these accounts. It keeps for activities and commodities the same disaggregation as in table 1 but provides the main distinction used for institutions and factors.

In column 24, of table 1B, the cost structure of activities is decomposed between payments to primary factors and to composite inputs. The latter are aggregates of intermediate inputs, of intermediates and primary, or (and) of primary factors. The identification of these composites is due to the assumption that activities first decide on their use and then on their composition. Cell (4,24) contains the payments from activities to composite factors. Column 4 shows their structure between primary and intermediate inputs. The first three rows of table 3 feature the basic disaggregation of primary factors between land, labor and capital. The incomes of these factors are either directly received from activities (in column 24) or from the composite factors (in column 4). The rest of the world (in column 13) pays the same amount to labor and capital--net factor income from abroad. The sum of all the entries in the first three rows of table 1B is GNP at factor cost.

Who gets this national income? This is shown in columns 1 to 3: households, companies and government. In SIAM2, households are disaggregated into three basic categories: (i) own account households; (ii) wage earners in the formal sector and (iii) wage earners in the informal sector. These concepts relate to characteristics of the household's head. The adopted disaggregation is motivated by the labor supply assumptions made in SIAM2 and which reflects available knowledge on the Thai economy. Basically, the first and third household categories have wage responsive participation rates. What distinguishes them is that own-account households receive the operating

TABLE 1B

Disaggregation of Factors and Institutions

				FACTORS				INST. CURRENT ACCOUNT										CAPITAL ACCOUNT												
				PRIM.				HOUSEHD.			CO.		GOVT.		F.S.			INVESTORS				SOURCES OF FIN.								
				LAND	LABOR	CAPITAL	COMPOSITE	OWN ACCT.	W.E.IN FORM.SEC.	W.E.IN INF.SEC.	PRIVATE	PUBLIC	IND.TAX COLLECT.	GEN. GOVT.	TOURISTS	REST OF WORLD		INF. PRIV. SECTOR	FORM. PRIV. SECTOR	STATE ENTERPRISES	GOVERNMENT	INFORMAL POOL	FORMAL POOL	PRIVATE POOL	PUBLIC POOL	CENTRAL		COMMODITIES	ACTIVITIES	TOTAL
				1	2	3	4	5	6	7	8	9	10	11	12	13		14	15	16	17	18	19	20	21	22		23	24	25
FACTORS	PRIMARY	LAND	1				○																						○
		LABOR	2				○									○												○	○
		CAPITAL	3				○									○												○	○
		COMPOSITE	4																									○	○
INSTITUTIONS CURRENT ACCOUNT	HOUSEHOLDS	OWN ACCOUNT	5	○	○	○					○			○		○													○
		WAGE EARNERS IN FORM. SEC.	6		○						○			○		○													○
		WAGE EARNERS IN INFORM. S.	7		○						○			○		○													○
	COVT. COMP.	PRIVATE	8			○		○	○	○				○															○
		PUBLIC	9			○																							○
		INDIRECT TAX COLLECTION	10																								○		○
		GENERAL GOVT.	11			○		○	○	○	○		○			○													○
	F.S.	TOURISTS	12													○													○
		REST OF THE WORLD	13					○	○	○				○													○		○
CAPITAL ACCOUNT	INVESTORS	INFL. PRIV. SECTOR	14																		○	○							○
		FORMAL PRIV. SECTOR	15																		○		○						○
		STATE ENT.	16																		○				○				○
		GOVERNMENT	17																						○				○
	SOURCES OF FINANCE	INFORMAL POOL	18																					○					○
		FORMAL POOL	19													○								○					○
		PRIVATE POOL	20																							○			○
		PUBLIC POOL	21									○		○		○										○			○
		CENTRAL POOL	22					○	○	○	○																		○
COMMODITIES			23				○	○	○	○				○	○	○		○	○	○									○
ACTIVITIES			24																								○		○
TOTAL			25	○	○	○	○	○	○	○	○	○	○	○	○	○		○	○	○	○	○	○	○	○	○	○	○	

surplus of their businesses whereas wage earners, in the informal sector, rely essentially on their wage income. The labor supply in the formal sector is assumed to be perfectly elastic. The second set of institutions sharing in national income are companies. They are separated between private and public corporations. The motivation for this distinction is to be able to track the resource mobilization effort of state enterprises. The last institution getting a share of GNP is government. This is government income from property and entrepreneurship.

Columns 1 to 3 of table 1B distribute GNP at factor cost on the various institutions. The latter, in columns 5 to 11, allocate their total resources on different outlays. They pay inter-institutional transfers, taxes, and they save. Accounts 14 to 22 are a disaggregation of capital accounts; they show the flows of savings and investment allocation in the economy. Table 1B introduces five "pools of funds" and four investing agents. Households and private companies channel their savings to a central savings pool (row 22). Public corporations and government put their savings in the public savings pool (row 21) which gets additional funds from the rest of the world (cell (22,13)). The central savings pool channels additional resources to the public sector pool and the sum of row 21 defines the total funds available to the public sector. Column 21 shows that these funds are used by both state enterprises and government. Finally, columns 16 and 17 indicate the fixed capital formation undertaken by government and state enterprises. The latter buy capital goods (cell (23,16)) the former allocate additional funds to the other investors in the economy. The adopted treatment of government investment implies that it contributes to the increase of the capital stocks of other agents in the economy. In this way, government

investment may contribute to increased production in future periods. Turn now to the private sector. The resources of the central savings pool, which are left after the public sector has helped itself, go to a private pool (cell (20,22)). The latter pool in column 20 allocates its funds between the informal (row 18) and the formal (row 19) pools. No other resources are assumed to flow to the informal pool and it invests (column 14) whatever it receives from the private pool. The formal pool, on the contrary, gets additional funds from the rest of the world (cell (19, 13)) and invests its total available resources in column 15. The foregoing structure of flows of funds remains relatively simple while allowing for sufficient interaction between the public, the private and the foreign sectors and for the possibility of computing the public, private and over-all savings gaps.

As mentioned in the discussion of the disaggregation of activities and commodities, the foreign sector is separated into two categories: (i) Tourists and (ii) the rest of the world. The latter accounts records all imports, exports, transfers and capital flows with the rest of the world. However, it distinguishes between two types of exports: tourist expenditures and the rest. Tourists expenditures, as a lump sum, are channelled from the rest of the world account to that of Tourists. The latter account has Tourists spending on commodities like other domestic institutions. The "normal" exports appear, as traditionally, as expenditures from the rest of the world on commodities. This treatment allows a better monitoring of the linkages between Tourists expenditures and the rest of the economy.

This completes the overview of the accounts. Table 1 shows the basic articulation of the economy in eight groups of accounts. Table 1A describes an intermediate stage of disaggregation of the activities and

commodities accounts while table 1B does the same with the institutional accounts. In the full SAM of SIAM2 almost all the cells of tables 1A and 1B are matrices or vectors. Some configurations are straightforward, others less so. The remaining of this chapter deals with the structures of the various cells of tables 1A and 1B.

Section 2: Production Activities

At the intermediate level of disaggregation considered in the previous section production activities are separated into: (i) agriculture, (ii) industry, (iii) energy and (iv) services. Although attractive, this classification is too broad. Supply responses, cost structures, and price regimes can vary within each of these four groups of sectors. Furthermore in a country like Thailand most production activities take place both in the "formal" and "informal" sectors, a distinction not captured in the above four-activity classification. These differences have some relevance when the issue is that of the restructuring of production patterns. Furthermore they also have some macroeconomic implications worth capturing. The outstanding example is the role of the pricing of specific energy products.

Starting from the four-category disaggregation mentioned above, SIAM2 disaggregates production activities into twenty two (22) sectors (see table 2). This articulation of the production system is based on the following aspects:

(i) differences in the output-supply responses;

(ii) differences in cost structures;

(iii) differences in price regimes on the markets of outputs;

(iv) present and expected relative importance of the activity in terms of income generation, employment and trade;

Table 2

Disaggregation of Activities

		Informal	Formal
Agriculture	1	Non Rubber Crops	
	2	Rubber	
	3	Other Agriculture	
Industry	4		Mining & Quarrying
	5	Food Processing	Food Processing
	6		Fertilizers
	7	Other Light Industry	Other Light Industry
	8		Heavy Industry
Energy	9	Energy Extraction 1	
	10		Energy Extraction 2
	11		Energy Transformation 1
	12		Energy Transformation 2
Services	14	Transportation and Communication	Transportation and Communication
	15	Trade	Trade
	16	Other Market Services	Other Market Services
	17		Non-Market Services

(v) distinction between formal and informal sectors;

Among these five aspects, the distinction between formal and informal sectors needs explanation. It is based on the conventions that all activities owned and managed by different people, facing fixed nominal wages and able to borrow whatever funds are needed to finance their investment are classified as formal. All activities owned and managed by the same household, facing flexible nominal wages and financially constrained are classified as informal. The separation of the activities of SIAM2 between the formal and informal sectors respond to this convention. In the following we review how the five criteria outlined above helped to define the disaggregation of activities in SIAM2.

Section 2.1 - Agricultural Activities

The share of the value-added in agriculture, including milling and processing activities, was in 1975 approximately 37% of GDP. The bulk of this value added is from non-rubber crops with a share of 28.2%. The share of rubber is close to 1% and non-crop agriculture shows a figure of 7.8%. Looking at exports the predominance of agriculture is even more striking. The sector, with its related processing activities, was responsible for 61.9% of exports. Non-rubber crops, on their own, contributed 53.4% of export proceeds. Exports of rubber and rubber products came close to 7.5% whereas exports of other-agriculture were 1%. The employment figures confirm even more the hegemony of agriculture on Thailand's economic scene. The share of the sector in total employment was more than 65.2%. Of course the weight of agriculture has decreased since 1975, but it still plays a crucial role. Because of the emergence of the land constraint concerns with respect to the future of agriculture have arisen. The increase of agricultural yields

through mechanization and the use of fertilizers are discussed. The transformation from extensive to intensive agriculture is encouraged. Given the importance of agriculture for employment, income generation and distribution, trade and resource mobilization, SIAM2 attempts to capture basic features of the agricultural sector in order to be able to contribute to the policy debate on the development of the sector.

In SIAM2, agriculture is disaggregated into three activites: (i) non-rubber crops, (ii) rubber and (iii) other agriculture. This is a minimal but sufficient disaggregation. It allows us to capture essential differences in supply responses and in cost structures. Indeed because of the land constraint one expects different supply responses between crops and non-crop agriculture. Furthermore, because of its specificity rubber supply behaves differently from the other crops. The cost structure of non-crop agriculture differ markedly also from that of the rest of the sector. Because it includes fisheries, its capital and energy intensities are higher. An additional advantage of the separation of rubber is that its production takes place essentially in the southern region of Thailand. In this way a regional dimension is introduced in SIAM2. In spite of the existence of pockets of formal sector activity, the whole of agricultural production is assumed to take place in the informal sector. This is a simplifying assumption which does not introduce any significant distortions given the overwhelming predominance of informal activities.

Table 2A shows four column accounts of the fully blown SAM underlying the SIAM2 model. These accounts describe the configuration of the outlays of the three agricultural activities. There are three entries in the account of other-agriculture which show payments to the primary factor

Table 2A

Payment of Activities to Factors: Agriculture

			ACTIVITIES			
			CROPS AND PROCESSING			
			CURRENT REVENUE	EXPECTED REVENUE	RUBBER	OTHER AGRICULTURE
PRIM. FACT.	CAP.	OTHER AGRICULTURE				◯
COMPOSITE FACTORS	Inf. Labor	OTHER AGRICULTURE				◯
	LABOR-CAPITAL	CROPS		◯		
		RUBBER			◯	
	LAND FERTILIZER	CROPS		◯		
		RUBBER			◯	
	INTERMEDIATE	CROPS - FERT & PEST		◯		
		RUBBER - FERT & PEST			◯	
		OTHER AGRICULTURE				◯
ACTIVITIES	Crops and Proc.	EXPECTED REVENUE	◯			
CUR. ACCT. INST.	House hold	FARMERS CROPS REVENUE	◯			

capital, to the composite factor informal-labor and to a composite of intermediates. The outlays of the activity rubber are on three composite factors: (i) an aggregate of labor and capital; (ii) an aggregate of land and fertilizers and (iii) a composite of intermediates excluding fertilizers. Table 2A features two column accounts for the activity of non-rubber crops. This is due to the special behavior this sector is assumed to have in the model. Indeed the model posits, that at the beginning of each period, given the expected prices of their outputs, the current prices of their inputs and their availability of land and capital services, farmers organize their production by maximizing the present value of their expected profits. This leads them this period to produce outputs which they will market next period. Meanwhile during the current period, they market their production of last period and get proceeds from their sales. The role of the two accounts, for non-rubber crops, appearing in table 2A is to record current revenues, the present value of expected revenues, the difference between the two, the current costs of production and the present value of expected profits. The expected revenue account has three outlays on composite factors: (i) an aggregate of labor and capital, (ii) an aggregate of land and fertilizers and (iii) a composite of intermediates. The costs of labor and intermediates are current costs. The sum of the outlays is the present value of expected proceeds. Consequently the outlays on land and capital are present values of expected rents. These present values of expected rents are in the rest of the SAM channelled to the income account of farmers. However, during the current period, farmers get the proceeds of their current sales which is the sum of the outlays of the current revenue account. The rationale of this latter account is that it uses current proceeds to finance the "costs" of the expected revenue account and to channel the difference to the income account

of farmers. Thereby farmers get the actual current rent on land and capital.

Section 2.2 - Industrial Activities

Including mining and quarrying and construction in industry, the share of the value added of the sector in GDP was 16.6% in 1975. This figure is to be contrasted with the 36.9% of agriculture.[6/] The share of industrial exports in total exports reached 28.7% which points to the non-negligible role of industrial production in trade. If one excludes the 7% share of mining and quarrying, manufacturing exports were responsible for 21.7% of export earnings. In terms of employment the role of industry was rather modest; it provided only 11.2% of total employment opportunities. This apparent low profile of the sector in national activity understates the tremendous growth it experienced during the seventies. Industry increased gradually its share in all relevant indicators having an average growth rate of 9.9% during the period 1973-81, compared with a GDP growth of 7.2%. Given the likely slowdown in agricultural growth, major questions in the beginning of the eighties are that of the role of industry and, of industrial strategy. The development of industry can be seen as an alternative way of contributing to employment and income generation and to the trade balance. This in turn poses choices of industrial strategy raising questions with respect to relative capital and energy intensities, protection and export incentives. The disaggregation of the industrial sector in SIAM2 is designed with these issues in mind. It tries to articulate the sector in a minimal number of activities but which however can shed light on the role of the sector in the economy, and on industrial strategy.

Industrial activities are separated into eight sectors. Construction is considered separately because its output is non-traded.

Although it is a small sector, fertilizers and pesticides is also separated from other industrial activities. This is due to (i) its importance as an input into agriculture; (ii) the extent that its price influences its use in agriculture and (iii) its likely development because of the expansion of domestic gas resources. Food processing is also considered separately because of the large agricultural base which provides its main intermediate inputs and because of its role in exports. The rest of the manufacturing sector is subdivided into two sectors (other light industry and heavy industry) which have different capital-output ratios. The distinction stems also from the fact that the process of import substitution moves generally from food processing, to light industry and then to heavy industry. Considering non-energy industry as a whole, one is left with mining and quarrying which is dominated in Thailand by tin, one of the main exports of the country (mining and quarrying excludes energy extraction). As it is shown in Table 2 both food processing and other light industry activities are assumed to take place in the formal and the informal sectors. Table 2B presents the configuration of the eight expenditure accounts of industrial activities.

The eight columns of table 2B are eight column-accounts of the fully blown SAM of SIAM2. They show the outlays of each production sector on the various inputs it uses. Two informal sectors appear in the table: (i) informal food processing and (ii) informal light-industry. These two sectors use one primary and two composite factors. The composites are informal-labor and an aggregate of intermediates while the primary factor is capital. All other activities are in the formal sector; they use blue and white collar

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6/ Agriculture in SIAM2 includes rice milling and other milling activities.

Table 2B

Payment of Activities to Factors: Industry

			ACTIVITIES							
			MINING AND QUARRY.	FORMAL FOOD PROCESS.	INFORMAL FOOD PROCESS.	FERT. AND PEST.	FORMAL LIGHT IND.	INFORMAL LIGNT IND.	HEAVY IND.	CONS-TRUC-TION
PRIMARY FACTORS	BLUE COLLAR	MINING & QUARRYING	○							
		FORMAL FOOD PROCESS.		○						
		FERT. AND PEST.				○				
		FORMAL LIGHT IND.					○			
		HEAVY INDUSTRY							○	
		CONSTRUCTION								○
	WHITE COLLAR	MINING & QUARRYING	○							
		FORMAL FOOD PROCESS.		○						
		FERT. AND PEST.				○				
		FORMAL LIGHT IND.					○			
		HEAVY INDUSTRY							○	
		CONSTRUCTION								○
	CASUAL WORKERS		○							○
	CAPITAL	MINING & QUARRYING	○							
		FORMAL FOOD PROCESS.		○						
		INFORMAL FOOD PROCESS.			○					
		FERT. AND PEST.				○				
		FORMAL LIGHT IND.					○			
		INFORMAL LIGHT IND.						○		
		HEAVY INDUSTRY							○	
		CONSTRUCTION								○
COMPOSITE FACTORS	INF. LAB.	INFORMAL			○			○		
	INTERMEDIATE	MINING & QUARRYING	○							
		FORMAL FOOD PROCESS.		○						
		INFORMAL FOOD PROCESS.			○					
		FERT. AND PEST.				○				
		FORMAL LIGHT IND.					○			
		INFORMAL LIGHT IND.						○		
		HEAVY INDUSTRY							○	
		CONSTRUCTION								○

labor, capital and a composite intermediate. Construction and mining and quarrying are, however, assumed to employ also casual workers which is the

Section 2.3. Energy Producing Activities

The contribution of the value added of the energy sectors to GDP was in 1975 about 3.7% From this perspective, these sectors appear to be negligible without any significant impact on the macroeconomic scene. However, if one looks at trade, the picture is startingly different. While in the sixties the share of energy imports in total imports was about 9%, by 1979-81 this ratio reached 28%. In 1980, 45% of the export earnings of Thailand were required to finance energy inputs. Besides its importance in trade (or because of it) active exploration has led to discoveries of gas resources in the gulf of Thailand. In parallel a potential for crude oil production seems to exist. These external and internal develoments have dramatically changed the role of energy in the economy. In the early eighties, in spite of the world recession and the relative softening of world oil prices, the pricing of energy products remains a major economic issue. It has resource mobilization, trade and distributional implications. In SIAM2, the energy activities are disaggregated in order to analyze energy pricing and the development of gas and oil production.

There are four energy activities in SIAM 2, two for energy-extraction and two for energy-transformation. Because of the potential for gas and oil, one formal activity is assumed to produce jointly these two commodities. All other energy extraction activities are lumped together in one sector: energy-extraction 1. This sector covers mainly the production of charcoal and firewood and the limited production of coal and lignite. Because of its nature, the sector is considered to be informal. The first sector of

energy-transformation produces petroleum products. Electricity is produced by the second energy-transformation sector. Table 2C shows the configuration of the outlays of the four energy-sectors.

The five columns of table 2C are columns of the SAM underlying SIAM2. Like in other informal activities, the payments of energy-extraction 1 go to one primary (capital) and two composite (informal labor, intermediates) factors. Similarly, as for other formal activities, energy-extraction 2 and energy-transformation 1 have outlays going to blue and white collar labor, to capital and to intermediates. The treatment of energy-transformation 2 is different because of the pricing regime of its output. The "Factor-Account" presents the composition of the marginal cost of producing electricity. Like in other formal sectors, this cost is composed of payments to blue and white collar workers, of purchases of intermediates and of returns to capital. The only difference is the separation of intermediates between on the one hand gas and petroleum products and on the other hand the rest of intermediates. The disaggregation is implemented in order to take into account the special role of these two energy-commodities in the production of electricity.7/ The output of electricity is, however, not priced at marginal cost. Electricity has an administered price. The product-account in table 2C shows how the proceeds of sales of electricity are decomposed between the marginal cost value and foregone capital income. This treatment of the electricity sector permits the separate identification of the returns to the sector under marginal cost and administered pricing rules.

7/ See for the formulation of the production decisions in electricity, chapter 3, section 1.2.

Table 2C

Payments of Activities to Factors: Energy

			ENERGY EXTRACTION 1	ENERGY EXTRACTION 2	ENERGY TRANSFORMATION 1	ENERGY TRANSF.2	
						PRODUCT ACCOUNT	FACTOR ACCOUNT
PRIMARY FACTORS	BLUE COLLAR	ENERGY EXTRACTION 2		◯			
		ENERGY TRANSFORMATION 1			◯		
		ENERGY TRANSFORMATION 2					◯
	WHITE COLLAR	ENERGY EXTRACTION 2		◯			
		ENERGY TRANSFORMATION 1			◯		
		ENERGY TRANSFORMATION 2					◯
	CAPITAL	ENERGY EXTRACTION 1	◯				
		ENERGY EXTRACTION 2		◯			
		ENERGY TRANSFORMATION 1			◯		
		ENERGY TRANSFORMATION 2				◯	◯
COMPOSITE FACTORS	INF-LAB.	OTHER AGRICULTURE	◯				
	INTERMEDIATE	GAS AND PETROLEUM					◯
		ENERGY EXTRACTION 1	◯				
		ENERGY EXTRACTION 2		◯			
		ENERGY TRANSFORMATION 1			◯		
		ENERGY TRANSFORMATION 2					◯
ACTIVITY	ENE-TRN2	FACTOR ACCOUNT				◯	

Section 2.4. Production of Services

Services is often a neglected sector. Although it does not directly contribute much to the external balance, its participation in employment and income generation is substantial. In 1975, its share of GDP was close to 43% and it generated 22% of the employment. Moreover the sector, with an 8% growth rate in the seventies participated actively in the over-all growth of the economy.

In SIAM2, the services sectors are disaggregated into four. A first distinction is made between market and non-market services. It is based on the nature of the services traded and their associated pricing rule. Non-market services are social services where prices are essentially administered. The market services are all other types of services with a marginal-cost-pricing type rule. A second distinction is made within the market services between those which are linked with commodity trade and those which have their own final purpose. The implementation of this second distinction leads to the separation of transportation, communication and trade on the one hand from other-market services on the other hand. Finally, because of differences in capital and energy intensities transportation and communication is distinguished from trade. Each of the three market services activities is disaggregated into a formal and an informal component.

The configuration of the outlay-accounts of the various services activities in the SAM underlying SIAM2 is presented in table 2D. All informal sectors, as previously, have three types of outlays - on capital, labor and intermediates. Similarly, all formal activities spend on blue and white collar workers, on intermediate inputs and they transfer an operating surplus to the account of capital. The non-market services sector is treated in the

Table 2D

Payment of Activities to Factors: Services

			ACTIVITIES							
			FORMAL TRANS. AND COMM.	INFORMAL TRANS. AND COMM.	FORMAL TRADE	INFORMAL TRADE	FORMAL OTHER MARKET SERV.	INFORMAL OTHER MARKET SERV.	NON-MARKET SERV.	
									PRODUCT ACCOUNT	FACTOR ACCOUNT
PRIMARY FACTORS	BLUE COLLAR	FORMAL TRANS. AND COMM.	○							
		FORMAL TRADE			○					
		FORMAL OTHER MARKET SERVICES					○			
		NON-MARKET SERVICES								○
	WHITE COLLAR	FORMAL TRANS. AND COMM.	○							
		FORMAL TRADE			○					
		FORMAL OTHER MARKET SERVICES					○			
		NON-MARKET SERVICES								○
	CAPITAL	FORMAL TRANS. AND COMM.	○							
		INFORMAL TRANS. AND COMM.		○						
		FORMAL TRADE			○					
		INFORMAL TRADE				○				
		FORMAL OTHER MARKET SERV. (DOMESTIC)					○			
		INFORMAL OTHER MARKET SERV.						○		
		NON-MARKET SERVICES							○	○
COMPOSITE FACTORS	INF-LAB	INFORMAL		○		○		○		
	INTERMEDIATE	FORMAL TRANS. AND COMM.	○							
		INFORMAL TRANS. AND COMM.		○						
		FORMAL TRADE			○					
		INFORMAL TRADE				○				
		FORMAL OTHER MARKET SERV.					○			
		INFORMAL OTHER MARKET SERV.						○		
		NON-MARKET SERVICES								○
ACTIVITIES	FML-OMS	FACTOR ACCOUNT							○	

same way as energy-transformation 2. The factor-account decomposes the marginal cost of the output and the product account records the difference between the value of the output at the marginal cost and at the administered price.

Section 3. Commodities in SIAM2

Because of differences in cost structures, their relative present and expected importance, differences in output-supply responses, distributional issues and pricing SIAM2 disaggregated production activities into 22 sectors. However, although pricing has implications on activities, it pertains primarily to commodities. Price regimes are commodity specific rather than activity specific. Furthermore, the bulk of indirect taxes are levied on commodities rather than activities. In addition, trade margins and transportation costs change the valuation of commodities before they reach their final users. Finally, some commodities are exported and others are imported. The latter add to domestic output to form domestic supplies.

In the overview of the accounts of SIAM2, the distributional channels between activities, domestic supplies, imports and the final users were described. Here we present the disaggregation of commodities, the linkages between the outputs of activities and domestic commodities, the combination of domestic and imported commodities to form the supplies of composites bought by domestic users and finally the formation of the f.o.b. value of exports.

3.1 - The Disaggregation of Commodities and the Make-Matrix

The SIAM2 considers 20 groups of commodities (table 3). Within the limits defined by the disaggregation of activities, the distinction between commodities relies on the following criteria: (i) the existence of particular

Table 3

Disaggregation of Commodities

Agriculture	1	Rice
	2	Other Exportable Crops
	3	Non-Traded Crops
	4	Rubber
	5	Other Agriculture
Industry	6	Mining and Quarrying
	7	Food Processing
	8	Fertilizers and Pesticides
	9	Other Light Industry
	10	Heavy Industry
	11	Coal, Lignite, Charcoal and Firewood
	12	Natural Gas
	13	Crude Oil
	14	Petroleum Products
	15	Electricity
	16	Construction
	17	Transportation and Communication
	18	Trade
	19	Other Market Services
	20	Non-Market Services

commodity taxation which tends to distort relative prices and (ii) the relative importance of domestic and world factors in the determination of prices. The existence of export taxes on rice and rubber motivated the separate identification of these two commodities. The role of world prices on domestic prices underlies the separation of non-rice export crops from the mainly non-traded crops. The existence of price interventions and the influence of world prices justify the separation of fertilizers and pesticides, crude-oil, natural gas, petroleum products, electricity and non-market services. The remaining disaggregation follows directly from that of activities with one variation however. The formal and informal sector firms engaged in the same activity are assumed to produce commodities which are differentiated but substitutable. Therefore, there is for example only one processed food commodity which is an aggregate of the supplies of the formal and informal firms in the sector.

Table 3A presents the configuration of the make-matrix 8/ on the SAM underlying SIAM 2. It also shows the vector of indirect taxes levied on each of the 20 domestically produced commodities. The rows of table 3A are the income accounts of activities and the columns are expenditure accounts defining the supplies of domestic commodities. The matrix in 3A has 22 activities delivering outputs to 20 commodities accounts. For example, the activity crops has its current revenue account supplying three commodities: rice, other exportable crops and non-traded crops. Similarly, energy extraction 2 delivers gas and crude oil. In a symmetric way, processed food,

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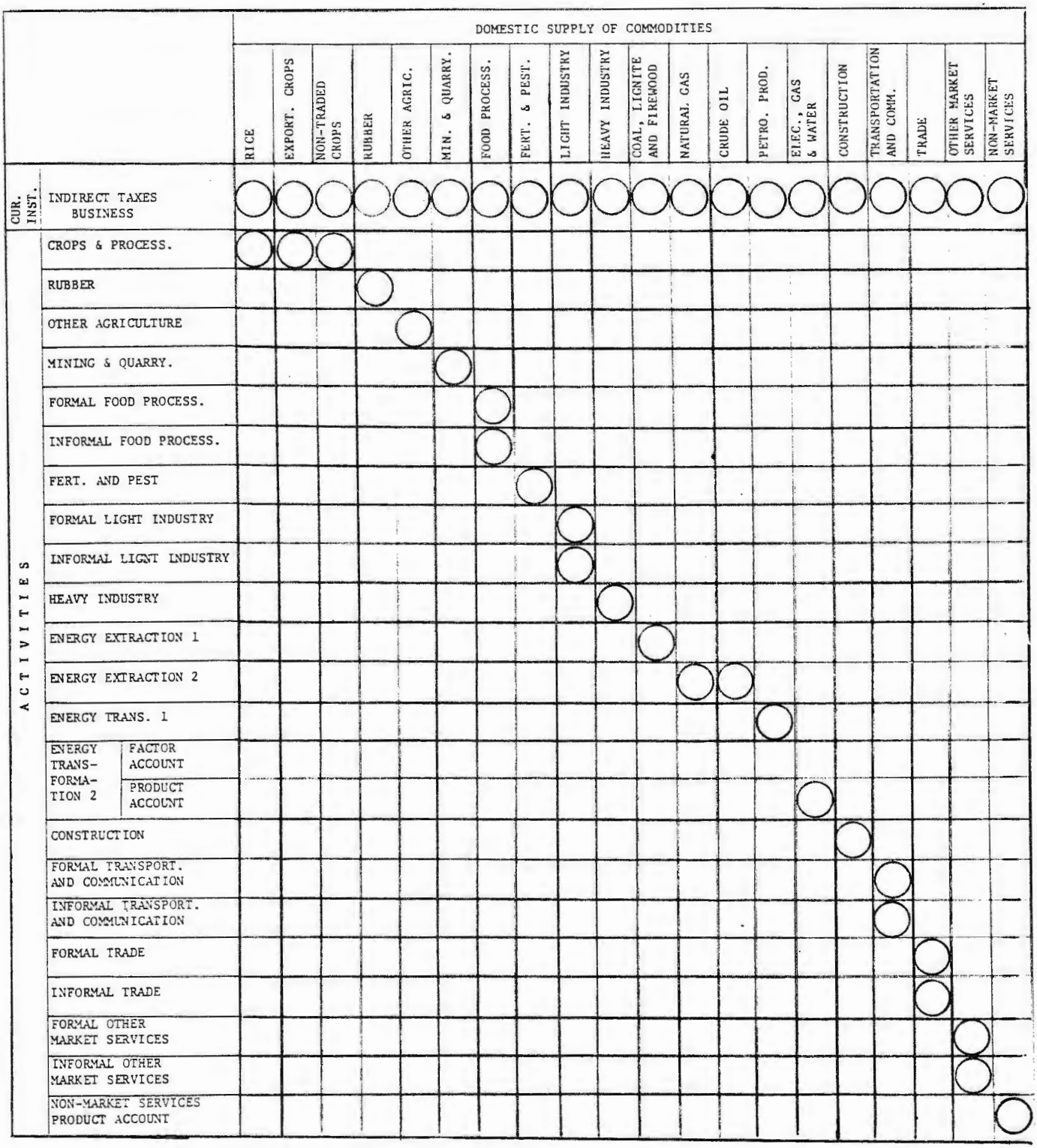
8/ The make-matrix maps activities into commodities. SIAM2 is one of the rare economy-wide models which have a number of commodities different from that of activities.

TABLE 3A

Mapping of Activities Into Commodities: The Make Matrix



light-industrial goods, transportation, trade and other market services are supplied by two activities in each case: formal and informal. The make matrix in SIAM2 is not square and not diagonal. The column sums in table 3A define the value of domestic commodities, inclusive of net domestic commodity taxes but exclusive of trade and transportation margins.

3.2 - From Producers to Domestic Users

The make-matrix, in table 3A, defines the total supplies of domestic commodities. As mentioned previously, these commodities are delivered to various domestic users through channels of distribution specific to each of them. What the user ultimately buys is a composite commodity which is an aggregate of imports and domestically produced goods and which includes all tariffs, taxes, trade and transportation margins. Given that the configuration of the linkages between the composite commodities, domestic supplies and imports is identical for all domestic users, it is presented only for the category of users of intermediate inputs.

