A COMPUTABLE GENERAL EQUILIBRIUM ANALYSIS OF AGRICULTURAL-DEMAND-LED GROWTH FOR THAILAND

BY

SAMART NITSMER

A Thesis
Submitted to the Faculty of Graduate Studies
in Partial Fulfillment of the Requirements
for the Degree of

DOCTOR OF PHILOSOPHY

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ABSTRACT

The objective of this study is to examine the impacts of agriculture-led development on economic growth and income distribution in Thailand using computable general equilibrium (CGE) analysis. The scope of the analysis includes three production sectors (agriculture, industry, and services), two types of labor and capital (agricultural and nonagricultural), and two household groups (rural and urban).

Three CGE models were designed. Model I is neoclassical with full employment of labor. Model II assumes a fixed nonagricultural wage leading to unemployment of labor. Model III incorporates an under-utilization of nonagricultural capital into Model II. Data were organized within a social accounting matrix (SAM) framework. Each model was calibrated to base period data, and then subjected to individual and multi-step combined simulations for various policy scenarios.

Agriculture-led development is defined in model specification as simultaneous increases in agricultural productivity and government investment in agriculture, and a reduction in agricultural export taxes. Using base period (1980) data in simulations, agriculture-led development stimulates agricultural growth and overall economic growth in all three models. Income distribution shifts in favor of rural households in Models II and III, and against rural households in Model I.

In contrast, when world prices for agricultural commodities are assumed to be lower than in the base period, agriculture-led development sustains agricultural growth, but in all three models income distribution shifts in favor of urban households.

Alternatively if world prices for agricultural commodities are assumed to be higher than in the base period, then again this strategy increases economic growth, but income distribution shifts in favor of rural households in the three models. The results of the simulation shows that an agriculture-led development strategy was plausible for Thailand under the conditions prevailing in the early 1980s.

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Life is like a particle performing a random walk in a high-dimensional space. To this end, "optimization principle" escorts me to form the conduct of life and I would like to express my profound gratitude to the Canadian International Development Agency (CIDA) for financial support toward the completion of M.Sc. and Ph.D. programs.

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for

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I. INTRODUCTION

1.1 Background

Kuznets (1973) explained what is currently the standard view of economic development in the context of economic growth and its implications for possible development strategies. These reflect stylised facts and inherent problems of an economy during its development process. As Dorfman (1991) put it:

> "When an economy grows it does not merely become larger; it is changed, or transformed, in many respects. In part these changes result from economies and diseconomies of scale that affect different sectors of the economy differently. In part they result from the circumstance that the various resources available to the economy do not increase proportionately with one another or with economic activity. In part they are the consequences of cumulative experience and understanding, that is, learning by doing, and of innovations. If the changes increase per capita output or raise levels of per capita consumption, we regard them as development."[1]

A dominant characteristic of development is structural change, especially during the process of industrialization. During industrialization, economic activity normally shifts first from agriculture to the manufacturing sectors, and later from manufacturing to the service sectors. The rate of change depends, fundamentally, on a (domestically and internationally) dynamic competitive advantage among sectors, and national policies designed to resist, retard or promote change. In the case of Thailand, this phenomenon was readily observed (**Table 1.1**). The contribution of agriculture to GDP declined continuously, from 33.8 percent in 1960 to 15.6 percent during the sixth national development plan.

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1 Dorfman (1991) "Review Article: Economic Development from the Beginning to Rostow", Journal of Economic Literature, vol. 29 (P.573, footnote 1)

Table 1.1: Structure of GDP in each Period of National Development Plan at 1972 Constant Prices.

	Agriculture (%)	Industry (%)	Services (%)	Total (%)
1960	33.8	11.7	54.5	100.0
Plan 1: 1961-1966	32.1	15.8	52.1	100.0
Plan 2: 1967-1971	27.5	15.8	56.7	100.0
Plan 3: 1972-1976	24.9	19.7	55.4	100.0
Plan 4: 1977-1981	21.5	21.8	56.7	100.0
Plan 5: 1982-1986	19.7	21.3	59.0	100.0
Plan 6: 1987-1991	15.6	24.0	60.4	100.0

Source: NESDB

In the 1960s Thailand's GDP grew about 8.3 percent a year. During this period, Thailand was overwhelmingly a raw material exporter. Exported primary products accounted for 80.0 percent of Thailand's total export value in 1960. Export values then dropped to 67.0, 54.0, and 23.6 percent in 1970, 1980, and 1991 respectively.

The gradual breaking of forest land for agriculture increased cultivated land area. The average area of cultivated land per farm worker rose from 4.8 rai per farm worker in 1961 to 7.0 rai per farm worker in 1977. The average then declined to 6.3 rai per farm worker in 1985[2] [Siamwalla and others, 1987: p. 17].

2 1 rai = 0.16 hectare

Export taxes imposed on rice and rubber were partly offset by government investments (irrigation, roads, and etc.) and subsidies. These taxes and infrastructure development encouraged diversification into upland crops (maize, cassava, sugarcane, pineapple, and treecrops). Lower relative export taxes on upland crops promoted the rapid growth of these exports. Thailand, however, has been faced with trade and non-trade barriers. The EC imposed an import quota on tapioca from Thailand, while the USA, the second largest rice exporter, has unduly subsidized rice exports. Japan banned all rice imports even though their domestic cost of production is much higher than the world price.

Thai industry developed under the protection of a national import substitution policy. Industrial growth was rapid; the industrial share of GDP rose from 11.7 percent in 1960 to 15.8 percent during the second national development plan. As a result of shifting the development strategy from import substitution to export promotion, at the beginning of the fourth national plan, industry's share of GDP increased to 24.0 percent during the sixth national plan.

Thailand used a combination of measures to promote domestic production and the export of various commodities. Incentives for investment in high priority sectors were also provided. Manufacturing sectors, especially during the import substitution regime, received a high degree of tariff protection. Greater protection was accorded to finished products as opposed to machinery and raw materials. Tariff rates were especially high for agro-processing products and textiles during the import substitution regime.

The nominal exchange rate of the baht against the US dollar remained unchanged (about 20.0 baht/US$) after the collapse of Bretton Woods in 1973 (the baht had been tied to US dollar until the early 1980s). However, inflation rates in the mid 1970s were between 14.3 and 21.8 percent a year and in the early 1980s were between 12.0 and 18.0 percent a year. Thus, the real exchange rate (the nominal rate adjusted for relative inflation) actually rose. This made exports less competitive. In July 1981 and November 1984, the baht was devalued against the strengthening US dollar by 8.7 and 14.7 percent respectively. In December 1985, the baht was devalued by a further 20.0 percent against other major currencies. [3] This resulted in an export boom in the late 1980s. On average GDP grew at a rate of 11.0 percent a year during the 1987-1990 period.

National agricultural, industrial and trade policies as well as monetary and fiscal policy have potent impacts on the growth or decline of all sectors of the economy. This study focuses on the agricultural sector and its link to other sectors.

1.2 Recent Development of Thai Agriculture

Thailand 's agricultural growth rate during the past decade has on average been about 4 percent a year. This rate of growth was achieved largely through an expansion of the area of cultivated land. Even though the average yields per rai of most major agricultural commodities increased, they remain low compared to other developing countries. **Table 1.2** shows average and potential yields of Thailand's major crops. These

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3 Devaluation was delayed because it was against political view. For example, Deputy Minister of Finance had to resign after devaluation of baht in 1984.

statistics suggest that there are considerable opportunities for improving agricultural productivity (both per rai and per farm worker) with respect to domestic and export demands.

Table 1.2: Average and Potential Yields of Major Crops.

Crops	Average yield (kg/ha) (1976)*	Average yield (kg/ha) (1990)**	Potential yield using present knowledge (kg/ha)*	Potential yield using improved production technology and required inputs (kg/ha)*
Rice				
Irrigated	2500	2531	3500	4500
Rainfed	1800	1881	2200	2500
Maize	1800	2456	2500	3000
Cassava	14500	13919	20000	25000
Groundnut[1]	1250	1325	1700	2000
Mungbean	900	694	1000	1300
Soybean	850	1312	1200	2000
Kenaf (fibre)	950	1175	1500	2500
Sugarcane	50000	48894	55000	65000

Note: These yields represent a very broad spectrum of Thai conditions and depend on climate, soil type, regional variation in cultural practices, etc.

[1] In-shell groundnut

Sources: * World Bank (1977) Thailand: Appraisal of the National Agricultural Extension Project, Report No. 1256a-TH.

** OAE (1991), Ministry of Agriculture and Cooperatives.

Thai agriculture has undergone considerable transformation and has been integrated into the national and world economies.[4] Indicators of domestic integration are: increasing productivity, a greater market orientation, declining relative and absolute employment of agricultural labour, declining contribution to GDP, and increasing dependence on non-farm inputs. Indicators of international integration are: capital movements in conjunction with interest rates, exchange rates, and levels of participation in world commodity markets.[5] Domestic and international integration leaves the agricultural sector vulnerable to shocks from a wider number of sources (Akrasanee, 1989).[6] Diversification of agricultural products and export markets, and macro-policy to some extent can alleviate the impacts of shocks. A case in point is the oil shocks in 1973 and 1979-1980 which resulted in 21.8 and 18.0 percent inflation rates in 1974 and 1980 respectively. The macroeconomic policies of Thai government during 1970s and early 1980s were used effectively to bring inflation rates under control (Uathavikul and others, 1987). Monetary policy was normally used to create and maintain both domestic and external stabilities through exchange rates.

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4 The details of agricultural development especially in developing countries can be seen from Schultz (1964), Myint (1984), de Janvry (1986), Schuh (1986), McCalla and Josling (1986), Roa (1986), and Timmer (1988).

5 Four phases of agricultural transformation: (i) getting agriculture moving, (ii) agriculture as a contributor to growth, (iii) integrating agriculture into the macro-economy, and (iv) agriculture in industrial economies, call for different policy approaches (Timmer 1988, p. 282).

6 Akrasanee (1989) Thailand in the International Economic Community: Synthesis, TDRI Year-End Conference. This main report combines all background papers presented during the conference.

In recent years, Thailand has been rapidly restructured from an agricultural economy into an early stage of industrialization. Economic growth in the agricultural sector in conjunction with the government's industrial promotion policies in the 1970s, has provided major sources of savings and foreign exchange that have helped establish the country's industrial base. Benefits from the industrialization policy emerged after the government began its export promotion policy. The benefits of these policies have been realized since the mid-1980s.

Thai agriculture has grown slowly relative to the industrial and service sectors (**Table 1.3**). There are numerous complex reasons for different expansion rates among sectors. These are: (i) the commodity terms of trade of agriculture relative to industrial and service sectors have been moving steadily against agriculture, this effect has been moderated by gradual removal of the barriers against exports e.g. export taxes on rice were dismantled in the late 1980s; (ii) very little new land is available for any expansion, a factor that has been quite marked since the late 1970s, yet the capital and labor upon which industrial and service sectors rely are both easily augmented; and (iii) the technologies used in both the agricultural and nonagricultural sectors are rather backward relative to the state of the art practices in the rest of the world. While the nonagricultural sector can easily acquire and adapt foreign technology and therefore grow rapidly, the acquisition and adaptation of foreign technology into Thai agriculture is certainly not simple or in some cases even possible. This is because research and technology investment that addresses the agricultural diversity in many areas of Thailand is still lacking e.g. in the Northeast region. Research and technology policy in Thailand

Table 1.3: Real GDP Shares and Annual Average Growth Rates for Thailand, Selected Years.

Year	Total GDP (%)	Agri-culture (%)	Industry (%)	Service (%)
1985	100	16.7	34.1	49.2
	(3.5)	(6.2)	(0.8)	(4.7)
1986	100	16.3	34.4	49.3
	(4.9)	(0.3)	(9.8)	(5.0)
1987	100	16.4	34.7	48.9
	(9.5)	(-0.2)	(12.8)	(11.1)
1988	100	16.6	35.9	47.5
	(13.2)	(10.2)	(16.8)	(11.6)
1989	100	15.2	37.8	47.0
	(12.2)	(6.3)	(15.5)	(11.0)
1970-75	100	26.1	26.5	47.4
	(5.6)	(3.9)	(9.5)	(5.6)
1976-80	100	24.6	29.6	45.8
	(8.0)	(4.1)	(10.3)	(8.2)
1981-85	100	19.1	32.4	48.5
	(5.7)	(4.9)	(5.2)	(6.3)
1986-89	100	16.1	35.7	48.2
	(10.0)	(4.1)	(13.7)	(9.7)
1970-89	100	22.0	30.6	47.4
	(7.2)	(4.3)	(9.5)	(7.4)

Note: Figures in brackets means growth rates.

Source: NESDB

tends to support commodities with a natural comparative advantage rather than those with a technological-led-comparative advantage. This is in contrast with many other developed countries.

The process of agricultural growth everywhere requires that the absolute level of employment in agriculture declines over time, given the combination of low income elasticity of demand for farm products (i.e. demand increases more slowly than income and supply) with productivity changes at least as rapid as in the rest of economy [Anderson, (1983), Johnson, Hemmi and Lardinois (1985)]. This structural transformation coupled with conflicting objectives of government policies (urban consumers vs. producers, export taxes vs. input subsidies or price support) with respect to Thai agriculture and distorted world prices due mainly to protectionist measures by developed countries, [Sathirathai and Siamwalla (1987), Bhagwati (1988)] have contributed to a downward pressure on real agricultural prices and per capita real income of Thai farmers. As a result, agriculture's relative importance to the economy in terms of its shares to GDP, exports, and employment, declined with economic growth (**Table 1.4**). Farm incomes cannot keep pace with those in the rest of economy, unless some marginal farmers leave the land or seek off-farm employment. So far, nonagricultural sectors (especially the industrial sector) have failed to absorb a significant proportion of people (two-thirds of the labor force remains employed in the agricultural sector) into their thriving activities. This imposes an obstacle to long-term economic growth and stability. It also limits the scope of the industrial development strategy because the majority of the labor force is unskilled with only a primary level education. Average per

capita value added in non-agriculture was about one and a half times that in agriculture (**Table 1.5**). The gap of per capita value added between these two sectors reflects many other fundamental problems such as high income inequality, regional disparities, segmented labour markets, educational imbalance within and among sectors.

Unequal income distribution (**Table 1.6**) usually results in small domestic market. The small size of the domestic market not only renders the country less able to adjust to short-run external shocks, but also hurts the development of domestic industries through the limited potential for achieving the scale and scope of economies and, to some extent, by preventing vigorous competition. In this case, industrialization must rely entirely on exports without significant benefit from a large and expanding domestic market. In many other countries as well as Thailand, the constraints of small domestic markets can explain the failure of an import substitution strategy. This reflects the persistence of dualistic patterns in developing self-dependent domestic industries (Adelman and Robinson, 1989).

1.3 Development Strategies[7]

During the turbulent world economy of the early 1970s and 1980s, Thailand sought to maintain economic growth in the face of a major deterioration in its external account and has perforce pursued sectoral adjustment to the new external realities (World Bank 1984). Trade strategy is therefore among the central elements of adjustment

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7 Strategy relies on the appropriate choice of policies. Thus, the strategy may consist of individual policy or the combination of policies. Chenery (1958) discusses the trade-offs of macro-and-micro-policies in specific and in general.

Table 1.4: Contribution of Agricultural Sector to GDP, Export, and Employment.

	1960 (%)	1970 (%)	1980 (%)	1990 (%)
GDP	33.8	27.0	20.6	14.4
Exports	80.0	67.0	54.0	22.6
Employment	82.2	79.3	70.0	65.9

Source: Office of Agricultural Economics, Ministry of Agriculture and Cooperatives.

Table 1.5: Regional Per Capita Income Classified by Sectors.

Region	1985/86		1988/89	
	Agr. (Baht)	Non-agr. (Baht)	Agr. (Baht)	Non-agr. (Baht)
North	6,368	12,499	8,484	11,880
Northeast	4,952	9,522	5,640	10,998
South	6,747	10,888	8,970	11,078
Central	9,794	10,836	11,313	11,688
Average	6,494	11,309	7,704	11,628

Source: Socio-economic Surveys, National Statistic Office.
US$1.00 = Baht 25.68 (1989)

Table 1.6: Percentage of Total Income Shared by Population Quintile Group.

Quintile		1975/76	1980/81	1985/86	1988/89
1-st.		49.26	51.47	55.63	54.63
	highest top 10%	33.40	35.44	39.15	37.50
	second top 10%	15.86	16.03	16.48	17.13
2-nd.		20.96	20.64	19.86	20.42
3-rd.		14.00	13.38	12.09	12.31
4-th.		9.73	9.10	7.87	8.07
5-th.		6.05	5.41	4.55	4.57
	second bottom 10%	3.62	3.28	2.75	2.79
	lowest bottom 10%	2.43	2.13	1.80	1.78
Total Share		100.00	100.00	100.00	100.00
Gini Coefficient		0.426	0.453	0.500	0.489
Variance of Logarithm of income		0.530	0.602	0.737	0.737

Source: Socio-economic Surveys, National Statistics Office.

strategy (NESDB 1987)[8], especially the incentive structure [especially through privileges provided by Board of Investment (BOI)] for trade liberalization advocated by the World Bank (1987). Therefore, Thailand has generally adopted the economic ideology of export-led-growth strategy since the 1970s. This strategy became more effective in the mid-1980s due mainly to policy instruments such as the relaxation of export taxes and import tariff system, establishment of priorities for export sectors, provision of subsidies to manufacturing exports, realistic exchange rates, adoption of positive real interest rate, minimal product and factor market distortions, low duties on imported inputs, and incentives and rules applied to all exports.[9]

Upon observing the apparent increase in foreign protection, world recession, and the structural imbalances (production, demand, employment, investment, and trade) emerging within Thailand, a number of Thai economists still argue in favor of continuing to rely on manufacturing export-led-growth as the major dynamic development strategy for Thailand during this decade (Akrasanee, Dapice and Flatters, 1991). However, it is not always clear in this debate whether a particular prognosis simply predicts what will happen or what should happen in the light of sluggish GATT negotiations, Japan's

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8 However, trade strategy cannot be sensibly addressed independently. There is still debate among trade theorists as to what trade strategy should be pursued by developing countries [Krueger (1984), Ocampo (1986), Lal and Rajapatirana (1987), Bliss (1988), Helleiner (1990)].

9 Beyond those mentioned, one crucial factor contributing to manufactured export boom in the past few years is the transition of the Asian NIC's (Hong Kong, Singapore, South Korea, and Taiwan) towards advanced capital intensive commodities. Their traditional labour intensive manufactured exports, such as textiles, garment, etc. have been relocated in "junior" NICs such as Thailand.

prolonged trade and service surpluses, and senior Asian NICs that are making investments throughout the world. The capital flows associated with their investments are playing an increasingly important role in determining the economic growth and structure of growth among regions and among countries within each region. This poses the question as to how Thailand can adjust its development strategy in response to the world environment with respect to the degree of openness of its economy to foreign trade.

This debate is fuelled in part by renewed export pessimism, and increased awareness of the vulnerability to shocks arising from Thai export markets. Some economists are urging the adoption of agriculturally based labor intensive commodity strategies whereas the majority of economists advocate a manufacturing-export-led-growth strategy. In fact, the manufacturing-export-led-growth is not the only potentially promising development strategy. Thailand still maintains a comparative advantage in producing many agricultural commodities (rice, rubber, cassava, fruits and fishery products) over the rest of the world. A reallocation of investment resources within the economy of Thailand in favour of an outward-looking development strategy which is agriculturally driven in the early stage of industrialization may possibly give more positive results.[10]

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10 Adelman (1984) advocated this approach based on her analysis of a small, food-shortage, low income, semi-industrial, open economy which is a stylization of South Korea of 1963.

1.4 Development Issues of Thai Agriculture

Agricultural growth and the alleviation of income disparity are rational objectives within the context of overall economic growth and improvements in the standard of living of Thai population. Increased agricultural production means more food for consumption and exports. If prices do not fall significantly, higher farming incomes and more foreign exchange earnings will result. If domestic food prices decrease and demand is responsive to prices, the real incomes of consumers will improve.

To attain the objective of reasonable growth in the predominantly agricultural economy of Thailand, with pressure on land and wide income differentials between rural and urban areas, agricultural productivity (yield per rai and per farm worker) must increase. There are a set of policy choices to jointly achieve an acceptable growth rate and a more equitable distribution of income. While it is not clear how much growth is reasonable or how much improvement in income distribution is desirable, it is clear that only policies or strategies leading to improvements in these indices are relevant, and hence alternative policies should be evaluated in terms of their potential growth and distributive outcomes. The impacts of each government policy on an income group must be compared to those on other income groups to determine both absolute and relative changes in income position. Thus, agricultural growth and poverty/inequality reduction may be in conflict and it is necessary to determine appropriate trade-offs.

In an open economy like Thailand, greater domestic agricultural production may or may not cause decreased food prices because of the linkages between domestic agricultural production and consumption and foreign trade. The government can intervene

to break the link between domestic and world prices i.e., by export taxes, reserve requirement, and quota allocation. This raises the question of how much and what type of government intervention is appropriate given the objectives of equitable agricultural growth. Due to the complexity and interdependency of the agricultural sector to other sectors this question cannot be answered without an analytical framework that highlights the key relationships among sectors, organizes the relevant information and traces the effects of different policies through the agricultural/food system. The computable general equilibrium (CGE) modelling approach helps to identify these linkages and consistency of information corresponding to a CGE model can be organized within a social accounting matrix (SAM) framework. Thus, the CGE model can render feasible policy choices to policy-makers.