Three steps are involved in the formation of the supplies of composite commodities. Domestic supplies of the 20 commodities are delivered to accounts of domestic goods (intermediates). The latter add trade and transportation margins to each commodity and form their value at purchasers prices. In parallel to that, accounts of imported goods (intermediates) buy from the rest of the world the various commodities and add import duties and business taxes; they define the value of imports on domestic markets. The domestic and imported goods accounts then deliver the goods to the accounts of the composite commodities to form the supply of the latter. One can imagine, in order to describe these three stages of distribution, the existence of a wholesaler, an importer and a retailer. The wholesaler buys the goods from

producers and bears the transportation and trade costs. Similarly, the importer buys from abroad, and pays taxes on the imports. Both the importer and the wholesaler would supply retailers who combine imported and domestic goods and supply the final users with composite commodities. Table 3B describes the transactions undertaken by the wholesaler, table 3C shows the transactions done by the importer and finally table 3D presents the composition of the supplies of retailers. These three tables pertain to the exchanges on intermediate commodities. Three similar tables, with the same configuration, are defined for each category of final users.

3.3 - From Producers to Exporters

In the same way wholesalers buy domestic production and supply domestic retailers, there are exporters who purchase domestic commodities and supply the rest of the world. Table 3E shows the transactions undertaken by the exporters. Like wholesalers they buy the domestic goods and bear transportation and trade costs. However, because of policy interventions in particular markets they also pay special taxes. Specifically, there is an export tax and export premium on rice and export taxes on rubber and light-industry. The column sums in table 3E define the f.o.b. values of exports.

Section 4. Factors of Production

Activities, in order to produce commodities, use factors of production. They thus generate incomes to primary factors and create a demand for intermediate inputs. Three types of concerns govern the disaggregation of factors of production in SIAM2: (i) the need to monitor employment and income distribution implications of the policy instruments captured by the model, (ii) the requirement to capture the price sensitivity of the use of

Table 3B

Payment of Domestically Produced Intermediates to Activities

		DOMESTIC GOODS AND SERVICES - INTERMEDIATES																	
		RICE	EXPORT. CROPS	NON-TRADED CROPS	RUBBER	OTHER AGRIC.	MINING & QUARRY.	FOOD PROCESS.	LIGHT INDUSTRY	HEAVY INDUSTRY	COAL,LIGNITE & FIREWD.	NATURAL GAS	CRUDE OIL	ELEC., GAS & WATER	CONSTRUCTION	TRANSP. AND COMM.	TRADE	OTHER MARKET SERV.	NON-MARKET SERV.
DOMESTIC SUPPLY OF COMMODITIES	RICE	○																	
	EXPORT. CROPS		○																
	NON-TRADED CROPS			○															
	RUBBER				○														
	OTHER AGRIC.					○													
	MINING & QUARRY.						○												
	FOOD PROCESS.							○											
	LIGHT INDUSTRY								○										
	HEAVY INDUSTRY									○									
	COAL,LIGNITE & FIREWD.										○								
	NATURAL GAS											○							
	CRUDE OIL												○						
	ELEC.,GAS & WATER													○					
	CONSTRUCTION														○				
	TRANSPORT. & COMM.	○	○	○	○	○	○	○	○	○	○					○			
	TRADE	○	○	○	○	○	○	○	○	○	○								
	OTHER MARKET SERV,																	○	
	NON-MARKET SERV.																		○

TABLE 3C

Payment of Imported Intermediates to Rest of the World and Indirect Taxes

			IMPORTED GOODS AND SERVICES - INTERMEDIATES																
			RICE	EXPORT. CROPS	NON-TRADED CROPS	RUBBER	OTHER AGRIC.	MINING & QUARRY.	FOOD PROCESS.	LIGHT INDUSTRY	HEAVY INDUSTRY	COAL,LIGNITE & FIREWD.	NATURAL GAS	CRUDE OIL	ELEC., GAS & WATER	CONSTRUCTION	TRANSP. AND COMM.	TRADE	OTHER MARKET SERV.	NON-MARKET SERV.
CURRENT INSTITUTION	REST OF THE WORLD			○	○	○	○	○	○	○	○	○		○			○		○	
	INDIRECT TAXES	BUSINESS		○	○	○	○	○	○	○	○									
		IMP-DUTY		○	○	○	○	○	○	○	○									

TABLE 3D

Payment of Composite Intermediate to Domestic and Imported Commodities

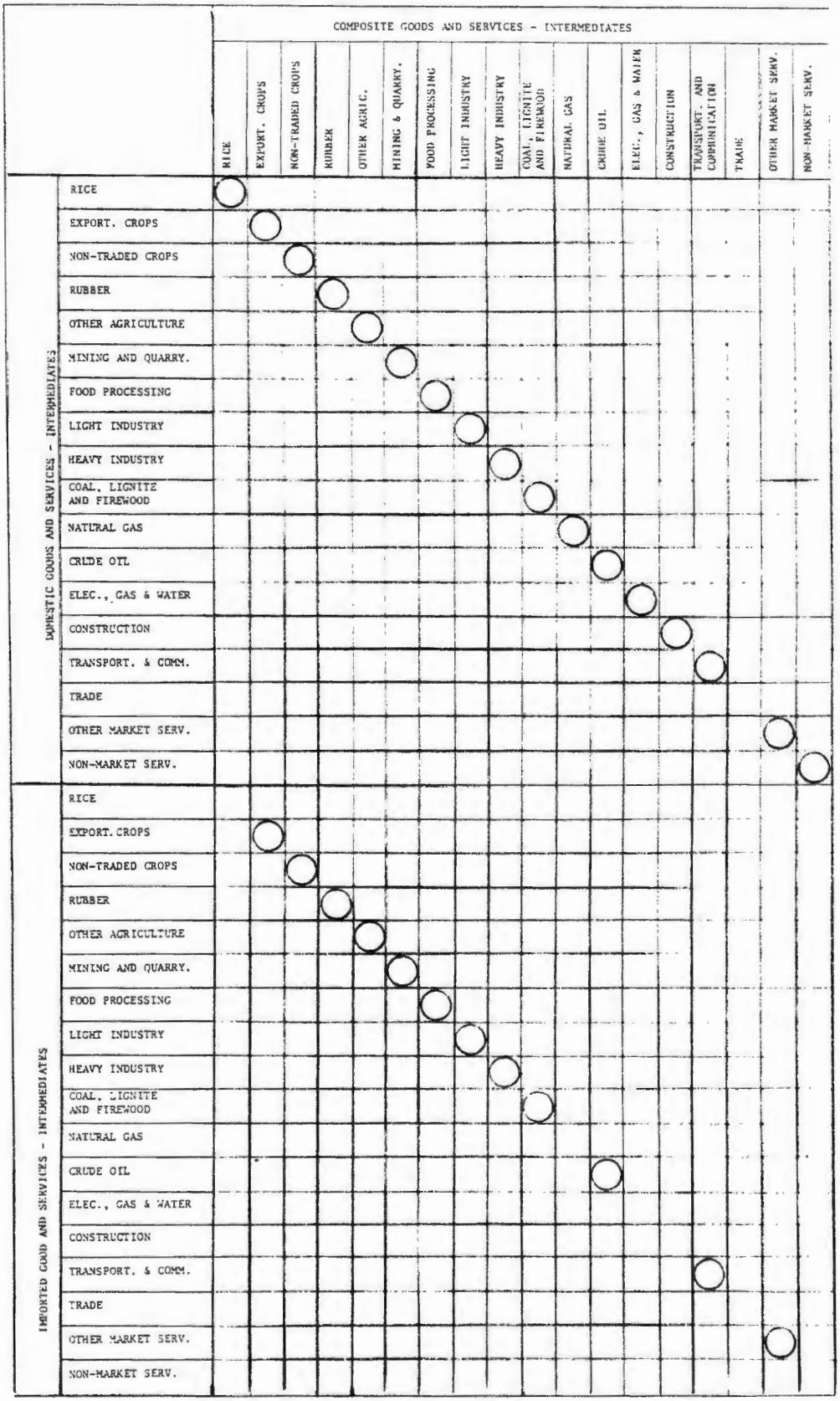
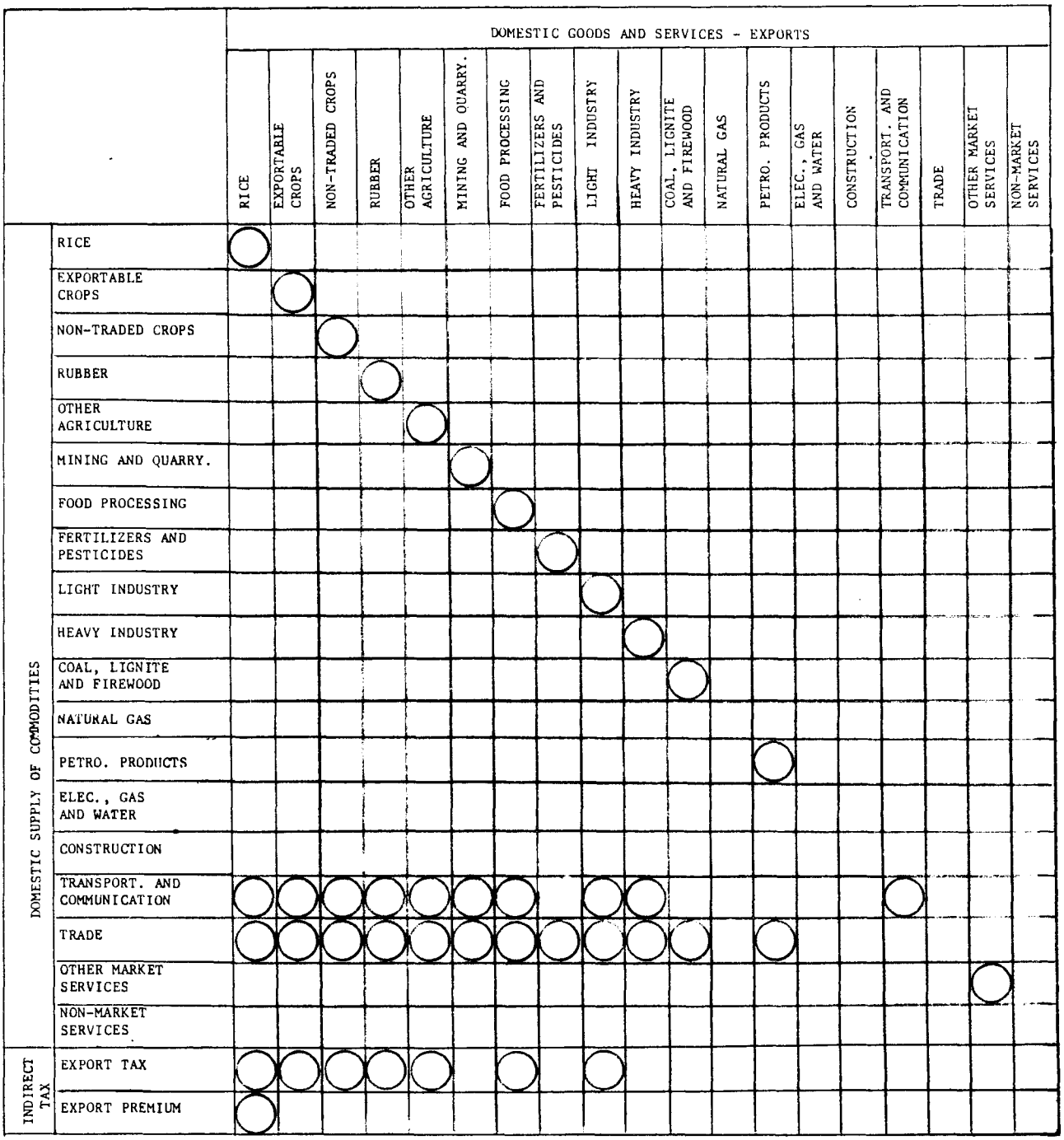


TABLE 3E

Payment of Exported Commodities to Domestic Supply of Commodities and Indirect Taxes



intermediate inputs and (iii) sector specific concerns especially in agriculture and energy.

As mentioned earlier, one of the objectives of SIAM2 is to monitor the distributional implications of adjustments in production and trade patterns to the environment of the economy. Typically, such adjustments will mean the relative expansion or contraction of particular activities. This will naturally affect the employment and income generation capacity of the concerned activities and by implication the welfare of the households engaged in them. The most straightforward way to capture such linkages is through the disaggregation of the factors of production.

In most production activities the costs of intermediate inputs are well above 30% of total costs. Usually these inputs are traded and their prices have strong linkages with world prices. Changes in these world prices can affect the total costs of production squeezing profits and limiting increases in wages. However, responses to changes in world prices can be dampened if there is some scope of substitution between inputs inducing a softening in the demand for intermediates. In order to capture such responses a simple way is to asume that as an aggregate, used in production, intermediates are sensitive to relative prices. It should be noted here that it is not only the prices of imported inputs (like oil) which are relevant here. Exported primary goods used also as intermediate inputs in other activities affect the costs of the latter.

Crop production uses among other inputs, capital, labor, land and fertilizers. Agricultural mechanization means a change in the capital-labor ratio which might be induced by changes in the relative costs of the two inputs. This substitutability between capital and labor can be specific and

separate of the responses of other inputs to relative price changes. Therefore it seems appropriate to treat capital and labor as a composite factor which has a degree of substitution between its components different from what it has with other factors. A similar treatment is also justified for land and fertilizers. Outside agriculture, the only other activity using specific composite input is energy transformation 2. Indeed, petroleum products are heavily used in the production of electricity. The coming on stream of gas production and the relative ease of substitution between petroleum products and gas in the production of electricity justify the existence of a separate composite input in that sector. It is a composite of gas and petroleum products.

The foregoing has led us to classify all inputs into two broad categories: (i) composite and (ii) elementary factors. The composites are aggregates of either intermediates, intermediates and primary or only primary inputs. The elementary factors are inputs in the standard sense. The composites are based on the assumption that the scope of substitutability within the composite is different from that between the composite and the other inputs used in the activity. Table 4 gives a summary disaggregation of the factors of production used in SIAM2.

Among the outlays of production activities, there are payments to composite intermediate inputs. Because the basket of intermediates is different from one production activity to another, 22 composite intermediate inputs are distinguished. Table 4A shows the configuration of the cost of each of the 22 composite intermediates. This is a 18 X 22 absorption matrix[9/]

9/ This matrix describes the absorption of intermediate inputs by the various production activities. See Bulmer-Thomas (1982).

Table 4

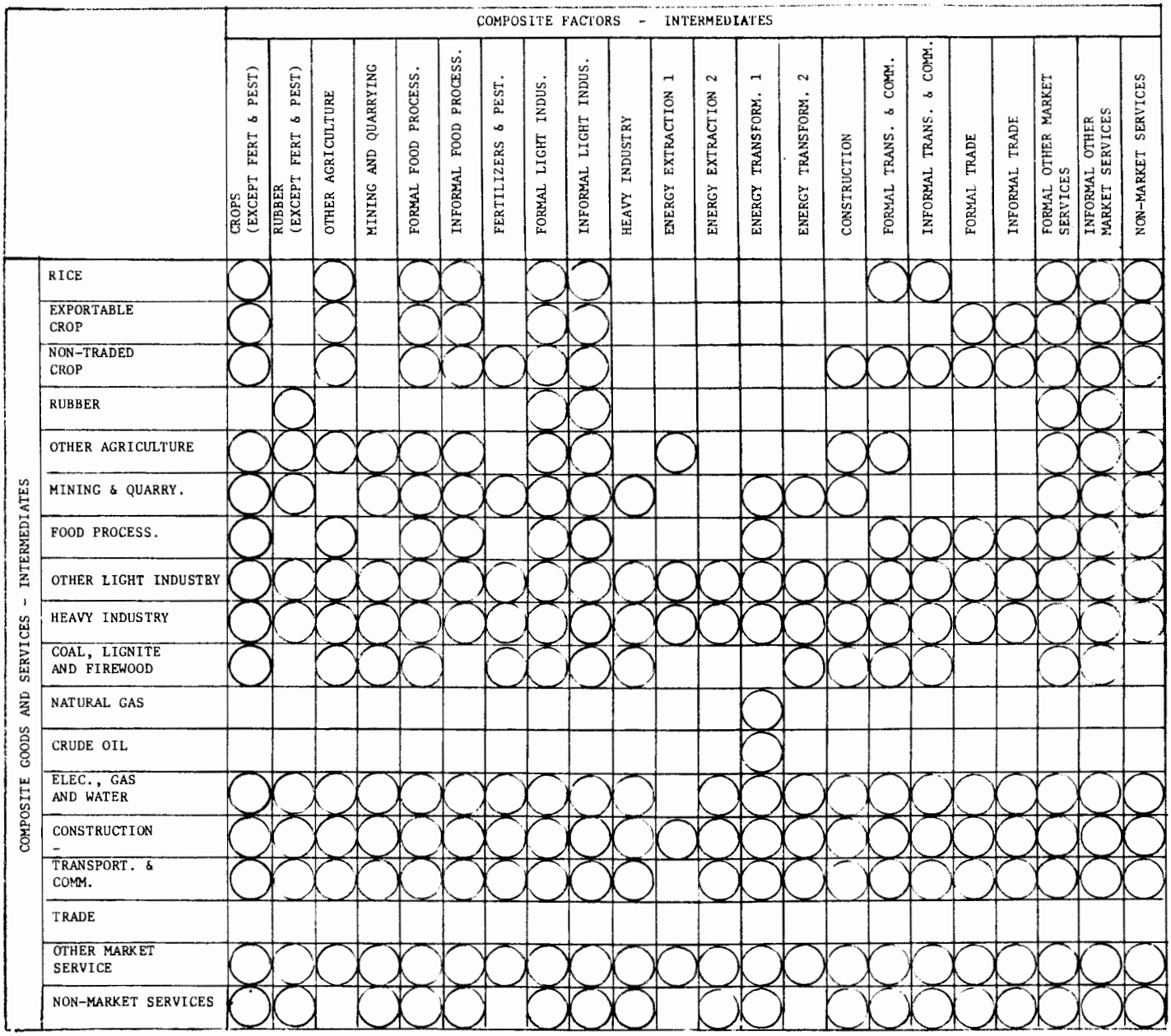
SUMMARY

DISAGGREGATION OF FACTORS OF PRODUCTION

INFORMAL ACTIVITIES		FORMAL ACTIVITIES		
CROPS - RUBBER	OTHER INFORMAL ACTIVITIES	CONSTRUCTION/ MIN. & QUARRY.	ENERGY TRANS. 2	OTHER FORMAL ACTIVITIES
COMPOSITE: Capital and Informal Labor	CAPITAL	CAPITAL BLUE COLLARS WHITE COLLARS	CAPITAL BLUE COLLARS WHITE COLLARS	CAPITAL BLUE CAPITAL WHITE COLLARS
COMPOSITE: Land and Fertilizers	COMPOSITE: Own Labor and Casual Labor	CASUAL WORKERS	COMPOSITE: GAS and Petroleum	COMPOSITE: Inmediates
COMPOSITE: Other intermediates	COMPOSITE: Intermediates		COMPOSITE: Oth Intermediates	

Table 4A

Payment of Composite Intermediate Inputs



which describes the composition of the intermediate inputs entering each production activity.

In a few production activities specific composites are considered. Table 4B shows their composition. The first four columns indicate that informal-labor includes own-labor and casual workers. Columns 5 to 8 decompose composite inputs entering non-rubber crops and rubber between labor and capital on the one hand and land and fertilizers on the other hand. Finally the last column of the table shows the composition of the composite entering energy-transformation 2. It uses gas and petroleum products.

At this point all factor incomes are distributed to elementary factors either directly from the production activities or through composites. What remains is to channel factor incomes to institutions. Table 4C shows the distribution of capital income to the households operating their own business[10/], to government and to public and private corporations. The capital income of the formal activities in other-market-services has a special treatment. The income generated by the activity is a domestic income. It is first directed to a national capital income account which also collects net capital income from abroad. The national capital income is finally distributed to the account of private corporations.

The distribution of land and labor income to households appears in table 4D. The first seven columns are straightforward: The factors distribute their incomes to the household owning them. The treatment of

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10/ The capital and land income from agriculture appearing in table 4c are expected incomes. In order to obtain actual income one has to add the figure appearing at the bottom of the first column of table 2A. See Section 7.1 of chapter 3.

Table 4B

Payment of Composite Factors to Factors of Production

			COMPOSITE FACTORS								
			INFORMAL LABOR				LAB-CAP		LAN-FRT		GAS PET.P
			CROPS	RUBBER	OTHER AGRIC.	NON AGRIC.	CROPS	RUBBER	CROPS	RUBBER	ENERGY TRAN. 2
PRIMARY FACTORS	OAB-LAB	CROPS	○								
		RUBBER		○							
		OTHER AGRICULTURE			○						
		NON AGRICULTURE				○					
	CASUAL WORK		○	○	○	○					
	CAPITAL	CROPS					○				
		RUBBER						○			
	LAND	CROPS							○		
		RUBBER								○	
COMPOSITE FACTORS	INF-LAB	CROPS					○				
		RUBBER						○			
COMPOSITE GOODS	FERTILIZERS AND PESTICIDES								○	○	
	PETROLEUM PRODUCTS										○
	INT.	NATURAL GAS									○

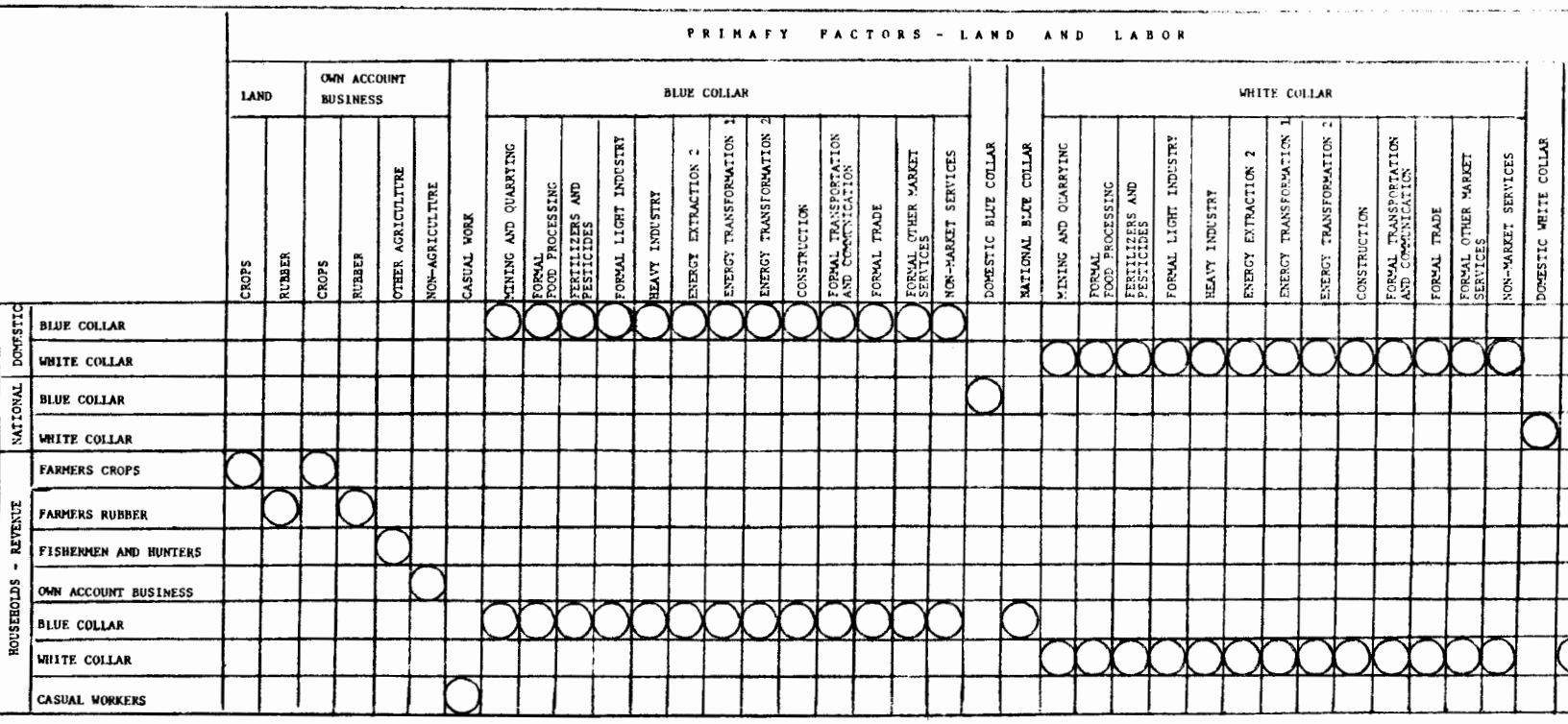
TABLE 4C

Capital Payment to Institutions

		PRIMARY FACTORS - CAPITAL																						
		CROPS	RUBBER	OTHER AGRICULTURE	MINING & QUARRYING	FORMAL FOOD PROCESSING	INFORMAL FOOD PROCESSING	FERTILIZERS AND PESTICIDES	FORMAL LIGHT INDUSTRY	INFORMAL LIGHT INDUSTRY	HEAVY INDUSTRY	ENERGY EXTRACTION 1	ENERGY EXTRACTION 2	ENERGY TRANSFORMATION 1	ENERGY TRANSFORMATION 2	CONSTRUCTION	FORMAL TRANSPORTATION AND COMMUNICATION	INFORMAL TRANSPORTATION AND COMMUNICATION	FORMAL TRADE	INFORMAL TRADE	NATIONAL FORMAL OTHER MARKET SERVICES	DOMESTIC FORMAL OTHER MARKET SERVICES	INFORMAL OTHER MARKET SERVICES	NON-MARKET SERVICES
CURRENT ACCOUNT INSTITUTIONS — HOUSEHOLDS REVENUE — FARMERS CROPS		○																						
HOUSEHOLDS REVENUE — FARMERS RUBBER			○																					
HOUSEHOLDS REVENUE — FISHERMAN AND HUNTERS				○								○												
HOUSEHOLDS REVENUE — OWN ACCOUNT BUSINESS							○			○								○		○			○	
GOVERNMENT																								○
PUBLIC CORPORATIONS															○		○							○
PRIVATE CORPORATIONS					○	○		○	○		○		○	○		○	○		○		○			

TABLE 4D

Distribution of Labor Income to Institutions



blue and white collar incomes is slightly different. It is designed to capture on the one hand the difference between incomes at average domestic wages and at sector-specific wage and on the other hand the difference between domestic and national income. Take the column of blue-collars in heavy industry. The column sum is the compensation paid to these workers by the activity. This compensation is decomposed between the value it would take at the average economy-wide wage of blue-collars and a wage differential. The former is distributed to the account: domestic blue-collars and the latter goes directly to the revenue account of blue-collar households. This takes care of the existence of a differential between average and sector specific wages. The account of domestic blue-collars then channels its income to the account of national blue-collars. The latter receives also a net labor income from the rest of the world and then distributes its income to blue-collar households. The configuration of the accounts of white-collars is identical.

Section 5: Current Account of Institutions

The national income is now distributed to institutions which eventually get additional incomes through inter-institutional transfers. Their total resources are then allocated over different outlays. The pattern of these outlays will vary between institutions. The implication is that shifts in income distribution will affect the receipts of the agents receiving these outlays. In particular, the pattern of consumption and the mobilization of savings will respond to shifts in income distribution. The disaggregation of institutions in SIAM2 is mainly designed to capture the effects of changes in income distribution on consumption patterns and on savings mobilization.

There are four broad categories of institutions in SIAM2: (i) households, (ii) government; (iii) corporations and (iv) the rest of the world. They are considered successively in the following.

5.1 Households' Accounts

Households are classified into three main categories. The first one covers own-account households who own and operate their businesses. This category includes three agricultural households and one for the rest of the economy. The separation of the agricultural households follows the disaggregation of activities. They are farmers growing non-rubber crops, rubber farmers and the group of fishermen, hunters and foresters. This latter group is also assumed to own the activity energy extraction 1 which is dominated by the production of charcoal and firewood. The second category of households is that of wage-earners in the formal sectors. It is composed of two groups of households, those whose head is a blue collar worker and those with a head who is a white collar. The last category of households is that of wage earners mainly employed in the informal sector. This category includes only one group of households where the head is employed as a casual worker. Because mining and quarrying as well as construction employ casual workers, the category does not exclusively belong to the informal Sector.

Table 5 shows the configuration of the outlays of the revenue accounts of the seven categories of households considered in SIAM2. Apart from blue and white collar households, these outlays are out of full and not actual income. Thus for these households consumption, taxes, interest payments, transfers abroad and savings exhaust the full income and are therefore larger than the actual income. For blue and white collar, the SAM records only actual receipts and outlays.

The committed expenditure accounts of each household receive resources for consumption. What happens to these resources is presented in table 5A. The first seven columns of the table show the committed

TABLE 5

Payment from the Revenue Accounts of Households

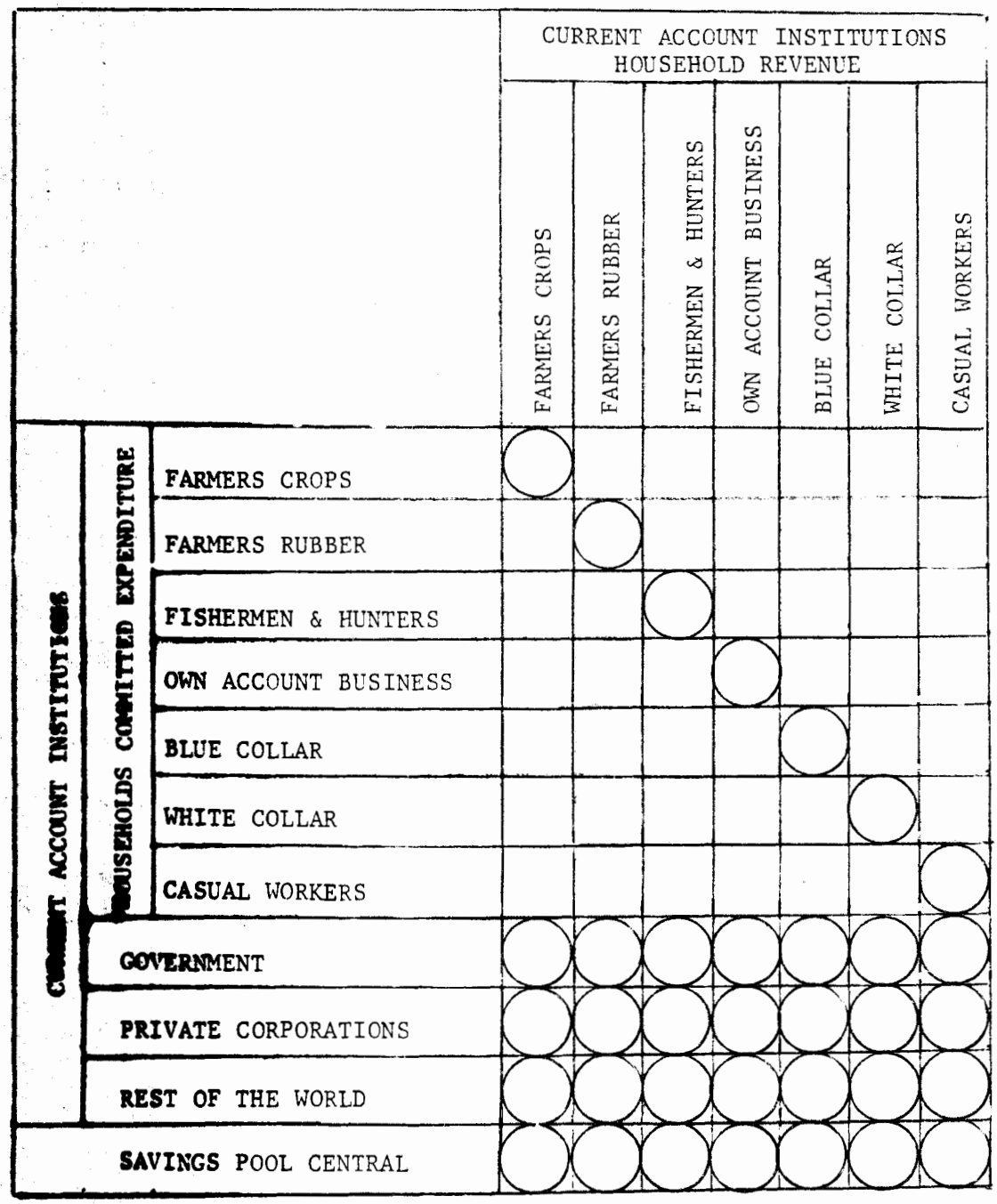
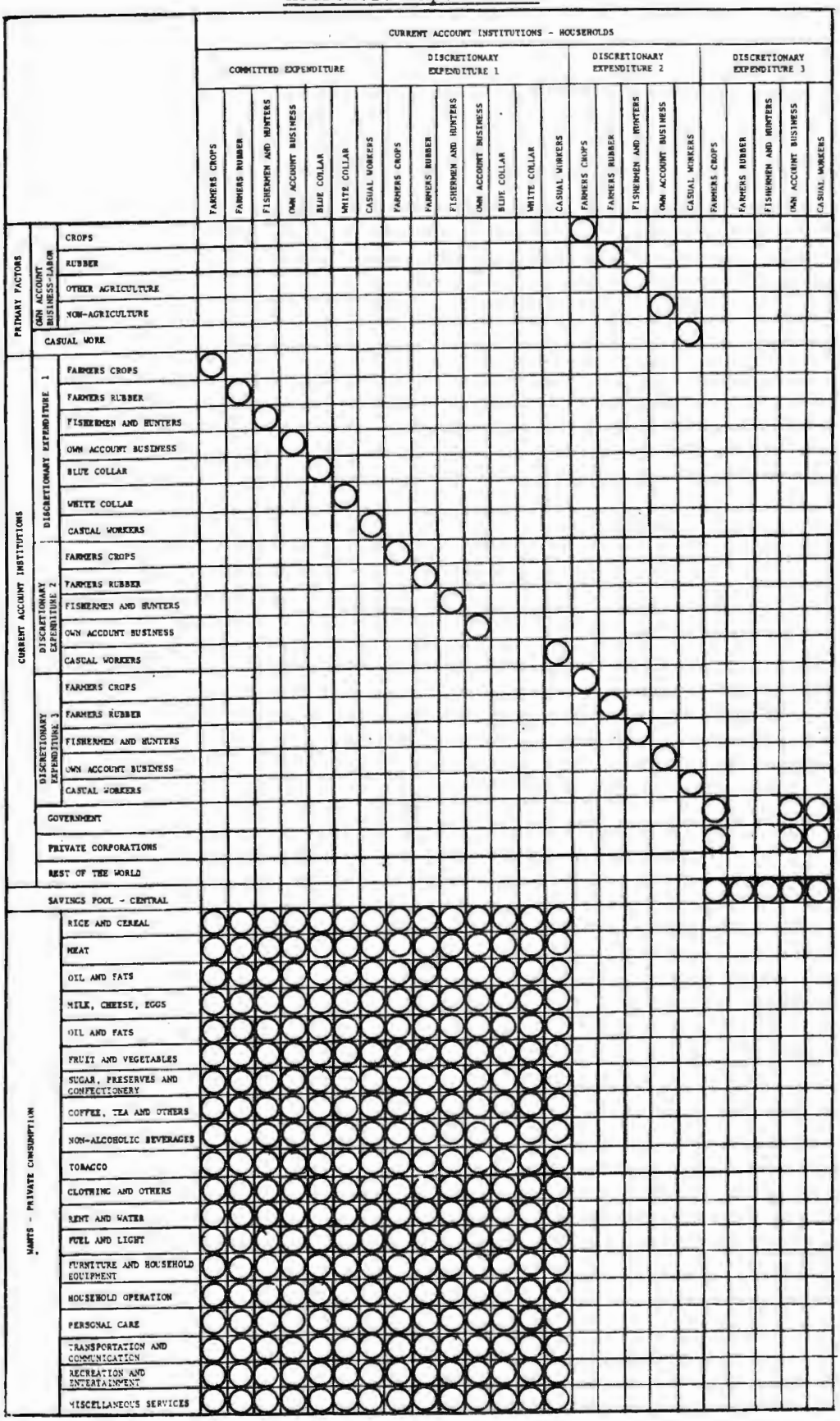


TABLE 5A

Household Expenditure



expenditures on the various types of consumption or wants and the excess of total over committed expenditure. This excess is an amount which the household is free to allocate at his discretion and therefore it is called the discretionary expenditure. The next seven columns of table 5A present the allocation of the discretionary expenditure. Blue and White collar household allocate their actual discretionary expenditure on wants. They only buy goods and non-factor services. The other households allocate their full discretionary expenditure over wants and leisure. The value of the foregone consumption due to leisure is paid to the discretionary account 2. This account then decomposes the foregone consumption between foregone income and transfers. The former is repaid back to the factor account which originally paid the household his full and not his actual income. The foregone transfers, which will be a negative number, is channelled to a discretionary account 3. There, the foregone transfers are allocated between taxes, interest on debt, transfers abroad and savings. In table 5, the revenue account allocates "too much" to these outlays, the excess is taken out in table 5A.

Households allocate their actual committed and discretionary expenditures over wants. However, in order to satisfy their wants they generally combine purchases of various commodities. Table 5B, shows the mapping between commodities and wants.

5.2. Other Accounts of Institutions

Apart from households, SIAM2 distinguishes between government, corporations and the rest of the world. Table 5C describes the government accounts. The first column is the revenue account which allocates resources to government consumption, to transfers to households, to the service of the

TABLE 5B

Mapping Between Commodities and Wants

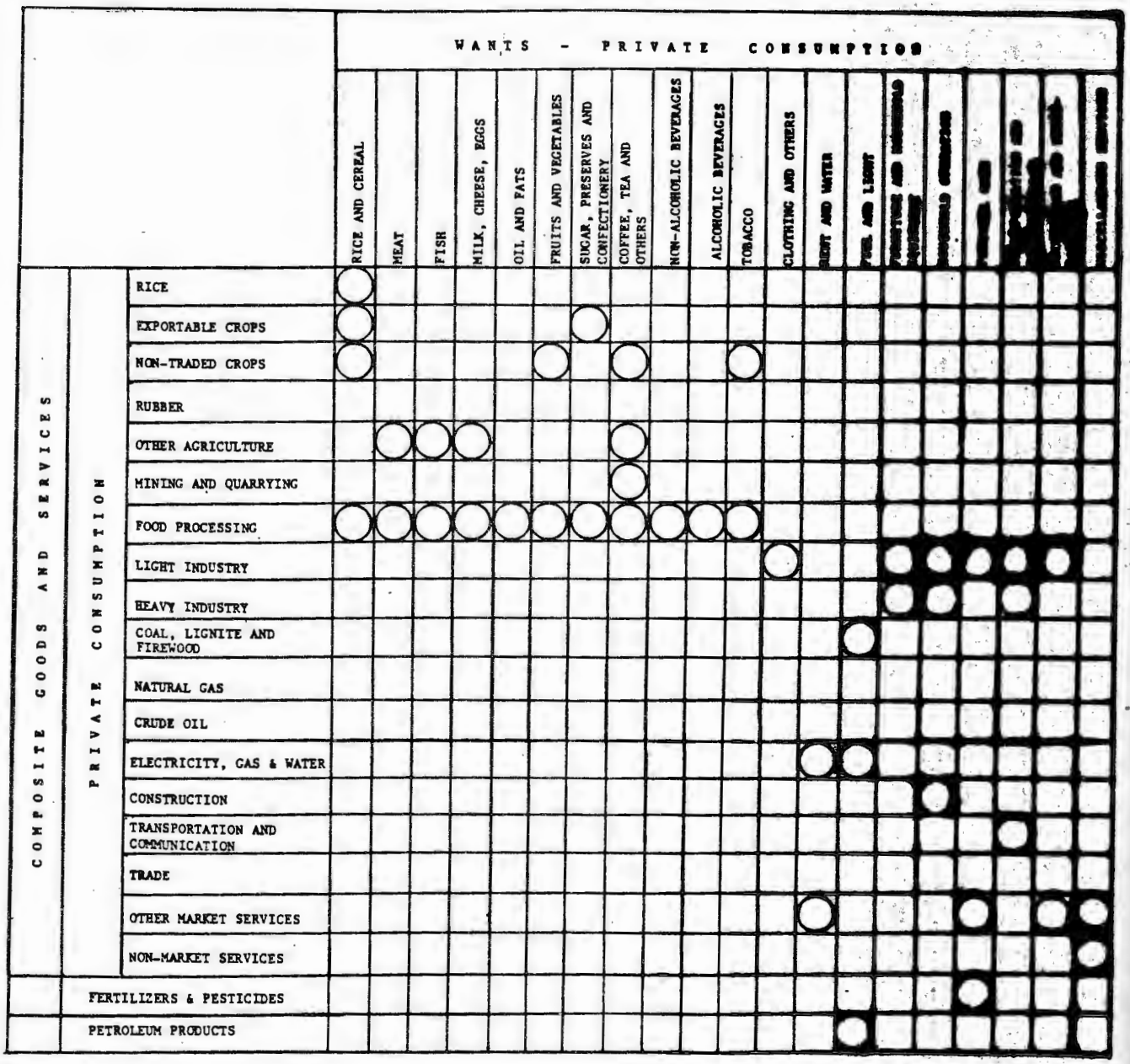


TABLE 5C

Government Current Account and Indirect Taxes

			CURRENT ACCOUNT INSTITUTIONS						
			GOVERNMENT		INDIRECT TAXES				
			REVENUE	EXPENDITURE	BUSINESS	IMPORT DUTY	EXPORT TAX	EXPORT PREMIUM
CURRENT ACCOUNT INSTITUTIONS	HOUSEHOLD REVENUE	FARMERS CROPS	○					
		FARMERS RUBBER						
		FISHERMEN AND HUNTERS	○					
		OWN ACCOUNT BUSINESS	○					
		BLUE COLLAR	○					
		WHITE COLLAR	○					
		CASUAL WORKERS	○					
	GOVERNMENT	REVENUE			○	○	○	○
		EXPENDITURE	○					
	PRIVATE CORPORATIONS		○					
	REST OF THE WORLD		○					
CAP. INST	SAVINGS POOL - PUBLIC		○					
COMPOSITE GOODS AND SERVICES	GOVERNMENT CONSUMPTION	RICE		○				
		EXPORTABLE CROPS		○				
		NON-TRADED CROPS		○				
		RUBBER						
		OTHER AGRICULTURE		○				
		MINING AND QUARRYING		○				
		FOOD PROCESSING		○				
		LIGHT INDUSTRY		○				
		HEAVY INDUSTRY		○				
		COAL, LIGNITE AND FIREWOOD						
		NATURAL GAS						
		CRUDE OIL						
		ELECTRICITY, GAS AND WATER		○				
		CONSTRUCTION		○				
		TRANSPORTATION AND COMMUNICATION		○				
		TRADE						
		OTHER MARKET SERVICES		○				
		NON-MARKET SERVICES		○				
	FERTILIZERS AND PESTICIDES			○				
	PETROLEUM PRODUCTS			○				

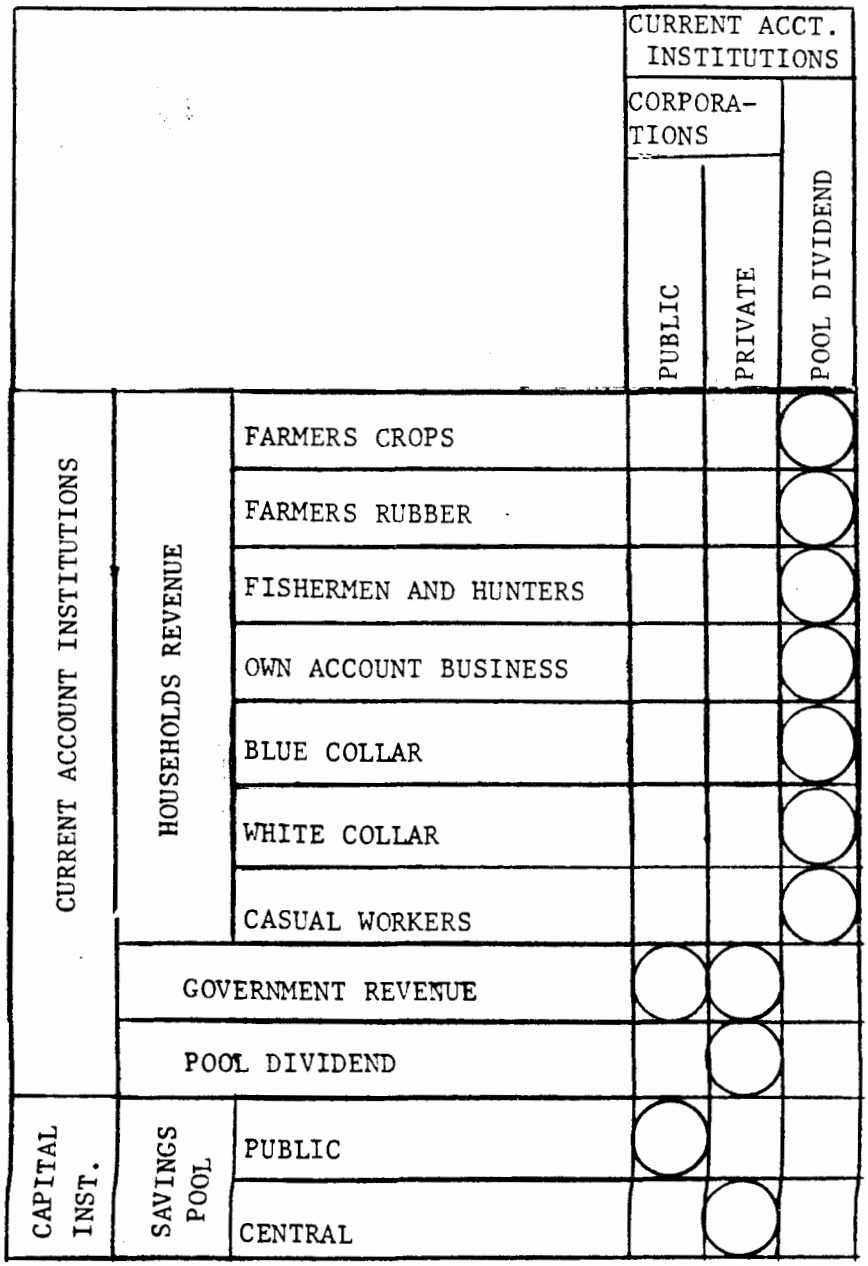
public debt and to transfers abroad. The difference between all these payments and the government revenue is the government savings on its current account and it goes to the public savings pool. The second column of table 5C, is the expenditure account of the government. It distributes the total resources the government allocates to consumption on various goods andservices. The role of the four remaining accounts in the table is to collect the various indirect taxes levied in the economy and to channel them to the government revenue account. The entry in each of the four last columns of table 5C is the total amount of taxes collected in the category of taxes concerned.

SIAM2 separates corporations between private and public. Table 5D indicates that all the resources of the public corporations are channelled to the public sector savings pool. Private corporations allocate their resources between taxes, dividends and savings. The taxes go to the government revenue account and the savings feed the central savings pool. All dividends 10/ are paid to a pool of dividends which in the last column of table 5D allocates them on the various households. This allocation reflects, among other things, the distribution of ownership of private corporations.

Finally, table 5E records the sources and allocation of foreign exchange inflows in the country. One particularity of the rest of the world account is that it includes both current and capital transactions. The main reason is that both types of transactions are governed by the same price of foreign exchange. The first column of table 5E shows the various foreign exchange inflows. Net factor income from abroad is decomposed into three elements: (i) capital, (ii) blue-collar labor and (iii) white collar labor, which appear as the three first entries. The next two elements in the first

Table 5D

Current Account of Public and Private Corporations



column are transfers to government and private transfers. This is followed by tourists' expenditure and then by the value of the various exports of goods and services. All these current inflows are then complemented by capital inflows. Private capital resources finance the formal pool whereas the public resources finance the public sector savings pool. The sum of the capital inflows is the sum of the current account deficit and of the changes in reserves. The second column in table 5E shows the allocation of tourists expenditures on different commodities while the last column presents the distribution of private transfers over the revenue accounts of the seven households of SIAM2.

Section 6. Investment Expenditures and The Flows of Funds

Households and private corporations generate savings and channel them to the central savings pool. Government and public corporations direct their savings to the public savings pool. These private and public savings are complemented by foreign capital inflows. All these resources are channelled to the various investing agents and finance their investment expenditures.

Table 6A shows the configuration of outlays for investment expenditures of the various investing agents in SIAM2. These agents are the nine informal sector, three public sector and eleven formal sector activities. These twenty three agents buy investment goods which are the outputs of light industry, heavy industry and construction. Because the purchase of livestock is also considered as an investment, the households engaged in non-crop agriculture allocate a share of their investment outlays on the composite commodity other-agriculture which includes livestock. An additional special account is introduced to record the changes in stocks in

Table 5E

Payment from Abroad and Tourist Expenditures

			CURRENT ACCOUNT INSTITUTIONS		
			REST OF THE WORLD	TOURISTS AND FOREIGN INSTITUTIONS	POOL OF PRIVATE TRANSFERS
PRIMARY FACTORS	NATIONAL	CAPITAL FORMAL OTHER MARKET SERVICES	○		
		BLUE COLLAR	○		
		WHITE COLLAR	○		
CURRENT ACCOUNT INSTITUTIONS	HOUSEHOLDS - REVENUE	FARMERS CROPS			○
		FARMERS RUBBER			○
		FISHERMEN & HUNTERS			○
		OWN ACCOUNT BUSINESS			○
		BLUE COLLAR			○
		WHITE COLLAR			○
		CASUAL WORKERS			○
	GOVERNMENT REVENUE		○		
	POOL OF PRIVATE TRANSFERS		○		
	TOURISTS AND FOREIGN INSTITUTIONS		○		
CAPITAL INST.	FORMAL POOL		○		
	PUBLIC SAVINGS POOL		○		
DOMESTIC GOODS AND SERVICES	EXPORTS	RICE	○		
		EXPORTABLE CROPS	○		
		NON-TRADED CROPS	○		
		RUBBER	○		
		OTHER AGRICULTURE	○		
		MINING AND QUARRYING	○		
		FOOD PROCESSING	○		
		FERTILIZERS AND PESTIC.	○		
		LIGHT INDUSTRY	○		
		HEAVY INDUSTRY	○		
		COAL, LIGNITE AND FIREWOOD	○		
		PETROLEUM PRODUCTS	○		
		TRANSPORT AND COMMUNICATION	○		
		OTHER MARKET SERVICES	○		
COMPOSITE GOODS AND SERVICES	TOURISTS AND FOREIGN INSTITUTIONS	RICE			
		EXPORTABLE CROPS			
		NON-TRADED CROPS			
		RUBBER			
		OTHER AGRICULTURE			
		MINING AND QUARRYING			
		FOOD PROCESSING			
		LIGHT INDUSTRY		○	
		HEAVY INDUSTRY			
		COAL, LIGNITE AND FIREWOOD			
		NATURAL GAS			
		CRUDE OIL			
		ELECTRICITY, GAS AND WATER			
		CONSTRUCTION			
		TRANSPORT AND COMMUNICATION		○	
	PETROLEUM PRODUCTS				

various commodities. The outlays of this account are shown in the last column of table 6A.

The natural question which arises at this stage is that of the financing of these investments and of the flow of funds between the savers and the investors. This is described in table 6B. The rows of this table are the receipt-accounts of the investing agents and the five financing pools identified in SIAM2. Assume the government and the public corporations have decided on their investments and on the public sector borrowing from abroad. This fixes the total of the row of the public sector savings pool and the amount appearing at the intersection of this row and the column of the rest of the world. Given the public sector savings additional finance has to be found to cover the investment plan. The public sector savings pool will get resources from the central savings pool. This will leave funds to the private sector which will appear at the intersection of the column of the central pool and of the row of the private pool. In turn the private pool will allocate its available resources between the formal and informal pool (column 6). The informal pool will distribute the resources it gets over the various informal activities which will invest only up to the amount of funds made available to them. This is shown in column 3. Assuming that all formal sector investors have decided on their investment, the resources made available from the private pool to the formal pool may not be sufficient. Additional funds are obtained through private borrowing from abroad. In summary, the above story tells that the public sector decides on its investment and its borrowing from abroad. It needs additional financing which it gets from the private sector. The latter allocates the remaining funds between formal and informal sectors. The informal sector cannot go and borrow abroad so it invests

TABLE 6A

Investment

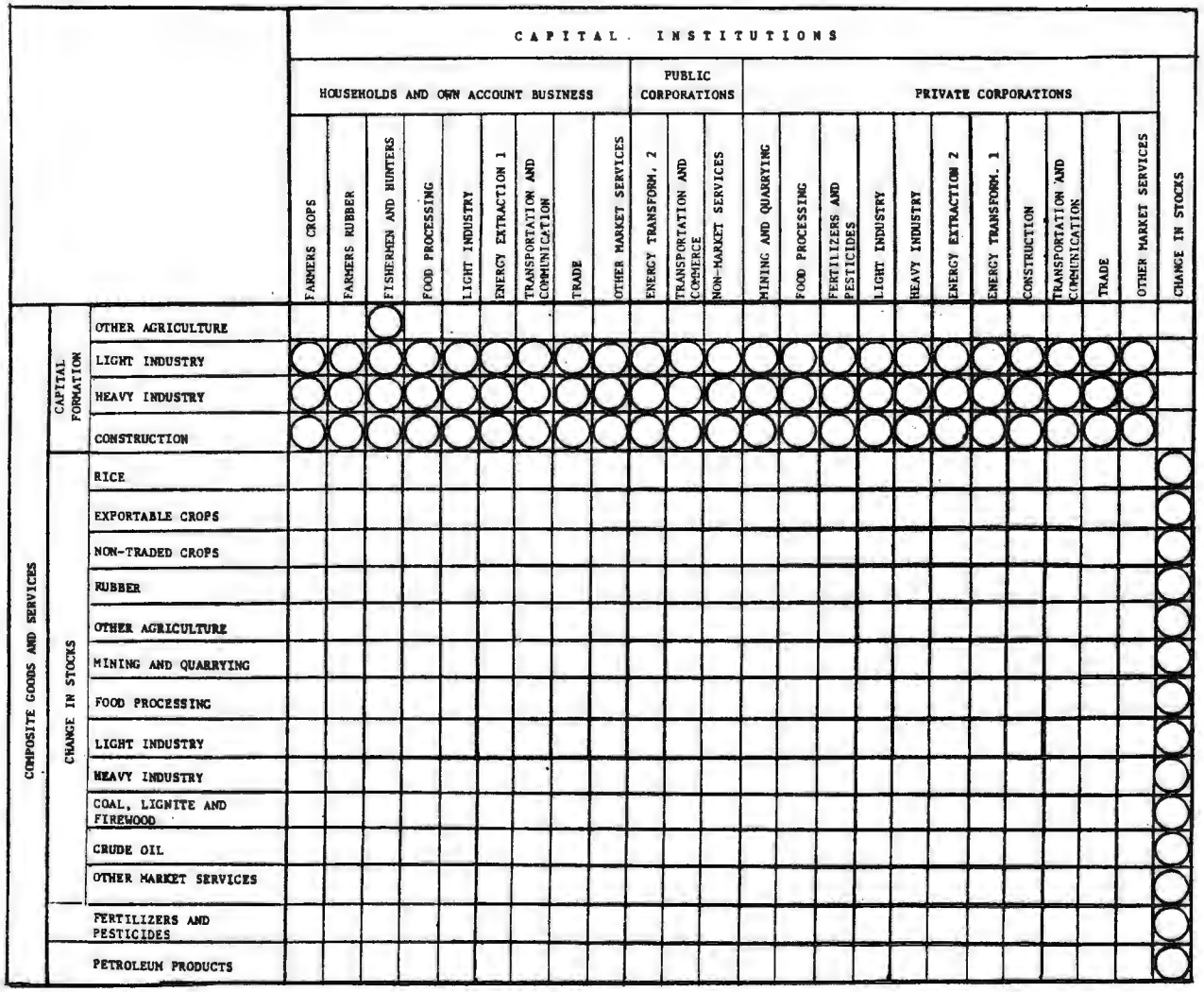


TABLE 6B: Savings and Investment

			CAPITAL INSTITUTIONS							MEMO ITEM	
				SAVINGS POOLS						SOURCES OF SAVINGS	
			GOVERNMENT	FORMAL	INFORMAL	PUBLIC	CENTRAL	PRIVATE	REST OF THE WORLD	PRIVATE SECTOR	PUBLIC SECTOR
CAPITAL INSTITUTIONS	HOUSEHOLDS AND OWN ACCOUNT BUSINESS	FARMERS CROPS	○		○						
		FARMERS RUBBER			○						
		FISHERMEN AND HUNTERS			○						
		FOOD PROCESSING			○						
		LIGHT INDUSTRY			○						
		ENERGY EXTRACTION 1			○						
		TRANSPORTATION AND COMMUNICATION			○						
		TRADE			○						
		OTHER MARKET SERVICES			○						
	PUBLIC CORPORATIONS	ENERGY TRANSFORMATION 2				○					
		TRANSPORTATION AND COMMUNICATION				○					
		NON MARKET SERVICES	○			○					
	PRIVATE CORPORATIONS	MINING AND QUARRYING		○							
		FOOD PROCESSING		○							
		FERTILIZERS AND PESTICIDES		○							
		LIGHT INDUSTRY		○							
		HEAVY INDUSTRY		○							
		ENERGY EXTRACTION 2		○							
		ENERGY TRANSFORMATION 1		○							
		CONSTRUCTION		○							
		TRANSPORTATION AND COMMUNICATION	○	○							
		TRADE		○							
		OTHER MARKET SERVICES		○							
	CHANGE IN STOCKS						○				
	GOVERNMENT					○					
	SAVINGS POOLS	FORMAL						○	○		
		INFORMAL						○			
		PUBLIC					○		○		○
		CENTRAL								○	
		PRIVATE					○				

amounts equal to whatever its share of domestic private funds is. On the contrary, the private sector can borrow from abroad which gives it the freedom to decide on its investment. This is only one story which can be told going through the SAM. The purpose of the accounting is to always be able to identify: (i) the financing need of each investor, (ii) the private and public sector savings gaps.

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Chapter 3: The Within Period Module of SIAM2

The first step in the design of a general equilibrium model is the identification of the level of disaggregation of the income and expenditure flows it should capture. This question is dealt with in chapter 2. The second step towards a general equilibrium model is to provide an explanation of the behavior of the income and expenditure flows. This behavior results from two sets of factors: (i) the independent decisions of the various agents intervening in the economy and (ii) the system constraints on these decisions which impose their over-all consistency. The present chapter deals with these two sets of issues. It describes in a first section the production decisions and their input demands implications. It then turns to households behaviors in a second section. The behaviors of corporations, the government and the rest of the world are considered in section three. The flows in the capital accounts and the investment decisions are taken up in section 4. Finally, section five deals with the systems constraints and the over-all consistency of decisions.

SIAM2 is a sequential dynamic general equlibrium model. Some economic signals and factor endowments are assumed to be invariant within each time period and to vary between periods. The present chapter considers only the within period equilibrium and deals only with the behavior of flows assumed to adjust within the period.

SECTION 1: Production Decisions and Input Demands

Table 3.1 summarizes the list of production activities in SIAM2. They are divided into two sets: formal and informal. Formal activities are owned and managed by different people, they face fixed nomimal wages and are not financially constrained. Informal activities are owned and managed by the

Table 3.1
Disaggregation of Activities

	Informal	Formal
Agriculture	1. Non Rubber Crops	
	2. Rubber	
	3. Other Agriculture	
Industry	4.	Mining & Quarrying
	5. Food Processing	Food Processing
	6.	Fertilizers
	7. Other Light Industry	Other Light Industry
	8.	Heavy Industry
Energy	9. Energy Extraction 1	
	10.	Energy Extraction 2
	11.	Energy Transformation 1
	12.	Energy Transformation 2
Construction	13.	Construction
Services	14. Transportation and Communication	Transportation and Communication
	15. Trade	Trade
	16. Other Market Services	Other Market Services
	17.	Non-Market Services

same households, they face flexible nominal wages and are financially constrained. Some activities belong only to the formal sector, others to the informal. Few activities take place in both the formal and informal. Thus SIAM2 disaggregates production into 17+5=22 activities.

1.1 Production Decisions in Informal Activities

There are nine informal activities in SIAM2. The households owning and operating these activities maximize a utility function under a budget constraint where profits from their business enter as income. The households

first maximize profits and then maximize utility under the budget constraint.[1/] Here we consider the profit maximization decision.

Crops other than rubber, and rubber are assumed to have the following technology. [2/]

$$
\begin{aligned}
q &= \left[\alpha_1 K^{*-\rho} + \alpha_2 A^{*-\rho} + \alpha_3 M^{-\rho}\right]^{-\frac{1}{\rho}}, \\
K^* &= \left[\beta N^{-\nu} + (1-\beta)\bar{K}^{-\nu}\right]^{-\frac{1}{\nu}}, \qquad (3.1) \\
A^* &= \left[\delta F^{-\theta} + (1-\delta)\bar{A}^{-\theta}\right]^{-\frac{1}{\theta}},
\end{aligned}
$$

In relations (3.1) $\bar{A}$ and $\bar{K}$ are the fixed inputs of land and capital. Land is aggregated with fertilizers F to form a composite land variable: A^*. Similarly capital and labor N are aggregated to form a composite capital K. M is a composite of intermediate inputs. The three composite variables enter the first relation of (3.1) to determine output q. The specification (3.1) allows to take into account the different relative substitutabilities between labor and capital on the one hand and fertilizers and land on the other hand. It furthermore permits some substitution between intermediate inputs as a whole and other inputs. It should be noted here that the employment variable N includes both hired and own-labor; they are assumed to be perfect substitutes thus the market wage ω of the hired labor is the opportunity cost of own-labor. Now given ω, p, the price of fertilizers and π, the price

---

1/ For more on the households-firm problem in SIAM2 see section 2.2.

2/ A discussion of an agricultural production function similar to (3.1) can be found in H. Kaneda (undated).

associated with the composite of intermediate inputs, cost minimization leads to the following marginal cost function:

$$\lambda = \lambda(\omega, p_f \pi, \bar{K}, \bar{A}, q) \ . \tag{3.2}$$

Rubber producers are assumed to face on the market a price, say p, and by equalizing p and λ, they determine their supply q and subsequently their demands for all inputs. 1/ Although technology (3.1) is the same for rubber and other crops. For the latter, production is assumed to take place this period, and to be put on the market next period. Thus for non-rubber crops the general form of (3.1) is

$$q_{t+1} = f(x_t) \tag{3.3}$$

where f(.) has the same structure as (3.1) and x_t is a vector of the same types of inputs. Another difference with rubber is that q_{t+1} is a composite output of three crops: rice, other exportable crops and other crops which are mainly non-traded. It is assumed that farmers expect, for next period, the prices of the three crops and, based on these expectations and on their production possibility frontiers, they derive their expected marginal revenue, 2/ p^*. Given their discount rate $\bar{i}$, the present value of the expected marginal revenue is vp^*, where $v = 1/(1+\bar{i})$. The marginal cost of farmers is

---

1/ Expressions for (3.2) and for the demands of inputs are messy. A full specification of the model is given in the appendix.