Agricultural-demand-led growth (ADLG) is a simultaneous combination of an increase in agricultural productivity, government investment in agriculture, and a reduction in agricultural export taxes. This strategy aims at stimulating and sustaining agricultural growth and improving income distribution for rural households. It is explored through a SAM/CGE approach. It is possible to determine whether this approach is feasible for Thailand. The policy analysis generates results which are plausible and potentially useful for policy makers. It also points out the unavoidably subjective nature of the model assumptions, parameter rationalizations, and magnitudes of policy shocks and their implications.

1.5 Research Objectives

The main objective of this study is to analyze a possible alternative development strategy for Thailand with special reference to the agricultural sector or agricultural-demand-led-growth (ADLG) and within the context of prospective changes in domestic and international environments. The specific objectives are:

1. To construct a multisectoral general equilibrium model for the Thai economy of the 1980s.
2. To analyze this ADLG strategy by simulation of the model with respect to specific policy choices available to policy-makers.

1.6 Organization of the Study

Chapter II describes a social accounting matrix (SAM) framework for computable general equilibrium (CGE) modelling. The multisectoral CGE model used in this study is developed in Chapter III, followed by the discussion of the SAM data base in Chapter IV. Chapter V presents a solution technique and base solution. Chapter VI analyses the empirical results of ADLG simulations. Chapter VII contains a summary and conclusions.

II. A SOCIAL ACCOUNTING MATRIX FRAMEWORK FOR CGE MODELLING

2.1 Introduction

This chapter discusses how a social accounting matrix (SAM) can be designed to be consistent within a CGE framework. The chapter begins with a description of SAM and its distinct features, particularly in the context of the "transaction value" (TV) approach. This is followed by a discussion of the common features of CGE modelling in developing countries. The chapter also addresses some issues revealed as a result of its application that are external to the SAM/CGE modelling approach.

2.2 A SAM-Based System for CGE Modelling

A SAM-base system for CGE modelling is viable if the accounting framework is complete in the sense that every receipt account is equal to a corresponding expenditure account. By this principle, if all necessary and modified neoclassical assumptions are met[11] the value of demand is equivalent to the value of supply in the Walrasian general equilibrium framework. This implies that all the transactions (value flows) in a CGE model can be represented within a SAM framework.

All the different types of transactions generate values which are recorded as the elements (in the cells) of a SAM matrix. These values or elements can either be expressed as numbers (data) or as mathematical functions that describe how the value of

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11 An applied or computable general equilibrium model goes beyond the Walrasian framework [see Dervis, de Melo, and Robinson (1982); Shoven and Whalley (1984, 1992); Decaluwé and Martens (1987); Robinson (1989)]. Also see Section 2.5 of this chapter.

each type of transaction is determined. An expression of this type is said to be in the transaction value (TV) format [Drud, Grais, and Pyatt (1986); Pyatt (1988)]. The TV describes the price-quantity relationship based on given technology and behaviour of economic agents.[12] Thus, a SAM captures both the theoretical specification and the empirical facts, and can be modified and adjusted, with regard to the availability of data, and according to the problem to be investigated.

2.3 A Social Accounting Matrix (SAM)

A SAM is an expansion of an input-output (i.e. Leontief, 1937) table and national income accounts. It is a square matrix designed to provide a record of transactions in which corresponding row and column sums are equal. Each row and column reflects a separate account in which expenditures and receipts must balance. The focus is on the nominal flow of funds, with the rows representing receipts and the columns expenditures.

A SAM reflects the common features of the economy that are embodied in the core CGE model. A SAM usually consists of the following accounts: factors of production, institutions (households, firms, government, the rest of the world), savings/investment, production activity, and commodities. These accounts represent the performance of an economy (**Table 2.1**). Each of the above mentioned accounts can be

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12 TV approach was originally employed with SAMLIB software during the earliest stage of its development at the World Bank. Later on, the SAMLIB evolved into GAMS/HERCULES, the software used in this research.[Drud and Kendrick (1990)]

disaggregated or aggregated according to the issues under investigation.[13] Thus, a SAM provides a consistent framework for the accounts of each of the various economic actors whose behaviour is being modelled. A SAM, requires at least a one year base data set for implementation with a CGE model.

2.4 The TV Approach to Simple CGE Model

Each non-empty cell of a SAM (see example in **Table 2.1**), represents a numerical estimate of the value of the transactions that correspond to it. Using a SAM as a framework for general equilibrium theory requires that the cells of the matrix be filled with mathematical expressions which describe, in conceptual terms, how the corresponding transaction values (TV) are determined.

The internal consistency of the SAM ensures that for each account, total receipts (recorded on rows, indexed by i) are equal to total expenditures (recorded in columns, indexed by j). For account 1, This may be written as:

$$\sum_{j} t_{1j} = \sum_{i} t_{i1}$$

(Total receipts of account 1) (Total expenditures of account 1)

and likewise for other accounts. If there are n accounts, the equilibrium condition requires that the total of receipts of each account be equal to the total of the

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13 King (1981) gives various examples as to how a SAM is disaggregated. One criterion for disaggregation noted by Decaluwé and Grais is: "If a product or factor is traded at different prices in different markets, one should open as many accounts as there are markets" (Decaluwé and Martens,1987; p.13).

Table 2.1: A Social Accounting Matrix (SAM)

	Factor of Production	Institutions		Production Activities	Commodities	Rest of World	Total
		Current Transactions	Capital Transactions				
	1	2	3	4	5	6	7
1. Factors of Production				Factor incomes from domestic activities		Net factor incomes from from abroad	Incomes of the factors of production
2. Institution: Current Transactions	Allocation of factor incomes to institutions	Current transfers between institutions			Incomes of institutions before foreign transfers	Net non-factor incomes from abroad	Incomes of institutions after foreign transfers
3. Institution: Capital Transactions		Savings	Capital transfers between institutions			Net capital flows from abroad	Aggregate savings
4. Production Activities					Supply of commodities by domestic activities		Gross outputs
5. Commodities		Expenditures on consumption commodities	Expenditures on capital goods	Expenditures on intermediate commodities		Export of commodities	Total expenditure on commodities
6. Rest of World		Current transfers from institutions to RoW			Imports		Total current income from the rest of world
7. Total	Incomes of the factors of production	Expenditures of institutions	Aggregate investments	Gross inputs	Total supply of commodities	Total net foreign exchange receipts	

Note: Compiled from various sources or see for example King (1981).

corresponding expenditures[14]:

$$y_i = \sum_{j=1}^{n} t_{ij} = y_j = \sum_{i=1}^{n} t_{ij} \qquad (2.1)$$

where t_{ij}, [i,j = 1,2,...,n], represents a receipt of account i and expenditure of account j. Therefore, the above equilibrium condition yields a set of n equations of receipts and expenditures.

The set of n accounts can be divided into two sub-sets.

(1) m accounts (m<n): the totals of each of these accounts are in some cases associated with a price p_j [$p_j = p_i$ for j = i; and under equation (2.1),then $q_i = q_j$] such that:

$$y_j = p_j q_j \qquad (2.2)$$

[j = 1,2,...,m; m<n]

where p_j and q_j are the price index and the volume of the quantity index associated with account j. In **Table 2.1** these are the "Production Activities" and "Commodities" accounts [j = 4,5]. Thus, equation (2.2) in general gives m equations defining total expenditure as the product of a price and a quantity.

p_j in equation (2.2) must be specified because the equation is defined. The general form can be expressed by;

---

14 Price along the row of SAM is constant or fixed by its design. With a theory expressed in TV form, t_{ij} represents an expenditure of account j which is received by account i. Thus, the row summation equations correspond to the demand side and the column summation equations correspond to the supply side, otherwise generate the adding-up conditions within the model i.e. transfer flows. As a result, modelling each of t_{ij} is done via columns.

$$p_j = p_j(p,\phi) \qquad (2.3)$$

where [j = 1,2,...,m_1; with $m_1 < m < n$], and m_1 is the number of accounts for which equation (2.2) is defined; but excluding the factor account (i.e."Factors of Production" [j=1] in **Table 2.1**) whose endowment is usually assumed to be fixed and whose factor incomes are distributed proportionate to the endowment.

p = a vector of prices associated with the j th column;

ϕ = a vector of parameters associated with the j th column.

Thus, equation (2.3) gives m_1 equations; and m-m_1 are associated with factor accounts i.e., the case of summation conditions.

(2) n-m accounts: the total of each of these accounts for which equation (2.2) is not defined i.e., transfer flows (in a national accounting sense) among institutions.[15]

The next step of TV approach is to specify the behaviour in each transaction value (t_{ij}) with the general formulation given by:

$$t_{ij} = t_{ij}(y,p,\phi) \qquad (2.4)$$

[i,j = 1,2,...,n)

where $y = (y_j)$ = a vector of total expenditures of the n accounts

[j = 1,2,...,n]

$p = (p_j)$ = a vector of prices associated with m of the n accounts; [j = 1,2,...,m; m<n]

---

15 **(1)** and **(2)** will become obvious if each account in a SAM is disaggregated. For example, institutions in **Table 2.1** can be broken down into households, firms, and government and each of these sub-accounts contains current and capital transfer accounts.

$\phi = (\phi_k)$ = a vector of r parameters or coefficients whose values are predetermined; [k = 1,2,...,r]

These particular specifications for the non-zero t_{ij} elements of a SAM are the structural forms of a CGE model. Thus, equation (2.4) gives h equations, where h is the number of TV (t_{ij}) in the non-empty cells of a SAM.

A linear dependence exists among the n equilibrium equations of the model, therefore one equation of the model is redundant (i.e., see Weintraub, 1974). Consequently, at this stage, the CGE comprises $n+m+m_1+h-1$ equations with $n+2m+h$ (y_j, p_j, q_j, and t_{ij}) unknowns. To solve this model, $m-m_1+1$ of the unknowns must be made exogenous. This corresponds to the choices of closure rules. Both the choices of closure rules and selection of predetermined values are outside the SAM framework and are discussed in **Section 2.6**.

To simplify the approach, this study briefly presents a small simple model with two production sectors (agriculture and industry), two factors of production (labor and capital), and two types of households (rural and urban).[16] **Figure 2.1** illustrates their interrelationships which correspond to an assumed SAM database shown in **Table 2.2**. Under this framework, and by assuming Cobb-Douglas production and utility functions, **Table 2.3** presents a CGE model formulated on the basis of standard neoclassical assumptions (producers maximize profit and consumers maximize utility).

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16 Drud (1988) and Chapters 1-3 of Drud and Kendrick (1990) systematically describe as to how the CGE model is tied closely to the TV approach, SAM database, and GAMS/HERCULES application.

Equations in **Table 2.3** especially in the columns "**Payment**" and "**Definition**" correspond to the SAM presented in TV form in **Table 2.4**. A TV approach within the SAM framework thus guarantees the existence of general equilibrium. t_{ij} represents more than thirty functional forms specified in the HERCULES software and a modeller may select the ones that are compatible with the CGE model design.

Figure 2.1: The Flow of Money, Goods and Factors

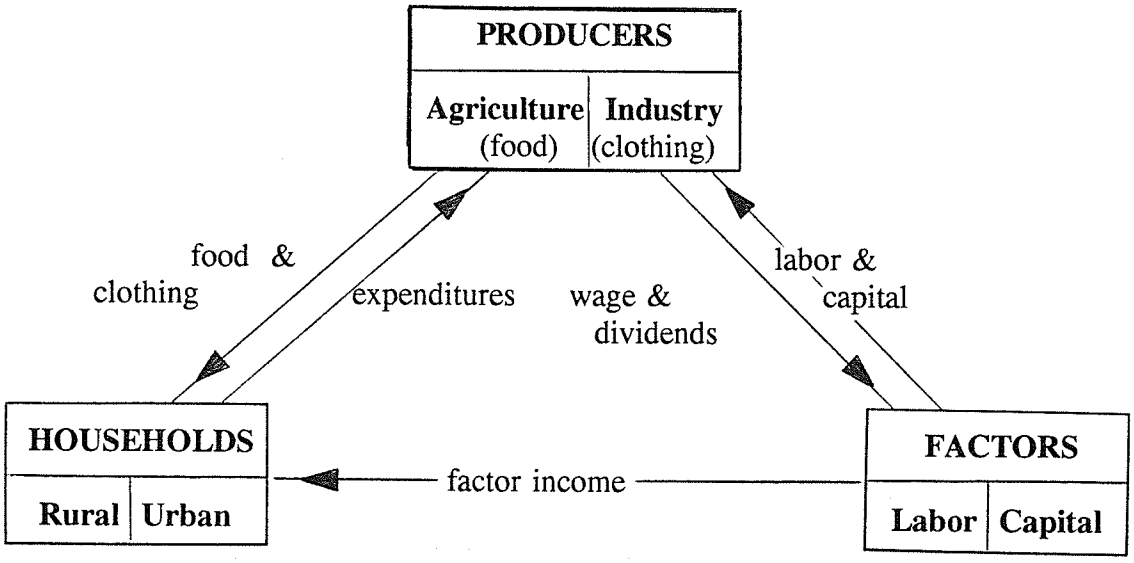

Table 2.2: A SAM Database.

		Factors		Households		Firms		Total
		L	K	RU	UR	AGR	IND	
Factors	**L**					75	85	160
	K					50	60	110
Households	**RU**	110	10					120
	UR	50	100					150
Firms	**AGR**			65	60			125
	IND			55	90			145
Total		160	110	120	150	125	145	

Note: (1) L = Labor; K = Capital; RU = Rural; UR = Urban; AGR = Agriculture; IND = Industry.

(2) 75 and 85 are wages that firms pay to labor; 50 and 60 are profits paid to capital. These factor incomes are then allocated to rural and urban households where 110 and 50 are labor income; 10 and 100 are capital income.

(3) Households use incomes to purchase food (65 and 60) and clothing (55 and 90). These household expenditures become firm revenues. Thus, the flow of money, goods,and factors is complete.

Table 2.3: Equations of A Small Simple CGE Model.

Name	Quantity	Payment	Definition
Production			
1. Output	$Q_S = b_S K_S^{m_S} L_S^{n_S}$	$P_S = \beta_S r^{m_S} w^{n_S}$	$Y_S = P_S Q_S$
2. Input	$K_S = m_S Y_S / r$	$t_{KS} = m_S Y_S$	$t_{KS} = rK_S$
	$L_S = n_S Y_S / w$	$t_{LS} = n_S Y_S$	$t_{LS} = wL_S$
Factors			
3. Income			$Y_K = rK$
			$Y_L = wL$
4. Transfer		$t_{HK} = m_{HK} Y_K$	
		$t_{HL} = n_{HL} Y_L$	
Households			
5. Consumption	$C_{SR} = \alpha_{SR} Y_R / P_S$	$t_{SR} = \alpha_{SR} Y_R$	$t_{SR} = P_S C_{SR}$
	$C_{SU} = \alpha_{SU} Y_U / P_S$	$t_{SU} = \alpha_{SU} Y_U$	$t_{SU} = P_S C_{SU}$
6. CPI	$Q_R = \gamma_R (C_{AR}^{\alpha_{AR}} + C_{IR}^{\alpha_{IR}})$	$P_R = P_A^{\alpha_{AR}} + P_I^{\alpha_{IR}}$	$Y_R = P_R Q_R$
	$Q_U = \gamma_U (C_{AU}^{\alpha_{AU}} + C_{IU}^{\alpha_{IU}})$	$P_U = P_A^{\alpha_{AU}} + P_I^{\alpha_{IU}}$	$Y_U = P_U Q_U$
Linkage			
7. Producers	$Q_S = C_{SR} + C_{SU}$	$Y_S = t_{SR} + t_{SU}$	
8. Factors	$K = K_A + K_I$	$Y_K = t_{KA} + t_{KI}$	
	$L = L_A + L_I$	$Y_L = t_{LA} + t_{LI}$	
9. Households		$Y_H = t_{HK} + t_{HL}$	

Note: (1) Variables: Q = quantity; P = price of output or price index; Y = income or payment; K = capital; L = labor; r = rental rate; w = wage; C = quantity consumed.

(2) Parameters: m,n = share parameter in Cobb-Douglas function, where $\beta_S = m_S^{-m_S} n_S^{-n_S} / b_S$; α = share or weight of good in utility function, where $\gamma_R = \alpha_{AR}^{-\alpha_{AR}} + \alpha_{IR}^{-\alpha_{IR}}$ and $\gamma_U = \alpha_{AU}^{-\alpha_{AU}} + \alpha_{IU}^{-\alpha_{IU}}$.

(3) Subscriptions: S represents for A = Agriculture and I = Industry; H represents for R = Rural and U = Urban.

(4) Some equations in this model are dependent. By choosing the relevant equations with regard to closure rules and predetermined values, the model can be fully determined.

Table 2.4: A SAM In TV Approach

		Factors		Households		Firms		Total
		L	K	RU	UR	AGR	IND	
Factors	**L**					t_{LA}	t_{LI}	Y_L
	K					t_{KA}	t_{KI}	Y_K
Households	**RU**	t_{RL}	t_{RK}					Y_R
	UR	t_{UL}	t_{UK}					Y_U
Firms	**AGR**			t_{AR}	t_{AU}			Y_A
	IND			t_{IR}	t_{IU}			Y_I
Total		Y_L	Y_K	Y_R	Y_U	Y_A	Y_I	

Note: t_{ij} = variable in value form; Y = income or expenditure
L = labor; K = capital; A = agriculture
I = industry; R = rural; U = urban

A SAM perspective on CGE modelling has two special requirements which are illustrated in **Figure 2.2**: (1) the development on the data side is to calibrate this SAM for data organization, and to resolve numerical discrepancies[17] [steps I and II]; and (2) the corresponding development on the conceptual side is to formulate a model of behaviour for each cell of the SAM, particularly the set of equations (2.4) [step III].

The formulation of behaviour and the calibration of the SAM are not independent activities. Aggregation and disaggregation depend upon the availability of data and the particular conceptual distinctions made. Thus, iteration and compromise are needed. When the process of iteration is complete, the derived SAM framework shows two versions: a specification of behaviour in TV form and a balanced set of data that record the value for each type of transaction for a base period. The two versions of the SAM are then combined for model calibration [step IV which requires V and VI] and subsequent analysis [step VII].

2.5 The CGE Modelling in Developing Countries[18]

CGE modelling is a natural extension of input-output and linear programming models with the inclusion of an endogenous output and price system, neoclassical substitutability in production and consumption, the optimization behaviour of individual agents and a complete treatment of income flow in an economy. Thus, CGE models are

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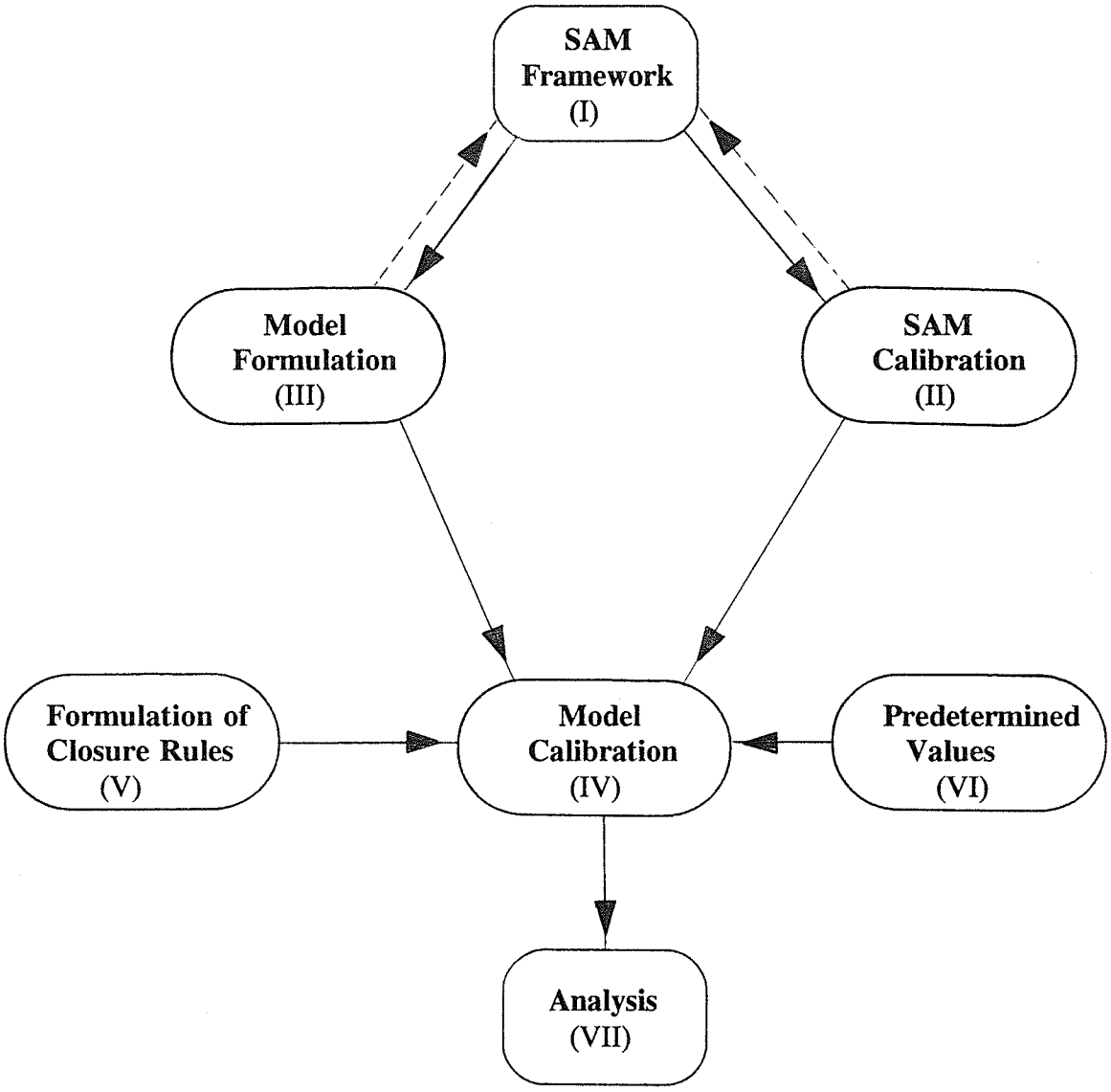
17 **Appendix A** in Dervis, de Melo, and Robinson (1982) gives a guideline as to how a SAM is developed.