2/ A formal treatment of this point is given with that of the inter-period module of SIAM2 (See chapter 4, sec.4.1).

like (3.2) except that it includes in its arguments the supply of the next period q_{t+1}:

$$\lambda = \lambda(\omega_t, p_{tf}, \pi_t, \bar{K}_t, \bar{A}_t, q_{t+1}) \quad . \tag{3.4}$$

By equalizing (3.4) with vp^*, farmers determine their next period supply which maximizes the present value of their expected profits. It should be noted that, $vp^* q_{t+1} - \omega_t N_t - p_{ft} F_t - \pi_t M_t = OS_t^*$ is the present value of the expected profit which would accrue to land and capital. However a similar calculation, last period, had determined the supply of this period $\bar{q}_t$. The price which will actually prevail this period is, say p_t. Thus the total receipts of farmers this period are $p_t \bar{q}_t$ and hence the actual operating surplus is:

$$OS_t = p_t \bar{q}_t - \omega_t N_t - p_{ft} F_t - \pi_t M_t \quad .$$

Farmers do not receive OS_t^* as operating surplus but OS_t. This is again why in the SAM the activity crops has two accounts (see table 4A, chapter 2). One account allocates the expected operating surplus OS_t^* to farmers and the other (current revenue) account adjusts farmers income so that they actually receive OS_t.

Consider now the technology of the other informal activities. They all have the same type of production function:

$$q = \left[\alpha_1 \bar{K}^{-\rho} + \alpha_2 N^{-\rho} + \alpha_3 M^{-\rho}\right]^{-\frac{1}{\rho}}, \tag{3.5}$$

where the variables have the same interpretation as before. The marginal cost curve associated with (3.5) is:

$$\lambda = \{1 - \alpha_1 (\frac{q}{\bar{K}})^{\frac{1-\sigma}{\sigma}}\}^{\frac{1}{\sigma-1}} \{\alpha_2^{\sigma}\omega^{1-\sigma} + \alpha_3^{\sigma}\pi^{1-\sigma}\}^{\frac{1}{1-\sigma}}, \qquad (3.6)$$

where again ω is the nominal wage and π the price of intermediates. The parameter $\sigma = 1/(1+\rho)$ is the elasticity of substitution. Relation (3.6) describes the within period supply behavior of the informal activities. For any price p they are facing, these activities are assumed to be able to adjust their supply within the period by choosing a level of production q such that $p = \lambda$. In this case, they maximize profits. This profit maximization leads also to the following demands for labor and intermediate inputs:

$$\omega N = \alpha_2^{\sigma} (p/\omega)^{\sigma-1} pq \quad \text{and} \quad \pi M = \alpha_3^{\sigma} (p/\pi)^{\sigma-1} pq \qquad (3.7)$$

The operating surplus accruing to capital will behave as follows:

$$OS = \alpha_1 (q/\bar{K})^{\frac{1-\sigma}{\sigma}} pq \qquad (3.8)$$

1.2 Production Decisions in Formal Activities

There are thirteen formal activities in SIAM2 (see table 3.1). Mining and Quarrying and Construction have the same type of production function:

$$q = [\alpha_1 L_1^{-\rho} + \alpha_2 L_2^{-\rho} + \alpha H_3^{-\rho} + \alpha M_4^{-\rho} + \alpha \bar{K}_5^{-\rho}]^{-\frac{1}{\rho}}, \qquad (3.9)$$

where q is the output, L_1, L_2 and H are blue, white collar and casual workers,

respectively. $\bar{K}$ is the fixed capital stock and M the composite of intermediate inputs. Let ω_1, ω_2, and ω be the nominal wages of blue, white collar and casual workers respectively and let π be the price of intermediates, then the marginal cost curve associated with (3.9) is:

$$\lambda = \{1 - \alpha_5^{\sigma}(\frac{q}{\bar{K}})^{\frac{1-\sigma}{\sigma}}\}^{\frac{1}{\sigma-1}} \{\alpha_1^{\sigma}\ \omega_1^{1-\sigma} + \alpha_2^{\sigma}\ \omega_2^{1-\sigma} + \alpha_3^{\sigma}\ \omega^{1-\sigma}\ \alpha_4^{\sigma}\ \pi^{1-\sigma}\}^{\frac{1}{1-\sigma}}, \qquad (3.10)$$

where $\sigma = 1/(1+\rho)$ is the elasticity of substitution. Relation (3.10) is also the supply curve of the two activities. For any given market price, p, of the output, producers would maximize profits by equalizing p to λ and thus determine their supply through (3.10). It is assumed that they can always adjust their supply within the period. The profit maximization leads also to their demands for inputs:

$$\omega_i L_i = \alpha_i(\frac{p}{\omega_i})^{\sigma-1} pq\ ,\ i = 1,2;\ \omega H = \alpha_3^{\sigma}(\frac{p}{\omega})^{\sigma-1} pq\ ;\ \text{and}\ \pi M = \alpha_4^{\sigma}(\frac{p}{\pi})^{\sigma-1} pq \qquad (3.11)$$

The operating surplus accruing to capital has the same expression as (3.8):

$$OS = \alpha_5(q/\bar{K})^{\frac{1-\sigma}{\sigma}} pq \qquad (3.12)$$

The rest of the formal activities in Industry, Transportation and Communication, Trade and Other Market Services behave in the same way as Mining and Quarrying and Construction. The only difference is that they are assumed not to hire casual workers. Indeed in those activities, either the importance of casual workers is very limited, or the activity takes place in both the formal and informal sectors. In the latter case, there is no need to take into account casual workers in both the formal and informal sectors.

Energy transformation 2 (Electricity) annd Non-Market Services are regulated activities. The output price is administered by government and they have to supply at that price irrespectively of their marginal cost. The activity Non-Market-Services has a technology like (3.9), but does not hire casual workers. Its marginal cost curve is like (3.10) except that the term associated with casual workers is absent. The marginal cost curve is, however, not the supply curve. Supply is assumed to be perfectly elastic at the administered prices. This means that Non-Market-Services are supplied at the administered prices irrespectively of the marginal cost associated. It is also assumed that supply always responds to demand. This is reasonable under the conditions that demand remains always within a certain range. This formulation of supply implies a wedge between the marginal cost and the price, absorbed by the operating surplus. Energy Transformation 2 behaves in the same way as Non-Market Services, however, the production function is slightly different. It takes into account the scope for substitution between gas and petroleum products:1/

$$q = \left[\alpha_1 L_1^{-\rho} + \alpha_2 L_2^{-\rho} + \alpha_3 E^{-\rho} + \alpha_4 M^{-\rho} + \alpha_5 \bar{K}^{-\rho}\right]^{-\frac{1}{\rho}},$$

$$E = \left[\beta E_1^{-\upsilon} + (1-\beta) E_2^{-\upsilon}\right]^{-\frac{1}{\upsilon}}. \qquad (3.13)$$

In (3.13), gas, E_1, and petroleum products, E_2, are aggregated into the composite energy input E. The substitution between the two types of energy is measured by the elasticity $\sigma_E = 1/(1+\nu)$. The composite energy input E enters

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1/ This is important for Thailand which has been a heavy oil importer and is now producing gas and will be substituting gas for oil in the production of power.

jointly with other inputs [1/] in the first level of the production function to determine output q.

Energy Extraction 2 (gas) and Energy Transformation 1 (petroleum products) produce with a Leontief technology on all inputs, primary and intermediates. Primary inputs are on the one hand blue and white collar workers and on the other hand capital. Both activities have a capacity constraint which defines the maximum level of production for a given period. The marginal and average costs are equal and independent of the level of activity. Normally these two activities will try to set a price with a mark-up over variable costs:

$$P_j = (1 + \bar{\mu}) \sum_i p_i a_{ij} \ , \qquad (3.14)$$

where $\bar{\mu}$ is the mark-up rate, j is the sector, i is the input index, and a_{ij} the input/output coefficient and p_i the input prices. However the price of gas is regulated by the government and hence exogenous to the activity.[2/] Consequently it is assumed that the mark-up rate adjusts in order to equalize the mark-up price with the regulated price:

$$\bar{p}^r_j = (1+\mu) \sum_i p_i a_{ij} \ , \qquad (3.15)$$

where now the mark-up rate μ is endogenous and the price $\bar{p}^r$ is exogenous.

1/ In (3.13) the composite intermediate M does not of course include gas and petroleum products.

2/ The producer price of petroleum products is in practice pegged to world prices; the producer price of gas is linked to the world price of fuel oil, the wholesale price index in Thailand, and a price index of U.S. exports.

1.3. Composition of Intermediate Inputs

Each of the 22 activities of SIAM2 has a demand for intermediate inputs. In most cases, an aggregate of all intermediates is assumed to be price responsive and derived from cost minimization. In the case of non-rubber crops and rubber, this aggregate excludes fertilizers. The demand for the latter is derived separately. Similarly in the case of energy-transformation-2, the aggregate intermediate excludes petroleum products and gas. Here again, the demands for these two inputs is obtained separately. The activities energy-extraction-2 and energy-transformation-1 have Leontief technologies and therefore the aggregate intermediate is not assumed to be price responsive. In all other activities, the general case of a price sensitive aggregate intermediate is adopted.

The question which arises now is how to obtain the intermediate demands for each individual intermediate inputs from the aggregates. In SIAM2, the assumption of strict complementarity of intermediate inputs within each aggregate is reviewed. Thus let M_j, $j = 1, 2, \ldots, 22$ be the 22 aggregates used on the 22 activities and let X_{ij} be the demand by activity j of commodity i as an intermediate input, then:

$$X_{ij} = a_{ij} M_j, \qquad i = 1, 2, \ldots, 20; \quad j = 1, 2, \ldots, 22. \tag{3.16}$$

where a_{ij} is a technical coefficient assumed constant within the period. The price Π_j of the aggregate M_j is then derived as:

$$\Pi_j = \sum_{i=1}^{20} p_i a_{ij}, \qquad j = 1, 2, \ldots, 22. \tag{3.17}$$

where p_i is the price of each individual commodity i. From (3.16), it is straightforward to derive the total intermediate demand for each commodity:

$$X_i = \sum_{j=1}^{22} X_{ij}, \qquad i = 1, 2, \ldots, 20. \tag{3.18}$$

Each of the X_i determined through (3.18) is a composite of imported and domestically produced intermediates. The next question is then how do import shares behave. Their specification follows the Armington approach (See Armington (1968)). Let PM_i be the landed price of imports of commodity i: XM_i, and let PD_i be the purchasers price of the associated domestically produced goods: XD_i, import shares are obtained as the solution to:

$$\begin{aligned} &\text{Min} \quad PM_i \cdot XM_i + \tilde{P}D_i \cdot XD_i \\ &\{XM_i, XD_i\} \\ &\text{Subject to} \quad \left[\delta_i XM_i^{-\rho_i} + (1 - \delta_i) XD_i^{-\rho_i}\right]^{-\frac{1}{\rho_i}} = X_i \end{aligned} \tag{3.19}$$

Problem (3.19) leads to shares of demand for domestic goods and of imports behaving in the following way:

$$\begin{aligned} (PM_i XM_i)/P_i X_i &= \delta_i^{\sigma_i} (P_i/PM_i)^{\sigma_i - 1} \\ \text{and} \qquad & \\ (\tilde{P}D_i XD_i)/P_i X_i &= (1-\delta_i)^{\sigma_i} (P_i/\tilde{P}D_i)^{\sigma_i - 1} \end{aligned} \tag{3.20}$$

where $\sigma_i = 1/(1 + \rho_i)$ is the elasticity of substitution measuring the degree of tradability of the goods considered and where P_i is the marginal cost of the composite Xi:

$$P_i = \left[\delta_i^{\sigma_i} PM_i^{1-\sigma_i} + (1 - \delta_i)^{\sigma_i} \tilde{PD}_i^{1-\sigma_i}\right]^{\frac{1}{1-\sigma_i}} \qquad (3.21)$$

Relations (3.20) define for each intermediate commodity its import intensity and the way it responds to changes in the relative prices. These prices are purchasers prices. The landed price of imports PM_i is related to the world price in foreign currency, $\bar{\Pi}_i^m$ and the exchange rate e in the following way:

$$PM_i = (1 + \bar{\tau m}_i)\bar{\Pi}_i^m e \qquad (3.22)$$

where $\bar{\tau m}_i$ is a tariff rate. Similarly, the purchasers price $\tilde{\tilde{PD}}_i$ of domestic goods is linked to the producers price PD_i^* as follows:

$$PD_i = (1 + \theta_i)\left[\alpha_{oi} PD_i^* + \alpha_{TC,i} PD_{TC}^*\right] \cdot \qquad (3.23)$$

In (3.23), $\alpha_{TC,i}$ is a coefficient defining the demand for transportation for each unit exchanged of the good. The term between square brackets is then the unit cost of the commodity before a trade margin is levied on it. The trade margin is a value share θ_i of that unit cost. The rationale for specification (23) is that transportation costs depend on the quantities exchanged where as trade margins are rather related to the values of the goods exchanged.

From the foregoing, one easily determines the contribution of intermediate demand to the balance of payments and to domestic aggregate demand. The burden of imports of intermediate goods on the balance of payments in foreign currency will be: $\sum_{i=1}^{20} \bar{\Pi}_i^m XM_i$. Similarly, for each of the input, its contribution to intermediate demand for domestic good at producers prices will be: $\alpha_{0i} \cdot XD_i \cdot PD_i^*$. One can also easily define the demands for transportation and trade as well as the fiscal impact of the tariffs.

SECTION 2: Households' Behaviors

Households are classified into seven categories in SIAM2, according to the occupation of the households head, (see Table 3.2). Each household supplies labor services against wage income and receives capital income and transfers. This total household income is then used to make transfers, to pay taxes and the interest on the household's debt, to spend on consumption and to save. For all households, except those headed by a blue or a white-collar worker, these decisions are interdependent. To keep the presentation simple we use the Stone-Geary specification for the utility function, (Stone, R. [1954]).

Table 3.2

Households Categories In SIAM2

1.	-	Farmers (Non Rubber Crops)
2.	-	Farmers (Rubber)
3.	-	Fishermen, Hunters and Foresters
4.	-	Other Own-Account Business
5.	-	Blue-Collar
6.	-	White-Collar
7.	-	Casual Workers

2.1 Blue-Collar, White-Collar and Casual Worker Households

Consider first households whose head is a blue or a white collar worker. The total supply of labor of each category is assumed to be given exogenously at the beginning of each period: $\bar{A}_1$ and $\bar{A}_2$ are exogenous. These two

labor constraints are however, assumed not to be binding. Thus up to $\bar{\Lambda}_1$ and $\bar{\Lambda}_2$, labor supply for the two categories is assumed to be perfectly elastic. Given the "institutionally" fixed nominal wages ω_{1i} and ω_{2i} for the two types of labor, in the various formal sectors, i=1,2,.....SF, labor income accruing to the two households are:

$$\sum_{i=1}^{SF} \omega_{1i} L_{1i} \quad \text{and} \quad \sum_{i=1}^{SF} \omega_{2i} L_{2i}, \tag{3.24}$$

respectively, with L_{1i} and L_{2i} being the actual demands of labor services in the various sectors. In addition to these two labor incomes, the two households receive transfer and capital incomes. The total forms the amount of income they get within the period, Y_1 and Y_2 for blue and white-collar households respectively. It is assumed that Y_1 and Y_2 are distributed over i) total consumption, ii) interest on the debt; iii) transfers abroad; iv) taxes and v) savings according to shares which remain constant within the period. Out of this allocation, each household will direct some amount to consumption say r_1 and r_2.

The next issue is that of the allocation of total consumption over wants. Under the assumption of a Stone-Geary utility function, the allocation is obtained through the Linear Expenditure System (LES) 1/

$$d_{ik} = \gamma_{ik} p_i + b_{ik} \left(r_k - \sum_{j=1}^{20} p_j \gamma_{jk} \right) \tag{3.25}$$

1/ The LES has been analyzed extensively. Thorough analyses and implementations of the LES can be found in Deaton, A. (1974), Carlevaro, F. (1975).

Table 3.3

Disaggregation of Wants in The SIAM2

1. - Rice and Cereals
2. - Meat
3. - Fish
4. - Milk, Cheese and Eggs
5. - Oil and Fats
6. - Fruits and Vegetables
7. - Sugar
8. - Coffee and Tea
9. - Non-Alcoholic Beverages
10. - Alcoholic Beverages
11. - Tobacco
12. - Clothing
13. - Rent and Water
14. - Fuel and Light
15. - Furniture and Household Equipment
16. - Household operation
17. - Personal Care
18. - Transportation and Communication
19. - Recreation and Entertainment
20. - Miscellaneous Services

with i=1,2,...20 for the wants index and k=1,2 the household index (blue and white-collar). In (3.25) d_{ik} is the amount spent on the category of wants i by household k. This is decomposed between the committed $\gamma_{ik}p_i$ and discretionary, $b_{ik}\left(r_k - \sum_j p_j \gamma_{jk}\right)$ expenditures. The parameters $0 < b_{ik} < 1$, add up to unity and are the marginal propensities to spend out of discretionary expenditure. The parameters γ_{ik} are the quantities of the committed expenditures and p_i are the prices to the consumers of the various commodities.

In contrast to the previous two households, those headed by a casual worker are assumed to decide jointly on both their supply of labor and demand for goods and services. The purpose here is to endogenize the labor force participation rate by making it wage-dependent. This is in line with current knowledge of labor market operations in Thailand where people are assumed to go in and out of the labor force according to the opportunity cost of leisure, (see T. Bertrand and L. Squire (1980)). Let Y be the total income casual workers' households receive, it is composed of wages, ωH and other incomes Z: $Y=\omega H+Z$. Let $\alpha_1 Y$, $\alpha_2 Y$, $\alpha_3 Y$ be the distribution of casual workers income of savings, taxes and interest payments. The amount left for consumption[1/] is:

$$\left(1 - \alpha_1 - \alpha_2 - \alpha_3\right)Y = \left(1 - \alpha_1 - \alpha_2 - \alpha_3\right)\left(\omega H + Z\right) , \qquad (3.26)$$

or for simplicity $\alpha_o(\omega H + Z)$. The decision-problem of casual workers households is:

1/ One can define ω as a gross wage and $\omega^* = \omega(1 - \alpha_1 - \alpha_2 - \alpha_3)$ as a net wage or consumption wage.

$$\underset{\{q_1, q_2, \cdots q, H\}}{\text{Max}} \quad U(q_1, q_2, \ldots, T-H) \quad ,$$

$$\text{Subject to} \quad \sum_{i=1}^{20} p_i q_i = \alpha_o(\omega H + Z) \tag{3.27}$$

According to (3.27), casual workers determine their demands of wants (q_i, i=1,2,...20) and their supply of labor H, by maximizing a utility function U( ), where T is the maximum amount of time they have available. If one assumes an extended Stone-Geary utility function 1/, the problem (3.19) leads to the LES:

$$\omega H = \omega\gamma_h - \frac{b_n}{\alpha_o}\{\alpha_o(Z + \omega\gamma_h) - \sum_{j=1}^{20} p_j\gamma_j\}$$

$$p_i q_i = p_i\gamma_i + b_i\{\alpha_o(Z + \omega\gamma_h) - \sum_{j=1}^{20} p_j\gamma_j\}, \quad i=1, 2,\ldots,20, \tag{3.28}$$

where γ_h is the maximum amount of labor casual workers could supply, γ_i(i=1,2,...,20) are committed expenditures, b_i(i,=1,2,...,20) are marginal propensities to spend out of maximum discretionary expenditure and b_n is the marginal propensity to forego discretionary expenditure. What (3.28) tells is the following. The household has a total committed expenditure for given prices: $\Sigma_j p_j\gamma_j$; it also could get an income as large as $Z + \omega\gamma_h$ and spend on consumption the α_o share of that income. The household has thus a potential discretionary expenditure described by the terms between brackets in (3.28). What the household actually does is to use the potential discretionary expenditure to buy back some leisure and allocates the rest on discretionary consumption of goods and services. It should be noted that (3.28) imply that a higher tax rate, passed on consumption, would lead to a lower demand of

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1/ See Abbot and Ashenfelter (1975).

goods and services $(\partial q_i/\partial \alpha_o > 0)$ and to a higher supply of labor $(\partial H/\partial \alpha_o < 0)$. .

2.2 Own Account Households

The behavior of farm households is very similar to that of casual workers. The difference is that the latter are only consumers who supply labor whereas the former draw income from operating their own-business, spend out of that income, hire outside labor, work in their own farm and may even hire themselves out.[1/] What essentially differs is not the utility function but the budget constraint. Indeed the budget constraint for rubber farmers is:

$$\sum_{i=1}^{20} p_i q_i = \alpha_o \left[p\phi(N,F,M,\bar{K},\bar{A}) - \omega(N - D) - p_f F - \pi M + Z \right] , \qquad (3.29)$$

where the right-hand side is total consumption, α_o is the consumption share in total income, $\phi(\quad)$ is the production function [2/] (3.1), p is the market-price of rubber, D is the amount of labor, rubber-farmers would supply[3/] and Z is transfer income. The problem of the household is to maximize a utility function, like the one appearing in (3.27), but under the constraint (3.29). The first order conditions of the utility-maximization include those of the profit maximization problem. Furthermore, they are separate and can be solved independently for N, F, and M. Thus one can approach the decision problem of the household by first solving for his production plan and then by determining the allocation of his consumption and his labor supply. This is the approach

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1/ For a similar type of household - firm model see Barnum and Squire (1979).

2/ The variables have the same interpretation as in (3.1).

3/ This is total supply of their own-labor on the farm and out of it.

followed here 1/. Consider again the budget constraint (3.29), it can be rewritten as follows:

$$\sum_{i=1}^{20} p_i q_i = \alpha_o \{[p\phi(N,F,M,\bar{K},\bar{A}) - \omega N - p_f F - \pi M] + (\omega D + Z)\} , \qquad (3.30)$$

it is now clear that the term between square brackets is profits. Let OS be maximum profits 2/, the problem of utility maximization of the household is now identical to the one facing casual workers. It leads, however, to a labor supply and demand for goods and services equations where the operating surplus appears explicitly:

$$\omega D = \omega\gamma_d - \frac{b_d}{\alpha_o} \{\alpha_o(Z + \omega D + OS) - \sum_{j=1}^{20} p_j\gamma_j\} ,$$

$$p_i q_i = p_i\gamma_i + b_i \{\alpha_o(Z + \omega D + OS) - \sum_{j=1}^{20} p_j\gamma_j\}, \quad i=1,2,\ldots,20 . \qquad (3.31)$$

For non-rubber farmers, the expressions for the supply of labor and demand for goods and services equations will be exactly identical to (3.31). However the variable OS will represent the actual capital and land income received during the period:

$$OS_t = OS_t^* + (p_t\bar{q}_t - vp_{t+1}^* q_{t+1}) , \qquad (3.32)$$

where OS_t^* is the present value of the expected profit, $p_t\bar{q}_t$ the actual

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1/ See Section 1.1 for the production decision.

2/ OS is dependent on factor prices, on the fixed inputs and on the level of activity.

revenues during this period and $vp^{*}_{t+1}q_{t+1}$ the present value of next period expected revenues.[1/]

The two remaining categories of households are the Fishermen, Hunters, and Foresters (FHF) on the one hand, and those operating their own business in the rest of the economy, on the other hand. The difference between these households and rubber-farmers is that their activities are scattered across various production sectors in the economy. The activities of FHF are assumed to take place in two sectors: Other Agriculture and Energy Extraction 1. The reason for extending their activities to the latter sector is that the bulk of the value added in the sector is due to charcoal extraction and firewood collection. It seems natural to assume that households engaged in forestry do own and operate businesses in the Energy Extraction 1 sector. The other households have their activities scattered in all non-agricultural informal sectors. Thus the two categories of households considered here receive profit income from various sectors in the economy. Their behavior will be described by relations identical to (3.31) but where the operating surplus is redefined to include profit incomes from all activities they are engaged in.

2.3: From Wants to Commodities

In the foregoing the consumption of each category of household is allocated on the various wants. This determines a matrix $Q = q_{ik}$ where an entry q_{ik} is the demand (volume) by household k on the want - type i. However, households satisfy their wants by buying goods and services. It is their demands for commodities which ultimately enters the commodity-balances

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1/ See Section 1.1 for a discussion of the production problem of these farmers. The term between brackets in (3.32) would appear in the first column of table 2A of chapter 2 as a payment to the revenue account of farmers.

identities. There is therefore the need to translate households demands in terms of wants into their demands in terms of commodities.[1/] In the SIAM2 this is done as follows. Let ζ be a matrix with elements $\|c_{ij}\|$. Each c_{ij} expresses the quantiy demand for commodity i associated with a unit demand in the category of wants j. In SIAM2, given that the number of wants - types and of commodities is equal, the matrix ζ is square. The matrix of households consumptions of commodities C is then defined as:

$$C = \zeta Q \tag{3.33}$$

The implicit assumption in (3.33) is that the matrix ζ is identical for all categories of households meaning that the mapping from wants to commodities is the same irrespectively of the household considered. This is a drawback. It cannot, however, be overcome in the present stage of development of the data. Formally, this is expressed as:[2/]

$$\rho' = P'\zeta \tag{3.34}$$

where ρ and P are the vectors of prices of wants and commodities respectively. The assumption of an identical ζ for all categories of households does not, however, imply that the cost of living indices do not vary between households. The latter face the same prices but do not have the same patterns of consumption.

1/ For a rationalization of the distinction between wants and commodities see K. Lancaster (1971).

2/ ' denotes transposition.

Relations (3.33) determine consumptions of commodities. However, these are composite commodities which are a mixture of imports and domestically produced goods. In SIAM2 it is assumed that import shares are not consumer specific. However, they are specific to private consumption and thus differ from the import shares of the other categories of aggregate demand. Let $C\iota$ be the vector[1/] of total private consumption of each category of composite commodities. Let C_i be an element of that vector. Import shares are derived following the Armington approach along the same lines as for intermediates.[2/] Also following the same approach as for intermediates, one derives the balance of payments and fiscal implications as well as the demand for domestically produced goods.

SECTION 3: Corporations, Government And The Rest of The World

Formal sector activities belong to corporations which collect profits and use them for various purposes. The government collects taxes, spends and contributes through its deficit to the national savings gap. Finally, the rest of the world, besides supplying goods and services to the home country, expresses a demand for domestically produced goods and services.

3.1 - Corporations: their current accounts

In SIAM2 corporations are classified into two categories: private and public. Private corporations receive the gross operating surpluses of the production activities they own, the interests households pay on their debt and the interests on the public debt. This forms their total income which is distributed, according to shares assumed constant within the period, on the

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1/ ι is a column vector of ones: $\iota' = (1,1,\ldots,1)$. Thus $C\iota$ is a column vector of total consumption by commodity.

2/ See section 1.3 of this chapter.

following items: dividends to households, taxes and corporate savings. The savings of private corporations are paid to a central savings pool which collects all the savings generated by private institutions. The income of the public corporations is only the gross operating surplus of the activities they own. It is assumed that it is totally saved and channelled to the public sector savings pool. Table 3.4 summarizes the operations on the current accounts of corporations.

Table 3.4

OPERATIONS ON THE CURRENT ACCOUNTS OF CORPORATIONS

Private Corporations

Total receipts of private corporations	=	Operating Surplus	+	Interest on Consumers Debt	+	Interest on Public Debt

Dividends = α_1 (Total receipts of private corporation);

Taxes = α_2 (Total receipts of private corporations);

Savings = α_3 (Total receipts of private corporations);

$$\alpha_1 + \alpha_2 + \alpha_3 = 1,\ 0 < \alpha_i < 1,\ i=1,2,3.$$

Public Corporations

Savings = Total receipts of public corporations = Operating surplus

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3.2. - The Current Accounts of the Government

The government receives direct and indirect taxes, transfers from abroad and capital income. The direct taxes are levied on the incomes of the seven categories of households and on the operating surplus of the private companies through constant tax rates. There are four categories of indirect taxes: (i) the business tax levied on domestically produced and imported commodities; (ii) the import duties levied on imports; (iii) the export taxes levied on a few exported commodities and (iv) the rice premium levied on exportable crops, in particular rice exports. All these taxes are commodity specific. The business tax on domestically produced goods is not differentiated by user. The business tax on imports and the import duties are differentiated according to the distinction of the commodities. Apart from direct and indirect taxes, the government receives transfers from abroad and capital income from property and entrepreneurship.

The government defines its expenditures in nominal terms. It thus decides on the amount of transfers it is going to make to the various categoreis of households and to the rest of the world. The government also pays the interests on the public debt and decides on the amount it allocates for current consumption. The government savings, on the current account, are determined residually as the difference between revenues and expenditures. These savings contribute to the resources of the public savings pool.

The total budget allocation for current consumption is then distributed on the various commodities purchased using constant value shares. This define the government demand for composite commodities. The latter are allocated between imports and domestically produced goods using the same approach as for intermediates and private consumption. The same fiscal, balance of payments as well as demand for domestically produced commodities

can be derived. Table 3.5 summarizes the operations on the current account of the government.

3.3 The Rest of The World

Unlike for other agents in the economy, the account for the rest of the world records both the current and capital transactions. This is because a price is attached to the foreign exchange and that it is the same for both types of transactions.

Foreign exchange inflows behave in the following way. Net factor income from abroad is composed of blue and white collar net remittances and net capital income. These three items are considered fixed in foreign currency. Besides net factor incomes, foreign transfers to government and to households are also assumed fixed in foreign currency. Other foreign exchange inflows are due to exports of goods and services. The world demands for Thai other-export crops and rubber are assumed to be perfectly elastic. There has been a lot of discussions and writings (see e.g. G.S. Tolley, V. Thomas and C.M. Wong (1982)) about the question of whether or not Thailand has some monopoly power on the world market of rice. In spite of all the efforts, there does not seem to be a clear-cut answer. Therefore we have adopted the assumption of a downward sloping demand curve with the view of assessing the general equilibrium implications of alternative values of the export elasticity[1/]. The world demands for all other exports of goods and services and for tourists' services are assumed to respond to the ratio of the world price to the country's suply price in the following way:

$$d = \bar{d}_o \exp\left[\bar{r}(t - t_o)\right] (e \cdot \bar{\pi})^{\eta} (p)^{1-\eta} \qquad (3.35)$$

1/ Given the way SIAM2 is set up, the adopted assumption can easily be changed to that of a perfectly elastic world demand.

Table 3.5
OPERATIONS ON THE CURRENT ACCOUNTS OF THE GOVERNMENT

Receipts

Receipts = Direct Taxes from Households + Direct Taxes from Corporations + Business Taxes + Import Tariffs + Export Taxes + Export Premium on Rice & Other Exportable Crops

Business Taxes = Business Taxes on Domestic Production + Business Taxes on Imports of Intermediates + Business Taxes on Imports of Consumer Goods + Business Taxes on Imports of Government for Consumption

+ Business Taxes on Imports of Capital Goods + Business Taxes on Imports for Stock Accumulation + Business Taxes on Imports of Government for Consumption .

Import Tariffs = Tariffs on Imports of Intermediates + Tariffs on Imports of Consumer Goods + Tariffs on Imports of Goods for Government Consumption + Tariffs on Imports of Capital Goods +

Tariffs on Imports for Stock Accumulation + Tariffs on Imports for Tourists .

Export Taxes = Export Tax on Rice + Export Tax on Exportable Crops + Export Tax on Rubber + Export Tax on Other Commodities

Outlays

Total Outlays = Transfers to Households + Interest on Public Debt + Transfers Abroad + Government Consumption + Savings,

the first four terms on the right-hand side are given exogenously and Savings adjust residually.

Consumption of Commodity i = β_i · (Government Consumption), with $0 < \beta_i < 1$ and $\Sigma_i \beta_i = 1$.

Consistency

Total Receipts = Total Outlays.

where d is the value of the exports, r is an exogenous rate of growth of the base year value $\bar{d}_o$, $\bar{\pi}$ is the world price, p the supply price, e the exchange rate and η the elasticity measuring the price responsiveness of exports. Specification (3.35) is there to capture the potential gains in competitivity of Thailand in non-traditional exports. Finally, in SIAM2, the current account deficit is separated between net private and net public borrowing from abroad. The former is left free to adjust the savings - investments balance, the latter which includes changes in foreign reserves is considered a policy variable.

The total amount tourists would spend in Thailand is thus determined by a relation like (3.35). However, this relation does not give the breakdown of their expenditure on the various commodities. The approach adopted in SIAM2 is to assume that Tourists behave like other consumers wanting to allocate their total consumption expenditure: they maximize a utility under a budget constraint. Again, if one assumes a Stone-Geary utility function, the LES would be the system of relations allocating tourists expenditures where total expenditure comes from a relation like (3.35). This system of relations would define tourists' demands for composite commodities which are aggregates of imports and domestically produced goods. The Armington approach is once more adopted here with all the ensuing implications.

Exports of goods and services, are supplied to the rest of the world at a price which includes trade margins, transportation costs and any eventual export tax. When exports behave according to (3.35), their prices are built up from producers prices by adding the various relevant margins. When the world demand is perfectly elastic, the world price determines the producers price after appropriate accounting for surcharges due to transportation, trade and taxes. Table (3.6) summarizes the transactions between the home country and abroad through the rest of the world account.

Table 3.6

OPERATIONS OF THE HOME COUNTRY WITH THE REST OF THE WORLD

Foreign Exchange Outflows (FEO)

Total FEO = Households Transfers Abroad + Government Transfers Abroad + Imports of Goods and Services .

Imports of Goods and Services = Imports of Intermediates + Imports of Consumer Goods and Services + Imports for Government Consumption + Imports of Capital Goods + Imports for Stock Accumulation + Imports for Tourists.

Foreign Exchange Inflows (FEI)

Total FEI = Net Factor Income + Transfers + Exports + Net Borrowing and Changes in Reserves.

Net Factor Income = Blue Collar Income + White Collar Income + Capital Income ; the three terms are exogenous.

Transfers = Private Transfers to Households + Public Transfers to Government ; the two terms are exogenous.

Exports = Tourists Expenditures + Exports of Goods and Other Services ; price responsive.

Net Borrowing + Changes in Reserves = Net Public Borrowing Changes in Reserves + Net Private Borrowing ; the first term is a policy variable, the second term adjusts residually.

Consistency

Total FEO = Total FEI .

Section 4: The Capital Accounts and Investment

In the foregoing we have reviewed the supply decisions and the determinants of all elements of aggregate demand except investment decisions. In this section the within period behavior of investment demand is taken up together with its financing.

4.1 Investment Decisions in the Within-Period Module of SIAM2

The demand for stocks in the within period SIAM2 module behaves in the following way. At the beginning of the period, expectations are formed on what would be the aggregate demand for each commodity within the period. Based on these expectations, a stock demand is determined and assumed 1/ not to change. Consequently, changes in the stocks of each composite commodity are also constant within the period. However, the import intensity of the variations in stocks is price sensitive. It is determined following the Armington approach along the same lines as intermediates.

Consider now fixed capital formation. It is a decision to increase the capital stocks of the various sectors in the economy and it implies a demand for capital goods. Capital formation, in the SIAM2, is undertaken by informal activities, private formal activities, state enterprises and government. As shown in table 3.1, there are nine informal activities in SIAM2. It is assumed that the "financial sector" decides to allocate to informal activities a given amount of funds (TFI). Based on calculations of rates of return and past allocations, the financial sector distributes (TFI) on the various informal activities 2/:

1/ See section 3 in chapter 4 describing the inter-period module of SIAM2.

2/ See section 2, chapter 4 for the behavior of the allocations shown.

$$SI_{jt} = \alpha_{jt}(TFI)_t, \quad j=1,2,\ldots,9 \tag{3.36}$$

where $0 < \alpha_{jt} < 1$, $(\Sigma\alpha_{jt} = 1)$ are allocation shares and SI_{jt} are the funds made available to the informal activity j during the period t. The funds SI_{jt} will allow the following amount of capital formation:

$$P_{jt}I_{jt} = SI_{jt}, \quad j=1,2,\ldots,9, \tag{3.37}$$

where I_{jt} is the volume of fixed investment P_{jt} is its price for the activity. Thus the informal sector in this specification is assumed to be financially constrained.

Private corporations and state enterprises are assumed to have a desired capital stock for the period and to adjust partially to it. Thus at the beginning of each period they decide on a certain volume of investment and they implement their decision without any change. Fixed capital formation in private corporations and state enterprises is therefore a predetermined variable for the within-period module of SIAM2. The government decision to invest is exogenous. The government decides both on the volume of its fixed investment and on its allocation over production activities. In order to capture the contribution of government investment to the production capacity of the economy, its investment in each activity is added to private and state enterprise capital formation in the activity. Thus capital stocks are larger than what they would be if only private capital formation is taken into account. By implication, capital returns accruing to the various production activities are inflated because of the investment of government.

In SIAM2, investors like other agents in the economy, buy composite goods which are aggregates of domestically produced and imported goods. Let $B = \|b_{ij}\|$ be a matrix where the element b_{ij} is the demand (volume) of capital good i by investor j, then

$$\beta_i = \sum_j b_{ij}, \quad i=1,2,\ldots,20, \tag{3.38}$$

is the total demand for the capital good i. These total demands are separated between imports and domestically produced goods using import shares determined along the Armington approach.

4.2. - Savings and Borrowings

There are three sources of savings in the SIAM2 model: (i) the private sector, (ii) the public sector and (iii) the rest of the world. All private sector savings whether from households or private corporations are determined as constant shares of the incomes of these institutions. All private sector savings are collected in a central savings pool. In the public sector, the government has its savings on its current account determined residually. The savings of the public corporations are assumed to be equal to their operating surplus. All savings of the public sector are collected in the public sector savings pool.

Net public sector borrowing from abroad [1/] is a decision variable and adds to the financial resources available to the sector. If the public sector needs additional resources to finance its planned investment, then it gets them from the central pool. This transfer from the central savings pool to the public sector savings pool is a direct crowding-out of the private

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1/ This includes changes in foreign assets held by the country.

sector. The resources left to the private sector are allocated between the formal and informal sectors of the economy. The coefficient used for this allocation is a parameter used as a policy-like instrument. The funds received by the informal sector are then allocated between the various informal activities which invest them. If the funds allocated to the formal sector are insufficient to finance its planned investment, then net private borrowing from abroad is allowed for to cover the deficit. The sum of the net public and private sector borrowing from abroad are equal to the current account deficit.

Table 3.7 summarizes the investment and savings transactions in the SIAM2.

Section 5: The System's Constraints and the Consistency of Economic Decisions

This section summarizes the within-period module of SIAM2 by giving a synthetic view of its system's constraints.[1/] The term is used here to indicate the types of market-clearing mechanisms assumed for the various markets. Thus it does not refer only to the macro-economic relations of the model. The issue of the closure appears on: (i) the foreign exchange market (exchange rate); (ii) the "money market" (the general price level); (iii) the markets of goods and non-factor services (prices) and (iv) the factor markets (wages and interest rates). These various markets are considered in the following.

1/ We use alternatively "systems constraints" or "closures" to indicate the rule imposed on each market in the economy telling how the market clears. Thus there are closures for factor markets, product markets, the foreign exchange market. Taylor (1978) uses closures to describe the macroeconomic constraints on the economy. Ginsburgh and Robinson (1982) describe the way the various markets clear as systems constraints.

Table 3.7

INVESTMENT AND SAVINGS

A. Public Sector

Public Sector Capital Resources	=	Government Savings	+	Savings of Public Corporations	+	Net Public Borrowing from Abroad + Changes in Reserves	+	Net Public Borrowing from The Domestic Private Sector

Public Sector Investment = Fixed Within the Period .

The net public borrowing from the domestic private sector adjusts to fill the public sector gap.

B. The Private Sector

Capital Resources from Domestic Sources Available for Private Sector Investment	=	Households Savings	+	Savings of Private Corporations	-	Net Public Borrowing from The Domestic Private Sector

Domestic Resources Available for the Formal Sector $= \alpha_1$ Capital Resources from Domestic Sources Available for Private Sector Investment , $0 < \alpha_i, < 1, \alpha_1 + \alpha_2 = 1.$

Formal Sector Investment (Fixed Within the Period)	=	Domestic Resources Available for the Formal Sector	+	Net Private Borrowing from Abroad

Informal Sector Investment = Domestic Resources Available for the Informal Sector

The net private borrowing from abroad adjusts to fill the private sector gap.

In SIAM2, the nominal exchange rate is assumed fixed. In practice its parity with the US$ is maintained relatively constant. The United States is one of the major trading partners of Thailand, however they share this position with Japan and the European Community. Vis-a-vis the currencies of the latter two, the Baht is floating with the dollar. Given that the dollar is used in most trading contracts and financial transactions, we have chosen to maintain the nominal exchange rate fixed. The issue of the extent of its flexibility remains however open.

There are no financial assets or money in SIAM2, hence no explicitation of the interaction between money and the general price level. The latter is an aggregate price in the model obtained as an average of the fixed and flexible prices in the economy. It is tied down by the exogenously fixed prices: regulated prices, formal sector nominal wages, and world prices which define a "basic" level of prices. The resource constraints, capital and informal labor, following demand variations determine changes of the aggregate price level around the "basic" level defined by the fixed prices. As such the general price level in SIAM2 is a relative price of resource constrained commodities in terms of unconstrained ones.

In the following, we consider first how the markets of goods and non-factor services clear and then turn to the closures on factor markets.

5.1 Markets of Goods and Non-Factor Services

There are 20 markets of goods and non-factor services in SIAM2 (see table 3.3). The exchange on eight of these markets takes place at a fixed price. These prices are fixed because they are determined by either the world-export or the world-import price or else they are regulated prices fixed by government policy (table 3.8).

Table 3.8

PRICE REGIMES IN SIAM2

Fixed Administered prices:	Gas, petroleum products, electricity, non-market services,
Fixed prices (from imports):	Fertilizers, crude oil,
Fixed prices (from exports):	Exportable crops, rubber,
Flexible prices:	All other commodities

Figure 3.a presents the market-clearing mechanisms for Other Exportable Crops. The price $\bar{p}^e$ is derived from the world-export price after adjustment for taxes. The total supply during the period is given at q and is inelastic. The price $\bar{p}^e$ and the demand schedule D determine domestic demand q_d and exports, equal to $q-q_d$, clear the market. In figure 3-b, the clearing on the rubber market is presented. The price $\bar{p}^e$ is again derived from the world-export price after taking account of taxes. Given the supply schedule S, output is determined at q. The demand schedule and the price $\bar{p}^e$ determine domestic demand at q_d and $q-q_d$ is exported.

Figure 4-a presents the market clearing mechanism for Fertilizers and Pesticides. The $\bar{p}^m$ is derived from the world-import price after taking into account import taxes. Given the supply schedule S, output is obtained at q. The demand schedule D and the price $\bar{p}^m$ determine domestic demand at q_d and q_d-q is imported. For years preceding 1983, crude oil is considered not produced in Thailand. The total demand for crude oil is imported at the world price. From 1983 onwards the market for crude oil behaves like in figure 4-b. Production is at $\bar{q}$ and the demand schedule is D. p^m is the landed price of imports. Domestic demand is at q_d and $q_d-\bar{q}$ is imported.

FIGURE 3

Behavior of Rice, Other Exportable Crops and Rubber Markets

Figure 3-a

Exportable Crops

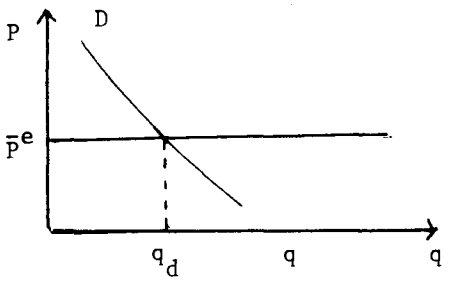


Figure 3-b

Rubber

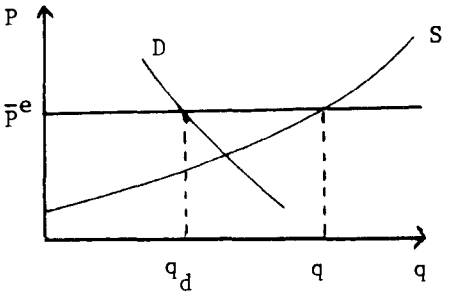


FIGURE 4

Behavior of Markets of Fertilizers and Pesticides and Crude Oil

Figure 4-a

Fertilizers and Pesticides

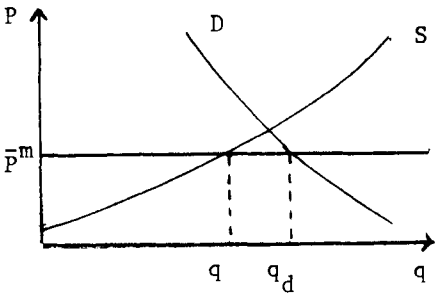


Figure 4-b

Crude Oil

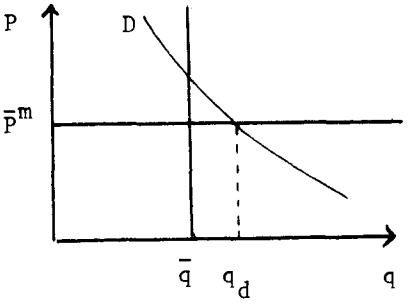
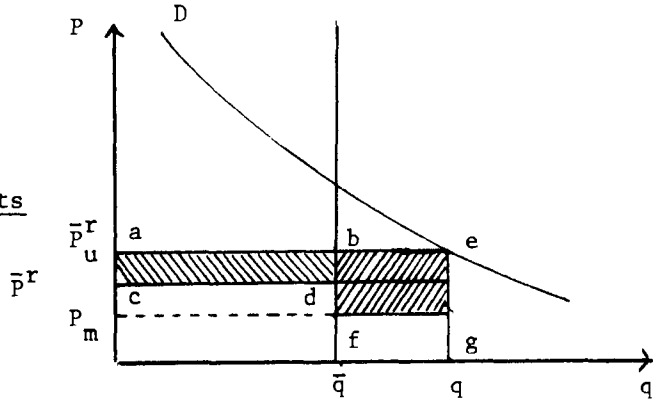


Figure 4-c

Petroleum Products



The market of petroleum products is explained in figure 4-c. The domestic production capacity is given at $\bar{q}$ and the demand schedule is D. There are two regulated prices $\bar{p}^r_p$ for producers (ex-refinery) and $\bar{p}^r_u$ for the users (retail price). The world price is p^m. Given the price $\bar{p}^r_u$, demand is at q_d and $q_d - \bar{q}$ is imported. The rectangles befg and abcd are the taxes collected by the treasury on imports and on domestic production respectively. The prices $\bar{p}^r_p$ and $\bar{p}^r_u$ are policy variables in SIAM2.

Figure 5-a illustrates the working of the market of gas. Capacity output is at $\bar{q}$. The whole of $\bar{q}$ is sold on the domestic market at the regulated price p_r. Domestic users are thus rationed at $\bar{q}$. Given their demand schedule D, they would be willing for this ration to pay the virtual price p_v (see Neary, et al. [1980]). The size of the rectangular $p_v abp_r$ is thus an implicit subsidy to the users of gas. If the price p_r were higher than p_v, users of gas would be paying an implicit tax rather than receiving an implicit subsidy. In figure 5-b, the operation of the markets of Electricity and of Non Market Services is presented. The schedule MC is the marginal cost curve of the activities along which hiring decisions of factors are taken. The regulated price at $\bar{p}^r$ determines the supply schedule. If the demand schedule is at D_1, supply is given by q_1 and the firm collects a pure rent over and above the quasi-rent of the fixed factor. If the demand schedule is at D_2, the firm supplies at q_2 but its quasi-rent is being squeezed: the marginal cost at q_2 is higher than the regulated price. The market is demand driven at the prices $\bar{p}^r$ and the operating surplus of the activity is adjusting.

All other markets of goods and non-factor services in SIAM2 have flexible prices: the price adjusts in order to clear the market. This is also the case for commodities supplied by both formal and informal sector

Figure 5

Behavior of the Markets of Gas, Electricity and Other Market Services

Figure 5-a

Gas

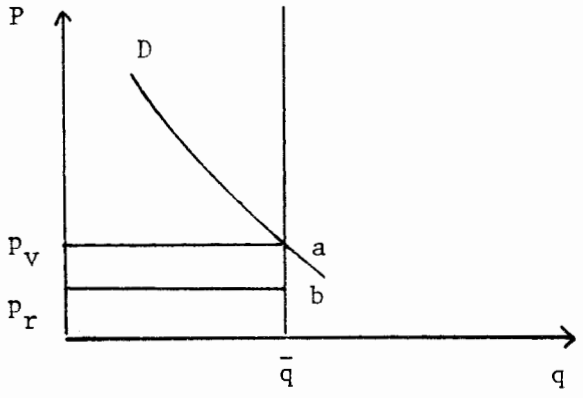
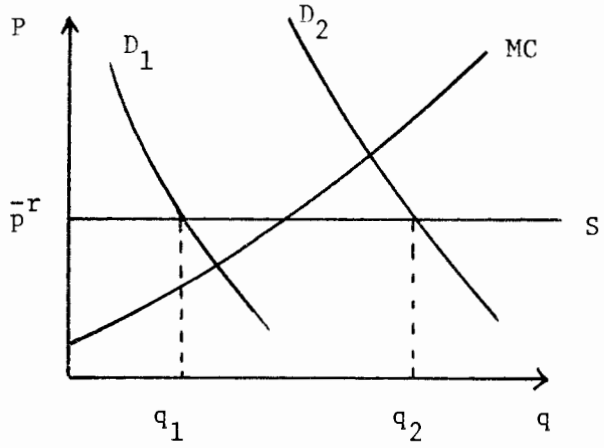


Figure 5-b

Electricity and
Nonmarket Services



firms. There, the starting assumption is that both types of firms are perfectly competitive. From the supply curves of each firm one derives an industry supply curve which intersects the industry demand curve and determines the market price. In turn, this price determines the market shares of the two firms. The specification can be thought of as the extreme case of a situation where there would be differentiation of the products of formal and informal firms and where the specific demand curves facing the two firms are relatively elastic. In the SIAM2 an Armington-type elasticity of substitution allows to feature cases where the differentiation between formal and informal goods is more or less pronounced.

5.2 Factor Markets

There are two categories of factor markets: labor markets and markets for financial resources. In the following we consider first adjustments on labor markets and then on those for financial resources.

Three labor markets appear in SIAM2: (i) one for informal labor, (ii) a market for blue-collar workers and (iii) a market for white collar workers. The latter two categories of labor are hired only in formal sector activities. Each formal production sector j faces a nominal wage ω_{1j} for blue collars and ω_{2j} for white collars. Through profit-maximization each sector expresses its demand for blue and white collar labor. These demands are added together to form the total demands in the economy for each category: blue and white collar labor. Total supplies of the two categories of labor are assumed to be inelastic in the period, thus fixing the short run resources of blue and white collar labor. These resources, however, are assumed not to be constraining: there is unemployment in each category. Basically then there are fixed nominal wages facing the formal sector and perfectly elastic supplies at these wages. Demand is accomodated. There is however, an upper-bound to labor availability. For each category of labor the wages facing each sector stand in fixed proportion to each other. Let $\bar{\omega}_{1k}$, and $\bar{\omega}_{2k}$ be the nominal wages of blue and white collar workers respectively in sector k then

$$\omega_{1j} = \bar{\gamma}_{1j}\bar{\omega}_1 \text{ and } \omega_{2j} = \bar{\gamma}_{2j}\bar{\omega}_2 ,$$

where j is an index of the production sectors and $\bar{\gamma}_{1j}$ and $\bar{\gamma}_{2j}$ are exogenous factors indicating where the wages in sector j stand relatively to those of sector k. The factors $\bar{\gamma}_{1j}$ and $\bar{\gamma}_{2j}$ are introduced to capture market imperfections and productivity differentials.

Consider now the market for informal labor. This is labor employed essentially in informal production activities. It is a composite of own labor and casual workers which are assumed to be perfect substitutes. The demand for informal labor results from the production decisions of all informal sector activities. Let N_1, N_2, N_3, N_4 be demands in non-rubber crops, rubber crops, other agriculture, and, in the rest of the economy respectively.[1/] Through their utility-maximization decision, farmers in non-rubber crops decide to supply their farm with an amount D_1 of their own labor; similarly rubber farmers supply D_2; fishermen, foresters and hunters supply D_3 and other own-account households supply D_4. This leads to the following demand for casual workers in the informal activities $\sum_{i=1}^{4} (N_i - D_i)$. Adding to this the demand for casual workers in Construction and Mining and Quarrying, the total demand for casual workers is obtained. This demand has to match the supply of casual labor in the economy (see relations 3.20). If there is any discrepancy the nominal wage of casual workers adjust to clear the market.

Financial resources are transfered between institutions through simple flows-of-funds. The private sector (households and corporation), channels its savings to a Central Savings Pool whereas the public sector directs its savings to a Public Savings Pool. The public sector (government and state enterprises) decides on its fixed investment in volume and on its borrowing from abroad. The difference between the value of the fixed investment and the sum of public savings and borrowing from abroad has to be financed from domestic sources. The public sector thus gets a share of the savings deposited in the Central Savings Pool. What is left in that pool is allocated between formal and informal sectors. The allocation is a

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1/ The demand expressed by the sector producing charcoal and firewood (Energy Extraction 1) is included in N_3 and not in N_4.

discretionary decision of the financial sector. The amount of funds allocated to the informal sectors is based on past distribution and calculations of rates of return. The value of fixed investment in each informal sector activity is equal to the amount of funds it gets. The informal sector is financially constrained. The formal sector decides on the volume of its fixed investment and gets financial resources from the Central Savings Pool. If these resources are insufficient to cover the value of the formal-sector investment, the sector borrows from abroad. The underlying assumptions here are: (i) the public sector makes a decision on its accumulation of foreign debt; (ii) depending on that decision and its investment it crowds-out more or less the private sector; (iii) the informal sector is financially constrained and cannot borrow from abroad, (iv) the formal sector prefers domestic financing (because of transaction costs, exchange risks) and borrows from abroad after having exhausted domestic resources and v) domestic and foreign interest rates are relatively in line with one another.

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Chapter 4: The Inter-Period Module of SIAM2

The previous chapter described the general equilibrium which obtains within one period. This equilibrium is conditional on resource endowments, policy parameters, structural parameters and the world environment. These variables define conditions considered fixed within one period but which may vary between periods. Their inter-period variations drive the SIAM2 model dynamically. Some of these variations are assumed to follow exogenously determined trends, others are the outcome of behavioral decisions.

In the following, we consider in section 1, the dynamics of supplies of non-rubber crops. Section 2 deals with the determinants of fixed capital formation while section 3 proposes a model for the behavior of changes in stocks. Section 4 reviews the inter-period variations of other variables and in particular land and labor endowments.

Section 1: Dynamics of Supplies of Non-Rubber Crops

In SIAM2 farmers are assumed to produce three non-rubber crops: rice, other exportable crops and other crops mainly non-traded. At the beginning of each period on the one hand they have total endowments of land and of capital, and on the other, they anticipate the prices which would prevail next year for each of the crop categories. Their decision problem is, given their technology and the input prices prevailing this period, how much to produce of each category of crops and how much to demand of each type of inputs.

Let $q_{1(t+1)}$, $q_{2(t+1)}$, $q_{3(t+1)}$ be the production of the three crops which they will put on the market next year and let $p^*_{1(t+1)}$, $p^*_{2(t+1)}$ and $p^*_{3(t+1)}$ be the corresponding prices which they anticipate to prevail next year. Assume the production possibility frontiers are given by

$$[\zeta_1 q^r_{1(t+1)} + \zeta_2 q^r_{2(t+1)} + \zeta_3 q^r_{3(t+1)}]^{\frac{1}{r}} = q^0_{(t+1)} , \qquad (4.1)$$

where ζ_i, i = 1,2,3 are share parameters, r measures the degree of curvature of the frontiers[1/] and $q^0_{(t+1)}$ is a given level of the composite output. One first question is how to allocate production between the three crops for each level $q^0_{(t+1)}$. A natural objective is to maximize the total expected revenue:

$$\sum_{i=1}^{3} p^*_{i(t+1)} q_{i(t+1)} , \qquad (4.2)$$

under the constraint of the production possibility frontier at $q_{(t+1)} = q^0_{(t+1)}$. In this case the marginal expected revenue of an increase in the composite output is given by:

$$p^* = (\sum_{i=1}^{3} \zeta_i^\sigma \, p_i^{*1-\sigma})^{\frac{1}{1-\sigma}} , \qquad (4.3)$$

where σ is the elasticity of substitution on the production possibility frontier. For each level of activity $q^0_{(t+1)}$, the supply of the three crops, under the present decision rule, is then:

$$q_{i(t+1)} = \zeta_i^\sigma \left(\frac{p^*}{p^*_i}\right)^\sigma q^0_{(t+1)}, \quad i=1,2,3. \qquad (4.4)$$

However, this supply is conditional on the level of activity $q_{0(t+1)}$. Under the assumption that farmers are profit-maximizers, the level of activity will be determined by equalization of the present value of the expected marginal revenue with the present marginal cost.

1/ r > 1 to ensure concavity.

The behavior of the marginal cost was discussed with the within-period module of SIAM2. It is derived from cost-minimization under the constraint of a two-level CES production function:

$$q_{(t+1)} = [\alpha_1 K^{*-\rho} + \alpha_2 A^{*-\rho} + \alpha_3 M^{-\rho}]^{-\frac{1}{\rho}},$$

$$K^* = [\beta N^{-\nu} + (1-\beta) \bar{K}^{-\nu}]^{-\frac{1}{\nu}},$$

$$A^* = [\delta F^{-\Theta} + (1-\delta) \bar{A}^{-\Theta}]^{-\frac{1}{\Theta}}, \qquad (4.5)$$

$$M = \text{Min } \{X_i/a_i\}, \; i=1,2,\ldots,c.$$

Given the prices of fertilizers, p_f, of other intermediate inputs, p_i, $i=1,2,\ldots,c$ and the wage, ω, minimizing costs under the constraint of the production function for a given level of capacity leads to a marginal cost curve:

$$\lambda = \lambda(p_f, p_1, p_2, \ldots, p_c, \omega, q_{(t+1)} / \bar{A}, \bar{K}, \Omega), \qquad (4.6)$$

where $\bar{A}$ and $\bar{K}$ are the fixed endowments of land and capital respectively, and Ω is the set of parameters reflecting the state of technology.

Equation (4.3) gives the expected marginal revenue for next period; equation (4.6) gives the current marginal cost. In order to determine their level of activity farmers will be equalizing the present value of the expected marginal revenue to the current marginal cost. Let $v = 1/(1+\bar{i})$, where $\bar{i}$ is the farmers discount rate, the level of activity is obtained by equalizing (4.6) with vp^*:

$$v\rho^* = \lambda(p_f, p_1, \ldots, p_c, \omega, q_{(t+1)} / \bar{A}, \bar{K}, \Omega), \qquad (4.7)$$

where p^* is obtained from (4.3). Through (4.4) and (4.7), the supplies of the crops for the next period, are determined.

The supplies of the three crops depend however on price expectations. In order to complete the model, an assumption on the formation of expectations is needed. The simplest way is to assume the following version of adaptative expectations. At the beginning of period t, the information available to the farmers contains the prices they obtained last period $p_{i(t-1)}$, i=1,2,3 and the expectations they had formed then for the present period p^*_{it}. With this information they attempt to anticipate the prices which would prevail next period: $p^*_{i(t+1)}$ as follows:

$$p^*_{i(t+1)} = (1 - \kappa_i)\, p^*_{it} + \kappa_i\, p_{i(t-1)}, \quad i=1,2,3, \qquad (4.8)$$

where $0 < \kappa_i \leq 1$ are weights farmers attach to the prices obtained last period relatively to the expectations they had formed then for the present period. The expression (4.8) leads to:

$$p^*_{i(t+1)} = \kappa_i \sum_{s=o}^{\infty} (1-\kappa_i)^s\, p_{i(t-1-s)}, \qquad (4.9)$$

which determines expected prices in terms only of realized past prices.

This completes the description of the dynamics of the supplies of non-rubber crops which we now summarize. At the beginning of a period farmers use past prices to anticipate the prices which would prevail next period (using 4.9). Knowing their production-possibilities frontiers (4.1), they

maximize expected revenues (4.2) which provides the marginal revenue corresponding to various levels of activity (4.3). Given their endowments in land and fixed capital, technology and factor prices, cost minimization provides the marginal cost associated with each level of activity. Because some factors are fixed this marginal cost incrases with the level of activity. Then farmers take into account their discount rate $\bar{i}$ and compare the present value of expected marginal revenues with marginal cost. They will choose the level of activity $q_{(t+1)}$ which will equalize the two (4.7).

A crucial assumption in the above description is that of strong separability of inputs and outputs. This means that changes in the relative prices of inputs will not affect the output mix and similarly changes in relative expected output prices will have no effect on input intensities. This is the cost paid to maintain a simple and transparent treatment of the behavior of the supplies of non-rubber crops.

Section 2: Fixed Capital Formation and Capital Accumulation

The SIAM2 model separates the investment activity of the public sector from that of the private. Within the latter, formal and informal activities are treated differently. All formal activities are assumed to decide on the amount of fixed investment (at constant prices) and then to attempt to find financing. The informal sector activities are thought to be financially constrained and to invest an amount equal to the value of finance they are able to obtain. Within the public sector, the investment activity of state enterprises is separate from that of government. However for both, the chain of causality runs in the same way as for the private formal sector: the amount of fixed investment (in constant prices) is decided upon and then the financing has to accommodate.

The investment of each informal activity adds to the corresponding capital stock and modifies between periods the capital endowments of the relevant sector. This is also the case for the investment of formal activities. Government invests in various sectors of production and its investment adds to private investment increasing the total capital resource endowment of the corresponding sector. Some activities of state enterprises, like Electricity, form an independent sector of production. In that case, the investment adds to the capital stock of the sector in a straightforward way. In other cases, like Transportation and Communication, there is one sector of production encompassing both state enterprises and private activities. When this occurs, all investments in the production sector, whether from private or public sources, add to the capital stock of the sector.