18 Extensive reviews of CGE modelling in developing countries appear in [Decaluwé and Martens (1987); Bandara (1991) ;Shoven and Whalley (1992)].

Figure 2.2: The SAM Approach to CGE Modelling



Source: Drawn from Pyatt (1988), p.344.

empirical counterparts of 'Walrasian general equilibrium' analysis. Robinson (1989: p. 907) discusses the essential components of the neoclassical approach to CGE modelling as follows:

> (i) specification of the representative agents whose behaviour is to be analyzed;
>
> (ii) identification of their behavioral rules and conditions under which they operate (i.e. profit maximization and utility maximization);
>
> (iii) specification of the signals which are used by the agents for their decisions (i.e. prices are important signals in a neoclassical CGE model); and
>
> (iv) identification of the 'rules of the game'(i.e. assuming perfect competition, a CGE model allows each agent to act as a price taker).

The choice of specifications for production, consumption, government, and external trade draw extensively from the above framework of knowledge, which reflects the formulation of relevant technological, behavioral, and institutional relationships. Such specifications render a system of equations that can be solved simultaneously to find a general equilibrium. The CGE models have often dealt with problems of economic development and stabilization that are common to several developing countries. The similarity of CGE models include:

(1) All CGE models are basically numerical applications of the Walrasian type neoclassical general equilibrium approach. These models determine only relative prices and the price system has to be normalised by the appropriate selection of a numeraire. Main equations of these models are derived from the constrained optimization of neoclassical production and utility functions. However, some modified neoclassical

features can be identified in certain applications of the CGE models to developing countries. For example, the government sector and imperfect competition have been introduced into CGE models via price fixing, quota rationing, and quantitative restrictions.

(2) Many of these applications deal with the problems of protection, stabilization, fiscal policy, income distribution and external shocks. Foreign exchange shortages, the vulnerability of domestic economies to external shocks, primary commodity dependence, continuous external debt problems and income distribution are all major problems in developing countries.

2.6 The Closure Rules and Predetermined Values

The closure rules are model assumptions made by a modeller regarding the operation of an economy in the base period. Sen (1963) originally discusses the theoretical aspects of the assumptions that reflect policy implications. The term 'closure' is used in various ways and with varying degrees of accuracy. It can be defined as the specification of endogenous and exogenous variables in the model or as the set of assumptions about how a model is closed [Decaluwé and Martens (1987); Robinson (1989)]. This also involves economic implications, especially those relating to economic policy. A model can be closed if there is sufficient information to compute a solution. The important point is that when different closure rules are applied to CGE models, the qualitative characteristics of the models change [Adelman and Robinson (1988)].

At least four different macroeconomic closures ('Keynesian', 'Kaldorian',

'Johansen' and 'Classical'), have been used in CGE models for developing countries (Robinson, 1989).[19]

Keynesian: This approach allows for unemployment via a fixed nominal wage. Under this closure, employment levels can increase in response to increases in aggregate demand via a reduction in the real wage.

Kaldorian: This approach generates full employment but violates the wage-marginal labour productivity relationship. Under this closure rule, the nominal wage in the labour market is flexible in order to maintain a full employment situation.

Johansen: Under this approach, investments are determined exogenously and consumption must adjust endogenously. Thus the modeller must assume a fiscal policy outside the model that makes planned savings equal to exogenously determined investment. This closure considers full employment equilibrium to be realized via adjustments of private consumption.

Classical: Under this approach, real investment is endogenous and adjusts to total available savings. The modeller assumes an interest-rate adjustment mechanism is at work outside the model, thus ensuring the clearing of the investment-saving market.

Dewatripont and Michel (1987) point out that there is no clear-cut theoretical justification for the selection of a particular closure rule except the modeller's assumptions about the particular economy under investigation. Thus, the choice of a closure rule may depend on the modeller's 'school of economic thought'. Neoclassical

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19 Decaluwé and Martens (1987) provide an example of these closure rules and their implications (pp. 53-62).

economists tend to use Classical closure [Dervis, de Melo, and Robinson (1982)] whereas 'structuralists' tend to use Keynesian closure [Taylor (1983)].

Predetermined values (parameters or variables) that enter into behaviour specifications include the following:

(1) control variables of public decision-makers; i.e., rates of customs duties and domestic taxes, allocation coefficients of government investment, government transfers and subsidies, and the like;

(2) technological and behavioral parameters i.e., technical substitution elasticities, domestic-import substitution elasticities, export demand elasticities, budget share of consumption, etc.;

(3) uncontrollable data or variables, such as international prices of imports and exports of foreign currency (if the country is small), the growth rates of current external transfers, etc.;

(4) the number of unknowns made exogenous in the model is also related to the closure of the system.

At this point, the model specification and the additional required information are in place. The model can be solved and simulated. Consistency and stability of the model can be checked by assigning alternative values to parameters, using different closure rules, and re-specification of TV form.

2.7 Conclusions

The merits and deficiencies of a SAM in CGE modelling are summarized below.

2.7.1 Merits

(i) For model calibration, a SAM-based approach can facilitate experimentation with alternative closure rules, parameter values or specifications of the TV forms.

(ii) The strength of the CGE model lies in its description of economic interdependence and price structure through the sectoral linkages in an economy.

(iii) CGE models can analyze various policy changes and external shocks using only base period data (any year). Additional information required outside a SAM framework can be drawn from a literature search and using the 'best guess'. Most studies use sensitivity analysis to alleviate any uncertainties about key parameter values to indicate the robustness of the results. Econometric techniques are not well suited for this type of analysis due to the unavailability of reliable long-term data, inconsistencies of available data, and frequent changes in policy regimes common in many LDCs, which necessitates complex structural modelling.

2.7.2 Deficiencies

(i) To solve the CGE model, it is necessary to move outside the SAM framework, especially with respect to the closure rules and predetermined parameter values mentioned in Section 2.6.

(ii) CGE models are deterministic and less useful in explaining either short-term adjustment or the evolution of long-term structural change and technology. However, it should be noted that the problems encountered in dealing with uncertainty about the

future and changing expectations are not limited to CGE modelling. Robinson (1989; p. 936) noted that 'the issue of dynamics is certainly not confined to multisector models and has long been recognized as a major problem in macroeconometric models as well'. Handling dynamic issues is as difficult a task in empirical work as it is in theory.

(iii) The absence of the role of money in CGE models requires modellers to implicitly assume that the monetary authorities adjust the money supply consistent with changes in the domestic price level emerging from alternative policy simulations. Recent attempts have been made to incorporate asset markets into CGE models, but this area is still under theoretical debate (McKinnon 1984).

Despite these limitations, it can be argued that acknowledgement of these deficiencies is really no more than a recognition of boundaries of the SAM framework, rather than a weakness in the CGE modelling approach. Modelling has been able to confront and remedy many of the weaknesses. A SAM/CGE modelling approach clearly illustrates the relevance and usefulness of economic theory and data organization. A great deal of work is required however to overcome the existing limitations.

III. THE EMPIRICAL MODEL

3.1 Introduction

This chapter is organized into three parts. In the first part, a multisectoral CGE model for Thailand is specified. The second part describes the main features of the model. The last part discusses some aspects of the application of the CGE model.

3.2 Model Specification

The multisectoral CGE model of the Thai economy characterizes the endogeneity of prices and incomes and incorporates of substitutability in consumption and production. Agents are assumed to be optimisers with supply and demand balanced via the market. The core of the model is based on a standard neoclassical formulation (Dervis, de Melo, and Robinson, 1982). The model specification incorporates with structuralist features[20] thus permitting a quantitative assessment of the effects of the ADLG strategy on economic growth and income distribution.

The model consists of three production sectors (agriculture, industry, and services), two types of capital (agricultural and non-agricultural), two categories of labor (agricultural and nonagricultural), two household groups (rural and urban), a single aggregate firm, government, and the rest of the world. Main components of the model are specified as follows:

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20 Chenery (1975); and Robinson (1989) discusses salient structuralist features in CGE modelling.

3.2.1 Production

The Production Functions

$$X_i^S = \bar{A}_i \cdot g_i(\bar{K}_{qi}, V_i, L_{ki}) \qquad [n] \quad (1)$$

The Net Price Equations

$$PN_i = PD_i - \sum_{j=1}^{n} P_j a_{ji} - td_i PD_i \qquad [n] \quad (2)$$

3.2.2 Labor Markets

The Labor Aggregation Functions

$$L_i = \lambda_i(L_{1i},...L_{mi}) \qquad [n] \quad (3)$$

The Labor Demand Equations: the wage adjusts to clear the market,

$$PN_i \frac{\partial X_i}{\partial L_{ki}} = W_k \qquad [2n] \quad (4)$$

The Aggregate Demand for Labor Equations

$$L_k^D = \sum_{i=1}^{n} L_{ki} \qquad [2] \quad (5)$$

The Supply of Agricultural Labor Equation

$$L_1^S = \bar{L}^A \qquad [1] \quad (6)$$

The Supply of Nonagricultural Labor Equation

$$L_2^S = \bar{L}^N \qquad [1] \quad (7)$$

The Labor Market Equilibrium Conditions

$$L_k^D = L_k^S \qquad [2] \quad (8)$$

3.2.3 Factor Incomes

Wage Income Equation

$$R_L = \sum_{i=1}^{n} \sum_{k=1}^{m} W_k L_{ki} \qquad [1] \quad (9)$$

Non-wage Income Equation

$$R_K = \sum_{i=1}^{n} (PN_i X_i - \sum_{k=1}^{m} W_k L_{ki}) \qquad [1] \quad (10)$$

3.2.4 Income Distribution

Household Income Equations

$$R_H = \upsilon_H R_L + \omega_H R_F + (1 - \omega_F) R_K \qquad [2] \quad (11)$$

After-Tax-Household Income Equations

$$R_{NH} = (1 - \phi_H) R_H \qquad [2] \quad (12)$$

Firm Income Equation

$$R_F = \omega_F R_K \qquad [1] \quad (13)$$

After-Tax-Firm Income Equation

$$R_{NF} = (1 - \phi_F)\left[R_F - \omega_H R_F\right] \qquad [1] \quad (14)$$

Government Income Equation

$$R_G = \sum_{H=1}^{2} \phi_H R_H + \phi_F R_F + \sum_{i=1}^{n} tm_i \bar{PW}_i ER \cdot M_i - \sum_{i=1}^{n} te_i PWE_i ER \cdot E_i + \sum_{i=1}^{n} td_i X_i^S PD_i \qquad [1] \quad (15)$$

3.2.5 Savings and Investment

Household Savings and Investment Equation

$$INV_H = \bar{S}_H R_{NH} \qquad [2] \quad \textbf{(16)}$$

Firm Savings and Investment Equation

$$INV_F = \bar{S}_F R_{NF} \qquad [1] \quad \textbf{(17)}$$

Government Savings and Investment Equation

$$INV_G = \bar{s}_G R_G + ER \cdot B \qquad [1] \quad \textbf{(18)}$$

Total Investment Equation

$$TINV = \sum_{H=1}^{2} INV_H + INV_F + INV_G \qquad [1] \quad \textbf{(19)}$$

Investment Equations: by sector of origin

$$Z_i = \sum_{i=1}^{n} s_{ij} TINV \qquad [n] \quad \textbf{(20)}$$

3.2.6 Product Demand

Total Consumption Equations

$$C_i = \sum_{H=1}^{2} C_{iH} + C_{iG} \qquad [n] \quad (21)$$

Household Consumption Equations

$$C_{iH} = b_{iH}(1 - \bar{S}_H)\frac{R_{NH}}{P_i} \qquad [2n] \quad (22)$$

Government Consumption Equations

$$C_{iG} = b_{iG}(1 - \bar{S}_G)\frac{R_G}{P_i} \qquad [n] \quad (23)$$

Intermediate Demand Equations

$$V_i = \sum_{j=1}^{n} a_{ij} X_j \qquad [n] \quad (24)$$

Composite price Equations

$$P_i = \frac{PD_i + PM_i \cdot M_i / D_i}{f_i(M_i/D_i, 1)} \qquad [n] \quad (25)$$

3.2.7 External Market

Import Price Equations

$$PM_i = \overline{PW}_i (1 + tm_i) ER \qquad [n] \quad (26)$$

Import Demand Functions

$$M_i = \left(\frac{\delta_i}{1 - \delta_i} \right)^{\sigma_i} \left(\frac{PD_i}{PM_i} \right)^{\sigma_i} D_i \qquad [n] \quad (27)$$

Export Price Equations

$$PWE_i = \frac{PD_i}{(1 + te_i) ER} \qquad [n] \quad (28)$$

Export Demand Functions

$$E_i = \overline{E}_i \left(\frac{\Pi_i}{PWE_i} \right)^{\eta_i} \qquad [n] \quad (29)$$

Balance-of-Trade Equation

$$B = \sum_{i=1}^{n} \overline{PW}_i \cdot M_i - \sum_{i=1}^{n} PWE_i \cdot E_i \qquad [1] \quad (30)$$

3.2.8 Product Market Equilibrium

Domestic Demand Equations

$$D_i = d_i \cdot (Z_i + C_i + V_i) \qquad [n] \quad (31)$$

Domestic Use Ratio Equations

$$d_i = \frac{1}{f_i(M_i/D_i, 1)} \qquad [n] \quad (32)$$

Total Demand Equations: Domestically Produced Goods

$$X_i^D = D_i + E_i \qquad [n] \quad (33)$$

Product Market Equilibriums

$$X_i^D - X_i^S = 0 \qquad [n] \quad (34)$$

3.2.9 Normalized Equation

$$\sum_{i=1}^{n} \Omega_i P_i = \overline{PI} \qquad [1] \quad (35)$$

There are 20n + 22 equations. Of these only 20n + 21 are independent (by Walras'law) in this static CGE model. The list of all endogenous and exogenous variables, parameters, and coefficients are presented in the **Tables 3.1** and **3.2**.

Table 3.1: Description of Endogenous Variables.

Symbol	Number	Description
X_i^S	n	Domestic production by sector
PN_i	n	Net or value-added prices
PD_i	n	Prices of domestically produced goods
L_i	n	Aggregate labor by sector
L_{ki}	2n	Labor by category and sector (k = 1,2; n= 1,2,3)
L_k^S	2	Total supply of labor by category
L_k^D	2	Total demand for labor by category
W_1	1	Agricultural labor wage
W_2	1	Nonagricultural labor wage
R_L	1	Wage income
R_K	1	Non-wage (capital) income
R_H	2	Household income by category
R_F	1	Firm income
R_{NH}	2	Net household income by category
R_{NF}	1	Net firm income
R_G	1	Government income

Table 3.1: Description of Endogenous Variables (Cont.)

Symbol	Number	Description
INV_H	2	Household investment
INV_F	1	Firm investment
INV_G	1	Government investment
B	1	Balance-of-payment deficit or foreign savings
$TINV_j$	1	Total investment by institutions: households, firm and government
Z_i	n	Investment by sector of origin
C_i	n	Total sectoral consumption
C_{iH}	2n	Household consumption by category
C_{iG}	n	Government consumption
V_i	n	Intermediate demand
P_i	n	Composite commodity prices
PM_i	n	Import prices
M_i	n	Imports
PWE_i	n	Export prices
E_i	n	Exports
D_i	n	Total demand for domestic use
d_i	n	Domestic use ratio
X_i^D	n	Total demand

Total number of endogenous variables = 20n + 21

Table 3.2: Description of Exogenous Variables, Parameters, and Coefficients.

Symbol	Description
$\bar{A}_i$	Productivity parameter
$\bar{K}_{qi}$	Aggregate capital stocks by category and sector
a_{ji}	Fixed input-output coefficients
td_i	Indirect tax rates
$\bar{L}^A$	Fixed supply of agricultural labor
$\bar{L}^N$	Fixed supply of nonagricultural labor
υ_H	Household group's share of wage income
ω_H	Household group's share of total dividends
ϕ_H	Income tax rates
ω_F	Firms'share of non-wage (capital) income
ϕ_F	The corporate tax rate
tm_i	The tariff rate
$\overline{PW}_i$	The world price of imports i.e., in "dollars"
te_i	The export subsidy rate or export tax rate
ER	The exchange rate
$\bar{S}_H$	Savings rates out of household incomes
$\bar{S}_F$	Savings rate out of firm income
$\bar{S}_G$	Savings rate out of government income

Table 3.2: Description of Exogenous Variables, Parameters, and Coefficients (Cont.)

Symbol	Description
s_{ij}	The capital composition coefficients
b_{iH}	The constant household expenditure shares
b_{iG}	The constant government expenditure shares
δ_i	The share parameter in the CES trade aggregation
σ_i	The trade substitution elasticity
$\bar{E}_i$	A constant term reflecting total world demand for commodity category i and the country's market share when $\Pi_i = PWE_i$
Π_i	An average world price for commodity category i
η_i	The price elasticity of export demand
Ω_i	The weights for the price index ($\Sigma_i \Omega_i = 1$)
$\bar{PI}$	The price level

3.3 Model Description

Each subsection in **Section 3.2** is elaborated with special reference to the Thai economy.

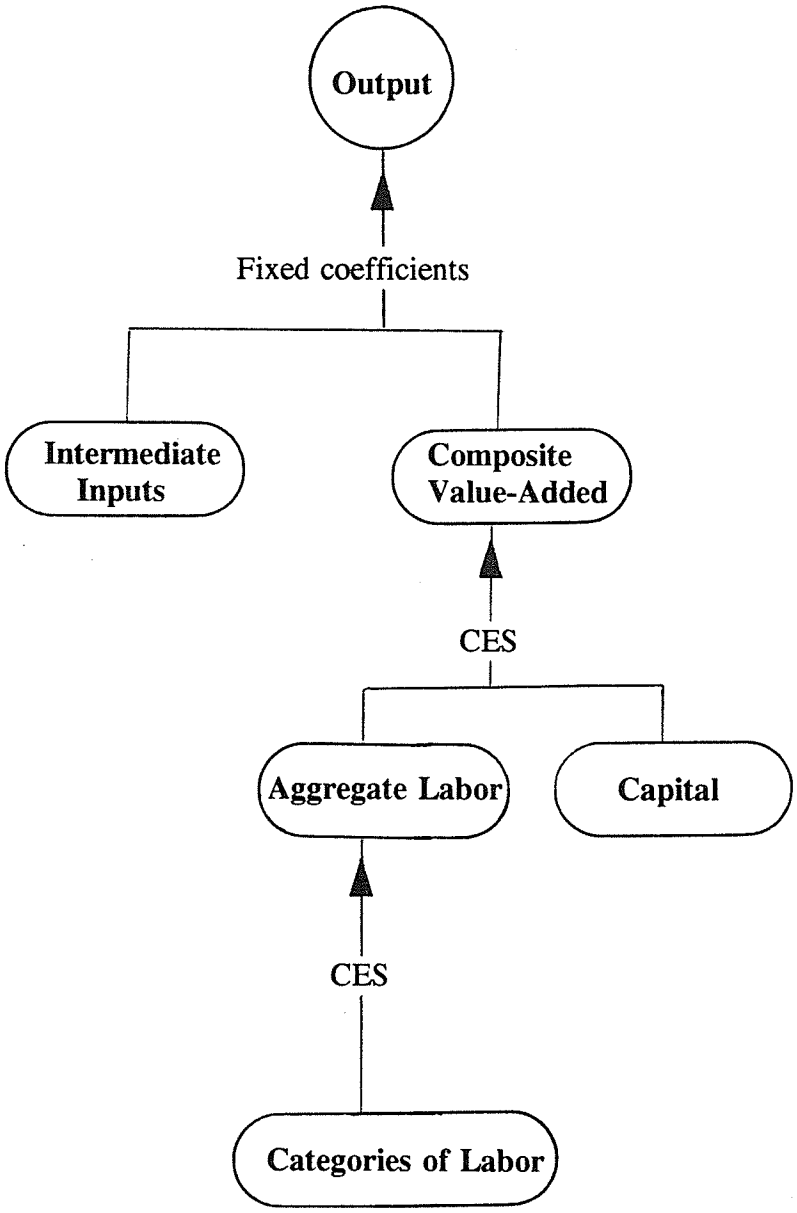
3.3.1 Production

The three aggregate production sectors are agriculture, industry, and services. Each sector employs capital, labour, and intermediate inputs. The intermediate inputs in each sector are combined with composite value added (capital and labor) in fixed proportions (Leontief input-output coefficients). However, there are substitutabilities between the factors of production (among two categories of labor: agricultural and nonagricultural, and between aggregate labor and sectoral specific capital) that depend on the relative prices of the factors. These are represented by constant elasticity of substitution (CES) production functions. A two stage CES production function is used for all sectors. Each stage of production has unique elasticities of substitution for different combination of inputs. **Figure 3.1** illustrates the structure of this production process. Given the CES production function, the input (labor) demand functions may be derived from the behaviour of profit maximization. These demand functions are used to specify the non-empty cells of the SAM that correspond to a payment from the sector of production to the input factors.

3.3.2 Factor Markets

The model assumes that the two types of labor, agricultural and nonagricultural, are freely mobile across sectors and enter into production along with capital which is sectorally specific and fixed. Profit maximization implies that the aggregate demand for

Figure 3.1: An Illustration of a Two Stage CES Production Function



labor of different categories is obtained by solving equation (4) and summation across production sectors [equation (5)]. Within the period, supply of both agricultural and nonagricultural labor are fixed exogenously. Wages in both markets are determined by the demand and supply of labor.

3.3.3 Factor Incomes

Levels of output, employment, and sectoral product prices determine factor remunerations: wage and non-wage incomes. Wage income in equation (9) results from the labor demand functions whereas the non-wage income or the profit from sectoral capital stock within a time period is determined residually [equation (10)].

3.3.4 Income Distribution

Household income for both rural and urban categories is derived from factor ownership. In this case, it is the sum of the share of wage income (υ_H and $\Sigma_H \upsilon_H = 1$), dividend (ω_H) of household groups, and the portion of profit accruing from household capital owned ($1-\omega_F$) [Equation (11)].[21] Equation (12) determines the after-tax-household income or disposable household income.

Firms aggregated into a single "firm" in this model. The firm owns a portion of total capital stock, denoted by ω_F. Firm income is derived using this share, and is represented by Equation (13). Since shareholders of the firm are households, a portion of firm income will be distributed to households as dividends ($\omega_H R_F$). The remainder is the retained earnings or net profit of the firm ($R_F - \omega_H R_F$). After subtracting corporate

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21 Government transfers and/or returns on household and firm investment in government assets i.e. bond can be incorporated into equations (11) and (13).

taxes from equation (13), it becomes equation (14) which represents aggregate net firm income.[22]

The government earns revenue from both direct and indirect taxes. Direct taxes accrue mainly from income taxes and corporate taxes whereas indirect taxes accrue from business and sales taxes, export taxes and tariffs [equation (15)].

3.3.5 Savings and Investment

In addition to government and private corporate savings, households save a fixed proportion of their disposable income.[23] The current account deficit (B, in foreign currency) is financed by foreign savings which adjust to balance the current account. Total savings are equatable with the level of investment [equation (19)]. Total savings are translated into investment by sector of origin using the capital composition coefficients (s_{ij}) in equation (20).[24]

3.3.6 Product Demand

An underlying assumption of this model is that the consumption behavior of each

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22 The model assumes that firm does not consume. The firm's activities are considered only with respect to savings and investment.

23 Households savings (equation 16) and firm savings (equation 17) can be broken down into two parts in the context of investment: own-investment, and investment in government assets i.e., bonds which are mentioned in footnote 21.

24 If the amount of capital formation in each sector which comes from total savings is known (i.e., by fixed share parameters), it is called "investment by sector of destination". If it is not known, and if total savings are spent on commodities produced by those sectors this implies that the sectors have to increase production and in turn investment. This is called "investment by sector of origin".[see Drud, and other (1986)]

household can be explained by the following linear expenditure system (LES)[25] :

$$P_i C_{iH} = \varphi_i P_i + \xi_i [b_{iH}(1-\bar{S}_H)R_{NH} - \Sigma_j \varphi_j P_j]$$

In this LES, each household group has a committed expenditure ($\varphi_i P_i$) for a certain number of units for each commodity (φ_i), known as 'minimum expenditure'. The amount that remains after the committed expenditures [$b_{iH}(1-s_H)R_{NH} - \Sigma_j \varphi_j P_j$], is known as 'supernumerary income'. Supernumerary income is allocated to the various commodities according to a fixed share (ξ_i). Thus, disposable household income less savings, and output prices (P_i) in equation (22) determine the demand for all commodity groups.

Government consumption, by commodity group in equation (23) is determined exogenously by the expenditure share parameter (b_{iG}).

Sectoral production levels (X_j) and the input-output coefficients (a_{ij}) described in equation (24) determine the demand for composite intermediate inputs.

Armington (1969) formulated composite commodity categories across countries with product differentiation by country, under a partial equilibrium framework. The CGE model in this study is design with the basic objective of defining a "composite" commodity (Q_i) that is a CES function of commodities produced abroad or imports (M_i), and commodities produced at home (D_i),

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25 The LES may be too restrictive for its applications i.e. it is derived from a directly additive utility function; goods cannot be inferior; and $0 < \xi_i < 1$, $\Sigma_i \xi_i = 1$. It is employed in this model due to its availability in the software (HERCULES). See Phlips (1983), pp. 122-32; Deaton and Muellbauer (1980), chapter 5.

$$Q_i = \gamma_i[\delta_i M_i^{-\rho_i} + (1-\delta_i)D_i^{-\rho_i}]^{-\frac{1}{\rho_i}}$$

where γ_i, δ_i, and ρ_i are parameters of the CES function in sector i, with $1/1+\rho_i = \sigma_i$ defining the elasticity of substitution between imported and domestically produced commodities. M_i and D_i are like inputs "producing" the composite output. The ratio of M_i to D_i is determined by relative prices. Sensitivity of this ratio to variations in relative prices is directly affected by the elasticity of substitution.[26] If domestic prices rise, then a given unit of the composite commodity will tend to contain more imports. The elasticity of substitution will influence the degree to which import shares will respond to changes in the relative prices of domestically produced and imported commodities. This reflects the fact that the imports and domestic commodities are not perfect substitutes.

The price of the composite output (P_i) relates to the price of imports (PM_i) and the price of domestic goods (PD_i). It is derived from minimizing cost subject to the CES aggregation function:

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26 The ratio (M_i/D_i or m_i) can be derived from the concept of cost minimization subject to the aggregate CES function and the outcome is obtained as follows:

$$m_i = \frac{M_i}{D_i} = \left(\frac{PD_i}{PM_i}\right)^{\sigma_i} \cdot \left(\frac{\delta_i}{1-\delta_i}\right)^{\sigma_i}$$

$$P_i = \frac{1}{\gamma_i}[\delta_i{}^{\sigma_i} PM_i^{1-\sigma_i} + (1-\delta_i)^{\sigma_i} PD_i^{1-\sigma_i}]^{\frac{1}{1-\sigma_i}}$$

The above equation therefore represents an alternative to equation (25) in the model.

3.3.7 External Market

The demand for imports (equation 27) is derived in the same way as the demand for factor inputs, using a traditional CES function.

Government policy can directly affect import prices. Adopting the small country assumption, world prices ($\overline{PW_i}$) are fixed. Denoting ad valorem tariffs by tm_i, and the exchange rate by ER, the import prices of commodities, by sector, for any given time period are determined by equation (26).[27] In the CES formulation adopted here, not only the prices of nontradable commodities but also the prices of domestically produced tradables are variable and not tightly controlled through tariff policy. Prices will however be influenced by changes in the prices of imported commodities due to tariff changes or exchange rate adjustment.

In this model, import supply is perfectly elastic. Thus, any import quantity can be bought at a fixed world price ($\overline{WP_i}$) measured in terms of foreign currency.

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27 PD_i is free to vary so as to equate the supply and demand for domestically produced goods which are sensitive to the ratio PM_i/PD_i. In pure trade theory there is no distinction between the foreign and domestic components with a given sectoral aggregation and results in $PM_i = PD_i = \overline{PW_i}(1-tm_i)ER$. Thus, domestic supply and demand play no role. This is not the case for product differentiation of aggregated commodities.

If Thailand's export prices are fixed in the world markets, independent of the quantities exported under the small country assumption, they will not be consistent with the specification of product differentiation and imperfect substitution on the import side. Given the assumptions of product differentiation and imperfect substitution (by the country of origin), it can be argued that a world price does not exist for Thai export (as an individual country). Rather an aggregate world price exists for a certain commodity category (Π_i), due to the CES aggregation of various components categorized by the country of origin. Thus the world price facing the buyer of a country's specific product can be represented by equation (28). Equation (28) implies that export price can be lower or higher than the domestic price depending on whether te_i is an export subsidy or the export tax for E_i is greater than zero.

The quantity of export demand (E_i) is a function of the level of world demand for the aggregate commodity in question. The ratio of aggregate world price (Π_i) to the country's export price (PWE_i) reflects international production costs, trade policies and export prices. Assuming the world is a single country which consumes products according to the rule of cost minimization subject to the CES composite commodity principle, then equation (29) represents the demand function for Thailand's output.

Demand for exports characterized by a constant elasticity of demand will depend on the relative prices between the domestic price and the world price (both are expressed in foreign currency via a fixed exchange rate). If the elasticity is infinite, the small country assumption holds, and the world price directly determines domestic price.

The supply of exports is equal to total domestic production net of domestic use and will therefore rise with increases in PD_i. Exports are determined by the interaction of domestic supply and foreign demand. Foreign demand and domestic supply elasticities jointly determine the sensitivity of exports to changes in relative prices.

The balance of trade equation (30) determines the net demand for foreign exchange. This model assumes that the exchange rate is fixed, thus foreign savings or capital inflow (B) must adjust to maintain the balance of trade. Alternatively, if foreign savings are fixed, the exchange rate must adjust keep the balance of trade in equilibrium.

3.3.8 Product Market Equilibrium

Demand for a domestically produced commodity (D_i) consists of consumer demand (C_i), intermediate demand (V_i), and investment demand (Z_i). Domestic demand and import demand (M_i) constitute a composite demand (Q_i) with a composite price P_i which are aggregated under a CES function. The domestic use ratio (d_i or D_i/Q_i) can be obtained by transforming m_i to d_i, since Q_i is linearly homogeneous in M_i and D_i. Therefore, equation (32) can be derived allowing domestic demand, by sector, to be determined in equation (31).

Total demand for output is the sum of domestic demand (D_i) and exports (E_i). Equation (34) determines the product market equilibrium by equilibrating prices. Relative prices that clear the commodity markets are thereby obtained. This allows demand to be equated with supply through the selection of a numeraire, or a normalized price equation.

3.3.9 Normalization Equation

A general equilibrium model usually determines relative prices only. It, therefore requires an additional normalization equation to fix the absolute price level. In this model, the normalization equation requires the weighted sum of domestic and import prices to be equal to a predetermined price index, $\overline{PI}$. Equation (35) in the model can be written explicitly as follows:

$$\sum_{i=1}^{n} PD_i\left(\frac{D_i}{\Sigma_i D_i + \Sigma_i M_i}\right) + \sum_{i=1}^{n} PM_i\left(\frac{M_i}{\Sigma_i D_i + \Sigma_i M_i}\right) = \overline{PI}$$

$\overline{PI}$ is thus self-generated through a system of equations in the model. Relative price adjustments in this model have no monetary implications. Monetary changes that might occur are assumed to be counteracted by the central bank (Bank of Thailand).[28]

3.4 Conclusions

The core of the CGE model for Thailand consists of a reconciliation of demand and supply by price adjustments. Price adjustments arise through the operation of the competitive markets for labor, commodities, and foreign savings. The model is developed to capture the structural and behavioral characteristics of the Thai economy. By selecting

28 Exogenous inflation can be introduced into the model by letting $\overline{PI}$ grow over time at a predetermined rate. However, inflation is not incorporated into this model.

appropriate macro-closure rules[29], the model can determine wages, profits, product prices and foreign savings, sectoral production, import, export, employment, consumption, investment, GDP, and the distribution of income. Hence, an ADLG strategy can be analyzed by introducing policy shocks.

29 In the core of the CGE model, the all flow-of-funds accounts must be specified in the system (i.e., no leakages). This involves the macroeconomic problem of reconciling aggregate savings and investment which is discussed in **Chapter V**.

IV. THAI ECONOMY AND THE DATA BASE

4.1 Introduction

This chapter briefly presents the main features of the Thai economy and its development in recent years. It then explains the 1980 SAM database and goes on to discuss other relevant information such as elasticities, parameters and coefficients required for CGE modelling. Finally, this chapter includes some remarks on the sources and availability of predetermined values.

4.2 Recent Thai Economy

Over the past three decades the Thai economy, on average, has grown at the rate of 7 percent per year. Between 1987 and 1991, the growth of GDP averaged 10.7 percent. Moreover, the structure of economy has evolved from dependence on primary commodities, to a diversified economy based on agriculture, industry, and services.

The most striking features of Thailand's recent growth have been the increase in both agricultural and manufactured exports; between 1987 and 1991 total exports rose by 24.7 percent per year. Manufacturing is the more dynamic of the two export sectors, with earnings of 377.5 billion baht in 1990. The growth of the manufacturing sector has been remarkable. In 1970 manufacturing accounted for 20 percent of GDP, but by 1989 it contributed 31 percent of GDP and had surpassed agriculture as the largest sector of the economy. **Table 4.1** gives a general socio-economic profile of Thailand.

Table 4.1: Thailand: Basic Socio-economic Data, 1989 (Unless Otherwise Noted)

Area (sq. km.)	513,000.0
Agricultural land (percentage of land area)	40.5
Forest land (percentage of total area, 1980)	29.0
GDP at current price (billion baht)	1,772.2
GNP per capita (baht)	31,528.0
Real GDP growth rate at 1972 prices (percent)	12.0
Agriculture as percentage of GDP	15.0
Manufacturing as percentage of GDP	21.0
Population (millions)	55.9
Percentage of population in urban areas	22.0
Population of capital city as percentage of urban (1990)	57.0
Population growth rate (percent, 1980-89)	1.9
Urban growth rate (percent, 1980-89)	4.7
Age structure of population (percent)	
0-14 years	33.6
15-64 years	62.2
Total fertility rate@	2.5
Life expectancy at birth (years)	66.0
Infant mortality (per thousand live births)	29.0
Daily per capita supply of calories (1988)	2,287.0
Medical care as percentage of GDP (1985)	3.5
Population per physician (1984)	6,290.0
Population per nursing person (1984)	710.0
Education expenditure as percentage of GDP (1985)	3.3
Primary school enrolment (percentage of school-age group, 1987)	95.0
Secondary school enrolment (percentage of school-age group, 1987)	28.0
Adult literacy (percent)	91.0
Commercial energy consumption per capita (kg. of oil equivalent)	330.0
Labor force (millions, 1985)	29.0
Labor participation rate (percentage of labor force, 1985)	52.8

Sources: World Bank (1991)
Bank of Thailand (1990)
TDRI (1990)

Note: 25.68 baht = 1US$ (1989)
@ The average number of children that would be born alive to a woman during her lifetime if she were to bear children at each age in accordance with prevailing age-specific fertility rates.

Agriculture: Currently agriculture's share of GDP is relatively small and has been declining. However, historically the strength of the Thai economy has been its agricultural resource base. Agricultural exports were a major source of foreign exchange earnings from 1954 to the early 1980s. This performance was particularly strong in light of the explicit export taxes which penalized primary producer incentives and incomes. Although the growth of agricultural outputs gradually diminished due to decreasing viability of new arable land, agriculture is still an important sector of the economy. In 1990 it accounted for 14.4 percent of GDP and nearly 22.6 percent of exports. The agricultural sector also remains the most important source of employment.

Industry: Even though primary commodities are still an important part of Thailand's exports, the burgeoning industrial export sector promises to be the driving force for future economic growth. In 1989 export earnings from textiles and integrated circuits alone almost equalled earnings from rice, tapioca, and rubber, the main agricultural exports. Growth of the industrial sector has been largely spurred by foreign investors who have recognized the advantages of low labor cost in Thailand. The output of the relatively young industrial sector concentrated principally in and around the Bangkok metropolitan region, includes textiles, leather products, wood products, footwear, chemicals, electronics, electrical machinery, and jewelry. Since 1986, some

firms have shifted from light manufacturing to more advanced products such as electronics and automobile assembly.

Services: During 1987-1989, services on average grew 11.0 percent per year. Trade in services has grown very rapidly since the 1980s. The most rapidly growing service sectors in terms of income are tourism, labor performed by Thai workers abroad as measured by remittances (especially the Middle East), and transportation. Income from tourism grew, on average, 10 percent per year between 1980 and 1985 and accelerated to 34 percent per year between 1986 and 1988. Remittances from abroad grew slowly during the second half of 1980s. Income from transportation grew rapidly at 72 percent during 1986-88. In terms of payments, the most important sectors were banking and finance which accounted for 57.5 percent of all payments in services in 1988.

Macroeconomic Adjustment: Domestic and international conditions in the mid-1970s necessitates changes in the government's monetary and fiscal policies. A relaxed monetary policy coupled with increased foreign commercial loans were accompanied by expansionary fiscal policies. In the late 1970s, world prices of primary Thai exports fell, eliminating Thailand's foreign exchange reserves. The second oil price shock in 1979-1980 had a profound effect on a more vulnerable economy. Oil import expenses rose dramatically, resulting in a current account deficit. In response to this situation, the government launched a series of adjustments to reestablish macroeconomic stability in the 1980s. The government cut spending, and implemented stringent tax collection measures. The baht was devalued three times: in 1981, 1984, and 1985. The government reduced external borrowing, and adjusted domestic oil prices upwards to reflect world

prices. To promote economic growth, the import substitution industrialization strategy was abandoned in favor of an export-oriented strategy. The government's decision to promote free enterprise led to an expansion of the industrial base that was magnified further by stimulation from foreign investment.

Outlook: Recent growth has occurred against a background of accelerating transition from an economy based on agriculture to one based on industry. This is reflected by the disparity in 1990 growth rates for the two sectors: manufacturing grew at the rate of 14 percent, while the growth rate for agriculture decreased by about 2 percent. Thus industry, particularly export oriented industry, has been the primary engine of the country's extraordinary growth recently. Factors contributing to business confidence in the economy were: the availability of a low-cost labor force, a realistic exchange rate policy, and the government's commitment to a policy of free enterprise.

Thailand's economy in the 1990s will be challenged by internal and external conditions. Internal factors consist of a severely limited infrastructure (communication and transportation systems, power and water supplies), depletion of natural resources: water, forest, and fishing grounds, environmental problems (water, air, and noise pollution) and how quickly policies respond to changing situations. External factors include incentives for foreign investment, world economic recovery, worldwide trade protectionism, technological change and adaptability, the low labor costs in other countries, and the volatility and long-term trends of commodity prices.

4.3 A SAM: Data Base for the Model

The base year data set that will be used is the 1980 SAM, drawn from Drud, Grais, and Pyatt (1986). This SAM is rearranged and adjusted to a framework that is compatible with the CGE model used in this study. The SAM data base presented in **Table 4.2** is a simplified description of the Thai economy that represents economic flows at a particular point in time. A figure in a cell is a payment from the column account to the row account. For example, the intersection of column 10 and row 5 is a payment by government to rural households, i.e., a transfer payment (0.5 billion baht). Another accounting feature intrinsic in a SAM is that all accounts must balance; each column total must be equal to the corresponding row total. For example, the summation of values in row 5 shows total rural household income (289 billion baht) and column 5 dispenses this amount of income on different items within the column. **Appendix A** elaborates some details of 1980 SAM database.

4.4 Sources of the Elasticities

Ideally, the elasticities required for this CGE model are the elasticities of factor substitution in CES production functions, domestic-import substitution elasticities, and export demand elasticities. Given the limited scope of this study and data constraints, it is not possible to conduct a full-scale estimation. Plausible values from existing literature sources and reasonable guesses will be incorporated. **Table 4.3** contains the elasticities to be used in running the model.

Table 4.2 Social Accounting Matrix, 1980 (billion baht)

		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	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
		Factors of Production				Institutions								Savings Account				Investment Account				Production Account									Commodity Account													Rest of the World	TOTAL
		Agr. L	Nag. L	Agr. C	Nag. C	Ru-H-In	Ru-H-Co	Ur-H-In	Ur-H-Co	Firms	Govt.In	Govt.Co	Indr.Tx	Ru-H-Sa	Ur-H-Sa	Firm-Sa	Govt-Sa	Ru-H-Iv	Ur-H-Iv	Firm-Iv	Govt-Iv	V-L-Agr	V-L-Ind	V-L-Ser	V-KL-Ag	V-KL-In	V-KL-Se	Act-Agr	Act-Ind	Act-Ser	Agr-Doms	Agr-Exp	Agr-Imp	Ag-Comp	Ind-Doms	Ind-Exp	Ind-Imp	In-Comp	Ser-Doms	Ser-Exp	Ser-Imp	Se-Comp		
1	Agr. L																					136	40	64.5																				240.5
2	Nag. L																					5	52	126.5																				183.5
3	Agr. C																								35																			35
4	Nag. C																									61	82																	143
5	Ru-H-In	240.5		25	20						0.5																																	2	289
6	Ru-H-Co					253																																						253
7	Ur-H-In	103.5	10	41						3	0.5																																3	241
8	Ur-H-Co							190																																				190
9	Firms				78	2		4			18																																		94
10	Govt.In				4	4		5		10			71																															3	97
11	Govt.Co										83																																		83
12	Indr.Tx																														2	3			29	0	19			17	0	0			71
13	Ru-H-Sa					30																																						30
14	Ur-H-Sa							42																																				42
15	Firm Sa									80																																		80
16	Govt-Sa										3																																		3
17	Ru-H-Iv													18																															18
18	Ur-H-Iv														22																															22
19	Firm-Iv															60																													60
20	Govt-Iv													12	20	20	3																											34	89
21	V-L-Agr																								141																				141
22	V-L-Ind																									92																			92
23	V-L-Ser																										191																	191
24	V-KL-Ag																											176																176
25	V-KL-In																												153															153
26	V-KL-Se																													273														273
27	Act-Agr																														227	74												301
28	Act-Ind																																	462	59									521
29	Act-Ser																																				416	32						448
30	Agr-Doms																																	229										229
31	Agr-Exp																																										77	77
32	Agr-Imp																																	3										3
33	Ag-Comp					103			29			0						4			5	9						22	47	12														232
34	Ind-Doms																																				491							491
35	Ind-Exp																																									99	99
36	Ind-Imp																																				201							201
37	In-Comp					90			103			8						14	21	53	80							40	232	69														692
38	Ser-Doms																																							433				433
39	Ser-Exp																																									32	32
40	Ser-Imp																																								26		26
41	Se-Comp					60			58			75						0	0	0	0							63	89	116														429
42	Rest of the World																																2				182				26			210
43	TOTAL	240.5	183.5	25	143	289	253	241	190	94	97	83	71	30	42	80	3	18	22	60	89	141	92	191	176	153	273	301	521	448	229	77	3	232	491	99	201	692	433	32	26	459	210	

Source: Drawn from Brud, Drain, and Pyatt (1986), and modified for the purpose of this study.