Consider now investment in informal activities. It is equal to the financial resources available to each of them. These are determined by allocating total financial resources, available to the informal sector, on the various informal activities. One can think of a financial sector which allocates a total amount of resources across various activities. Let $(TFI)_t$ be the total financial resources available to the informal sector, then

$$P_{it} I_{it} = \alpha_{it}(TFI)_t, \quad i=1,2,\ldots,n \tag{4.10}$$

where I_{it} is fixed investment in volume, P_{it} the price of fixed investment, α_{it} is the share of financial resources going to sector i ($\sum_i \alpha_{it} = 1$), and n the total number of informal activities. Formally now, the question is how are the α_{it}, $i=1,2,\ldots,n$ determined and how do they change

through time. Dervis, de Melo and Robinson (1982) suggest the following specification:[1/]

$$\alpha_{it} = SP_{i(t-1)} + \mu\, SP_{i(t-1)}\left(\frac{R_{i(t-1)} - AR_{t-1}}{AR_{t-1}}\right),\ i=1,2,\ldots,n \qquad (4.11)$$

where SP_{it} is a sectoral share in aggregate profits, μ is a parameter indicating intersectoral "mobility" of financial resources, R_{it} is a sectoral profit rate and AR_t is the average profit rate. Specification (4.11) indicates that if there is no "mobility" of funds across sectors ($\mu = 0$), any difference between sectoral and average profit rates will not affect the share of funds allocated to each sector. Furthermore this share will be equal to the last period share of the sector in aggregate profits. With "mobility" of funds, sectors with profit rates higher than average will pull resources over and above their respective profit shares whereas the sectors with lower than average profit rates would give up resources. Thus with $\mu > 0$, relations (4.11) allow for allocation shares α_{it} to respond to relative profitability. The variability of the α_{it} in (4.11) is around sectoral shares in aggregate profits: $SP_{i(t-1)}$. The underlying idea here is that if there were no "mobility" of funds ($\mu = 0$) and if all profits were saved, then the investment undertaken by each activity would be self-financed. Thus (4.11) is broadly based on the idea that savings come essentially from profits and that firms get more or less than their available resources according to their relative profitability and to the "mobility" of funds. However, in SIAM2, (4.11) would be applied to shares allocating funds available to informal activities between the latter. Hence the link between the funds which each activity would

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1/ $0 \leq SP_{it} \leq 1$ and $\Sigma SP_{it} = 1$ hence $\Sigma\alpha_{it} = 1$ for all μ's.

receive, its profits, and eventual savings is more remote than what is implicit in (4.11). Furthermore, the mechanism assumed in SIAM2 is that the financial sector allocates across informal activities a given amount of funds. It seems difficult to assume that such a financial sector would be able to have a good idea of aggregate informal profits and hence of an average profit rate in the whole informal economy, weighted by sectoral profit shares. A reasonable approach would be to assume: (i) that the financial sector knows the allocations of funds it has made in past periods, (ii) that it is provided with individual profit rates for each informal activity, and (iii) that based on previous allocations of funds, it uses available profit rates to fix an average profit rate for activities in the informal sector. These assumptions would lead to a respecification of (4.11):

$$\alpha_{it} = \alpha_{i(t-1)} + \mu\, \alpha_{i(t-1)}\left(\frac{R_{i(t-1)} - \bar{R}_{(t-1)}}{\bar{R}_{t-1}}\right),\ i=1,2,\ldots,n, \qquad (4.12)$$

where $\alpha_{i(t-1)}$ are the shares used last period to allocate the funds, $R_{i(t-1)}$ are sectoral profit rates, μ is still a "mobility" of funds parameter and

$$\bar{R}_{(t-1)} = \sum_{i=1}^{n} \alpha_{i(t-1)}\, R_{i(t-1)}. \qquad (4.13)$$

Given (4.13), (4.12) obviously satisfies the activity constraint $\sum_i \alpha_{it} = 1$. Relations (4.11) tell the following story: the financial sector has some inertia in its allocation of funds, however at each period it reviews the performance of informal activities and according to the extent of the "mobility" of funds it reorients its financing between various informal activities. To complete the specification of (4.12), one needs to define more precisely the sectoral profit rates R_i. Let $P_{i(t-1)}\, K_{i(t-1)}$ be the value of

the capital stock, in sector 1, at the end of period t-1, let δ_i be the rate of depreciation in the sector i and OS_{it} be the gross operating surplus[1/] in sector i, in period t, the profit rate R_{it} is defined as[2/]:

$$R_{it} = \frac{OS_{it} - P_{i(t-1)}\ \delta_i\ K_{i(t-1)}}{P_{i(t-1)}\ K_{i(t-1)}},\ i=1,2,\ldots,n. \qquad (4.14)$$

A relevant issue in the formulation of (4.14) is whether to include or not in the operating surplus the wages of own-labor. Excluding it means that the financial sector gets information on the amount of own-labor, imputes to it a wage and computes the would-be compensation. It then calculates a pure rate of return on capital. It does not seem unreasonable to assume that such a calculation is undertaken and that a pure rate of return on capital is computed. Furthermore SIAM2, in the within period module generates an imputed compensation to own-labor. Consequently we opt here for the exclusion of the imputed compensation of own-labor from the operating surplus and for a profit rate which measures a pure rate of return on capital.

Consider now fixed capital formation in private formal activities. It is assumed in SIAM2 that these activities decide on their demand for fixed capital and then consider the financing of this demand. They always are able to finance their fixed capital formation whether from domestic or foreign sources. In SIAM2, fixed capital formation in formal activities is

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1/ OS_{it} is the income accruing to capital.

2/ This formulation of R_{it} ignores capital gains. The within period module of SIAM2 does not produce directly the rate of return on capital in agriculture because the production decision is based on expected prices. The model however provides the current combined income of capital and land. The two incomes are separated using the following ratio α: $\alpha = [P^*(\partial Q/\partial K)\cdot K]/[P^*(\partial Q/\partial A)\cdot A]$, where P^* is the expected price, K is capital, A is land and Q is production.

exogenous. The shifts in the amounts invested between periods have to be specified by the user. This is also the case for public sector and government investment.

Once investment decisions are made, the capital endowments for the next period are derived. This is done in the same way for all production activities whether in the formal, informal or public sectors. Let I_{jt} be the amount of fixed capital formation going into sector j, then

$$K_{j(t+1)} = I_{jt} + (1- \delta_j)K_{jt} \quad , \quad j = 1,2,\ldots,22)$$

where K_j is the capital stock of sector j and δ_j is a rate of depreciation which is sector specific. The index t is for time.

Section 3: Behavior of Changes in Stocks

In SIAM2 investment is disaggregated between fixed capital formation and changes in stocks. The behavior of fixed investment was considered in section 2, we deal here with the behavior of changes in stocks. Inventories are assumed to adjust between periods following a simple behavioral rule.

Let Q^*_{it} be the aggregate demand for commodity i expected, at the beginning of period t, to prevail during the period. The demands for stocks of commodities during period t, S_{it} are related to expected demand as follows:

$$S_{it} = \alpha_i + \beta_i Q^*_{it} \quad , \quad i=1,2,\ldots,c, \qquad (4.15)$$

where β_i is the change in the demand of stocks induced by a change in expected aggregate demand and α_i is a stock level corresponding to a zero expected demand. Assuming adaptative expectations:

$$Q^{*}_{it} - Q^{*}_{i(t-1)} = \lambda_i (Q_{i(t-1)} - Q^{*}_{i(t-1)}), \quad i=1,2,\ldots c, \tag{4.16}$$

where λ_i is an adjustment parameter such that $0 < \lambda_i \leq 1$, expected aggregate demands can be expected in terms of past realized values:

$$Q^{*}_{it} = \lambda_i \sum_{s=0}^{\infty} (1-\lambda_i)^s \, Q_{i(t-1-s)}, \quad i=1,2,\ldots,c. \tag{4.17}$$

Manipulations of the preceding relations lead to the following expression for changes in stocks:

$$\Delta S_{it} = \beta_i \, \lambda_i \, \Delta Q_{i(t-1)} + (1-\lambda_i)\Delta S_{i(t-1)}, \quad i=1,2,\ldots,c, \tag{4.18}$$

where $\Delta Q_{it} = Q_{it} - Q_{i(t-1)}$ and $\Delta S_{it} = S_{it} - S_{i(t-1)}$. If β_i were equal to one, then changes in stocks in the present period would be the average of last period changes in stocks and in production. One can derive from expression (4.18) a determination of changes in stocks in terms only of past increases in aggregate demands

$$\Delta S_{it} = \beta_i \, \lambda_i \sum_{s=o}^{\infty} (1-\lambda_i)^s \, \Delta Q_{i(t-1-s)}, \quad i=1,2,\ldots,c. \tag{4.19}$$

Thus changes in stocks are a moving averages of past variations in aggregate demands. Under relatively stable growth paths and with the presumption that $0 < \beta_i < 1$, the path of changes in stocks would also be stable.

Section 4: Resource Endowments, Structural Parameters, Policy Instruments and the World Environment.

A path of the economy generated by the SIAM2 model is a sequence of equilibria. These equilibria are conditional on a certain number of variables and parameters whose values change between periods reflecting changes, and anticipations of changes, in the environment of the economy. The foregoing sections of this chapter discussed how agricultural supplies, fixed capital formation and demands for stocks shift between periods. Other changes in the environment of the economy are taken up here.

Thailand is relatively well endowed with agricultural land. Expansion of land has greatly contributed in the past to the growth of agricultural production and to the impressive performance of agricultural exports. The outlook on land availability is uncertain. Estimates vary. SIAM2 considers in each period land as a fixed factor entering the production of agricultural activities. The land endowment can be shifted between periods according to the user's expectations on land availability.

The within period module of SIAM2 identified three labor markets: (i) an informal labor market; (ii) one for blue collars and (iii) another for white collars. On the first of these markets each category of households intervening there is endowed, each period, with a "potential" supply of labor. The "potential" supplies are allowed to shift between periods in an exogenous way. The shifts should reflect the growth in the labor force and its composition by category of suppliers of labor. Blue and white collar labors are suppliers of labor. Blue and white collar labors are supplied by households with a blue and white collar head, respectively. It is assumed that there is unemployment and that supply is perfectly elastic at the current

exogenously given nominal wage. SIAM2 does not however keep track of the labor supply and of the unemployment for these two categories of labor.

Consumers' behaviors, producers' technologies and traders' behaviors depend on a set of parameters which characterize their responses to various signals which reach them. These parameters are essentially intercepts and elasticities. Behaviors and technology can shift through time under the influence of a number of circumstances. These shifts can be captured by changes in the parameters governing behaviors and technology. Shifts in these "structural" parameters will contribute to the shape of the path of the economy obtained as a sequence of equilibria.

The government intervenes in the economy in various ways. It spends on goods and services, it invests, collects direct and indirect taxes, borrows from abroad and domestically, makes transfer payments and eventually changes the parity of the Baht with other currencies. The government also contributes to the setting of energy prices: electricity, gas, petroleum products. All these policy instruments affect the equilibrium which the economy can reach in each period. Altogether, policy instruments define a policy environment which will also drive the economy between periods.

Thailand has a small open economy. Its performance depends on the behaviors of world prices and on the state of the economies of its trade partners. The sequence of equilibria defined by SIAM2 is conditional on the values taken by the world parameters. Shifts in world prices and varying performances of the world economy will shift the equilibrium defined in the within-period module of SIAM2. Variations in the world environment will contribute to the definition of the path of the economy.

In summary the economy as defined by SIAM2 will shift between periods under the influence of four sets of parameters and variables;

(i) resource endowments; (ii) policy parameters; (iii) structural parameters; (iv) the world environment. Farmers' production behaviors and inventories accumulation will also contribute to the definition of the sequence of equilibria as defined in SIAM2. Investment decisions through capital stocks will affect the resource endowments of the economy.

Reference

Dervis, K., J. de Melo, and S. Robinson (1982), General Equilibrium Models for Development Policy, Cambridge, Cambridge University Press.

Part II

INTERVENTION IN THE ENERGY AND RICE SECTORS

In the following the SIAM2 is used to analyze interventions in the energy and rice sectors. With the 1982 drop in oil prices, the issue of dropping the domestic prices was raised in Thailand. Chapter 5 analyzes the macroeconomic and distribution implications of maintaining and dropping domestic energy prices in the face of a drop in the world prices of oil. In chapter six the issue of the appropriate scheme for the support of the price of rice is considered. The "buying programme" scheme and manipulations of the export tax rate are compared and their macroeconomic and distribution implications are assessed.

Chapter 5: Coping with a Decline in Energy Prices

I. Introduction

When the domestic price of a traded commodity is a policy variable, changes in the world price raise the question of the adjustment of the domestic price. During the seventies, energy prices were the most outstanding example. Usually advice based on efficiency grounds recommended that domestic prices be kept in line with increasing world prices. On equity grounds, advice usually recommended caution and warned against the unfavorable effects on employment and income distribution of raising domestic prices. In most cases, and in particular in the case of Thailand, domestic prices were indeed adjusted upwards and brought in line with world prices. This was thought to be an appropriate measure in order to bring under control an increasingly unsustainable external imbalance and accumulation of foreign debt. Invariably, lip service was paid to equity considerations and assessments of income distribution and employment implications were rarely undertaken. Now, at the beginning of the eighties, real and nominal world prices of energy are dropping, which raises again the issue of the adjustment in domestic prices, but in a different context. This chapter is set up to analyse, for Thailand, growth, resource balance, employment and income distribution implications of alternative adjustments in the domestic prices of energy.

Looking back at analyses of the increases of energy prices, two categories of studies can be found. In the first category, the focus is macroeconomic. The aim is to assess the effects on growth, the resource balance and the general price level of the surge in the world prices of energy. Traditional demand oriented macroeconomics was rapidly realized to be neglecting a major channel for transmission of energy prices to the domestic

economy, the supply side. Energy is an intermediate input; a surge in its price is also a supply shock. Following Findlay and Rodriguez (1977), analyses of the supply response were presented. They were later extended to take into account endogenous savings and investment behaviors--Obstfeld (1980)--this latter extension is thought essential for a satisfactory analysis of the behavior of the current account. The focus on the supply response leads to the explicitation of the two features of a surge in energy prices: (i) an unfavorable supply shock and (ii) a transfer to the rest of the world--see van Wijnbergen (1980). But no study of the macroeconomics of a surge in oil prices provides also insights into employment and income distribution issues. Analyses focussing on the latter subjects are mainly input-output based. They attempt to measure the first round effects on cost-of-living indices under alternative assumptions on energy prices and on their taxation. Disregarding second round effects, these studies bypass income generation, factor markets and the distribution of factor incomes.[1/]

With respect to Thailand analyses of the macroeconomic implications of the oil price shocks have been undertaken by Amranand and Virabongsa (1981) and Drud and Grais (1983). Despite their general equilibrium nature, these approaches use traditional demand-oriented macroeconomics. Attempts are made to assess supply effects through exogenous shocks of the cost structures of production activities, but in a way which is not satisfactory. Another study developed by Hughes (1983) focussed on income distribution following the input-output approach. Its main result is that the unfavorable income distribution effects are not substantial and do not deserve the emphasis they have been given. Hughes however disregards general equilibrium effects by

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1/ See, e.g., World Bank-Energy Department (1981).

bypassing income generation, factor markets and the distribution of factor incomes.

In the present chapter we address the growth, resource balance, employment and income distribution effects of the drop in the world prices of energy. What are these effects if domestic prices are kept rising, if they are immediately adjusted to world prices or if they are kept constant in nominal terms awaiting an eventual future increase? The analysis is done for Thailand within the framework of a general equilibrium model[1/] which allows the derivation of both macroeconomic and income distribution implications in a consistent way. As a general equilibrium framework, it takes into account the role of energy as an intermediate input, so capturing both supply and demand effects.

Section 2 of the chapter attempts to disentangle the effects of a drop in the world prices of energy, of a general slow down in all world prices, and of an expansion in world trade, assuming that domestic prices of energy follow a path independent of changes in the world environment. A comparison of alternative adjustments in domestic prices of energy is undertaken in Section 3. Conclusions follow in Section 4.

2. Cheaper World Energy

The reference scenario describes a path with given assumptions on the development of the world economy policy interventions. This section considers the modification of this path if a further drop in the world prices of energy occurs. However, consistent with the view that such a drop is only temporary

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1/ S. Gupta (1983) uses also a general equilibrium model to analyze sectoral and macroeconomic responses of the Indian economy to the second (1979/80) oil price shock.

and that energy prices will surge again in the future, the cost of energy to domestic users is left growing as in the reference path.

One does not expect a drop in the world prices of energy without other changes in the world economy. Presumably cheaper energy is associated with a slow down in world inflation and commodity prices. Presumably also world trade would expand more rapidly. Macroeconomic and distribution effects of such simultaneous changes are difficult to disentangle. We therefore consider each of them separately in the following.

Section one compares the outcomes of the reference path (path A) and path B where only the world prices of energy drop. The modifications in path B when world inflation and commodity prices slow down (path C) are taken up in section 2. Finally section 3 considers the effects of a more rapid expansion of world trade (path D)

2.1. A Drop in the World Prices of Energy

We assume that in 1984 world energy prices drop to an equivalent of $20 a barrel for crude oil. They would remain at this level in 1985 and then grow at the same rate as in the reference path. By 1989, the world prices of energy would be back to their 1982-83 level. This assumption implies a 31% price drop in 1984, no growth in 1985 and 9% growth thereafter.[1/] This path of the world prices of energy is the only change relative to the reference scenario. Domestic prices to users are left growing as in the reference scenario.

Panels A and B of table 1 presents the growth outcome of the drop in energy prices. Panels A and B of table 2 give the modifications in the macroeconomic resource balance while employment results are shown in panels A

1/ Given the assumptions on other world prices this is approximately a 3% real growth rate.

Table 1
Growth in Selected Aggregates in the Absence of Adjustments in the Domestic Prices of Energy

	A Reference Path		B Drop in the world prices of energy		C Slowdown in all world prices		D Expansion of world trade	
	1982-85	1986-89	1982-85	1986-89	1982-85	1986-89	1982-85	1986-89
Constant Price Aggregates								
Private consumption	4.8	6.0	4.8	6.1	4.6	6.0	4.7	6.0
Public consumption	4.4	4.7	4.4	4.7	4.7	4.8	4.6	4.8
Investment	3.8	7.0	4.6	7.3	4.2	7.2	4.4	7.3
Public investsment	3.4	4.5	3.4	4.5	3.4	4.5	3.4	4.5
Private investment	4.4	7.9	5.6	8.3	5.1	8.2	5.4	8.3
Exports GNFS	8.3	8.2	8.3	8.5	8.3	8.2	9.1	8.2
Imports GNFS	1.6	3.4	2.0	3.5	2.0	3.1	2.6	3.3
GDP at market prices	6.2	7.2	6.3	7.4	6.1	7.4	6.3	7.4
GDP deflator	3.9	6.6	4.4	6.2	2.7	6.5	3.1	6.4

Table 2
Macroeconomic Resource Balance in the Absence of Adjustment in the Domestic Prices of Energy

	A Reference Path			B Drop in world energy prices			C Slowdown in all world prices			D Expansion of world trade		
	1984	1985	1989	1984	1985	1989	1984	1985	1989	1984	1985	1989
Public Sector												
Savings	.9	1.3	2.4	3.1	3.9	6.1	2.8	3.5	5.5	2.9	3.8	5.9
- Government	-.6	-.2	1.0	1.6	2.4	4.5	1.3	1.9	3.8	1.4	2.2	4.2
- State enterprises	1.5	1.5	1.4	1.5	1.5	1.6	1.5	1.6	1.7	1.5	1.6	1.7
Investment	7.5	7.1	6.1	7.4	7.0	6.0	7.6	7.3	6.2	7.5	7.2	6.1
- Government	3.7	3.4	2.8	3.6	3.3	2.8	3.7	3.5	2.9	3.7	3.4	2.9
- State enterprises	3.8	3.7	3.3	3.8	3.7	3.2	3.9	3.8	3.3	3.8	3.8	3.2
Public Sector Deficit	-6.6	-5.8	-3.7	-4.3	-3.1	+.1	-4.8	-3.8	-.7	-4.6	-3.4	-.2
- Net public borrowing from abroad	2.7	2.4	1.7	2.7	2.4	1.7	2.8	2.6	1.8	2.8	2.5	1.8
- Net public borrowing from domestic sources	3.9	3.4	2.0	1.6	.7	-1.8	2.0	1.2	-1.1	1.8	.9	-1.6
Private Sector Savings	17.8	17.8	17.9	17.3	17.2	17.1	17.3	17.2	17.0	17.4	17.3	17.1
Less Net public borrowing from domestic sources	3.9	3.4	2.0	1.6	.7	-1.8	2.0	1.2	-1.1	1.8	.9	-1.6
Domestic resources available to the private sector	13.9	14.4	15.9	15.7	16.5	18.9	15.3	16.0	18.1	15.6	16.4	18.7
Investment	15.1	15.1	14.9	15.3	15.5	15.6	15.5	15.8	15.6	15.4	15.7	15.6
Private sector deficit	-1.2	-.7	+1.0	+.4	+1.0	+3.3	-.2	+.2	+2.5	+.2	+.7	+3.1
Net private borrowing from abroad	1.2	.7	-1.0	-.4	-1.0	-3.3	.2	-.2	-2.5	-.2	-.7	-3.1
Current Account Deficit	3.9	3.1	.7	2.3	1.4	-1.6	3.0	2.4	-.7	2.6	1.8	-1.3
Net public borrowing from abroad	2.7	2.4	1.7	2.7	2.4	1.7	2.8	2.6	1.8	2.8	2.5	1.8
Net private borrowing from abroad	1.2	.7	-1.0	-.4	-1.0	-3.3	.2	-.2	-2.5	-.2	-.7	-3.1

and B of table 3. Finally, table 4, again in panels A and B, indicates distributional consequences.

There are two main macroeconomic results: (i) a slight acceleration in growth, and (ii) a strong improvement in the current account deficit. Both results can be traced back to the wedge between the world and domestic prices of energy. The wedge leads to improved fiscal collection, a reduction in the public sector deficit and in public borrowing from domestic sources. The outcome is greater resources available to the private sector leading to increased informal investment and less formal borrowing from abroad. Over the period 1982-85 the increased investment pulls aggregate demand and leads to a slightly higher growth rate but also accelerates the GDP deflator. Over the period 1986-89, strong private investment continues to pull the economy; it is however now complemented by greater production capacity. The latter allows for an improved competitiveness which contributes to more exports.

As is shown in table 3, a drop of 31% in the world prices of energy does not allow for a substantial acceleration in total employment. Only over the period 1986-89 does the growth rate of total employment increase from 2.7% to 2.8%. According to the Constant Elasticity of Substitution (CES) technology representing most of production processes in the SIAM2 model, the assumption of cost minimization implies the following relation for labor demand:

$$\dot{N}/N = s(\dot{p}/p - \dot{w}/w) + \dot{q}/q,$$

where N is employment, p the output price, w the wage, q output and s the elasticity of substitution, with a dot denoting derivation with respect to time. Thus the rate of expansion of employment depends on the rates of expansion of output prices, wages and output. The first term of the relation captures substitution effects while the second reflects output effects.

Table 3

Employment Growth in the Absence of Adjustments in the Domestic Prices of Energy

	A Reference Path		B Drop in world energy prices		C Slowdown in all world prices		D Expansion of world trade	
	1982-85	1986-89	1982-85	1986-89	1982-85	1986-89	1982-85	1986-89
Total Employment	1.3	2.7	1.3	2.8	1.8	1.7	1.8	1.7
Employment by Sector of Production								
Agriculture	.9	2.4	1.0	2.5	1.9	.7	1.7	.8
Industry	3.5	4.8	3.6	4.7	2.8	5.2	3.4	5.3
Energy	8.5	14.6	8.4	15.0	8.2	15.1	8.4	15.1
Construction	.0	3.6	.7	3.9	-.2	3.9	.1	3.9
Services	1.9	2.6	1.9	2.6	1.4	3.5	1.5	3.5
Employment by Socio-Economic Categories								
Blue collars	1.2	5.4	1.3	5.5	.4	5.3	.9	5.3
White collars	.8	3.7	.8	3.7	.5	3.6	.7	3.6
Casual workers	-5.5	-2.7	-5.4	-2.1	-3.3	-10.1	-4.0	-10.0
Own account: Agriculture	2.3	2.5	2.3	2.5	2.9	2.1	2.8	2.1
Own account: Non-agric.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Wages								
Blue collar	8.8	7.5	8.8	7.5	8.8	7.5	8.8	7.5
White collar	8.5	7.5	8.5	7.5	8.5	7.5	8.5	7.5
Informal labor	5.4	11.2	5.5	11.3	4.6	9.6	5.1	9.8

Table 4
Income Distribution in the Absence of Adjustments
in the Domestic Prices of Energy

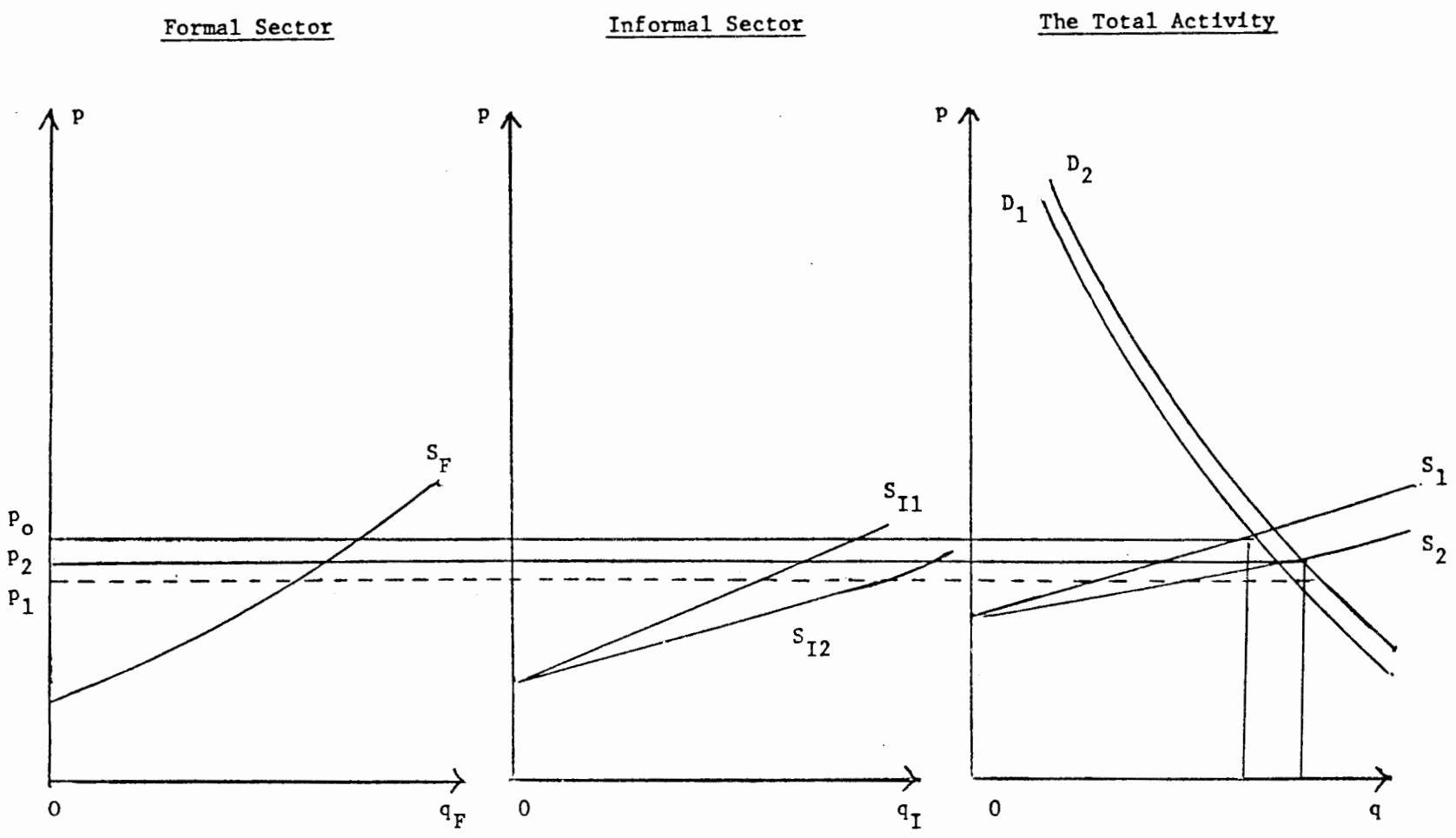
	A Reference Path		B Drop in world energy prices		C Slowdown in all world prices		D Expansion of world trade	
Real Incomes Per Capita	1982-85	1986-89	1982-85	1986-89	1982-85	1986-89	1982-85	1986-89
Farmers: crops	3.9	2.3	3.7	2.3	1.2	4.2	1.5	4.0
Farmers: rubber	1.7	4.2	1.8	5.0	2.0	4.3	1.5	4.3
Own account: Other agriculture	11.8	13.3	11.7	13.0	12.5	11.3	13.0	11.2
Own account: Non agriculture	2.3	4.0	2.3	4.4	3.0	3.2	3.1	3.3
Blue collars	3.6	3.6	3.7	3.9	4.7	3.2	4.7	3.4
White collars	3.6	3.5	3.5	3.6	4.4	3.2	4.3	3.3
Casual workers	1.5	4.0	1.5	4.5	2.8	2.4	2.8	2.5

Distribution of Real Incomes per Capita*	1981	1984	1985	1989	1984	1985	1989	1984	1985	1989	1984	1985	1989
Farmers: crops	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Farmers: rubber	1.13	1.12	1.07	1.08	1.13	1.06	1.17	1.19	1.17	1.17	1.17	1.13	1.15
Own account: Other agriculture	.88	1.30	1.46	2.01	1.17	1.20	1.77	1.22	1.35	1.76	1.22	1.36	1.77
Own account: Non agriculture	1.58	1.67	1.63	1.62	1.63	1.51	1.64	1.73	1.70	1.64	1.72	1.69	1.65
Blue collars	1.95	2.16	2.10	2.09	2.13	1.97	2.10	2.28	2.24	2.17	2.27	2.22	2.17
White collars	3.80	4.26	4.14	4.11	4.16	3.87	4.07	4.46	4.38	4.22	4.42	4.32	4.20
Casual workers	.94	.99	.95	.93	.96	.87	.95	1.02	1.00	.93	1.02	.99	.93

* The ratio of the real per capita income of each household to the real per capita income of non rubber farmers.

According to table 3, in almost all sectors employment expands slightly more quickly under path B. For construction the case is relatively clear; the strong investment expansion leads to increased demand for construction and pulls employment in the sector. The output price and demand of construction dominate the slight acceleration in the informal wage of casual workers; employment expands. In most other sectors, the output effects dominates and employment also expands. However, in industry, during the period 1986-89, employment growth slightly decelerates. This is due to a slowdown in the growth of output prices. The expansion of private investment in the informal sectors leads to increased capacity and competition with formal sector firms, producing similar goods, This competition slows down the increases in the output prices of both types of firms. This phenomenon is illustrated in figure 2. Initially market demand and supply are at D_1 and S_1 respectively with the price p_o clearing the market. The expansion of the capacity of informal sector firms make their supply curve shift from SI_1 to SI_2 leading to a shift in aggregate supply from S_1 to S_2. Now informal sector firms, at the new price p_1 have a larger share of the market. However, because of the overall expansion of the economy, the market demand may shift from D_1 to D_2 with a new market price p_2 and a new distribution of market shares. The main result is that the output price is now lower. Such a drop underlies the slower growth of industrial employment in path B. If one looks at employment by socio-economic category, the rate of expansion of employment is uniformly faster or identical after the drop in energy prices The deceleration of casual workers employment is less rapid which is due to the increased capacity in informal sector firms and to the expansion of construction. The new equilibrium allows for a slightly faster increase in the informal wage.

Figure 2: Price Implication of Additional Informal Investment



The general, though weak, expansion of the economy between paths A and B, together with the slowdown in the CPIs result, for most of the households, in more rapid increases in real incomes per capita (table 4). However, households employed in non-crop agriculture experience a slowdown in real income per capita. A large part of non-crop agriculture is fisheries which is energy intensive. The relative drop in the output price of the sector jointly with the increasing domestic costs of energy hurt the profitability of the sector and leads to a lower growth in the real incomes per capita of the households employed in it.

One can look at a drop in the world prices of energy as, on the one hand a transfer from abroad to the country, and on the other hand as a favorable supply shock on producers reducing their intermediate costs. In the above scenario B, only the transfer aspect is captured as the drop in world prices is not passed on to domestic users. The issue is then who benefits from this transfer. By allowing a wedge between domestic prices and world prices, we allowed for the government to be the first beneficiary of the transfer. However this has far reaching ramifications. Through helping to close the budget deficit, such a transfer alleviates the burden of public borrowing on domestic savings. It leaves more resources to the private sector leading to an expansion of production capacity, increased competitivity and higher growth, and to a substantial reduction in the current account.[1/] In

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1/ Viewed from the perspective of the trade balance, the drop in the world prices of energy leads to an amelioration of the terms of trade. In the reference scenario, the terms of trade drop by -1.3% and -.4% for the periods 1982-85 and 1986-89 respectively, while in path B they increase by .9% for the first period and drop by -.3% for the second.

terms of distribution, most sectors of the economy benefit though to a limited extent. The main conclusion is that, even if not passed on, a drop in the world prices of energy benefits the economy but in a limited way.1/

2.2 The Accompanying Slowdown in Commodity Prices

In the two preceding scenarios, the world prices of all commodities are assumed to grow between 8% and 10% in 1984 and 1985. They do not however grow uniformly as a view on the market of each sector is incorporated in the assumptions. Beyond 1985 all prices (except energy) are assumed to follow a uniform path and grow between 6% and 7%. Should a drop in the world prices of energy occur, it is unlikely that other commodity prices will be left unchanged. Most likely, for other countries, like for Thailand, the increase in commodity prices will slow down. World inflation presumably would decelerate. In order to come closer to what might happen, we consider now the effects of the drop in energy prices, as in path B, but with a slowdown in commodity prices. More precisely all non-energy prices are assumed to increase by 4% in 1984 and by 5% in 1985. Beyond 1985 they follow the same trend as in the two previous scenarios.