Note: Factors of Production
Agr. L = Agricultural Labor
Nag. L = Nonagricultural Labor
Agr. C = Agricultural Capital
Nag. C = Nonagricultural Capital

Institutions
Ru-H-In = Rural Household Income
Ru-H-Co = Rural Household Consumption
Ur-H-In = Urban Household Income
Ur-H-Co = Urban Household Consumption
Govt. In = Government Revenue
Govt. Co = Government Consumption
Indr. Tx = Indirect Tax

Savings Account
Ru-H-Sa = Rural Household Savings
Ur-H-Sa = Urban Household Savings
Firm-Sa = Firm Savings
Govt-Sa = Government Savings

Investment Account
Ru-H-Iv = Rural Household Investment
Ur-H-Iv = Urban Household Investment
Firm-Iv = Firm Investment
Govt-Iv = Government Investment

Production Account
V-L-Agr = Value-Added Labor in Agriculture
V-L-Ind = Value-Added Labor in Industry
V-L-Ser = Value-Added Labor in Service
V-KL-Ag = Value-Added Capital and Labor in Agriculture
V-KL-In = Value-Added Capital and Labor in Industry
V-KL-Se = Value-Added Capital and Labor in Services
Act-Agr = Agricultural Production
Act-Ind = Industrial Production
Act-Ser = Service Production

Commodity Account
Agr-Doms = Domestic Agricultural Consumption
Agr-Exp = Agricultural Export
Agr-Imp = Agricultural Import
Ag-Comp = Agricultural Composite Commodity
Ind-Doms = Domestic Industrial Consumption
Ind-Exp = Industrial Export
Ind-Imp = Industrial Import
In-Comp = Industrial Composite Commodity
Ser-Doms = Domestic Service Consumption
Ser-Exp = Service Export
Ser-Imp = Service Import
Se-Comp = Service composite Commodity

Table 4.3: Elasticities Used in Model Calibration

Sector	Elasticities of Factor Substitution@		Import Demand Function*	Export Demand Function*
	L & L	Agg.L & K		
Agriculture	0.4	0.8	0.8	6.0
Industry	0.6	2.5	1.5	2.6
Services	0.5	3.0	3.0	2.3

Note: (1) @ Best guess based on varying these values during calibrations.

(2) * Drawn from Drud, Grais, and Pyatt (1986), p. 142.

(3) L & L means substitution between labor categories.

(4) Agg.L & K means substitution between aggregate labor and specific capital.

Elasticities of substitution between primary factors in equation (1) are unavailable. Some studies have set these values between 0.5 and 1.[30] Substitution parameters between different types of labor vary among sectors and in their degree of aggregation. For example, in the case of labor-intensive production, the values are relatively high while for capital-intensive production, the values may be relatively low. Moreover, if the wage is relatively fixed in environments governed by policy, labor-labor substitution parameters are not important under uniform wage indexation (assumed across various

30 Bandara (1989) reviews these elasticities from various sources.

types of labor). The magnitudes of elasticities of substitution in **Table 4.3** are thus dependent on selecting an appropriate set of values during the calibrations that render the base solution.

Elasticities of substitution between domestic and imported commodities in equation (27) are difficult to estimate due to the unavailability of time series data on: import prices and quantities, domestic prices and quantities, quantitative restrictions, and other factors causing seasonal fluctuations. Even though some recent CGE models developed for Thailand attempted to estimate these elasticities, (OAE, 1991), the classification of commodity categories varies from one study to another. Elasticity values for commodity categories from literature searches in some developing countries (i.e., South Korea, Turkey, India, Columbia, and Chile) vary mainly due to differences in aggregation of commodities, and are set between 1.5 and 5.0.

In practice, product differentiation causes the elasticity of substitution value between imports and domestic products to be fairly low. This study drew these values from a previous study on Thailand [Drud, Grais, and Pyatt (1986)] in the early 1980s, despite a lack of details regarding justification.

For the export demand elasticities in equation (29), world prices are relatively sensitive to Thai export volume of the commodity groups (especially agricultural commodities) even though, there is a differentiation between Thai exports and export of other countries. This model assumes that Thailand faces a constant elasticity demand function for its exports. If the demand elasticity is set at 0.20 (absolute term), then it resembles the 'small country' export criterion. However, product differentiation as well

as the level of aggregation within each sector also embody the values of these elasticities. To reflect the growth of Thai exports in the 1980s, for agricultural exports the value is set to 6.0, for industrial and service exports the elasticities of demand are fixed at 2.6,and 2.3 respectively.[31]

Household expenditure shares for consumption in equation (22) can be calibrated by HERCULES; but an expenditure commitment in a certain amount for each commodity group (with regard to the LES) must be specified from household survey data prior to calibration. This model assumes that a committed expenditure is three to five times higher than a discretionary expenditure. This variation depends on the types of households and commodities.

4.5 Parameters and Coefficients

The rest of the parameters i.e., technological progress, shares of household wage income, shares of household dividend, share of corporate profit, rates of savings by households, firm and government etc. in **Table 3.2** can be calibrated directly from the SAM database by HERCULES.

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31 Sussangkarn and others (1988) set these values as follows: the elasticities of traditional crops, nontraditional crops, nonagricultural commodities, and service are fixed at 5.0, 3.5, 1.5, and 0.3 respectively while Vongpradhip (1989) set 2.0 and 1.2 for agriculture and non-agriculture respectively.

4.6 Conclusions

The SAM framework principally provides data for the CGE model. Required information such as elasticities of substitution between primary factors, elasticities of domestic-import substitution, export demand elasticities, and other parameters were drawn from the literature, best guesses, estimated by econometric methods, or calibrated by HERCULES. However, before calibrating the SAM, the choice of closure rules is required for the model's solution and will be discussed in Chapter V.

V. CALIBRATION AND THE BASE SOLUTION

5.1 Introduction

This chapter is organized into five sections. The first section discusses the alternative choices of closure rules for the CGE model. The second section explains the implementation of GAMS/HERCULES. The calibration technique is outlined in the third section. Features of base solutions are highlighted in the forth section, followed by the conclusions in the final section.

5.2 The Closure Rules

Closure rules will depend upon the assumptions made with respect to the economic system, in particular the role of factor markets and the mechanism that balances saving and investment.[32] These assumptions will cause the number of equations to be equal to the number of endogenous variables in the model.

The CGE model discussed in Chapter III has a standard classical closure rule: total investment is determined by available savings. To render the analysis more practical for planning purpose, all three models assume that government investment is exogenously determined (i.e., by policy makers) or it is said to be 'investment driven'. Thus, the government savings rate and foreign savings inflow must adjust to equalize total investment-savings. Investments by households and firms are determined by available

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32 Changing the assumptions and the parameters of the model is called 'sensitivity analysis' and this qualitatively affects the results of model simulation.

savings (i.e., fixed shares of their savings).[33] Thus, the current account deficit is the residual that maintains the savings-investment balance (i.e., there will be a capital inflow or a foreign savings inflow). Model I assumes full employment for both agricultural and nonagricultural labor; therefore wages must adjust to clear the labor markets.

Model II assumes that the nonagricultural wage in Model I is fixed due to a legislated minimum wage. Model II therefore allows for unemployment and a Keynesian type of wage rigidity. The unemployed are extraneous to this model since only the employed earn incomes based on their factor ownership[34] In turn, this will be the functional income distribution.

Model III incorporates an additional assumption about the returns on nonagricultural capital. These returns are assumed to be equivalent to a fixed share of the total value of output produced in Model II. This implies that the industrial and service sectors are operating at levels below capacity. Therefore labor and capital are not substitutable. This situation existed in Thailand during the period of the import substitution strategy and the export promotion strategy. A further assumption is that demand for labor is a fixed per unit of output. This model is therefore driven by aggregate demand and hence embodies a Keynesian-type closure rule. **Table 5.1**

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33 This seems close to reality. Thus, the model is neither completely 'investment driven' nor 'savings driven'. Many studies assume either investment driven or savings driven.

34 This is the trade-off of CGE modelling at the macro-level. In reality, full employment and unemployment can be observed in different sectors. At the aggregate level of this study, both full employment and unemployment are therefore assumed.

summarizes the underlying assumptions of the model.

Table 5.1: Model Assumptions

Assumptions	Model I	Model II	Model III
1. Government Investment	fixed in all models		
2. Exchange Rate	fixed in all models		
3. Current Account	residual in all models		
4. Wage	adjusts to yield full employment	fixed nonagricultural wage rate	
5. Nonagricultural Capital			fixed share of total value of output

The equation that determines the numeraire is often defined contemporaneously with the closure rules. If factor price is exogenous, its value must be fixed relative to the numeraire. Thus, the choice of numeraire is often related to the specification of savings-investment behavior. The residual current account deficit is relevant to an open economy like Thailand. Thus, it is reasonable to use the nominal exchange rate (**ER**) as the numeraire in this CGE model. All prices will therefore be measured relative to world prices and the domestic price levels are based on a real foundation. It should be noted that the ultimate choice of the numeraire is often influenced by the causal relationships between price indicators. For example, if the wage rate is indexed on the CPI, then it is reasonable to use the latter as the numeraire.

The nominal exchange rate (**ER**), chosen as a numeraire in this general equilibrium framework, simplifies the interpretation of results from the policy simulation. In equations (26) and (35), all prices are measured relative to world prices ($\overline{\mathbf{WP}}$) which, by modelling, are fixed relative to the fixed exchange rate (**ER**). Thus, a current account deficit (i.e., inflow foreign savings) adjusts total savings to achieve the desired investment. This is why a fixed nominal exchange rate is a broadly held assumption in CGE studies and is a standard assumption for model specification in the CGE software i.e. GAMS/HERCULES.[35]

5.3 The GAMS/HERCULES Software

HERCULES is a problem solving program and operates as a subsystem of GAMS.[36] In its application, HERCULES interfaces with GAMS only for data manipulation and report writing.[37] HERCULES is designed to organize and construct

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35 Alternative assumptions of a fixed nominal exchange rate are a flexible exchange rate and a fixed real exchange which require closure rules discussed in Section 2.6. Conceptually, there are at least six different approaches to exchange rate adjustments: monetary approach, partial elasticity approach, Keynesian multiplier approach, income-absorption approach, Keynesian policy approach, and purchasing-power-parity approach. See Krueger (1983), Bilson and Marston (1984).

36 There are quite a number of software packages for CGE models. The World Bank has developed three packages: one by Dervis, Melo and Robinson (1982); another is the TV method with the SAMLIB software by Drud, Grais, and Pyatt (1986); and a non-linear programming manipulated by the GAMS software in Brooke, Kendrick, and Meeraus (1988). The GAMS/HERCULES later was developed later and independently from the World Bank. Others are MPS/GE [Rutherford (1989)], and GEMPACK. See Bandara (1991), Robinson (1989) for extensive references.

37 GAMS stands for General Algebraic Modelling System and HERCULES stands for a High-level Economic Representation for Creating and Using Large Economy-wide Systems.

economy-wide models. The CGE model developed in Chapter III can be manipulated by HERCULES. The built-in HERCULES system contains a menu of about thirty-nine admissible functional forms that can be selected with regard to a model's design. The alternatives of closure rules can be chosen to compliment the scenarios to be investigated. The following briefly presents the main steps in the use of GAMS/HERCULES for solving the CGE model in this study.[38]

(1) The summation of non-empty cells of a SAM database in a given row must equal to those in the corresponding column. This means that accounts must be balanced. GAMS checks for internal consistency in a SAM before HERCULES executes the model. If errors exist, GAMS will give messages that correspond to the defective line number in the model program.

(2) To execute the model, HERCULES requires that the information be arranged as planes in a three dimensional array. The first plane is a SAM database as presented in **Table 4.2**. The second plane which corresponds to the first plane, specifies functional forms according to the underlying assumptions of the model. The third plane, also corresponds to the first two planes, and contains parameters that will be calibrated by HERCULES or explicitly specified by the modeller.[39]

(3) HERCULES solves the model and reports the results (base solution) through

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38 Drud and Kendrick (1990), vols.1 and 2 give details of HERCULES software. Especially, Chapters 1-3 of volume 1 present key concepts of HERCULES system.

39 This also includes the case when HERCULES cannot calibrate the parameters due to complex functional forms and the modeller has to specify certain values on this plane and/or the modeller wants to specify certain values in order to do sensitivity analysis.

GAMS.

(4) Policy simulations are initiated using the base solution.

5.4 The Calibration Technique

Calibration is performed in steps (2) and (3) discussed in **Section 5.3**. This procedure involves choosing the model's parameters, i.e., elasticities identified in **Table 4.3** and executing the model to obtain the base solution [Mansur and Whalley (1984); Whalley (1985)]. The model presumes that the SAM database (**Table 4.2**) is in equilibrium. This condition is called the 'benchmark' equilibrium. Values of the model parameters are selected to allow the model to replicate the benchmark data set or a SAM database to give the 'base solution'. Thus, the calibration procedure involves parameters drawn from outside the SAM/CGE framework. This is necessary when different functional forms such as CES and LES are introduced into the CGE model. In practice, the calibration procedure involves a set of data for the particular year. An important consideration in calibration is that it depends completely on data for a single year.[40]

5.5 The Base Solution

Calibration renders the same 'base solution' for all three models. These are new SAMs replicated from the SAM database shown in **Table 4.2**. The new SAMs contain both calibrated and previously specified parameters. Base solutions may be obtained from

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40 Jorgenson (1984), Lau (1984) remark some issues emerging from calibration procedure.

different structural assumptions and predetermined values in calibration. The SAM contains only values and these values depend on prices and quantities. To utilize this SAM, all prices in the base case are set equal to one. Therefore the base SAM can be used to generate indices for policy simulation. **Appendix C1** presents an example of base solution for Model III.

5.6 Conclusions

There are no definite rules for selecting the closure rules. Behavior of the overall model critically depends on the closure rules. Structural specifications in the model and the subsequent solutions will be affected by these rules. Parameters used for calibration must be chosen to allow the model to reproduce the SAM database.

The study has thus far dealt with repeated calibrations (experiments) to determine the appropriate parameter values for the base solution. The next stage of the analysis involves policy simulations which are the subject of **Chapter VI**.

VI. EMPIRICAL RESULTS

6.1 Introduction

Each model described in **Chapter V** was simulated and subjected to policy experiments and external shocks. This chapter begins with a schema of the simulations that were conducted. The section provides both an analysis and a comparison of results from model simulations. In the third section, the results from simulations of models that incorporated different combinations of policy changes are presented. The fourth section compares these findings with other studies. Conclusions drawn from the empirical analyses are provided in the final section.

6.2 The Schema of Simulation Implementation

Policy experiments were designed at an aggregate macro-level to reflect the recent and current economic situations facing Thailand.

6.2.1 Scenario I: An Increase of Agricultural Productivity

Agricultural yields in Thailand are low because farming practices in many parts of the country utilize outdated technology. Thus, there are many opportunities to improve productivity on a per unit of labor or per rai basis. The government has provided incentives to farmers to use inputs more efficiently through improved credit delivery mechanisms, the irrigation infrastructure, pricing systems, land ownership restructuring, research and extension services. Despite these programs, the government still faces the problem of allocating agricultural inputs and outputs efficiently due to resource constraints. At the farm level, individuals have different degrees of aversion to risk, and

resource constraints which will compel them to react differently to new policies and programs. This gap has been narrowed in recent years through private sector initiatives such a 'contract farming'.[41] Contracting farming integrates the above mentioned factors and forces is common in many areas of Thailand. The government has also promoted this type of agricultural development, particularly in select areas with a high potential for success. In the empirical model, the efficiency parameter, $\bar{A}$, in equation (1) captured the productivity change affected by labor and capital utilization. The model assumed that agricultural productivity increased 5 percent from the base value.

6.2.2 Scenario II: An Increase of Government Investment in the Agricultural Sector

Government investment in the agricultural sector is low relative to the industrial sector. The major portion of government investment in agriculture supports the development of the irrigation infrastructure. Research and development is also needed to enable Thai farmers to acquire more intensive farming methods. These factors directly enhance productivity in Scenario I. This involves the equations discussed in Section 3.2.3 (savings and investment) that determine the share of government investment among the three sectors (agriculture, industry, and services) in the SAM database. These shares are originally calibrated in the SAM database by the model. Increased investment in this model can be drawn from government debt (savings), and foreign loan (savings). Any changes in these shares due to policy shifts affects all three sectors. Therefore, increased

41 Contracting farming is an agreement between farmers and business firms to produce agricultural commodities under a guaranteed purchasing price. In many cases, firms provide inputs and supervise farmers through the production process.

government investment in agriculture was reflected in two steps: (i) an increased share of government contributions to agriculture from the base value; and (ii) exogenous government investment was allocated to those sectors based on the new shares in (i). The model assumed that the government increased total investment by 5 percent from the base value and reallocated these funds according to new schedule of investment which increased agriculture share by 10 percent.

As mentioned in footnote 24, an increase of government investment, in this case, is an increase of "investment by sector of origin" which means the government uses money [equation (18)] to purchase available agricultural and industrial commodities, and services. This induces greater production of these commodities (in the agricultural, industrial, and service sectors) which indirectly implies that there is capital formation in those sectors but the rate of capital formation remains unknown due to the unavailability of data. This is an indirect approach in incorporating investment into the CGE model when the rates of capital formation in the production sectors are not known.

6.2.3 Scenario III: Reduction of Agricultural Export Taxes

In the past, agricultural exports, especially rice and rubber, were heavily taxed as Thailand had a high comparative advantage. The high comparative advantage was due to cheap labor costs and the low cost of expanding arable land. This situation has changed recently. Other means of maintaining international competitiveness have to be found or Thailand will lose its ability to compete in the international markets. A possible solution might be a reduction of agricultural export taxes which would make the exports more competitive. Some export taxes (i.e., rice) have already been removed while others

remain in effect. This type of policy shift is consistent with Scenarios I and II mentioned above. Moreover, a reduction of export taxes is a rational policy response to the decline in agricultural world prices caused by the substantial subsidies used by developed countries. Protectionist sentiments may be addressed at the current round of GATT negotiations.

The agricultural export tax (te_i) was included in equation (28) of the model. The original value of the export tax rate was an average calibrated from the SAM database. The model assumed that the export tax rate was decreased by 30 percent from the base value.

6.2.4 Scenario IV: A Decrease in World Price of Agricultural Commodities

The economy of a nation must also make adjustments when faced with unforeseen external shocks. An example is the protection afforded agricultural sectors in industrial countries which in turn results in depressed world prices. The model assumed that the world price of agricultural commodities (WP_i) in equation (26) drops 5 percent from the base value. This scenario was based on a pessimistic view of the outcome at the GATT negotiations.

6.2.5 Scenario V: An Increase in World Price of Agricultural Commodities

This scenario was formulated under the optimistic expectation that GATT negotiations would result in increased trade liberalization.[42] The model assumed that only the world price of agricultural commodities (WP_i), in equation (26), increased 5

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42 Only those existing commodities exported i.e. rice, rubber, cassava, and fishery products which have comparative advantage over those of the rest of the world will benefit from rising world prices under trade liberalization.

percent from the base value.

6.2.6 Scenario VI: The Revaluation of Thai Currency (Baht)

This scenario simulated a rise of the exchange rate of baht. The model assumed the baht was revalued against foreign currencies by 5 percent from the base value (equation 26). This would cause higher Thai export prices (more expensive) for foreign buyers and decreased import prices (cheaper) for domestic buyers. In general, this situation tends to depress exports and to increase imports.

6.2.7 Scenario VII: The Devaluation of Thai Currency (Baht)

This was the opposite case of Scenario VI. The model assumed the baht was devalued against foreign currencies by 5 percent from the base value. This situation tended to encourage exports and depress imports.

It should be noted that **Scenario VIII** was a combination of Scenarios I, II, III, and IV; and could be called 'ADLG with pessimistic trade'. **Scenario IX** was a combination of Scenarios I, II, III, and V; and could be called 'ADLG with optimistic trade'. **Section 6.4** will elaborate on the combined policy simulations. **Figure 6.1** provides the schema of simulations for the three models.

6.3 Individual Policy Simulation

Policy simulation is a mechanism to compare different equilibrium states when the model was subject to changes in policy variables or exogenous shocks. This is sometimes termed 'counterfactual equilibrium analysis'. It presents a comparison between the status quo and the hypothetical situation that arises as a consequence of a substantial

policy change.[43] This section presents the results of seven policy simulations for each model. It should be mentioned, that the results of all simulations (scenarios) are compared with the base case. Even though the assumptions were changed with regard to **Model II** and **Model III**, all base cases remained the same (as in **Model I**) except for the calibration of a few new parameters. Since many variables were affected by policy simulation, only certain key indicators were used to analyze the major economic effects of each experiment.

6.3.1 Scenario I of Models I, II, and III

This section describes the results of increased agricultural productivity as detailed in Section 6.2.1. It operates through increased marginal products of aggregate labor and agricultural capital. **Appendix B** elaborates and interprets the implications of these changes. Since factor incomes are distributed on the basis of marginal products, the results from these changes were increases in the agricultural wage: 1.50 (I), 3.50 (II), 3.40 (III) and increases in the rental rate: 0.80 (I), 2.40 (II), 2.90 (III).[44] In other words, factor incomes of labor and capital in the agricultural sector in the three models showed corresponding increases with the new wage and rental rate.

Since agricultural and nonagricultural labor are substitutable and mobile across sectors and aggregate labor and nonagricultural capital are also substitutable, productivity changes in the agricultural sector had an impact on the nonagricultural sectors by

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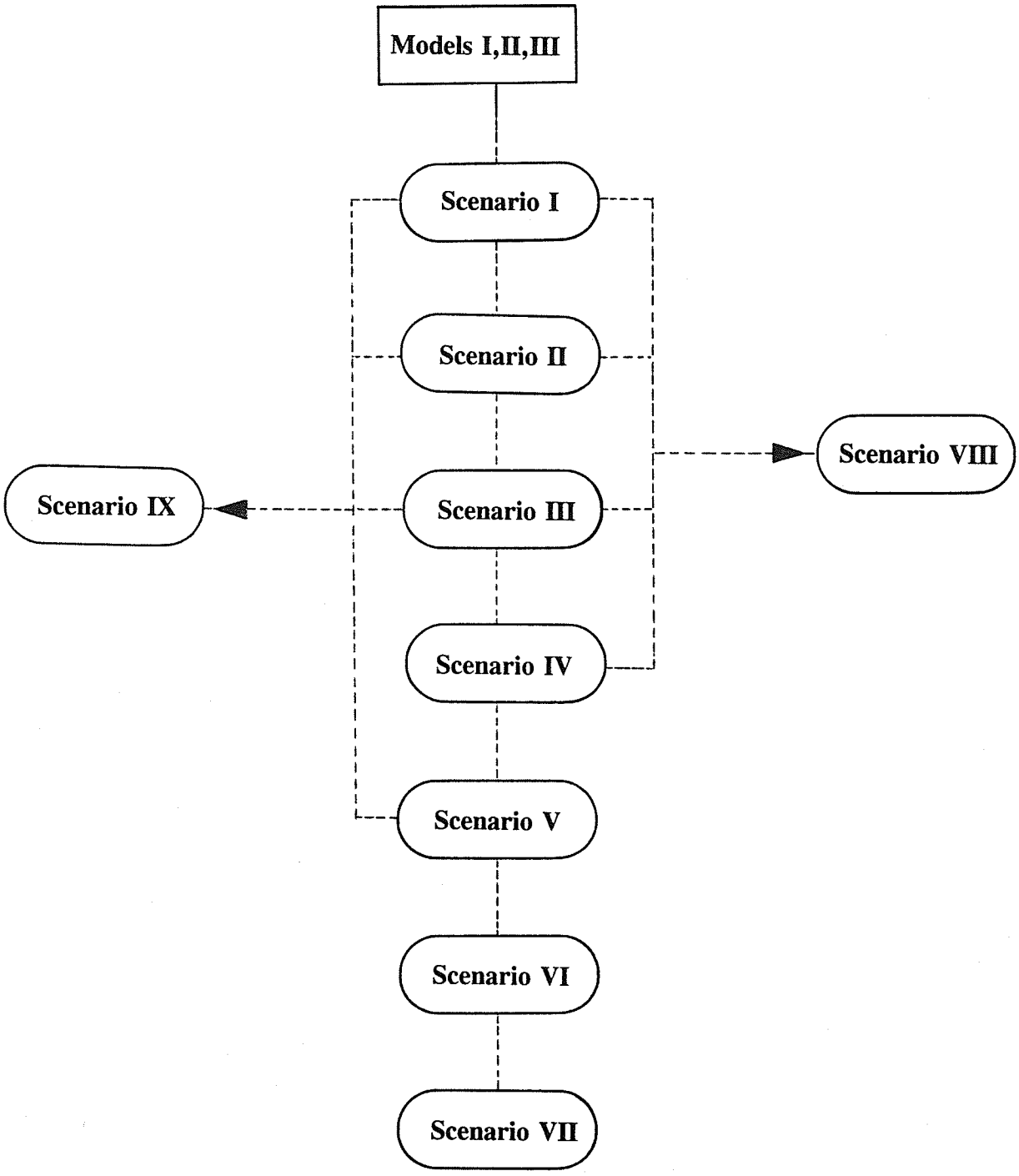
43 The nature and the magnitude of variations or changes imposed are at the discretion of policy makers, and usually are made to explore variations of goal or target variables.

44 For convenience in explanation, I, II, and III symbolize Models I, II, and III respectively and all figures are in percentage changes.

Figure 6.1: Schema of Policy Simulation



increased wages 5.20 (I) and rental rates 4.10 (I), and 2.50 (II). These factor prices did not change in Model III due to the specification of this model. Excluding Model III, all relative prices of inputs used in nonagricultural sectors increased as well as the output prices of nonagricultural commodities. As a result, household incomes, based on their factor ownership, increased 1.59 (I), 3.28 (II), and 3.34 (III) for rural households and 4.69 (I), 3.64 (II), and 3.42 (III) for urban households. Households spent the added incomes on taxes, consumption, and savings.

Increased agricultural productivity shifted the agricultural supply curve outward and to the right and price tended to decline. The decline of agricultural prices induced households to increase consumption of agricultural commodities. Since the major items in the consumption basket of rural households were the agricultural commodities, rural household CPI dropped 0.20 (I), 0.80 (II), and 1.00 (III). The urban household CPI increased 1.10 (I), 0.10 (II), but declined by 0.10 in (III), due mainly to a larger expenditures on nonagricultural goods at prices that were relatively higher than for agricultural goods.

If productivity increases such that it outweighs the producer's losses due to lower agricultural prices and the low income elasticity of demand for agricultural commodities, especially that for food, then the producer's income will increase. At the same time, urban households also gain from lower food prices. This was likely the expected results under Scenario I for all models. Considering the ratio of rural household income to urban household income, the ratios decreased 2.92 (I), 0.33 (II), and 0.08 (III). This meant that the absolute incomes of the household groups increased disproportionately with respect

to their factor incomes from wages and rental rates. Ratios of rural consumption to urban consumption decreased 1.73 (I) but increased 0.60 (II), and 0.83 (III) because increases in rural consumption in Models II and III were greater than urban consumption. Moreover, the purchasing power of rural households also increased due to a decrease in the rural CPI.[45] This implied that consumption shifted in favor of rural households in the case of Models II and III but against rural households in Model I. Full employment equilibrium (Model I) probably affected the above results: increases in the wage and rental rate in the nonagricultural sector were much greater than those in the agricultural sector.

In Models II and III, the ratios of income and consumption tended to shift in favor of rural households. Therefore, the results showed that income distribution between rural and urban households was affected by increased productivity in agricultural sector.

Government revenue increased 3.84 (I), 3.57 (II), and 3.87 (III) as higher household income increase direct tax revenue. The revenue from indirect taxes also increased due to higher levels in GDP. GDP at constant market prices increased 2.65 (I), 3.85 (II), and 4.30 (III).

All three sectors contributed to GDP growth in Model I but the composition of GDP changed. Agriculture's share increased 5.18 (I) and the shares from industry and services declined 1.88 (I), and 1.94 (I) respectively. GDP in Models II and III showed

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45 Rural and urban CPIs in this CGE model are derived from the linear expenditure system (LES) and are used to evaluate the purchasing power of rural and urban households; since household income is in nominal terms while consumptions is in real terms.

a similar pattern. The share of agriculture rose 3.85 (II), and 3.79 (III) and the shares from industry and services fell 1.59 (II) and 1.32 (II); and 1.52 (III) and 1.32 (III) respectively. It should be noted that contributions to GDP growth from the three sectors increased in absolute values in all models. This was coupled with a change in the structure of GDP as measured by the relative shares of each sector due to technological progress in agriculture.

Agricultural exports increased in all models: 24.50 (I), 21.15 (II), and 21.93 (III) due to low export prices relative to world prices. Agricultural imports declined 0.60 (I) but increased slightly by 0.07 (II), and 0.09 (III). This may have been due to the fact that growth in household income in both Models II and III was greater than in Model I. For nonagricultural commodities: imported industrial goods, and imported services increased in all models: 3.85 (I) and 11.35 (I); 3.53 (II) and 6.65 (II); and 3.61 (III) and 5.86 (III) respectively due to high domestic prices relative to world prices. Exports of industrial goods and services declined 4.77 (I) and 7.05 (I); 1.77 (II) and 2.74 (II); and 1.02 (III) and 1.88 (III), respectively because of high export prices relative to world prices. Thus, increases in agricultural exports were slightly offset by increases in imported nonagricultural commodities. As a result, the balance-of-trade deficit improved 5.78 (I), 9.61 (II), and 11.92 (II).[46] **Table 6.1** summarizes the results of increased agricultural productivity.

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46 Base value of trade deficit is 42. If the new value of trade deficit (i.e. due to increased productivity) is less than the base case, then the percentage change is negative which means the trade deficit improves or shrinks. This measurement uses the base value as a reference level. If the percentage change is positive, trade deficit rises or worsens.

Table 6.1: The Effects of an Increase of 5 Percents of Agricultural Productivity for Three Models.

Indicators	Base	Model I	Model II	Model III
		Percentage Changes		
Employment				
Agri. wage	1.000	+1.50	+3.50	+3.40
Nonag. wage	1.000	+5.20	none	none
Agri. employment	240.500	none	none	none
Nonag. employment	183.500	none	+4.05	+3.37
Capital				
Agri.rental rate	1.000	+0.80	+2.40	+2.90
Nonag.rental rate	1.000	+4.10	+2.50	none
Agri. capital	35.000	none	none	none
Nonag.capital	143.000	none	none	none
Income Distribution				
(a) RU-HH-Inc.	289.000	+1.59	+3.28	+3.34
(b) RU-HH-Con.	253.000	+1.83	+4.11	+4.38
(c) UR-HH-Inc.	241.000	+4.69	+3.64	+3.42
(d) UR-HH Con.	190.000	+3.54	+3.49	+3.52
(e) (a)/(c)	1.199	-2.92	-0.33	-0.08
(f) (b)/(d)	1.332	-1.73	+0.60	+0.83
Rural CPI	1.000	-0.20	-0.80	-1.00
Urban CPI	1.000	+1.10	+0.10	-0.10
Government Revenue	**97.000**	**+3.84**	**+3.57**	**+3.87**
GDP at current market prices	**673.000**	**+3.27**	**+3.42**	**+3.56**
GDP* at constant market prices	**673.000**	**+2.65**	**+3.85**	**+4.30**
Agriculture/GDP*	27.043	+5.18	+3.85	+3.79
Industry/GDP*	29.866	-1.88	-1.59	-1.52
Service/GDP*	43.091	-1.94	-1.32	-1.32
Balance of Trade	**42.000**	**-5.78**	**-9.61**	**-11.92**
Import	210.000	+4.74	+3.89	+3.86
Agriculture	2.000	-0.60	+0.70	+0.90
Industry	182.000	+3.85	+3.53	+3.61
Services	26.000	+11.35	+6.65	+5.86
Export	168.000	+8.21	+8.55	+9.34
Agriculture	77.000	+24.50	+21.15	+21.93
Industry	59.000	-4.77	-1.77	-1.02
Services	32.000	-7.05	-2.74	-1.88
Terms of Trade	0.000	-1.411	-2.157	-2.561

Note: 1. All prices at the base case are one, thus quantity and value are the same.
2. Terms of Trade = (export at current market prices/import price deflator) - export at constant market prices.
3. Income is in nominal terms; consumption is in real terms.

In brief, the overall effects of productivity changes in the agricultural sector were increased wage, and rental rates. Agricultural prices decreased relative to nonagricultural (manufacturing and service) prices. Agriculture's share in GDP increased. Rural and urban households income both increased, but favored the latter with respect to income distribution. However, urban household consumption was slightly offset by increased CPI increase for Model I. The balance-of-trade deficit improved.

6.3.2 Scenario II of Model I, II, and III

This section describes the results of greater government investment in agriculture as detailed in Section 6.2.2. Total government investment in the economy was increased by 5 percent from 89 billion baht to 93.45 billion baht. The agricultural sector's share of government investment was increased by 10 percent from 0.101 to 0.111. These investments were made through the purchase of investment goods in final markets (investment by sector of origin). The increase level of demand by government raised the prices of all agricultural and nonagricultural commodities. This induced greater production and sectoral investment in all three models. Increased investment was accompanied by higher wage and rental rates.

The agricultural wage increased slightly by 0.40 (I) and the nonagricultural wage increased by 0.50 (I). Rental rates of agricultural and nonagricultural capital increased 0.30 (I) and 0.50 (I) respectively. Models II and III displayed the same patterns observed in Model I. The agricultural wage and rental rate increased at the same rates 0.60, and 0.50 respectively in Models II and III. Nonagricultural wages were assumed to be fixed but were relatively higher than the agricultural wages. Accordingly, the employed

nonagricultural labor increased by 0.43 (II), and 0.35 (III). The rental rate of nonagricultural capital rose 0.40 (II) but did not change in Model III due to the model's assumptions.

As a consequence, factor incomes and hence household incomes increased 0.42 (I), 0.60 (II), and 0.60 (III) for rural households; and 0.52 (I), 0.41 (II), and 0.39 (III) for urban households. The level of consumption also increased in all models: 0.06 (I), 0.30 (II), and 0.32 (III) for rural households; and 0.18 percent in all three models for urban household. Observed increases in rural consumption for Model III was the highest among all models.

The ratio of rural household income to urban household income declined slightly by 0.08 (I) but increased 0.17 (II), and 0.25 (III). The ratio of rural consumption to urban consumption fell by 0.15 (I) but this increased by 0.07 (II and III). Income distribution and consumption pattern shifted in favor of rural households for Models II and III. In Model I the shift was in the opposite direction because the absolute income and real consumption of rural households increased less than that for urban households. This again may have been caused by the restrictive assumption of full employment in the labor market in Model I.

As household incomes increased, government revenue also increased in accordance with income taxes and indirect taxes paid through sectoral commodities. Government income rose 0.60 (I), 0.57 (II), and 0.60 (III).

The industrial sector played a key role in GDP growth even though the share of government investment in agriculture increased. GDP at constant market prices rose by

0.04 (I), 0.16 (II), and 0.21 (III). This may have be because the structure of government investment in the base case was biased toward industry which accounted for 0.899 of the total share. Increasing the government's share (10 %) in agricultural investment was insufficient to maintain agricultural growth at a rate equivalent to that of industrial growth in all models. As a result, the agricultural sector's share of GDP declined lightly by 0.13 (I), 0.26 (II), and 0.27 (III) while that for the industrial sector increased 0.33 (I), 0.35 (II) and 0.36 (III). In reality, the growth of factors of production, research and development contributed significantly to GDP growth but were not fully represented in this scenario. Thus low GDP growth resulted when investment was introduced into the economy.

Total exports declined by 1.60 (I), 1.55 (II), and 1.47 (III) due to the high export prices of all types of commodities relative to world prices. Total imports increased by 1.04 (I), 0.96 (II), and 0.95 (III) due to relatively high domestic prices. As a result, the balance of trade worsened for all models. The trade deficit rose by 10.07 (I), 9.66 (II), and 9.42 (III). **Table 6.2** summarizes the results of increased government investment in agriculture.

Since the CGE model used a short-run approach, the growth of GDP of the three models was not as high as that for government investment. Thus, exports declined while imports increased and the balance-of-trade deficit worsened. Income distribution improved in favor of rural households, especially in Models II and III. It should be noted that in the long run, if complementarity between employment and capital growth was more flexible, the GDP growth would have been higher. This is because GDP growth

Table 6.2: The Effects of an Increase of Goverment Investment toward Agricultural Sector for Three Models.

Indicators	Base	Model I	Model II	Model III
		Percentage Changes		
Employment				
Agri. wage	1.000	+0.40	+0.60	+0.60
Nonag. wage	1.000	+0.50	none	none
Agri. employment	240.500	none	none	none
Nonag. employment	183.500	none	+0.43	+0.35
Capital				
Agri.rental rate	1.000	+0.30	+0.50	+0.50
Nonag.rental rate	1.000	+0.50	+0.40	none
Agri. capital	35.000	none	none	none
Nonag.capital	143.000	none	none	none
Income Distribution				
(a) RU-HH-Inc.	289.000	+0.42	+0.60	+0.60
(b) RU-HH-Con.	253.000	+0.06	+0.30	+0.32
(c) UR-HH-Inc.	241.000	+0.52	+0.41	+0.39
(d) UR-HH Con.	190.000	+0.18	+0.18	+0.18
(e) (a)/(c)	1.199	-0.08	+0.17	+0.25
(f) (b)/(d)	1.332	-0.15	+0.07	+0.07
Rural CPI	1.000	+0.40	+0.30	+0.30
Urban CPI	1.000	+0.30	+0.20	+0.20
Government Revenue	**97.000**	**+0.60**	**+0.57**	**+0.60**
GDP at current market prices	**673.000**	**+0.50**	**+0.51**	**+0.53**
GDP* at constant market prices	**673.000**	**+0.04**	**+0.16**	**+0.21**
Agriculture/GDP*	27.043	-0.13	-0.26	-0.27
Industry/GDP*	29.866	+0.33	+0.35	+0.36
Service/GDP*	43.091	-0.15	-0.08	-0.08
Balance of Trade	**42.000**	**+10.07**	**+9.66**	**+9.42**
Import	210.000	+1.04	+0.96	+0.95
Agriculture	2.000	+1.00	+1.15	+1.15
Industry	182.000	+1.00	+0.97	+0.98
Services	26.000	+1.35	+0.88	+0.79
Export	168.000	-1.60	-1.55	-1.47
Agriculture	77.000	-2.32	-2.65	-2.58
Industry	59.000	-0.97	-0.65	-0.57
Services	32.000	-1.05	-0.57	-0.47
Terms of Trade	0.000	+0.660	+0.562	+0.522

Note: 1. All prices at the base case are one, thus quantity and value are the same.
2. Terms of Trade = (export at current market prices/import price deflator) - export at constant market prices.
3. Income is in nominal terms; consumption is in real terms.

is usually induced by growth in factor availability, labor, capital, and technological change.

6.3.3 Scenario III of Models I, II, and III

This section describes the results of reducing agricultural export taxes as discussed in Section 6.2.3. This tax rate was cut by 30 percent and caused export prices to be lower in all models. Agricultural exports thus became more competitive in the world markets and exports increased by 1.39 (I), 1.33 (II), and 1.29 (III). This encouraged producers to increase production and consequently resources were mobilized toward agricultural sector.

Factor prices rose in all models. The agricultural wage rose equally by 1.20 percent in all three models. The nonagricultural wage rose 0.10 (I) but it was fixed for the other two models. As such, the level of nonagricultural employment increased by 0.08 (II) and 0.12 (III). The rental rate of agricultural capital increased equally by 1.80 percent for all models and the rental rate of nonagricultural capital rose by 0.40 (I, II).

Rural household income showed greater increases than that of urban households in all models: 1.18 (I), 1.22 (II), and 1.21 (III) for rural households; and 0.23 (I), 0.21 (II), and 0.22 (III) for urban households. Consumption by rural households also increased 0.58 (I), 0.63 (II), and 0.61 (III) but consumption by urban households declined by 0.21 (I, II), and 0.22 (III). The ratio of rural household income to urban household income increased by 0.92 (I), and 1.00 (II, III). The ratio of consumption also rose 0.83 (II), and 0.75 (I, III). Thus, income distribution and consumption patterns shifted in favor of rural households.

Government revenue dropped 0.52 (III), and 0.50 (I, II) due mainly to the decline in revenue from the agricultural export taxes. GDP growth at constant market prices was not significant for all models since the growth of the agricultural sector was offset by a decline in the nonagricultural sectors. Agriculture's share of GDP increased slightly 0.40 (I), and 0.38 (II, III), while that of industry and services share of GDP declined by approximately 0.25 and 0.07 percent respectively for all models.

Total imports increased about 0.55 percent for all models. This increase arose from higher imports of many commodities because of high domestic prices relative to world prices. For domestic agricultural commodity, prices remained slightly lower than world prices but the commodities (imported and domestically produced) were not perfect substitute.

As previously mentioned, agricultural exports increased due to reduced export taxes but nonagricultural exports declined as a result of high export prices relative to world prices. Industrial exports decreased by 1.16 (I), 1.09 (II), and 1.18 (III). Exported services also declined 1.02 (I), 0.92 (II), and 0.95 (III). Consequently, total imports outweighed total exports and the balance-of-trade deficit rose 2.13 (I), 2.05 (II) and 2.21 (III). **Table 6.3** summarizes the effects of reducing agricultural export taxes.

Gains from the reduction in agricultural export taxes accrued to producers directly and hence were diverted to savings/investment and higher consumption. Higher levels of consumption, in turn, increased domestic demand for both agricultural and nonagricultural goods. Thus, there was the potential to expand domestic markets through reduced agricultural export taxes in combination with other policies that enhanced GDP

Table 6.3: The Effects of Reduction of Agricultural Export Tax for Three Models.