2.2.1 The 1982-1985 Period

The change considered here has two components: (i) a favorable supply shock through the slowdown in import prices and (ii) an unfavorable demand shock through the slowdown on world markets of the prices of

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1/ A result partially concealed by the figures presented is the reduced profitability of the gas and petroleum products sectors. Legally in Thailand, the output prices of these sectors are pegged to world prices, hence when the latter drop, the returns to these sectors suffer. An indication of this phenomenon appears in the lower ratios of private savings to GDP in table 2.

commodities substitutable with Thai exports. During the period 1982-85, the second component dominates.[1/] The economy slows down slightly and the GDP deflator decelerates. The improvement in the current account deficit is less pronounced than in path B.[2/]

Government expenditure is defined in nominal terms, therefore real government consumption increases faster. Also because of the slight contraction of the economy, tax collection does not improve. Both phenomenon lead to a moderate drop in government savings as a share of GDP. The public sector deficit, again as a share of GDP, is larger than in path B; public sector domestic borrowing increases leaving less resources for the private sector. The contraction of private sector resources is the cause of larger private borrowing from abroad and the reduced growth of informal investment.

In both paths B and C, formal sector nominal wages grow at the same rate. However, in the latter path, prices decelerate substantially implying higher real wages in the formal sector. Jointly with the slight contraction of the economy, the higher relative cost of formal labor leads to a lower growth rate of non-agricultural employment. Agricultural employment however expands more rapidly. The main reason lies in the behavior of farmers who decide on their production on the basis of the present value of expected prices and current costs. When the double shock of a slowdown in import and in export prices happens, production costs decelerate more rapidly than the

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1/ The terms of trade instead of improving at .9% per year deteriorate at an annual rate of .5%.

2/ Results are shown in tables 1,2,3 and 4, in panels B and C.

present value of expected prices. The consequence is increased production.[1/] This expansion of agricultural production, jointly with the slower growth of the informal wage will help expand agricultural employment. Higher employment of casual workers and "own accounts" in agriculture follows.

In spite of the expansion of agricultural output (path C relative to path B), real incomes of farmers do not increase as much. The main reason is the higher growth of agricultural output itself. Farmers finance the cost of producing the crop of next period with their current receipts. When their output expands, their cost also expands relatively to their current receipts. Their net income is reduced and as a consequence the growth in their real income decelerates. Contrary to what farmers experience, all other households see their real incomes grow faster. Blue-collars, white-collars and casual workers benefit the most. For the first two categories, the effect of the increase in their real wages dominates that of the slowdown in their employment while in the case of casual workers there is an increase in both real wages and employment. All three other households see their real incomes improve though to a lesser extent.

1/ Let the supply function be $q = f(\overset{+}{P^*}, \overline{w}, \overline{!}, \overline{p}, \overset{+}{\overline{K}}, \overset{+}{\overline{A}})$ where q is output, P* the present value of expected prices, w the wage, ! the price of intermediates, the price of fertilizers, $\overline{K}$ capital and $\overline{A}$ land. The response of the output to changes in these varieties is indicated by the signs above the variables. Between paths B and C, $\overline{K}$ and $\overline{A}$ do not change, the supply will depend on the relative changes of the other variables which is given below:

	1984			1985		
	Path B	Path C	% Change	Path B	Path C	% Change
P*	.973	.973	.0%	.981	.968	-1.33%
w	1.108	1.080	-2.5%	1.227	1.187	-3.3%
!	.989	.938	-5.2%	1.120	1.000	-10.7%
p_f	1.071	1.040	-2.9%	1.135	1.061	-6.5%

From the above figures it becomes clear that agricultural output will expand.

2.2.2 The Period 1986-89

Over the period 1986-89, the paths of the economy are similar when only the world prices of energy drop or when the drop is accompanied by a general slowdown in world prices. One difference between the two paths is the acceleration of the GDP deflator to 6.5%. This acceleration is brought about by the lower growth of investment during the 1982-85 period, leading to a slower expansion of production capacity. With comparable levels of aggregate demand, pressure on prices builds up and the GDP deflator accelerates.

With respect to employment, the rate of growth falls substantially due to slower expansion of agricultural output and employment. The more rapid increase of the output of agriculture during the period 1982-85 puts downward pressures on agricultural prices in subsequent years. While the expansion of the other sectors of the economy pushes input prices up. The outcome is a reduction in the present value of expected profits, lower growth of output and of employment.

While real income of farmers increases faster at 4.2%, real incomes of all other households slow down when all world prices decelerate. The higher growth of farmers' real income is due to the lower growth of their output. As they need less inputs, the financing requirement of their costs of production is reduced which leaves a larger net income. For all other households, the expansion of activity and employment is not enough to dominate the increases in CPI's with, as a result, a slow down in real incomes. In terms of variations in real incomes, the general deceleration of world prices, for most of the households, induce initially a higher and then a lower growth rate than in the situation where only energy prices drop.

2.3. Expansion of World Trade

When the world prices of energy drop, energy consumers benefit while energy producers suffer. Given that the former have a larger share of the world economy than the latter, world income expands more rapidly.[1/] The growth in world trade accelerates. The macroeconomic and distributional effects of the expansion in world trade, associated with the drop in energy prices, are taken up here. Table 1 indicates the growth implications while table 2 presents information on the macroeconomic resource gap. Tables 3 and 4 give employment and distribution indicators respectively.[2/]

The expansion of world trade means that additional world income is spent at home. Macroeconomic outcomes are as expected. The growth rate of GDP increases, the current account deficit improves. Tax collection relatively to public consumption increases and the public sector deficit narrows. The larger resources available to the private sector contribute on the one hand to more informal investment and on the other hand to the reduction of private borrowing from abroad. Because during the period 1982-85 production capacity has not yet expanded, greater aggregate demand puts pressure on prices and the GDP deflator accelerates. Real government consumption as a consequence decelerates.

The rate of growth of total employment does not however change. This stability conceals for the period 1982-85 both a slowdown in agricultural and an acceleration in non-agricultural employments. The acceleration follows the general expansion of the economy while the deceleration in agriculture is due to increased relative costs. Indeed farmers' expected prices adapt to the

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1/ This presumes no large transfers back to oil exporters.

2/ Comparisons are made here between panels C and D of tables 1, 2, 3 and 4.

expansion of the economy slower than the costs of their inputs. The reduced present value of expected profits leads to a slowdown in the growth of their production and employment. This is particularly apparent in the employment of casual workers.

Over-all the expansion of world trade tends to produce a slight acceleration in the growth of per-capita real incomes. Rubber farmers however experience a slowdown in the growth of their incomes because their output price is determined by the world price. When world trade expands, pulling Thai exports, it puts pressure on domestic costs, leads to a cut in the profitability of rubber production and hence a slowdown in the growth of rubber farmers' incomes.

From the drop in the world price of energy, to the general slowdown in world price and to the expansion in world trade, significant effects on income distribution are essentially due to the general deceleration in world prices. This happens because such a deceleration has two sides: (i) lower world inflation and (ii) a change in the relative prices faced by the Thai economy. When the domestic price level follows world prices, all nominally fixed magnitudes in the economy increase in real terms implying a change in relative prices. Such a change, jointly with a change in relative world price underlies the observed employment and income distribution effects. Between paths A and D, non-rubber farmers and casual workers experience the largest variations in their real incomes and would suffer moderately over the whole decade. Blue and white collar households appear to be the major beneficiaries of the changes while the three remaining households see a relatively stable growth in real incomes, though the distribution of this growth across time varies.

3. Adjustments in Domestic Prices of Energy

The previous section considered growth, macroeconomic employment and income distribution effects of a drop in the world prices of energy. When this change is considered on its own, the transfer implied from the rest of the world to the domestic economy is first captured by the government. Through the improvement in the public sector deficit, the resources available to the private sector increase, less borrowing from abroad is needed and more informal investment takes place. The implications on income distribution and employment are limited. When an over-all slowdown in world prices is associated with the drop in energy prices, the macroeconomic effects of the latter are dampened. Employment and income distribution are however affected more. If an expansion in world trade takes place simultaneously the growth and resource balance effects of the drop in energy prices, on its own, are again obtained. The employment and income distribution results of an over-all slow down of world prices are largely maintained.

Under the above scenarios, domestic prices of energy keep growing as in the reference path. The assumption is that authorities expect a surge in energy prices sometime in the future and desire to familiarize domestic users with high energy costs. A second kindred motivation would be to avoid disruptions in domestic behaviors if and when the surge in world price happen. For future reference let us call such a policy "conservative."

Authorities may have another point of view. One argumentation would point out that the world price of energy is its opportunity cost. Therefore if world prices are dropping, domestic prices, on efficiency grounds should follow. This is a "liberal" viewpoint where prices need reflect opportunity costs. A third view - we shall refer to it as "centrist" - would maintain domestic prices at their present level until world prices catch up and then

have them follow the trend in world prices. How do growth, resource balance, employment and income distribution effects of the conservative, liberal and centrist policies compare? This is taken up in the following. Table 5 presents the specific assumptions on energy prices used to reflect the three types of policies.

3.1. Growth and Resource Balance

A drop in the world prices of energy if passed to domestic users has two aspects: (i) a transfer from the world to the domestic economy and, (ii) a favorable supply shock on domestic non-oil producers. As we have seen the second aspect is not allowed for under the conservative policy. The liberal policy would allow the supply effect to take place immediately while the centrist one would distribute it through time.1/

Under the liberal policy, the wedge between domestic and world prices of energy vanishes. The govenment does not capture the transfer from the rest of the world, its deficit grows. A larger share of private savings has to be channelled to the public sector. The private sector suffers as the informal sector invests less and the formal sector borrows more abroad. The improvement in the current account deficit is substantially slowed down. On the other hand domestic users benefit from the drop in domestic prices, activity expands. The growth in both real private and public consumption accelerates significantly pulling imports into the economy. The increase in aggregate demand puts pressure on price; the GDP deflator accelerates. The economy loses its competitiveness, exports slow slightly while the growth in imports is accelerated. During the period 1986-89, all the benefits of the drop in domestic prices disappear. The economy adapts again to increased

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1/ Growth and resource balance results for the centrist, liberal and conservative policies are presented in Tables 6 and 7.

Table 5

Assumptions on the World and Domestic Prices of Energy

($ per barrel of oil[1/])

	1981	1982	1983	1984	1985	1986	1987	1988	1989
World Price and Liberal Policy	34	32 (-5.0)	29 (-10.0)	20 (-31.0)	20 (0.0)	21.8 (9.0)	24 (9.0)	26 (9.0)	28 (9.0)
Conservative Policy	34	32 (-5.0)	29 (-10.0)	29 (0.0)	32 (9.0)	34 (9.0)	38 (9.0)	41 (9.0)	45 (9.0)
Centrist Policy	34	32 (-5.0)	29 (-10.0)	29 (0.0	29 (0.0)	29 (0.0)	29 (0.0)	29 (0.0)	29 (0.0)

1/ Figures between brackets are growth rates.

domestic and world prices while it has less contributed to increasing its production capacity while oil prices were low.[1/] The economy decelerates.

If the centrist policy is adopted, the wedge between world and domestic prices is initially maintained and gradually reduced. During the period 1982-85, the growth and resource balance performances of the economy are similar to the ones obtained with the conservative policy. During the period 1986-89, while world prices of energy are growing, domestic prices are kept at their initial level. The transfer from abroad to the home economy is gradually reduced while domestic users are shielded from unfavorable developments in energy prices. Real growth of private and public consumption accelerates pulling imports in. Through the channel of the public sector deficit resources available to the private sector become less important. Informal sector investment slows down, and the formal sector remains a net borrower from abroad while it is able to become a net lender under the conservative policy.

At the levels of growth and the resource balance, the trade-offs involved between the liberal and centrist policies are twofold. On the one hand it is a choice between consumption and investment growth; on the other hand it is a choice between growth now and growth tomorrow. However, if one takes the period 1982-89 as a whole, the growth performance of the economy does not really change between the three policies considered. In terms of the resource balance and in particular the current account deficit, the conservative, liberal and centrist policies lead to different results. As a share of GDP, the current account deficit looks like the one obtained under

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1/ In SIAM2 and in the experiments reported here formal investment is fixed while informal investment vary with the availability of financial resources.

Table 6

Growth in Selected Aggregates when Domestic Energy Prices are Adjusted

	A		D		E		F	
	Reference Path		No adjustments in domestic prices		Fast adjustment in domestic prices		Slow adjustment in domestic price	
			Conservative		Liberal		Centrist	
	1982-85	1986-89	1982-85	1986-89	1982-85	1986-89	1982-85	1986-89
Constant Price Aggregates								
Private consumption	4.8	6.0	4.7	6.0	5.8	6.0	4.9	6.6
Public consumption	4.4	4.7	4.6	4.8	5.4	4.7	4.7	5.4
Investment	3.8	7.0	4.4	7.3	4.0	7.0	4.4	6.9
Public investment	3.4	4.5	3.4	4.5	3.4	4.5	3.4	4.5
Private investment	4.4	7.9	5.4	8.3	4.4	8.0	5.4	7.6
Exports GNFS	8.3	8.2	9.1	8.2	9.0	8.3	9.1	8.3
Imports GNFS	1.6	3.4	2.6	3.3	4.4	3.4	2.8	4.6
GDP at market prices	6.2	7.2	6.3	7.4	6.5	7.3	6.4	7.5
GDP deflator	3.9	6.6	3.1	6.4	3.4	6.7	3.1	6.7

Table 7
Macroeconomic Resource Balance when Domestic Energy Prices are Adjusted

	A			D			E			F		
	Reference Path			No adjustment In Domestic Prices Conservative			Fast Adjustment in Domestic Prices Liberal			Slow Adjustment in Domestic Prices Centrist		
	1984	1985	1989	1984	1985	1989	1984	1985	1989	1984	1985	1989
Public Sector												
Savings	.9	1.3	2.4	2.9	3.8	5.9	.1	.4	1.4	2.9	3.2	2.5
- Government	-.6	-.2	1.0	1.4	2.2	4.2	-1.0	-.7	.3	1.4	1.7	1.2
- State enterprises	1.5	1.5	1.4	1.5	1.6	1.7	1.1	1.1	1.1	1.5	1.5	1.3
Investment	7.5	7.1	6.1	7.5	7.2	6.1	7.2	6.9	5.8	7.5	7.2	5.8
- Government	3.7	3.4	2.8	3.7	3.4	2.9	3.5	3.3	2.7	3.7	3.4	2.7
- State enterprises	3.8	3.7	3.3	3.8	3.8	3.2	3.7	3.6	3.1	3.8	3.8	3.1
Public Sector Deficit	-6.6	-5.8	-3.7	-4.6	-3.4	-.2	-7.1	-6.5	-4.4	-4.6	-4.0	-3.3
- Net public borrowing from abroad	2.7	2.4	1.7	2.8	2.5	1.8	2.7	2.5	1.7	2.8	2.5	1.8
- Net public borrowing from domestic sources	3.9	3.4	2.0	1.8	.9	-1.6	4.4	4.0	2.7	1.8	1.5	1.5
Private Sector												
Savings	17.8	17.8	17.9	17.4	17.3	17.1	18.0	18.0	18.1	17.4	17.4	17.8
Less Net public borrowing from domestic sources	3.9	3.4	2.0	1.8	.9	-1.6	4.4	4.0	2.7	1.8	1.5	1.5
Domestic resources available to the private sector	13.9	14.4	15.9	15.6	16.4	18.7	13.6	14.0	15.4	15.6	15.9	16.3
Investment	15.1	15.1	14.9	15.4	15.7	15.6	14.6	14.7	14.4	15.4	15.5	14.6
Private sector deficit	-1.2	-.7	+1.0	+.2	+.7	+3.1	-1.0	-.7	+1.0	+.2	+.4	+1.7
Net private borrowing from abroad	1.2	.7	-1.0	-.2	-.7	-3.1	1.0	.7	-1.0	-.2	-.4	-1.7
Current Account Deficit	3.9	3.1	.7	2.6	1.8	-1.3	3.7	3.2	.7	2.6	2.1	.1
Net public borrowing from abroad	2.7	2.4	1.7	2.8	2.5	1.8	2.7	2.5	1.7	2.8	2.5	1.8
Net private borrowing from abroad	1.2	.7	-1.0	-.2	-.7	-3.1	1.0	.7	-1.0	-.2	-.4	-1.7

Table 8

Employment Growth When Domestic Prices of Energy are Adjusted

	A Reference Path		D Expansion of World Trade Conservative		E Fast Adjustment in Domestic Prices Liberal		F Slow Adjustment in Domestic Prices Centrist	
	1982-85	1986-89	1982-85	1986-89	1982-85	1986-89	1982-85	1986-89
Total Employment	1.3	2.7	1.8	1.7	1.6	1.9	1.7	1.7
Employment by sector of production								
- Agriculture	.9	2.4	1.7	.8	1.4	1.0	1.7	.6
- Industry	3.5	4.8	3.4	5.3	4.2	5.4	3.5	6.0
- Energy	8.5	14.6	8.4	15.1	9.0	15.1	8.5	15.5
- Construction	.0	3.6	.1	3.9	-1.3	3.6	-.1	2.8
- Services	1.9	2.6	1.5	3.5	1.4	3.4	1.5	3.4
Employment by Socio-Economic Category								
- Blue collars	1.2	5.4	.9	5.3	1.7	5.5	1.1	6.0
- White collars	.8	3.7	.7	3.6	1.1	3.7	.8	4.0
- Casual workers	-5.5	-2.7	-4.0	-10.0	-5.2	-10.4	-4.2	-11.7
- Own-account:								
Agriculture	2.3	2.5	2.8	2.1	2.5	2.3	2.8	2.0
Non-agriculture	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Wages								
- Blue collars	8.8	7.5	8.8	7.5	8.8	7.5	8.8	7.5
- White collars	8.5	7.5	8.5	7.5	8.5	7.5	8.5	7.5
- Informal labor	5.4	11.2	5.1	9.8	6.4	10.1	5.3	10.8

the reference path. The drop in the world prices of energy does not make any difference. In the centrist policy, the current account deficit almost vanishes by 1989, while it becomes a surplus under the conservative policy. If one attaches some weight to the smoothness of adjustments to the external environment, to the rapid decelaration in the increase in foreign indebtedness and to the maintenance of growth, from the macroeconomic point of view the centrist policy would seem superior to the two others.

3.2. Employment and Income Distribution

Compare now the employment implications of the centrist and liberal policies during the 1982-85 period. On main result emerges: formal employment benefits, informal employment suffers. Indeed the expansion of the economy and the cut in the real formal wages produce a higher level of formal employment in the liberal policy. However, that same expansion drives up the real informal wage cutting in informal employment. This result is accentuated by the relatively smaller informal investment and capacity expansion when energy prices are dropped. The increased financing needs of the public sector leave less resources for informal investment hence lower employment in construction and in the informal sectors in general. During the 1986-89 period, the centrist policy benefits more to the informal than to the formal sector. Indeed over this latter period, domestic energy prices, under the liberal policy, increase with world prices whereas they remain constant under the centrist policy. Thus through the same channels as for the 1982-85, but in opposite direction, formal employment benefits less than the informal.

Table 9 presents results in terms of trends and distribution of real incomes per capita of the seven categories of households. Consistent with the macroeconomic results real incomes per capita, during the period 1982-85, increase faster under the liberal than under the centrist policies. On the

Table 9
Income Distribution when the Domestic Prices of Energy are Adjusted

		E Fast Adjustment in Domestic Prices Liberal			F Slow Adjustment in Domestic Prices Centrist		
Real Incomes Per Capita		1982-85		1986-89	1982-85		1986-89
- Farmers: crops		2.9		3.3	1.8		4.7
- Farmers: rubber		1.5		3.6	1.5		4.0
- Own Account:							
Other agriculture		17.0		12.0	13.7		13.7
Non-agriculture		3.6		3.2	3.2		3.5
- Blue collars		4.8		3.2	4.8		3.3
- White collars		4.7		3.2	4.4		3.4
- Casual workers		3.3		2.6	2.9		2.7
Distribution of Real Income Per Capita *	1981	1984	1985	1989	1984	1985	1989
- Farmers: crops	1.0	1.0	1.0	1.0	1.0	1.0	1.0
- Farmers: rubber	1.13	1.12	1.07	1.08	1.17	1.12	1.09
- Own Account:							
Other agriculture	.88	1.30	1.46	2.01	1.22	1.37	1.91
Non-agriculture	1.58	1.67	1.63	1.62	1.72	1.68	1.60
- Blue collars	1.95	2.16	2.10	2.09	2.27	2.20	2.08
- White collars	3.80	4.25	4.14	4.12	4.42	4.29	4.08
- Casual workers	.94	.99	.95	.93	1.02	.98	.91

* The ratio of the real per capita income of each household to the real per capita income of non-rubber farmers.

latter period, 1986-89, the opposite happens. Looking at the gap between the highest and lowest real incomes per capita, in 1984 and 1985 the years of the drop in prices of energy, the centrist policy appears to be less equitable than the liberal policy. The main reason for that is the lower growth rate of the real per capita income of non-rubber farmers under the centrist policy. Indeed under this latter policy, during the two years, non-rubber farmers output expands more than under the liberal policy. The need to finance this output leaves less real income to farmers. Thus while non-rubber farmers income grows substantially more slowly, the rates of growth of the other incomes do not vary as much[1/] leading to increased differences in real per-capita income levels, under the centrist policy. This result would argue that dropping the domestic prices of energy with the world prices is more equitable. However as table 9 shows, for the years 1984 and 1985, the differences are not so large. Furthermore looking at the outcome for 1989, the centrist policy produces a more equitable distribution. Again, this result is obtained for the same reason: a substantial difference in the rate of growth of non-rubber farmers incomes. However, now the difference produces more equity under the centrist policy. Ultimately, the distribution of real per capita income does not vary substantially between the two policies, in particular towards the end of the eighties, when a few years after the drop in prices have elapsed.

1/ Except for own-account other-agriculture households who are mainly involved in fisheries where the variation in the domestic price of energy has a direct and substantial impact.

4. Conclusions

At the end of the day, having gone through the meanders of the general equilibrium effects of a drop in the world prices of energy, what conclusions to draw?

(1) The macroeconomic growth performance of the economy seems insensitive to the policy chosen when one looks over a 10-year horizon.1/

(2) However, the distribution of growth differs across time and across components of GDP. Passing on the drop in world prices to domestic users means more growth now and growth of consumption relative to investment. It also implies slower growth tomorrow as the economy needs to absorb future increases in energy prices. If the fall in world prices is not passed on to domestic users, then the economy operates under relatively higher costs of energy now and relatively lower costs of energy tomorrow, and its growth gradually accelerates. The distribution of growth tilts, more toward investment initially, and more towards consumption later.

(3) From the point of view of the macroeconomic resource balance passing on the drop in world prices to domestic users has significant effects. If domestic prices drop with world prices, the current account deficit remains at the same levels as if energy prices had not fallen at all.

(4) If, on the contrary, domestic prices remain at their current level, the improvement in the current account deficit is faster. It almost vanishes by the end of the eighties.

(5) Aggregate employment is not significantly affected by the alternative policies on the domestic prices of energy. However, relative variations in the growth of formal and informal employment can be observed.

1/ One has to note here that the results are obtained under an assumption of a limited response of investment demand.

(6) Initially passing on world prices to domestic users helps the growth of formal labor more than not passing them on. Informal labor absorption improves more however if domestic energy prices are kept stable. Later the opposite result is obtained. Over the long period employment growth, whether formal or informal, does not vary much.

(7) The distribution of real per-capita incomes across households does not vary much between the liberal and centrist policies. Initially, at the time of the price drops, the two policies produce slightly different result depending on the behavior of farmers incomes. When time have elapsed, the differences, in terms of distribution, between the two policies almost vanish.

(8) A final point worth noting when discussing energy prices is that on their own, their direct effects are not substantial. The indirect effects they generate, notably the over-all changes in world prices and the expansion of world trade, have as much, if not more, repercussions than only the world prices of energy. In the case of Thailand, this needs to be associated with the implications on the performance of agriculture. Indeed agriculture remains a major driving force of the Thai economy and determines to a large extent its macroeconomic path.

No policy has a clear advantage on all accounts. However, if one is concerned with accumulation of foreign debt, the policy of fully and immediately adjusting domestic prices to world prices is less appropriate. Maintaining domestic prices helps to close the current account deficit more rapidly. It furthermore, allows a smoother adjustment path with accelerating growth, and may also temporarily shield domestic users from eventual future increases in world prices. Discriminating between the two policies on employment and income distribution grounds is difficult. The choice is between being better-off now or tomorrow, which depends on expectations and rates of time preference.

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Chapter 6: Impact of the Price Support Programme for Rice.

1. Introduction: The Purpose of the Price Support Programme

The production of rice is the most important economic activity in the Thai economy as approximately 55% of the working population are engaged in activities related to rice production or the rice trade.[1/] Rice farmers are also one of the poorest segments of agricultural households particularly those who cultivate rice under the rain fed condition. As a result it has been the policy of the Thai government for many years to raise the domestic price of paddy and farmers' income through the price support programme. The scheme consists of support buying of rice in the domestic market as well as intervention at the export level through the adjustment of various kinds of export taxes. In the past, the government has shown a clear preference towards the use of the support buying programme rather than the adjustment of the export taxes particularly during the years 1980-1982. As a result the costs incurred by the government from the support buying programme of the recent years have risen to about 5,000 million baht (3% of government annual budget) thereby worsening the level of public sector's savings. The enormous financial loss of the programme has led the government to scale down the loss during the 1982/83 season by lowering the target price for rice - the first time that this has been done during the past six years. Moreover, export taxes on rice is kept unchanged, mainly to prevent the fall in government revenue and to repay the debt incurrred by the price support programme.

1/ Labour Force Survey, National Statistical Office.

The purpose of this paper is to examine the impact and effectiveness of the price support measures and whether the government should have acted differently during the early part of 1983. The use of appropriate policy instruments could save considerable revenues for the government as well as providing benefits to rice farmers. This paper is divided into three parts. The first part presents a brief background on the government's price support programme. In the second section the SIAM2 computable general equilibrium model is used to analyze the effect of two schemes which are normally implemented as a part of the price support programme: export tax reduction and support buying scheme. Finally, the last section presents the conclusion and policy recommendations.

2. Background

The government price support or guarantee programme has been implemented nearly every year since 1966. The scheme consists of two components. The first component involves the adjustment of various forms of export taxes and controls while the second part consists of the purchase of either rice or paddy by the government during the harvesting season. Prior to 1975 the scheme was only conducted on a limited scale, but from the 1975/76 season onwards the government has been intervening heavily in the rice market particularly during the past 3 years.

There are three types of taxes on rice export: export duty levied by the Ministry of Finance, export premium collected by the Ministry of Commerce on behalf of the Farmers' Aid Fund, and the rice reserve requirement levied by the Ministry of Commerce. The current level of export duty is 5% and the rate has rarely changed. Export premium, on the other hand, often fluctuates as the government has relied on the premium as a policy instrument to stabilize the domestic price of rice. Since 1975 income from the rice premium accrues

to the Farmers' Aid Fund which is normally the ultimate source of financing of the support buying programmes for various types of agricultural commodities. The rice reserve requirement, on the other hand, was established with an aim of providing cheap rice for poor urban consumers and to prevent the shortage of rice in the domestic market as a result of excessive export. An exporter was required to sell rice to the government at a price which was below the market price in proportion to the amount of export. For example, the exporter may have to sell half a ton for every one ton exported. Thus the reserve requirement is simply a form of export tax. In October 1981 this method of collection of the reserve requirement was abolished and the government simply levied a specific tax on rice export in place of the reserve requirment. In 1982 falling world price of rice and the failure of the government price support programme forced the government to substantially lower the rice premium and the reserve requirement. The latter was finally reduced to zero in May 1982. As a result, total export taxes on rice declined sharply in 1982. For instance, the average level of all types of export taxes on 5% rice in 1982 was 931 baht/ton (or 16.1%) compared with 2964 baht/ton (or 39.6%) in 1981.

Apart from these taxes at the export level, the government also imposes various forms of controls which have often been used as a part of the price support programme. Rice exporters normally have to satisfy a number of conditions, for instance they must be a member of the Board of Trade. After having satisfied these conditions they would be allocated a quota based on past performance and they must sell the rice at a price not below the minimum export price set by the Rice Subcommittee of the Board of Trade in order to prevent excessive competition among exporters. An outright export ban has rarely been used. In a move to liberalize the export trade and raise the

domestic price of rice the government, on 23 December 1980, lifted the quota system and later abolished the minimum price requirement at the end of 1981. The export trade in rice is now quite competitive.

The support buying programme, on the other hand, normally consists of the purchase of rice or paddy by the government, and the accumulation of stocks by rice exporters. During the past 3 years the government mainly purchased rice from rice mills at the government's target price hoping that the creation of the artificial demand for rice would in turn raise the price of paddy. Direct buying of paddy has only been conducted on a limited scale. Rice purchased by the government would be stored and then either exported or sold to domestic consumers. Since the government has no storage facility the purchased rice is usually stored at rice mills until the government requires it. This has allowed the mills to substitute the government stock for their own working stocks thereby reducing the effectiveness of the programme despite the fact that the purchase of rice by the government has amounted to about 10% of total paddy production. The loss in the programme has been large: the accummulated loss on the support buying programmes of the past three years (1980/81, 1981/82, 1982/83) alone has amounted to 5,000 million baht. The ultimate source of finance is mainly the Farmers' Aid Fund.

The enormous loss (about 2% of government annual budget) made by the government and the continuous fall in the price of rice in the world market have forced the government to lower the target price for the first time in six years, and to limit the scale of the support buying programme during the 1982/83 season. Moreover, it refused to lower the rate of export duty and premium, mainly to maintain the government revenue from these sources and to repay the debt incurred by the programme.

3. Impact of the Price Support Programme

Since the price support programme normally consists of two components: export tax reduction and support buying programme, in this section we shall examine two measures (i) the removal of the 5% rice export duty and (ii) the support buying of rice in order to accumulate a stock of rice amounting to 5000 million baht. The removal of the export duty is assumed to take place at the beginning of the year which coincides with the harvesting season and it is assumed that the government allows its budget deficit to widen without cutting its expenditure. The increase in the deficit would be financed by domestic borrowing. The accumulation of stocks of 5000 million baht of rice represents a purchase of around 900,000 tons of rice or 8% of total production. It is assumed that the stocks are held indefinitely, i.e., the government maintains this amount of stock throughout the period under consideration, and that the purchase is only made in 1983. No net purchase is made in subsequent years. Further, it is assumed that the government has its own storage facility, so that this amount of rice is totally withdrawn from the market. It should be noted that this scheme is slightly different from the current scheme implemented by the government. The government's scheme only involves a temporary withdrawal of rice from the market. Rice purchased by the government is normally sold in the market later in the year which makes it less effective than our scheme.

The impact of the two schemes partly depends on the influence of Thailand in the world rice market. As one of the biggest rice exporters in the world, it is likely that Thailand is not faced with a perfectly elastic world demand for rice. Estimates of the price elasticity of world demand greatly varies among studies and no conclusive answer has been found. In this paper we will, therefore, analyze the impact of the schemes under three

assumptions on the price elasticity of the world demand for Thai rice: 1.0, 3.0 and 10.0.

3.1. Removal of the Export Duty

Removal of the export duty on rice at the beginning of 1983 represents a reduction in the tax rate by 5% (of the value of exports). As the export trade is competitive due to the liberalization programme carried out by the government over the previous two years, the immediate effect is to lower the export price f.o.b. This would lead to a higher demand for Thai rice by the rest of the world and a larger amount would be exported. Since the supply of rice in the short run is predetermined by the decision to cultivate rice, the weather condition and the use of relevant inputs during the previous year, the amount of rice available for domestic consumption would decline thereby pushing up the domestic price of rice. However, rice farmers would be earning a higher amount of revenue which would raise their consumption including the consumption of rice. Thus, the substitution effect arising from rice as a result of higher price would be partly compensated by the income effect as a result of higher farmers' income. A new equilibrium would be established at a point where the quantity of rice export is higher than previously with a lower export price (f.o.b.). Further, the domestic price would rise and the difference between the domestic price and the world price would be reduced.

The policy has a clear distributional effect. Crop farmers would benefit from the higher price of rice while other types of households would suffer, particularly rubber farmers and casual workers because they consume more rice (per household) than white collar or blue collar or non-agricultural own account workers.