Indicators	Base	Model I	Model II	Model III
		Percentage Changes		
Employment				
Agri. wage	1.000	+1.20	+1.20	+1.20
Nonag. wage	1.000	+0.10	none	none
Agri. employment	240.500	none	none	none
Nonag. employment	183.500	none	+0.08	+0.12
Capital				
Agri.rental rate	1.000	+1.80	+1.80	+1.80
Nonag.rental rate	1.000	+0.40	+0.40	none
Agri. capital	35.000	none	none	none
Nonag.capital	143.000	none	none	none
Income Distribution				
(a) RU-HH-Inc.	289.000	+1.18	+1.22	+1.21
(b) RU-HH-Con.	253.000	+0.58	+0.63	+0.61
(c) UR-HH-Inc.	241.000	+0.23	+0.21	+0.22
(d) UR-HH Con.	190.000	-0.21	-0.21	-0.22
(e) (a)/(c)	1.199	+0.92	+1.00	+1.00
(f) (b)/(d)	1.332	+0.75	+0.83	+0.75
Rural CPI	1.000	+0.60	+0.60	+0.60
Urban CPI	1.000	+0.40	+0.40	+0.40
Government Revenue	**97.000**	**-0.50**	**-0.50**	**-0.52**
GDP at current market prices	**673.000**	**+0.55**	**+0.55**	**+0.54**
GDP* at constant market prices	**673.000**	**ns**	**+0.04**	**ns**
Agriculture/GDP*	27.043	+0.40	+0.38	+0.38
Industry/GDP*	29.866	-0.25	-0.24	-0.25
Service/GDP*	43.091	-0.08	-0.07	-0.06
Balance of Trade	**42.000**	**+2.13**	**+2.05**	**+2.21**
Import	210.000	+0.56	+0.55	+0.55
Agriculture	2.000	+0.85	+0.85	+0.85
Industry	182.000	+0.45	+0.44	+0.45
Services	26.000	+1.33	+1.24	+1.26
Export	168.000	+0.04	+0.05	ns
Agriculture	77.000	+1.39	+1.33	+1.29
Industry	59.000	-1.16	-1.09	-1.18
Services	32.000	-1.02	-0.92	-0.95
Terms of Trade	0.000	+0.222	+0.203	+0.231

Note: 1. All prices at the base case are one, thus quantity and value are the same.
2. Terms of Trade = (export at current market prices/import price deflator) - export at constant market prices.
3. Income is in nominal terms; consumption is in real terms.
4. ns = non-significance.

growth and income distribution to rural households.

6.3.4 Scenario IV of Models I, II, and III

Virtually all developed countries protect their agricultural producers and in many cases subsidize agricultural exports, this lowers world prices, and consequently the prices Third World farmers receive for their production. Scenarios IV and V incorporate the effects of shocks from policy changes, by raising the developed country's protectionism in Scenario IV and lowering it in Scenario V.

Scenario IV simulated a 5 percent decrease in world agricultural prices resulting from rising protectionism as detailed in Section 6.2.4. This meant that the import prices for Thailand (excluding tariffs) went down 5.00 percent and thereby encouraged greater agricultural imports 0.50 (I), 0.40 (II), and 0.45 (III). Agricultural exports declined 6.15 (I), 5.90 (II), and 5.73 (III) due mainly to a reduction in agricultural production. This resulted in lower wage and rental rates for all models. The agricultural wage dropped 5.00 (I); and 5.20 (II, III). The rental rate of agricultural capital decreased 7.50 (I, III); and 7.60 (II). The nonagricultural wage declined 0.40 (I). This wage was fixed by the assumptions for Models II and III; and thus resulted in lower the levels of nonagricultural labor employed (unemployment increases) due to the decline of all domestic output prices in relation to world prices. The rental rate of nonagricultural capital also declined 1.70 (I) and 1.60 (II).

Factor incomes and therefore household incomes and consumption declined. Rural household income decreased 4.95 (I), 5.08 (II), and 5.07 (III); and 0.93 (I), 0.85 (II), and 0.89 (III) for urban households. Rural household consumption declined for all

models: 2.48 (I), 2.66 (II), and 2.58 (III). In contrast, urban household consumption increased 0.96 (I), 0.97 (II), and 1.01 (III). This was because the income of rural households declined even further than that of urban households; and to some extent, this effect was offset by a decline in rural and urban CPI. This situation skewed income distribution as well as consumption toward rural households. This was observed from the changes in the ratios of rural household income to urban household income, and in the consumption ratio which dropped for all models (**Table 6.4**).

Government revenue decreased 1.90 (I), 1.88 (II), and 1.79 (III) due to declines in GDP and household incomes. GDP at constant market prices declined 0.05 (I), and 0.14 (II) but the drop was insignificant for Model III. These results were due mainly to the diminishing contributions of agriculture to GDP. Contributions to GDP from nonagricultural sectors also increased slightly. Agriculture's share of GDP decreased 1.79 (I), 1.69 (II), and 1.72 (III); and the shares of GDP from industry and services increased: 1.10 (I) and 0.36 (I); 1.08 (II) and 1.10 (II); and 1.15 (III) and 0.28 (III) respectively.

The trade deficit increased 0.22 (I), and 0.53 (II), but declined by 0.16 (III). The decline of total exports in Model III was insignificant, while the change in total imports was commensurate with the other two models.

Economic recession was a consequence of this policy experiment: economic and income growth was curtailed, income distribution became more inequitable, and the balance-of-trade deficit worsened. Among the three models, Model III showed the smallest negative effects on government revenue, GDP growth, and the balance-of-trade

Table 6.4: The Effects of Decreasing World Price of Agricultural Commodity for Three Models.

Indicators	Base	Model I	Model II	Model III
		Percentage Changes		
Employment				
Agri. wage	1.000	-5.00	-5.20	-5.20
Nonag. wage	1.000	-0.40	none	none
Agri. employment	240.500	none	none	none
Nonag. employment	183.500	none	-0.32	-0.48
Capital				
Agri.rental rate	1.000	-7.50	-7.60	-7.50
Nonag.rental rate	1.000	-1.70	-1.60	none
Agri. capital	35.000	none	none	none
Nonag.capital	143.000	none	none	none
Income Distribution				
(a) RU-HH-Inc.	289.000	-4.95	-5.08	-5.07
(b) RU-HH-Con.	253.000	-2.48	-2.66	-2.58
(c) UR-HH-Inc.	241.000	-0.93	-0.85	-0.89
(d) UR-HH Con.	190.000	+0.96	+0.97	+1.01
(e) (a)/(c)	1.199	-4.09	-4.25	-4.25
(f) (b)/(d)	1.332	-3.45	-3.60	-3.60
Rural CPI	1.000	-2.50	-2.50	-2.60
Urban CPI	1.000	-1.90	-1.80	-1.90
Government Revenue	**97.000**	**-1.90**	**-1.88**	**-1.79**
GDP at current market prices	**673.000**	**-2.86**	**-2.88**	**-2.83**
GDP* at constant market prices	**673.000**	**-0.05**	**-0.14**	**ns**
Agriculture/GDP*	27.043	-1.79	-1.69	-1.72
Industry/GDP*	29.866	+1.10	+1.08	+1.15
Service/GDP*	43.091	+0.36	+1.10	+0.28
Balance of Trade	**42.000**	**+0.22**	**+0.53**	**-0.16**
Import	210.000	-2.30	-2.24	-2.25
Agriculture	2.000	+0.50	+0.40	+0.45
Industry	182.000	-1.88	-1.86	-1.85
Services	26.000	-5.46	-5.13	-5.20
Export	168.000	-0.19	-0.24	ns
Agriculture	77.000	-6.15	-5.90	-5.73
Industry	59.000	+5.09	+4.83	+5.22
Services	32.000	+4.41	+4.02	+4.19
Terms of Trade	0.000	-4.596	-4.521	-4.661

Note: 1. All prices at the base case are one, thus quantity and value are the same.
2. Terms of Trade = (export at current market prices/import price deflator) - export at constant market prices.
3. Income is in nominal terms; consumption is in real terms.
4. ns = non-significance.

deficit while the income distribution situation was not significantly different.

6.3.5 Scenario V of Models I, II, and III

This section describes the results from a scenario of a 5 percent increase in world agricultural price due to lower levels of trade protectionism detailed in Section 6.2.5. This resulted in a slight decline of agricultural imports by 0.40 (I), 0.30 (II), and 0.35 (III). Exports rose moderately 5.67 (I), 5.40 (II) and 5.25 (III) due to low domestic price relative to world prices. This encouraged the domestic production of agricultural commodities for export. Resources, labor and capital were mobilized and thus wage and rental rate rose in the agricultural and the nonagricultural sectors. The agricultural wage increased 5.10 (I), and 5.30 (II, III). The rental rate of agricultural capital increased 7.70 (I), 7.80 (II), and 7.60 (III). Nonagricultural wage rose 0.40 (I) but were held constant by specification in Models II and III. The additional agricultural production therefore drew the level of nonagricultural employment up 0.34 (II), and 0.49 (III). The rental rate of nonagricultural capital also went up 1.70 (I), and 1.60 (II).

Factor incomes, especially in the agricultural sector increased and a major portion of income was diverted to rural households according to the existing pattern of factor of ownership. This was made obvious by the 5.03 (I), 5.17 (II), and 5.15 (III) increases in rural household income; and also the 0.96 (I), 0.87 (II), and 0.91 (III) increases of urban household income. Thus, the income of rural households showed a greater increase than that for urban households. As a result, urban household consumption declined by between 0.90 and 0.95 percent approximately, for the three models, but rural household consumption increased with a corresponding rise in rural household income. Income

distribution and consumption apparently moved in favor of rural household. This was indicated by the positive changes in the ratio of rural household income to urban household income and also by the ratio of rural consumption to urban consumption **(Table 6.5)**.

Government revenue rose by 1.92 (I), 1.89 (II), and 1.81 (III). GDP at constant market prices went up by 0.04 (I), and 0.13 (II) but GDP growth in Model III was insignificant. This growth accrued mainly through the growth of agriculture in all models. Agriculture's share of GDP increased 1.67 (I), 1.56 (II), and 1.59 (III), while the shares of industry and services diminished by 1.02 (I) and 0.34 (I); 1.00 (II) and 0.28 (II); and 1.06 (III) and 0.26 (III) respectively.

The trade deficit slightly declined 0.30 (I), 0.62 (II) but a little bit increased by 0.04 (III). This was because only agricultural exports increased while the exports of industrial goods and services decreased 4.77 (I) and 4.17 (I); 4.52 (II) and 3.80 (II); and 4.86 (III) and 3.94 (III) respectively due to high export prices relative to world prices. Imports of industrial goods and services increased for all models. However, only the total exports of Models I and II could counterbalance total imports and resulted in improving trade deficit. Thus, a slight increase of world agricultural price improved the balance-of-trade deficit even though this improvement was counteracted by increased imports and decreased exports of nonagricultural commodities.

From this policy experiment, the more world agricultural price increased, the more income distribution shifted in favor of rural households, and the greater was the improvement in the trade deficit. Among the three models, Model III showed the least

Table 6.5: The Effects of Increasing World Price of Agricultural Commodity for Three Models.

Indicators	Base	Model I	Model II	Model III
		Percentage Changes		
Employment				
Agri. wage	1.000	+5.10	+5.30	+5.30
Nonag. wage	1.000	+0.40	none	none
Agri. employment	240.500	none	none	none
Nonag. employment	183.500	none	+0.34	+0.49
Capital				
Agri.rental rate	1.000	+7.70	+7.80	+7.60
Nonag.rental rate	1.000	+1.70	+1.60	none
Agri. capital	35.000	none	none	none
Nonag.capital	143.000	none	none	none
Income Distribution				
(a) RU-HH-Inc.	289.000	+5.03	+5.17	+5.15
(b) RU-HH-Con.	253.000	+2.43	+2.62	+2.54
(c) UR-HH-Inc.	241.000	+0.96	+0.87	+0.91
(d) UR-HH Con.	190.000	-0.90	-0.91	-0.95
(e) (a)/(c)	1.199	+4.00	+4.25	+4.25
(f) (b)/(d)	1.332	+3.30	+3.53	+3.45
Rural CPI	1.000	+2.50	+2.50	+2.50
Urban CPI	1.000	+1.90	+1.80	+1.90
Government Revenue	**97.000**	**+1.92**	**+1.89**	**+1.81**
GDP at current market prices	**673.000**	**+2.91**	**+2.92**	**+2.88**
GDP* at constant market prices	**673.000**	**+0.04**	**+0.13**	**ns**
Agriculture/GDP*	27.043	+1.67	+1.56	+1.59
Industry/GDP*	29.866	-1.02	-1.00	-1.06
Service/GDP*	43.091	-0.34	-0.28	-0.26
Balance of Trade	**42.000**	**-0.30**	**-0.62**	**+0.04**
Import	210.000	+2.35	+2.28	+2.29
Agriculture	2.000	-0.40	-0.30	-0.35
Industry	182.000	+1.90	+1.87	+1.88
Services	26.000	+5.69	+5.30	+5.38
Export	168.000	+0.13	+0.16	-0.05
Agriculture	77.000	+5.67	+5.40	+5.25
Industry	59.000	-4.77	-4.52	-4.86
Services	32.000	-4.17	-3.80	-3.94
Terms of Trade	0.000	+4.846	+4.767	+4.877

Note: 1. All prices at the base case are one, thus quantity and value are the same.
2. Terms of Trade = (export at current market prices/import price deflator) - export at constant market prices.
3. Income is in nominal terms; consumption is in real terms.
4. ns = non-significance.

response to shocks from agricultural world prices regarding the growth of both GDP and exports. This was due to the assumptions of this model which provided opportunities for adjustment in the domestic nonagricultural sectors rather than agricultural sector. This was the trade-off of Model III with respect to Scenarios IV and V.

6.3.6 Scenario VI of Models I, II, and III

This section describes a revaluation of the Thai currency (baht) by 5 percent as detailed in Section 6.2.6. This discouraged production of export commodities and lowered agricultural and nonagricultural wages and rental rates for Model I. Agricultural wages also dropped 6.80 (II) and 6.70 (III). The employment of nonagricultural labor declined 3.90 (II), and 3.36 (III) implying higher unemployment of nonagricultural labor.

Rural and urban household incomes declined for all models. However, the decline of rural household income was more severe than that for the urban households. As a result, rural household consumption decreased. In contrast, urban household consumption increased slightly. This was because the decline in urban income was smaller than that for rural income and the falling urban CPI to some extent stimulated consumption. The distribution of income and consumption shifted in favor of urban households. This could be observed from the decline (negative sign) of the ratios of rural household income to urban household income and rural household consumption to urban household consumption shown in **Table 6.6**.

Government revenue declined for all models due to decreases in household income and indirect taxes receipts. GDP at constant market prices declined 1.15 (II), and 1.47 (III) but the drop in GDP in Model I was insignificant.

Table 6.6: The Effects of the Revaluation of Thai Currency (Baht) for Three Models.

Indicators	Base	Model I	Model II	Model III
		Percentage Changes		
Employment				
Agri. wage	1.000	-5.00	-6.80	-6.70
Nonag. wage	1.000	-4.90	none	none
Agri. employment	240.500	none	none	none
Nonag. employment	183.500	none	-3.90	-3.36
Capital				
Agri.rental rate	1.000	-5.00	-6.50	-6.90
Nonag.rental rate	1.000	-4.90	-3.50	none
Agri. capital	35.000	none	none	none
Nonag.capital	143.000	none	none	none
Income Distribution				
(a) RU-HH-Inc.	289.000	-4.92	-6.49	-6.52
(b) RU-HH-Con.	253.000	+0.03	-2.13	-2.32
(c) UR-HH-Inc.	241.000	-4.82	-3.86	-3.67
(d) UR-HH Con.	190.000	+0.13	+0.19	+0.21
(e) (a)/(c)	1.199	-0.08	-2.75	-2.92
(f) (b)/(d)	1.332	-0.15	-2.32	-2.55
Rural CPI	1.000	-5.00	-4.50	-4.30
Urban CPI	1.000	-5.00	-4.00	-3.90
Government Revenue	**97.000**	**-4.69**	**-4.44**	**-4.65**
GDP at current market prices	**673.000**	**-4.93**	**-5.08**	**-5.16**
GDP* at constant market prices	**673.000**	**ns**	**-1.15**	**-1.47**
Agriculture/GDP*	27.043	-0.04	+1.23	+1.26
Industry/GDP*	29.866	+0.05	-0.21	-0.22
Service/GDP*	43.091	-0.01	-0.63	-0.64
Balance of Trade	**42.000**	**+1.44**	**+5.22**	**+6.96**
Import	210.000	+0.17	+0.97	+1.00
Agriculture	2.000	+0.10	-1.25	-1.40
Industry	182.000	+0.16	+0.47	+0.40
Services	26.000	+0.24	+4.67	-5.41
Export	168.000	-0.20	-0.67	-1.23
Agriculture	77.000	-0.25	+2.88	+2.32
Industry	59.000	-0.16	-3.16	-3.64
Services	32.000	-0.17	-4.61	+4.19
Terms of Trade	0.000	+0.092	+0.970	+1.248

Note: 1. All prices at the base case are one, thus quantity and value are the same.
2. Terms of Trade = (export at current market prices/import price deflator) - export at constant market prices.
3. Income is in nominal terms; consumption is in real terms.
4. ns = non-significance.

The structure of GDP in Model I changed slightly: the contribution of agriculture and services to GDP declined slightly 0.04 (I) and 0.01 (I) respectively, and the contribution of industry increased slightly 0.05 (I). Agriculture's share of GDP increased 1.23 (II), and 1.26 (III) but the share of industry and services decreased 0.21 (II) and 0.63 (II); and 0.22 (III) and 0.64 (III) respectively. Thus, the adjustment in the industrial and services sectors in Models II and III was quite different from that in Model I. Models II and III reflected a phenomenon of Thai agriculture. Thai farmers can better absorb a negative impact from a revaluation of baht than the other two sectors. This is reasonable since the majority of Thai agriculture is composed of family farms. The majority of farmers continue to produce and accept lower prices (due to a rise of baht) and earn lower incomes because adjustment in production can be very slow and costly. They can either remain on the land or migrate to urban areas for better opportunities which can also be costly. This situation makes the standard of living of Thai farmers declined while farming activities continue.

Total imports increased 0.17 (I), 0.97 (II), and 1.00 (III) and total exports declined 0.20 (I), 0.67 (II), and 1.23 (III). This worsened the balance-of-trade deficit. The trade deficit increased 1.44 (I), 5.22 (II), and 6.96 (III). Even though agricultural exports increased 2.88 (II), and 2.32 (III), this did not offset the increase of total imports, especially of services.

It should be noted that the terms of trade shifted in favor of export commodities but these commodities were also more expensive to foreign buyers. Thus, the exports of industrial commodities and services declined while imports of these commodities

increased. This was because their export prices were relatively higher than the import prices (before tariffs) and the commodities were not perfect substitutes.

Results of this experiment suggested recessionary pressures were on the Thai economy when the baht was revalued. This was observed in declining factor prices, production, and GDP growth; increased unemployment of nonagricultural labor (Models II and III); increased skewness of income distribution, and the worsening trade deficit. It should be noted that the results of this scenario (Models II and III) especially the structural change in GDP and the change in foreign trade, were opposite to those observed under Scenario IV.

6.3.7 Scenario VII of Models I, II, and III

This section describes the results of devaluation of Thai currency (baht) against foreign currencies as detailed in Section 6.2.7. This situation stimulated domestic production for export. Resources were mobilized and their prices (wages and rental rates) rose in all models (nonagricultural wage is fixed in Models II and III). Consequently, employment of nonagricultural labor increased 3.82 (II) and 3.30 (III).

Rural and urban household incomes rose for all models. Consumption of rural households increased, especially for Models II and III. In contrast, consumption of urban households dropped slightly in all models. This may have been because the rate of urban CPI showed a greater increase than the increase in urban income. For rural households, this worked in the opposite direction. Thus, income distribution and consumption shifted in favor of rural households. This could be observed from the positive signs of the ratios of rural household income to urban household income and rural consumption to urban

consumption shown in **Table 6.7**.

Government revenue increased for all models due to higher household incomes and indirect taxes receipts. GDP at constant market prices increased 1.10 (II), and 1.40 (III) while the GDP growth for Model I was insignificant.

The structure of GDP for Model I changed slightly: the contribution of agriculture to GDP increased 0.03 (I) and that for industry dropped 0.04 (I); the GDP share of the services sector also increased, but not significantly. Agriculture's share of GDP dropped 1.15 (II), and 1.19 (III) but that of industry and services increased 0.19 (II) and 0.59 (II); and 0.21 (III) and 0.60 (III) respectively. The adjustment of the industrial and services sectors for Models II and III is quite different from that for Model I (full employment equilibrium). With respect to Models II and III, this implied that the two sectors gained a comparative advantage over agriculture when overall exports became more competitive in the world market. This was likely the case for Thailand where the industrial and services sectors can adjust more quickly than the agricultural sector. This indicated the decline of Thai agriculture under this scenario.

Total exports increased 0.18 (I), 0.69 (II), and 1.23 (III) and total imports declined 0.15 (I), 0.88 (II), and 0.90 (III). This improved the balance of trade. The trade deficit contracted by 1.30 (I), 4.79 (II), and 6.38 (III). The increase in exports resulted mainly from the industrial and service sectors: 3.04 (II) and 4.52 (II); and 3.52 (III) and 5.27 (III) respectively. On the import side, these two items declined moderately, particularly in Model III. Thus, agriculture played a declining role in foreign trade under this scenario.

Table 6.7: The Effects of the Devaluation of Thai Currency (Baht) for Three Models.