The effect of the policy on the overall economic growth rate is less obvious. On the one hand, total household consumption is likely to rise as crop farmers have a higher marginal propensity to consume than most non-agricultural households which suffer as a result of the removal of the tax. On the other hand, the increase in the government budget deficit would lead to more borrowing by the government in the domestic market. This would tend to crowd out the private sector both formal and informal from the use of domestic savings. However, the formal sector firms are able to borrow from abroad to satisfy their investment needs and thus the effect of the higher budget deficit would entirely fall on the informal sector. As a result total investment may decline thereby slowing down the economy.

The higher domestic price of rice is likely to lead to higher prices of other commodities. The short run gain in farmers' income would thus be partly reduced by the higher price level including the prices of farmers' inputs which would in turn slow down farmers' production response to the higher price of rice. Moreover, the higher cost of converting paddy into rice would tend to depress the price of paddy received by farmers (for any given level of rice price). Nevertheless, the long run effect on rice production should still be positive.

The success of the scheme when viewed from the income distribution objective largely lies in the nature of the world rice market. On one extreme, if the world demand for Thai rice is perfectly elastic then the tax reduction would be fully translated into a higher domestic price while the export price would be left unchanged. Farmers' income from rice would rise by about 5%. On the other extreme, if the world demand for Thai rice is very inelastic then the tax reduction would largely lead to a decline in the export price while the domestic price would barely change. Positive distributional

effect would be small and could even be negative as the higher budget deficit experienced by the government causes a crowding out of the informal sector.

In this paper the analysis is carried out using the SIAM2 computable general equilibrium model under the assumptions of three different values of the price elasticity of the world demand for Thai rice: 1.0, 3.0 and 10.0.

Table 1

Effect of Export Tax Reduction of 5% on the Demand for Rice
(% change)

	Price elasticity of the world demand for rice		
	1.0	3.0	10.0
Real domestic utilization and stock accumulation	-0.36	-0.46	-0.51
Quantity of export	1.50	1.94	2.17
Domestic price	3.25	4.15	4.61
Export price f.o.b.	-1.48	-0.64	-0.21

In the case that the price elasticity of the world demand for Thai rice, which from now on will be referred to as η, is 3.0, the removal of the 5% export duty on rice would lead to a rise in the domestic price of 4.2% in 1983 while a 0.6% fall in the export price would be registered as the quantity of rice exports rises by 1.9%. This is brought about by a decline in the domestic utilization of rice as intermediate inputs into other industries and as consumer goods because firms would try to use rice and paddy more efficiently and consumers would tend to switch away from rice. The decline in the domestic utilization of rice is found to be 0.46% which is relatively small because crop farmers, who are the beneficiary of the policy, have a much

higher marginal propensity to consume rice than other types of households. If the price elasticity of the world demand for rice (η) rises to 10.0 the effect is similar. The removal of the 5% tax leads to a rise in the domestic price of 4.6% while the export price declines by 0.2%. In the case that $\eta = 1.0$ the picture is also similar. The removal of the export tax causes the domestic price to rise by 3.3% while the export price declines by 1.5%. At the same time the quantity of rice export increases by 1.5%.

The higher price of rice not only raises farmers' income but also pushes up the general price level. Therefore the initial rise in farmers income is partly reduced by the higher price level. In the case that $\eta = 3.0$, the consumer price index during the first year is found to rise by 0.4 - 0.96%, depending on the type of household. White collar households which normally consume relatively less rice are faced with a 0.42% rise in the CPI while casual workers and rubber farmers would see their CPI rising by 0.8%. Crop farmers, on the other hand, would face a higher price index of 0.96% which would have a significant effect in reducing the gain from the higher price of rice. If $\eta = 10.0$ then the CPI would rise by 0.47 - 1.07% and if $\eta = 1.0$ the rise in the CPI would be less at around 0.3 - 0.75%.

The distributional effect could be measured by the change in real income of each type of households. This is shown in Table 2. It is clear that crop farmers' income would rise by 1.44 - 2.05%, while the incomes of other types of households would decline. Casual workers would suffer most as their real income would decline by 0.64 - 0.89%, depending on the value of η, followed by rubber farmers, non-agriculture own account households, blue collar and white collar households, respectively. Fishermen, hunters and foresters, surprisingly, would only see their income eroded by 0.05 - 0.06%. This is because crop farmers have a rather high marginal propensity to consume

Table 2

Effect of Export Tax Reduction of 5% on Households Income
(% change)

Types of households	Real income			Consumer price index		
	$\eta = 1$	$\eta = 3$	$\eta = 10$	$\eta = 1$	$\eta = 3$	$\eta = 10$
Crop farmers	1.44	1.85	2.05	0.75	0.96	1.07
Rubber farmers	-0.59	-0.78	-0.86	0.62	0.80	0.88
Fishermen, hunters and foresters	-0.05	-0.06	-0.06	0.57	0.73	0.81
Non-agriculture own account	-0.29	-0.37	-0.40	0.44	0.56	0.62
Blue collar	-0.28	-0.35	-0.39	0.41	0.53	0.59
White collar	-0.21	-0.26	-0.29	0.32	0.42	0.47
Casual workers	-0.64	-0.81	-0.89	0.63	0.80	0.89

fish and as the production of fish is faced with problemef declining fishing area in the Gulf of Thailand, 1/ the price of fish would rise. This would substantially cushion the impact of the higher price of rice. It should be noted that the rise in crop farmers' income is less than the rise in the price of rice because crop farmers also include non-rice farmers and partly derive their income from off farm activities.

Since crop farmers have a higher marginal propensity to spend than non-agricultural households, total private consumption in the economy rises by 0.21 - 0.30% in 1983 which in turn results in a higher level of production in the economy. This would further push up the domestic price level in addition

1/ This is taken into account in the model by specifying a rather high marginal cost curve for fishing, livestock and forestry.

to the upward shift in the marginal cost curve as a result of the higher price of rice in the domestic market. A consequence of this would be a lower export demand for non-rice commodities, particularly industrial goods and non-factor services. Thus the quantity of non-factor services export would fall by 0.12 to 0.18% while the rise in the total quantity of good export (including rice) would only amount to 0.16 - 0.22%.

Investment, on the other hand, could either rise or fall depending on the value of η. In the case that η = 10 the removal of the export duty leads to a large increase in the domestic price of rice and hence relatively large GDP growth rate. This growth is more than sufficient to generate enough private savings and increase in tax revenue to maintain the level of investment. Table 3 shows that the loss of export tax revenue of 1012 m. baht is partly compensated by other taxes and the final increase in the level of budget deficit is only 591 m. baht. Further, the increase in private savings more than compensates for the bigger budget deficit, and there is enough savings left to boost real private investment in the informal sector by 0.36%. However, in the case that η = 1.0 the increase in the economic activity is insufficient to generate enough savings and taxes to maintain the level of investment. The result is a decline in the informal sector investment in real terms by 0.06%.

The outlook for the current account deficit is similar to that of the savings - investment situation. When η = 1 the reduction in the export duty leaves the value of rice export unchanged while the exports of other goods decline because the domestic production cost is higher as a result of the rise in the price of rice. Therefore, the value of export declines while the value of import rises in response to increased economic activity and substitution away from the more expensive domestic goods. The final result is a small

Table 3

Effect of Export Tax Reduction of 5% on Selected Economic Indicators
(% change)

	Price elasticity of world demand for rice		
	1.0	3.0	10.0
Private consumption (%)	0.21	0.27	0.30
Investment (%)	-0.01	0.03	0.05
- Informal sector investment	-0.06	0.22	0.36
Exports (%)	0.16	0.20	0.22
- Goods		0.24	0.30
0.33			
- Non-factor services	-0.12	-0.16	-0.18
GDP (%)	0.16	0.21	0.24
Balance of Payments			
- Current account (in baht)	-50	176	288
- CA/GDP (%)	-0.02	0.06	0.07
Government Finance			
- Revenue	-767	-654	-591
- Export taxes	-1050	-1029	-1012
- Budget deficit	-767	-654	-591

deterioration of the current account deficit. But if $\eta = 10$ then the current account deficit improves by 288 m baht.

The long run effect of the policy should be less than the effect incurred in the first year and largely depends on farmers' response to the rise in the price of rice. It is assumed that farmers do respond to price changes but with a time lag. Thus the rise in the price of rice would eventually lead to an increase in the production of rice which would come about as a result of agricultural intensification (eg. farmers are able to use more fertilizers) as well as a substitution away from other crops. Since the demand for Thai rice is less than perfectly elastic, the increase in output

and hence export would inevitably lead to a fall in the price of rice thereby reducing benefits accruing to farmers. The smaller the η the larger would be the fall in the export price of rice. The long run effect of the policy on the level of economic activity would, therefore, be less than in the short run.

In the case that $\eta = 3.0$, the removal of the export duty at the beginning of 1983 would raise the production of rice in 1989 by 0.93% compared with the reference path, while total agriculture production as a whole would be 0.53% higher than otherwise. The higher production of rice has a negative effect on both the domestic price and the export price. In 1989, the latter is found to be 1.21% lower than in the referece path compared with the corresponding figure of 0.64% for the first year. Farmers income in real terms is still higher than in the reference case but the gain is lower than in the first year, while white collar and blue collar workers are still worse off. However, casual workers who are severely affected during the first year are better off as the higher agriculture production leads to a higher demand for casual workers and reduces migration of agricultural own account workers into the non-agriculture sector. This effectively raises the wage rate of casual workers. As a result, in 1989, the real income of casual workers is actually 0.22% higher than in the reference path.

The overall effect on the level of GDP is positive but small. The removal of the export duty in 1983 is found to raise the level of real GDP in 1989 by .06% compared with the reference path. However, the higher GDP is mainly the result of higher agriculture production which is labor intensive. So total employment in the economy rises by 0.25% or 68,000 persons.

In the case that $\eta = 1.0$, production response to the higher price of rice is also observed. However, the higher levels of production and export

lead to a lower export price which in turn lowers the domestic price. In 1989, the export price and the domestic price are found to be 5.1% and 0.7% lower than in the reference path respectively. Farmers are thus barely better off as their real income is only 0.27% higher than in the reference path while other types of households also benefit from the policy. This implies that if the government really believes that η is small then the whole agriculture and trade policy has to be reformulated as the promotion of rice export would no longer be in the benefit of Thailand. Instead, the government should control the level of rice production and encourage farmers to switch to other crops.

3.2. Support Buying Programme for Rice

In this scheme it is assumed that the government accumulates a stock of rice amounting to 5000 m baht by purchasing from the domestic market during the harvesting season. The stock is stored in government warehouses and is kept at this level indefinitely. By purchasing rice the government would run a higher budget deficit which would be financed by borrowing from domestic sources.

Table 4
Effect of Support Buying Programme on the Demand for Rice
(% change)

	Price elasticity of the world demand for rice		
	1.0	3.0	10.0
Real domestic utilization and stock accumulation	3.02	4.24	4.98
Quantity of export	-12.62	-18.02	-21.14
Domestic price	14.91	7.07	2.52
Export price f.o.b.	14.44	6.84	2.44

Table 5
Effect of Support Buying Programme on Households Income
(% change)

Types of	Real Income			Consumer Price Index		
	$\eta = 1$	$\eta = 3$	$\eta = 10$	$\eta = 1$	$\eta = 3$	$\eta = 10$
Crop farmers	6.74	3.12	1.05	3.39	1.59	0.52
Rubber farmers	-2.82	-1.29	-0.41	2.97	1.34	0.42
Fishermen, hunters, and foresters	-0.07	-0.14	-0.15	2.68	1.22	0.38
Non-agriculture own account	-1.27	-0.61	-0.22	2.09	0.93	0.28
Blue collar	-1.28	-0.66	-0.29	1.96	0.87	0.26
White collar	-0.95	-0.47	-0.20	1.56	0.68	0.19
Casual worker	-2.87	-1.36	-0.48	2.99	1.35	0.42

Table 6
Effect of Supporting Buying Programme on Selected Economic Indicators
(% change)

	Price elasticity of world demand for rice		
	1.0	3.0	10.0
Private consumption (%)	1.02	0.44	0.12
Investment (%)	-0.06	-0.44	-0.65
- Informal sector investment	-0.45	-3.07	-4.55
Exports (%)	-1.72	-2.22	-2.54
- Goods		-2.01	-2.74
-3.26			
- Non factor services	-0.59	-0.24	-0.04
GDP (%)	0.72	0.26	0.00
Balance of Payments			
- Current account (m. baht)	-369	-2462	-3629
- CA/GDP (%)	-0.09	-0.22	-0.41
Government Finance			
- Revenue	1118	71	-504
- Export taxes	0	-139	-216
- Budget deficit	-3882	-4929	-5504

The scheme essentially withdraws 5000 m baht worth of rice from the market and thus the success of the scheme largely depends on the nature of the world rice market. To the extent that the price elasticity of the world demand for Thai rice (η) is small the accumulation of stocks would have a large effect on the price of rice. On the other hand, if the world demand for Thai rice is perfectly elastic then the withdrawal of rice from the market would have absolutely no effect on the price of rice. Thus in the case that $\eta = 1$ the programme would reduce the quantity of rice export in 1983 by 12.6% thereby raising the export price and the domestic price by 14.4% and 14.9% respectively. However, if $\eta = 10$, the effect on prices would be smaller: the export price and the domestic price would both rise by about 2.4 - 2.5% while the quantity of export would decline by 21%. The rise in the domestic price of rice would in turn affect the prices of other commodities and household incomes in the same way as for the reduction in the export tax as already explained. If $\eta = 1$ then the domestic CPI of various households would rise by 1.56% - 3.39%. Real income, on the other hand, would rise by 0.7% for crop farmer households while other households would suffer a loss in income. Fishermen, hunters and foresters would suffer least as crop farmers have a high marginal propensity to consume fish, while the casual workers and rubber farmers would suffer most with real income falling by 2.8 - 2.9%.

An essential difference between the accumulation of stock and the reduction of export tax is that the former achieves a higher price of rice by withholding the supply of rice from the world market. Thus exports would drop and the current account deficit would widen unless η is sufficiently low. In the case that $\eta = 1$, the value of rice export would remain unchanged but the higher domestic inflation as a result of the higher price of rice would slow down the export of other commodities in real terms. As a result the quantity

of export drops by 2.0% but the value of exports remains approximately unaltered because of the higher export prices of rice and other goods. The current account, therefore, deteriorates by only 369 m baht. In the case that $\eta = 10$, the accumulation of the rice stock would have little effect on the world price of rice which would rise by 2.4%. The value of export would, thus, decline significantly thereby widening the current account deficit by 3629 m baht.

As for the reduction in the export tax, the effect on GDP is positively correlated with the price of rice. Thus, if $\eta = 1$ the scheme would raise the GDP growth rate in 1983 by 0.72% which is higher than in the other two cases. The higher level of economic activity would in turn raise the amount of government revenue thereby cushioning the wider budget deficit. If $\eta = 1$ then the government revenue would rise by 1118 m baht and as a result the government budget deficit would only rise by 3882 m baht. On the other hand, if $\eta = 10$ the effect of the scheme on the overall economic activity is negligible which results in a fall in the government revenue because crop farmers who benefit from the scheme pay very little income taxes while income taxes paid by white collar, blue collar and casual workers are significantly reduced. So in this case the government budget deficit widens to 5504 m baht. The deficit is financed by domestic borrowing which inevitably leads to a fall in the informal sector investment.

The long run effect of the scheme largely depends on the production response to prices. If there are no production responses then the scheme would essentially have a once and for all effect, i.e., the situation in subsequent years would be the same as in the case where the scheme was not carried out in 1983. However, if the production of rice responds to prices, the situation could be different particularly when η is small. In the case

that $\eta = 1$ the scheme has such a large effect on the price of rice in 1983 that it encourages farmers to produce more rice which would later push down the export price. In fact, in 1987 the supply of rice would be about 5.73% higher than otherwise and this would push down the world price by 15.6%. So farmers would be the losers this time. On the other hand, if η is larger, say 10, the effect of the scheme on the price of rice would not be sufficiently large to create a significant rise in the supply of rice in the long run. In this case the situation would resemble the one which would have occurred if the scheme had not been carried out in 1983.

3.3 Comparison of the Two Schemes

Direct comparison of the two schemes is not appropriate because the amounts of financing involved are different. The export tax reduction would cost the government about 1000 m baht compared with 5000 m baht for the support buying programme (before changes in other taxes are taken into account). Since the main objective of the government is to raise the price of rice,a convenient index for hte effectiveness of the schemes is the change in domestic price of rice for a given amount of financial loss incurred by the government. The financial loss is defined as the net increase in the government deficit as a result of a scheme, i.e., the effect of the scheme on other sources of government revenue is taken into account.

The table below shows the percentage change in the price of rice during the first year for a net financial loss of 1,000 m. baht.

Effectiveness of the Two Schemes: Change in Price of Rice for a Net Financial Loss of 1,000 m.baht

%	$\eta = 1$	$\eta = 3.0$	$\eta = 10.0$
Reduction of Export taxes	4.24	6.35	7.80
Support Buying	3.84	1.43	0.46

It is clear that the change in the price of rice is larger when the export tax is reduced than when the support buying programme is implemented for all cases of η . Moreover, the export tax reduction does not involve a deficit on the current account as in the support buying programme which operates through the withholding of rice from the world market. It can safely be concluded that the reduction in export taxes is a more efficient instrument in raising the domestic price of rice than the support buying scheme.

4. Conclusion and Recommendation

Our analysis shows that the reduction of the export tax is an effective way of raising the domestic price of rice even if the world demand for Thai rice is not very elastic. The rise in the domestic price of rice would in turn improve farmers' income but would depress the incomes of other types of households particularly casual workers and rubber farmers. As farmers have a higher marginal propensity to spend than other non-agricultural households, the effect of the policy on the overall economic activity is positive. On the other hand, the support buying programme operates through the withdrawal of rice from the market thereby inducing higher price. The rise would be large if the price elasticity of world demand is small. However, it is found that this scheme is less effective than the reduction in the export duty given the same amount of financing in all three cases of η. It should be noted that this scheme is slightly different from the government's support buying programme which involves the purchase of rice by the government during the harvesting season under the belief that the domestic price of rice is abnormally low during this period. Rice purchased by the scheme would then be sold during the later part of the year. Given the competitive nature of the rice trade, including the export trade, this type of scheme is unlikely to have any effect on the price of rice, in particular if

the government simply leaves the purchased rice at rice mills which normally hold stocks of rice anyway. The scheme considered in this paper is clearly more efective than the actual scheme implemented by the government. Nevertheless, the reduction in the export duty of rice is found to be a more effective way of raising the domestic price than our support buying programme.

At the beginning of 1983 the government was reluctant to reduce the export premium or export duty. But if it had removed the export duty altogether the domestic price of rice would have risen 3 - 4.6% or about 180 - 276 baht/ton. The price of paddy would roughly rise by the same amount representing an increase of 6 - 9%.1/

Since farmers are responsive to prices, the higher price of rice has a positive effect on the level of production but the time lag could be long. It is found that the removal of the export duty would raise the level of agriculture production by about 0.53% which would in turn create more jobs (68,000 jobs more than in the reference path). However, if η is small, the higher level of rice production would not benefit the economy or farmers as it would lower the export price and wipe out the positive effect of higher production. In this case, the entire agriculture policy would need to be reformulated.

Our recommendations are as follows:

(i) The government should use the export tax as the instrument to regulate the domestic price of rice.

(ii) The support buying programme should be discontinued as the reduction of export duty seems to be a more effective way of raising the domestic price of rice even in the case where $\eta = 1.0$.

1/ Price of paddy is around 3000 baht/ton.

(iii) Whether the export tax should be reduced in order to improve the distribution of income depends on the nature of the world rice market. Unless the world demand for Thai rice is rather price inelastic the reduction on the export duty would have a positive effect on both the distribution of income and the level of economic activity. However, if η is small then a reduction in the export duty would not be an appropriate action, and in this case the entire agriculture policy would need to be rethought. Production control would be a more appropriate policy.

(iv) Finally, as the price of rice has a significant effect on wide ranging issues particularly income distribution, the formulation of the rice pricing policy should be carried under an economy-wide framework. Further, the SIAM2 model has shown that a computable general equlibrium, model (CGE) is one of the best instruments presently available for this purpose.

Conclusions

The SIAM framework is now in use at the National Economic and Social Development Board in Bangkok and in the World Bank. It is providing insights into policy issues with medium run implications and contributing to the gathering of information for decision making. SIAM2 proves that if built collaboratively with its users, a general equilibrium framework is a worthwhile instrument for economic management. It needs however to be specific to the economy under consideration and to be focussing on a limited set of well defined issues. General equilibirum frameworks have come a long way from the sometimes esoteric expositions found in economic theory. Although they are now implementable, their implementations suffer from a number of drawbacks, notably in terms of (i) the evaluation of behavioral and technological parameters and (ii) the understanding and specifications of the dynamics. These drawbacks should not lead to disregard the general equilibrium approach but rather to more effort to improve on it. General equilibrium frameworks are no longer costly to develop and implement. What is costly is the gathering of their data base, but who would pretend to do applied economic analysis without a data base.

One of the areas where a multisectoral general equilibruim framework is most useful is the analysis of macroeconomic and distributional implications of sectoral policy interventions. SIAM2 was used to contribute to the discussion on two sectoral policy issues: (i) the appropriate domestic prices of energy when the world prices drop and (ii) the appropriate scheme to support the price of rice. With respect to energy prices, if one is

essentially concerned with the external imbalance and foreign debt accumulation, then it would seem preferable not to drop the domestic energy prices with the world prices. The cost in terms of growth and income distribution does not seem important. The comparison of a buying programme for rice and of a reduction in export taxation indicate that the latter is a more effective way of raising the domestic price of rice. The price increase would lead to higher production and employment. However if the elasticity of the world demand for rice is small, the larger supply will tend to depress export price and could well wipe out the positive effect of higher production.

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Charles R. Blitzer, Peter B. Clark, and Lance Taylor, editors

Surveys the specification and uses of medium-term and perspective economywide planning models.

Oxford University Press, 1975; 4th printing, 1982. 382 pages (including selected additional readings, bibliography, subject and author index).

LC 74-29171. ISBN 0-19-920074-2, $9.95 paperback.

The Effects of Population Growth, of the Pattern of Demand, and of Technology on the Process of Urbanization: An Application to India

Rakesh Mohan

This paper uses a non-linear, three-sector, two-region wage-and-price endogenous dynamic general equilibrium model to study the effect of population growth, the pattern of demand, and of technological change on urbanization in the context of a low-income developing country starting at a low level of urbanization.

World Bank Staff Working Paper No. 520. 1982. 47 pages.

ISBN 0-8213-0008-3. $3.00.

NEW

Financing of Investment in India, 1975–1985: A Sources and Uses of Funds Approach

Armando Pinell-Siles and V.J. Ravishankar

This paper presents sources and uses of funds accounts integrated in a macroeconomic framework for analyzing financing patterns and economic interdependence among sectors in India, contrasting the period 1975–80 with the Sixth Plan period, 1980–85.

World Bank Staff Working Paper No. 543. 1982. 92 pages.

ISBN 0-8213-0205-5. $3.00.

General Equilibrium Models for Development Policy

Kemal Dervis, Jaime de Melo, and Sherman Robinson

Provides a comprehensive study of multisector, economywide planning models with particular emphasis on issues of trade, distribution, growth, and structural change. Theoretical discussion of the properties of multisector, applied general equilibrium models is combined with numerical applications to particular countries and problems. The models considered range from input-output and linear programming to the more recent nonlinear computable general equilibrium (CGE) models. The authors consider how these models

can be used to analyze questions of growth and structural change, the selection of foreign exchange regime, and the impact of alternative development strategies on the distribution of income. The empirical applications are based both on cross-country analysis and on the experience of particular countries and demonstrate how such models provide a useful framework for policy analysis. Particular attention is focused on the problems of planning and policy formulation in mixed-market economies and on the nature of models required to capture the important mechanisms that constrain policy markets.

Cambridge University Press, 32 East 57th Street, New York, N.Y. 10022. 1982. xviii + 526 pages.

LC 81-12307. ISBN 0-521-24490-0, $42.50 hardcover; ISBN 0-521-27030-8, $17.95 paperback.

NEW

The Global Framework: An Update

Brian Nolan

This paper presents the methodological background to the Global Modelling Framework used in the *World Development Report* exercises of the World Bank. It gives an overall view of this framework and discusses in some detail the data base supporting the global analysis and the methods of reconciling data from various sources.

World Bank Staff Working Paper No. 533. 1982. 58 pages.

ISBN 0-8213-0047-4. $3.00.

Human Factors in Project Work

Heli Perrett and Francis J. Lethem

World Bank Staff Working Paper No. 397. June 1980. 85 pages (including 3 annexes, 5 charts, bibliography).

Stock No. WP-0397. $3.00.

Human Resource Development and Economic Growth in Developing Countries: A Simultaneous Model

David Wheeler

World Bank Staff Working Paper No. 407. July 1980. 130 pages (including 8 appendixes, bibliography).

Stock No. WP-0407. $5.00.

NEW

Incorporating Uncertainty into Planning of Industrialization Strategies for Developing Countries

Alexander H. Sarris and Irma Adelman

This survey of existing literature on planning under uncertainty focuses on issues of international trade and investment allocation. Various ways of incorporating uncertainty into target-planning models are discussed and proposals for possible empirical applications are outlined.

World Bank Staff Working Paper No. 503. January 1982. 58 pages (including appendix, references).

Stock No. WP-0503. $3.00.

Interdependence in Planning: Multilevel Programming Studies of the Ivory Coast

Louis M. Goreux

Provides a system for analyzing each component of a country's economy independently and relates the interdependencies between the components.

The Johns Hopkins University Press, 1977. 448 pages (including bibliography, index).

LC 77-4793. ISBN 0-8018-2001-4, $27.00 (£16.20) hardcover; ISBN 0-8018-2006-5, $9.95 (£6.00) paperback.

The International Comparison Project

Three volumes that establish a worldwide system of international comparisons of real product and of the purchasing power of currencies.

Phase I: A System of International Comparisons of Gross Product and Purchasing Power

Irving B. Kravis, Zoltan Kenessey, Alan Heston, and Robert Summers

Establishes the methodology and presents comparisons of gross domestic product per capita and currency purchasing power for ten countries in 1970 and six of the same countries in 1967.

The Johns Hopkins University Press, 1975. 306 pages (including glossary, index).

LC 73-19352. ISBN 0-8018-1606-8, $27.50 (£16.50) hardcover; ISBN 0-8018-1669-6, $8.95 (£5.50) paperback.

Phase II: International Comparisons of Real Product and Purchasing Power

Irving B. Kravis, Alan Heston, and Robert Summers

Updates Phase I and adds six new countries, comparing the figures for the sixteen countries for the years 1970 and 1973.

The Johns Hopkins University Press, 1978. 274 pages (including glossary, index).

LC 77-17251. ISBN 0-8018-2019-7, $25.00 (£15.00) hardcover; ISBN 0-8018-2020-0, $8.50 (£5.00) paperback.

Phase III: World Product and Income: International Comparisons of Real GDP

Irving B. Kravis, Alan Heston, and Robert Summers

This report restates and extends the methodology set out in the first two volumes. Particular attention is given to the problem of comparing services and to the conflicting demands of regional and global estimates. Comparisons are given of prices, real per capita quantities, and final expenditure components of GDP for thirty-four countries for 1975. By relating

the results to certain widely available national income accounting data and related variables, the authors develop extrapolating equations to estimate per capita GDP for the thirty-four countries for 1950 to 1978. In addition, the 1975 distribution of world product by region and per capita income class is estimated. The 1975 results confirm relations between both quantities and prices and per capita income found in the earlier volumes.

The Johns Hopkins University Press, 1982. 398 pages.

LC 81-15569. ISBN 0-8018-2359-5, $35.00 hardcover; ISBN 0-8018-2360-9, $15.00 paperback.

Landsat Index Atlas of the Developing Countries of the World

Fourteen four-color maps, applications of Landsat imagery, reading and uses of the index maps, and procedure for securing imagery.

The Johns Hopkins University Press, 1976. 17 pages, 13½" x 21", spiral bound.

LC 76-46190. ISBN 0-8018-1923-7, $12.00 (£7.25) paperback.

Methodologies for Measuring Agricultural Price Intervention Effects

Pasquale L. Scandizzo and Colin Bruce

World Bank Staff Working Paper No. 394. June 1980. x + 96 pages (including 4 appendixes, references).

Stock No. WP-0394. $5.00.

A Model of an Agricultural Household: Theory and Evidence

Howard N. Barnum and Lyn Squire

Innovative model of short-run behavior that combines production and consumption decisions in a theoretically consistent fashion for an agricultural household.

The Johns Hopkins University Press, 1980. xi + 107 pages (including appendix, references).

LC 78-21397. ISBN 0-8018-2225-4, $6.95 (£4.75) paperback.

The Political Economy of Specialized Farm Credit Institutions in Low-Income Countries

J. D. Von Pischke, Peter J. Heffernan, and Dale W. Adams

World Bank Staff Working Paper No. 446. April 1981. iii + 99 pages.

Stock No. WP-0446. $5.00.

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Clive Bell, Peter Hazell, and Roger Slade

This innovative study develops quantitative methods for measuring the direct and indirect effects of agricultural projects on their surrounding regional and national economies. These methods are then applied to a study of the Muda irrigation project in northwest Malaysia. A linear programming model is used to analyze how a project changes the farm economy, and a social accounting matrix of the regional economy is then estimated. This provides the basis for a semi-input-output model, which is used to estimate the indirect effects of the project on its region. Thereafter, a similar methodology is used to estimate the project's effects on key national variables, thus permitting a full social cost-benefit analysis of the project.

The Johns Hopkins University Press. 1982. 336 pages (including maps and index).

LC 81-48173. ISBN 0-8018-2802-3, $30.00 hardcover.

Redistribution with Growth

Hollis Chenery, Montek S. Ahluwalia, Clive Bell, John H. Duloy, and Richard Jolly

Describes existing inequality in incomes in developing countries and proposes a reorientation of development policy to achieve more equitable distribution.

Oxford University Press, 1974; 4th printing, 1981. 324 pages (including annex, bibliography).

ISBN 0-19-920070-X, $9.95 (£5.00) paperback.

French: Redistribution et croissance. *Presses Universitaires de France, 108, boulevard Saint-Germain, 75006 Paris, France, 1977.*

ISBN 22403102, 58.20 francs.

Spanish: Redistribución con crecimiento. *Editorial Tecnos, 1976.*

ISBN 84-309-0624-X, 880 pesetas.

Risk Analysis in Project Appraisal
Louis Y. Pouliquen

Discusses methodological problems and the usefulness of simulation; illustrated by three case studies.

The Johns Hopkins University Press, 1970; 4th printing, 1979. 90 pages.

LC 79-12739. ISBN 0-8018-1155-4, $5.50 (£3.25) paperback.

French: L'appréciation du risque dans l'évaluation des projets. *Dunod Editeur, 24–26, boulevard de l'Hôpital, 75005 Paris, France, 1972.*

21 francs.

Shadow Prices for Project Appraisal in Turkey
Afsaneh Mashayekhi

World Bank Staff Working Paper No. 392. May 1980. 57 pages.

Stock No. WP-0392. $3.00.

Social Cost-Benefit Analysis: A Guide for Country and Project Economists to the Derivation and Application of Economic and Social Accounting Prices
Colin Bruce

World Bank Staff Working Paper No. 239. August 1976. ii, iii + 143 pages (including 6 annexes).

Stock No. WP-0239. $5.00.

Techniques for Project Appraisal under Uncertainty
Shlomo Reutlinger

Presents a method of evaluating risk in investment projects and means for using quantitative measures of risk in decisionmaking.

The Johns Hopkins University Press, 1970; 4th printing, 1979. 108 pages (including annex, bibliography).

LC 74-94827. ISBN 0-8018-1154-6, $5.95 (£3.50) paperback.

What Is a SAM? A Layman's Guide to Social Accounting Matrices
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World Bank Staff Working Paper No. 463. June 1981. 59 pages (including references).

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