Indicators	Base	Model I	Model II	Model III
		Percentage Changes		
Employment				
Agri. wage	1.000	+5.00	+6.90	+6.80
Nonag. wage	1.000	+4.90	none	none
Agri. employment	240.500	none	none	none
Nonag. employment	183.500	none	+3.82	+3.30
Capital				
Agri.rental rate	1.000	+5.00	+6.60	+6.90
Nonag.rental rate	1.000	+4.90	+3.40	none
Agri. capital	35.000	none	none	none
Nonag.capital	143.000	none	none	none
Income Distribution				
(a) RU-HH-Inc.	289.000	+4.92	+6.56	+6.59
(b) RU-HH-Con.	253.000	-0.03	+2.03	+2.21
(c) UR-HH-Inc.	241.000	+4.82	+3.80	+3.63
(d) UR-HH Con.	190.000	-0.12	-0.22	-0.22
(e) (a)/(c)	1.199	+0.08	+2.67	+2.83
(f) (b)/(d)	1.332	+0.07	+2.25	+2.40
Rural CPI	1.000	+5.00	+4.40	+4.30
Urban CPI	1.000	+5.00	+4.00	+3.90
Government Revenue	**97.000**	**+4.69**	**+4.44**	**+4.64**
GDP at <u>current</u> market prices	**673.000**	**+4.93**	**+5.08**	**+5.17**
GDP* at <u>constant</u> market prices	**673.000**	**ns**	**+1.10**	**+1.40**
Agriculture/GDP*	27.043	+0.03	+1.15	-1.19
Industry/GDP*	29.866	-0.04	+0.19	+0.21
Service/GDP*	43.091	ns	+0.59	+0.60
Balance of Trade	**42.000**	**-1.30**	**-4.79**	**-6.38**
<u>Import</u>	210.000	-0.15	-0.88	-0.90
Agriculture	2.000	-0.05	+1.20	+1.30
Industry	182.000	-0.14	-0.43	-3.63
Services	26.000	-0.21	-4.20	-4.81
<u>Export</u>	168.000	+0.18	+0.69	+1.23
Agriculture	77.000	+0.23	-2.71	-2.21
Industry	59.000	+0.14	+3.04	+3.52
Services	32.000	+0.16	+4.52	+5.27
<u>Terms of Trade</u>	0.000	-0.083	-0.990	-1.271

Note: 1. All prices at the base case are <u>one</u>, thus quantity and value are the same.
2. <u>Terms of Trade</u> = (export at current market prices/import price deflator) - export at constant market prices.
3. Income is in nominal terms; consumption is in real terms.
4. ns = non-significance.

This experiment suggested the Thai economy would expand when the baht was devalued. This was seen in increased factor prices, production, and GDP growth; increased employment of nonagricultural labor (Models II and III); and an improvement in income distribution for rural households. Increases in exports and decreases in imports improved the balance-of-trade deficit and fuelled demand in the economy. The results of this scenario (Models II and III) especially the structural change in GDP and foreign trade were the opposite to those observed under Scenario V.

6.4 Combined Policy Simulation[47]

This section describes the results of two combined policy simulations: **Scenario VIII,** 'ADLG with Pessimistic Trade' and **Scenario IX**, 'ADLG with Optimistic Trade'.[48] **Scenario VIII** was a combination of Scenarios I, II, III, and IV. **Scenario IX** was a combination of Scenarios I, II, III, and V. The two scenarios (VIII and IX) could be simulated either by combining Scenarios I, II, III, and IV (or V) in one run or by sequentially summing individual scenarios (I, II, III, and IV or V respectively) after each run; the final outcomes from both approaches were equivalent. The latter procedure was used for this presentation to illustrate negative, positive and/or neutral effects of each subsequent scenario on certain key indicators of the model.

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47 Many studies fail to recognize combined policy simulations since they are complicated by interactions between negative and positive factors. [see Bandara (1991), Decaluwé and Martens (1987), de Janvry and Sadoulet (1987), Shoven and Whalley (1984), Srinivasan and Whalley (1986), de Melo (1982), de Melo 1988)].

48 The ADLG approach in this study focuses only on the **agricultural sector**.

Tables 6.8, **6.9** and **6.10** respectively illustrate the results of simulations for **Models I**, **II**, and **III** which were organized somewhat differently from Tables 6.1-6.7 to show the step-by-step effects of combined policy shocks. Each table contains five scenarios symbolized as **A**, **B**, **C**, **D**, and **E** where: **A** was Scenario I; **B** was a combination of Scenarios I, and II; **C** was a combination of Scenarios I, II, and III or ADLG; **D** was a combination of Scenarios I, II, III, and IV or **Scenario VIII** (ADLG with Pessimistic Trade); and **E** was a combination of Scenarios I, II, III, and V or **Scenario IX** (ADLG with Optimistic Trade). When combined, Scenarios I, II, and III likely enhanced one another, therefore **C** rather than the base case could be used as a benchmark for **D** and **E**.[49] This meant **D** and **E** could be compared with **C** which, in turn, was compared with the base case. This approach simplifies the explanation since the state of the economy at a point of time could be represented by **C**.

In **Tables 6.8**, **6.9** and **6.10**, Scenarios I, II, and III were combined and simulated, giving the results presented in column **C** (or the state of economy at **C**). Impacts on the parameters of interest were greater than those observed for individual scenarios. Positive effects included increased wages, rental rates, household incomes, and GDP. Income distribution shifted in favor of rural households in both Model II and Model III. In contrast, income distribution was less skewed in Model I relative to that observed for the individual scenarios. A counteracting effect (from negative change to

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49 Implicitly, the base case was the original reference level which had already been subjected to various types of shocks. Individual policy simulations in **Section 6.3**, might each be considered to be a combined policy simulation if the base case was taken into account. However, the combined policy simulations described in this section were explicit.

Table 6.8: The Effects of ADLG with Pessimistic Trade (D) and with Optimistic Trade (E) for Model I.

		A	B	C	D	E
Indicators	**Base**	**Percentage Changes**				
Employment						
Agri. wage	1.000	+1.50	+1.80	+3.10	-2.30	+8.60
Nonag. wage	1.000	+5.20	+5.70	+5.90	+5.20	+6.50
Agri. employment	240.500	none	none	none	none	none
Nonag. employment	183.500	none	none	none	none	none
Capital						
Agri.rental rate	1.000	+0.80	+1.00	+2.90	-5.10	+11.10
Nonag.rental rate	1.000	+4.10	+4.60	+5.00	+3.00	+7.10
Agri. capital	35.000	none	none	none	none	none
Nonag.capital	143.000	none	none	none	none	none
Income Distribution						
(a) RU-HH-Inc.	289.000	+1.59	+1.94	+3.19	-2.15	+8.61
(b) RU-HH-Con.	253.000	+1.83	+1.86	+2.48	-0.19	+5.09
(c) UR-HH-Inc.	241.000	+4.69	+5.22	+5.51	+4.31	+6.72
(d) UR-HH Con.	190.000	+3.54	+3.75	+3.55	+4.44	+2.72
(e) (a)/(c)	1.199	-2.92	-3.08	-2.17	-6.17	+1.75
(f) (b)/(d)	1.332	-1.73	-1.88	-1.05	-4.43	+2.25
Rural CPI	1.000	-0.20	+0.10	+0.70	-2.00	+3.30
Urban CPI	1.000	+1.10	+1.40	+1.90	-0.10	+3.90
Government Revenue	**97.000**	**+3.84**	**+4.42**	**+3.81**	**+2.14**	**+5.90**
GDP at current market prices	**673.000**	**+3.27**	**+3.73**	**+4.33**	**+1.15**	**+7.54**
GDP* at constant market prices	**673.000**	**+2.65**	**+2.69**	**+2.72**	**+2.61**	**+2.82**
Agriculture/GDP*	27.043	+5.18	+4.99	+5.43	+3.56	+7.18
Industry/GDP*	29.866	-1.88	-1.52	-1.78	+0.34	-2.80
Service/GDP*	43.091	-1.94	-2.08	-2.18	-1.77	-2.57
Balance of Trade	**42.000**	**-5.78**	**+4.23**	**+6.73**	**+6.84**	**+6.54**
Import	210.000	+4.74	+5.79	+6.45	+3.71	+9.24
Agriculture	2.000	-0.60	+0.30	+1.20	+1.50	+0.95
Industry	182.000	+3.85	+4.85	+5.37	+3.18	+7.58
Services	26.000	+11.35	+12.75	+14.37	+7.57	+21.46
Export	168.000	+8.21	+6.61	+6.72	+6.26	+7.10
Agriculture	77.000	+24.50	+22.05	+23.58	+16.86	+29.75
Industry	59.000	-4.77	-5.62	-6.78	-1.70	-11.50
Services	32.000	-7.05	-7.97	-8.97	-4.58	-13.10
Terms of Trade	0.000	-1.411	-0.734	-0.579	-5.597	+4.720

Note: 1. All prices at the base case are one, thus quantity and value are the same.
2. Terms of Trade = (export at current market prices/import price deflator) - export at constant market prices.
3. A = Scenario I; B = Combined Scenarios I and II; C = Combined Scenarios I, II and III; D = Combined Scenarios I, II, III and IV; E = Combined Scenarios I, II, III and V.
4. Income is in nominal terms; consumption is in real terms.

Table 6.9: The Effects of ADLG with Pessimistic Trade (D) and with Optimistic Trade (E) for Model II.

		A	B	C	D	E
Indicators	**Base**	**Percentage Changes**				
Employment						
Agri. wage	1.000	+3.50	+4.00	+5.40	-0.30	+11.10
Nonag. wage	1.000	none	none	none	none	none
Agri. employment	240.500	none	none	none	none	none
Nonag. employment	183.500	+4.05	+4.48	+4.60	+4.12	none
Capital						
Agri.rental rate	1.000	+2.40	+2.80	+4.80	-3.50	+13.20
Nonag.rental rate	1.000	+2.50	+2.90	+3.30	+1.50	+5.10
Agri. capital	35.000	none	none	none	none	none
Nonag.capital	143.000	none	none	none	none	none
Income Distribution						
(a) RU-HH-Inc.	289.000	+3.28	+3.82	+5.13	-0.42	+10.76
(b) RU-HH-Con.	253.000	+4.11	+4.39	+5.08	+2.14	+7.96
(c) UR-HH-Inc.	241.000	+3.64	+4.05	+4.29	+3.26	+5.34
(d) UR-HH Con.	190.000	+3.49	+3.68	+3.48	+4.40	+2.61
(e) (a)/(c)	1.199	-0.33	-0.17	+0.83	-3.59	+5.17
(f) (b)/(d)	1.332	+0.60	+0.68	+1.50	-2.25	+5.18
Rural CPI	1.000	-0.80	-0.50	none	-2.50	+2.60
Urban CPI	1.000	+1.10	+0.30	+0.80	-1.10	+2.70
Government Revenue	**97.000**	**+3.57**	**+4.13**	**+3.53**	**+1.51**	**+5.57**
GDP at current market prices	**673.000**	**+3.42**	**+3.91**	**+4.50**	**+1.33**	**+7.72**
GDP* at constant market prices	**673.000**	**+3.85**	**+4.01**	**+4.06**	**+3.84**	**+4.27**
Agriculture/GDP*	27.043	+3.85	+3.56	+3.95	+2.24	+5.51
Industry/GDP*	29.866	-1.59	-1.22	-1.47	-0.39	-2.46
Service/GDP*	43.091	-1.32	-1.39	-1.46	-1.14	-1.76
Balance of Trade	**42.000**	**-9.61**	**-0.05**	**+2.28**	**+2.84**	**+1.60**
Import	210.000	+3.89	+4.84	+5.45	+2.88	+8.06
Agriculture	2.000	+0.70	+1.80	+2.75	+2.90	+2.55
Industry	182.000	+3.53	+4.49	+4.99	+2.87	+7.13
Services	26.000	+6.65	+7.50	+8.91	+2.98	+15.04
Export	168.000	+8.55	+6.98	+7.07	+6.66	+7.40
Agriculture	77.000	+21.15	+18.37	+19.81	+13.47	+25.59
Industry	59.000	-1.77	-2.34	-3.45	+1.42	-7.98
Services	32.000	-2.74	-3.24	-4.17	-0.09	-7.99
Terms of Trade	0.000	-2.157	-1.552	-1.390	-6.328	+3.819

Note: 1. All prices at the base case are one, thus quantity and value are the same.
2. Terms of Trade = (export at current market prices/import price deflator) - export at constant market prices.
3. A = Scenario I; B = Combined Scenarios I and II; C = Combined Scenarios I, II and III; D = Combined Scenarios I, II, III and IV; E = Combined Scenarios I, II, III and V.
4. Income is in nominal terms; consumption is in real terms.

Table 6.10: The Effects of ADLG with Pessimistic Trade (D) and with Optimistic Trade (E) for Model III.

		A	B	C	D	E
Indicators	**Base**	**Percentage Changes**				
Employment						
Agri. wage	1.000	+3.40	+3.90	+5.30	-0.40	+11.00
Nonag. wage	1.000	none	none	none	none	none
Agri. employment	240.500	none	none	none	none	none
Nonag. employment	183.500	+3.37	+3.72	+3.87	+3.26	+4.49
Capital						
Agri.rental rate	1.000	+2.90	+3.40	+5.30	-2.80	+13.60
Nonag.rental rate	1.000	none	none	none	none	none
Agri. capital	35.000	none	none	none	none	none
Nonag.capital	143.000	none	none	none	none	none
Income Distribution						
(a) RU-HH-Inc.	289.000	+3.34	+3.88	+5.18	-0.35	+10.80
(b) RU-HH-Con.	253.000	+4.38	+4.68	+5.36	+2.49	+8.18
(c) UR-HH-Inc.	241.000	+3.42	+3.80	+4.06	+3.00	+5.13
(d) UR-HH Con.	190.000	+3.52	+3.72	+3.50	+4.48	+2.59
(e) (a)/(c)	1.199	-0.08	+0.08	+1.08	-3.25	+5.42
(f) (b)/(d)	1.332	+0.83	+0.90	+1.73	-1.95	+5.40
Rural CPI	1.000	-1.00	-0.80	-0.20	-2.80	+2.40
Urban CPI	1.000	-0.10	+0.10	+0.50	-1.40	+2.50
Government Revenue	**97.000**	**+3.87**	**+4.46**	**+3.84**	**+1.90**	**+5.79**
GDP at current market prices	**673.000**	**+3.56**	**+4.07**	**+4.65**	**+1.52**	**+7.82**
GDP* at constant market prices	**673.000**	**+4.30**	**+4.51**	**+4.53**	**+4.46**	**+4.60**
Agriculture/GDP*	27.043	+3.79	+3.50	+3.89	+2.16	+5.48
Industry/GDP*	29.866	-1.52	-1.16	-1.41	-0.27	-2.46
Service/GDP*	43.091	-1.32	-1.40	-1.46	-1.17	-1.74
Balance of Trade	**42.000**	**-11.92**	**-2.64**	**-0.16**	**-0.22**	**-0.23**
Import	210.000	+3.86	+4.80	+5.42	+2.85	+8.04
Agriculture	2.000	+0.90	+2.05	+2.90	+3.20	+2.65
Industry	182.000	+3.61	+4.58	+5.08	+2.95	+7.22
Services	26.000	+5.86	+6.61	+8.02	+2.07	+14.17
Export	168.000	+9.34	+7.85	+7.89	+7.73	+7.99
Agriculture	77.000	+21.93	+19.24	+20.64	+14.48	+26.26
Industry	59.000	-1.02	-1.51	-2.71	+2.58	-7.60
Services	32.000	-1.88	-2.29	-3.26	+0.99	-7.24
Terms of Trade	0.000	-2.561	-1.996	-1.802	-6.920	+3.555

Note: 1. All prices at the base case are one, thus quantity and value are the same.
2. Terms of Trade = (export at current market prices/import price deflator) - export at constant market prices.
3. A = Scenario I; B = Combined Scenarios I and II; C = Combined Scenarios I, II and III; D = Combined Scenarios I, II, III and IV; E = Combined Scenarios I, II, III and V.
4. Income is in nominal terms; consumption is in real terms.

positive change or vice versa) appeared in a worsening balance-of-trade deficit; the trade deficit increased by 6.73 (I), and 2.28 (II) due to a decline in exports of nonagricultural commodities and an increase in total imports. In Model III, total exports, (especially agricultural exports) and total imports increased but the increase in total exports outweighed the increase in total imports, thus the deficit contracted a slight 0.16 percent. Government revenue increased in all models but slightly less than that shown in columns **A** and **B**, due to a reduction in agricultural export taxes.

6.4.1 Scenario VIII: The Effects of ADLG with Pessimistic Trade for Models I, II, and III

Scenario VIII is represented by column **D**, it was obtained by shocking the economy at state **C** (column **C**) with a decline in world agricultural prices. The impacts of combined shocks/policies were marked, and were quite noticeable when compared with the results shown in **Table 6.4**. However, a comparison of the results of **D** with **C**, provided an alternative perspective.[50]

The agricultural wage in Scenario VIII was 2.3 (I), lower than the base case but even lower, 5.40 (I) or [(-2.30) - 3.10], when compared with **C**. In the same way, the wage was 0.30 (II) and 0.40 (III) lower than the base and 5.70 (II, III) or [(-0.30) - 5.40 for II; (-0.40) - 5.30 for III] lower than in **C**. The nonagricultural wage was 5.2 (I) higher than the base. In contrast, the wage was 0.70 (I) or [5.20 -5.90] lower than in **C**. Nonagricultural employment was 4.12 (II) and 3.26 (III) higher than the base. In

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50 The question of which scenario (the base case, Scenario IV, or **C**) should have been compared with **D** was crucial, particularly with respect to concerns about policy effectiveness.

The rental rate of agricultural capital was 5.10 (I), 3.50 (II), and 2.80 (III) lower than the base. In contrast, it was even lower, 8.00 (I), 8.30 (II), and 8.10 (III) when compared with **C**. The rental rate of nonagricultural capital was 3.00 (I) and 1.50 (II) higher than the base. In contrast, it was 2.00 (I) and 1.50 (II) lower than in **C**.

Rural household income was 2.15 (I), 0.42 (II), and 0.35 (III) lower than the base or 5.34 (I), 5.55 (II), and 5.53 (III) lower than in **C**. Urban household income was 4.31 (I), 3.26 (II), and 3.00 (III) higher than the base. In contrast, it was 1.20 (I), 1.03 (II), and 1.06 (III) lower than in **C**. Thus, for all models, rural household income declined while urban household income rose. As a result, rural household consumption declined slightly, especially in Model I. In contrast, urban consumption went up in all models. The increase in rural consumption in Models II and III was a result of a declining rural CPI which helped to maintain the purchasing power of rural households (the decline in income was less than the drop in the CPI). Income distribution shifted in favor of urban households in all models.

Government revenue was 2.14 (I), 1.51 (II), and 1.90 (III) higher than the base. In contrast, it was 1.67 (I), 2.02 (II), and 1.94 (III) lower than that in **C**. GDP growth, like government revenue, was higher than the base case, but GDP growth was lower than in **C**. GDP at constant market prices drew substantial contributions from the growth of agriculture, even though world agricultural prices declined. Thus, combined policies (Scenario VIII or 'ADLG with Pessimistic Trade' in **D**) alleviated the overall impacts more effectively than the individual Scenario IV. However, when comparing the overall impacts of **D** with those of **C**, the situation in almost in all accounts of **D** deteriorated

impacts of **D** with those of **C**, the situation in almost in all accounts of **D** deteriorated except for the change in structure of GDP and the pattern of foreign trade which revealed trade-offs among the three sectors.

The balance-of-trade deficit worsened in Models I and II. The deficit was 6.84 (I) and 2.84 (II) higher than the base and only 0.11 (I) and 0.56 (II) higher than in **C**. The deficit was 0.22 (III) or 0.6 (III) lower than in **C**.

The results of **Scenario VIII** (ADLG with Pessimistic Trade) may be summarized as follows: with declining world agricultural prices the ADLG helped to sustain agricultural growth and in turn overall economic growth. This was in contrast to Scenario IV (without ADLG), where agricultural growth and overall growth declined. Even though income distribution in both scenarios shifted in favor of urban households, the indices in 'ADLG with Pessimistic Trade' showed a lower measure of equitable growth. Thus, the ADLG (combined domestic policies) possibly insulated the economy when world agricultural prices declined.

6.4.2 Scenario IX: The Effects of ADLG with Optimistic Trade for Models I, II, and III

This scenario was the opposite case of Scenario VIII. **Scenario IX**, represented by column **E**, was simulated by shocking the economy at state **C** (column **C**) with increasing world agricultural prices. The results of combined shocks/policies were more promising than those from the individual shock/policy experiments shown in **Table 6.5**.

The agricultural wage was 8.60 (I) higher than the base. In contrast, it was 5.50 (I) or [8.60 - 3.10] higher than in **C**. Similarly, the wage was 11.10 (II), and 11.00 (III)

higher than the base or 5.70 (II, III) or [11.10 - 5.40 for II ; 11.00 - 5.30 for III] higher than in C. The nonagricultural wage was 6.5 (I) higher than the base. In contrast, it was only 0.60 (I) or [6.50 -5.90] higher than in C. Nonagricultural employment was 5.09 (II), 4.49 (III) higher than the base and just 0.49 (II), and 0.62 (III) higher than in C.

The rental rate of agricultural capital was 11.10 (I), 13.20 (II), and 13.60 (III) higher than the base. In contrast, it was 8.20 (I), 8.40 (II), and 8.30 (III) higher than in C. The rental rate of nonagricultural capital was 7.10 (I) and 5.10 (II) higher than the base but only 2.10 (I) and 1.80 (II) higher than in C.

Rural household income was 8.61 (I), 10.76 (II), and 10.80 (III) higher than the base or 5.42 (I), 5.63 (II), and 5.62 (III) higher than in C. Urban household income was 6.72 (I), 5.34 (II), and 5.13 (III) higher than the base or 1.21 (I), 1.05 (II), and 1.07 (III) higher than in C. Consequently, rural and urban household consumption increased in all models and income distribution shifted in favor of rural households.

Government revenue was 5.90 (I), 5.57 (II), and 5.79 (III) higher than the base or 2.09 (I), 2.04(II), and 1.95 (III) higher than in C. GDP at constant market prices increased. GDP growth was higher when compared with the base case, but lower when compared with C.

GDP growth resulted mainly from the growth of agriculture. Thus, the combined policies in this scenario stimulated a greater amount of overall economic growth than that observed in Scenario V.

The balance-of-trade deficit worsened. The trade deficit was 6.54 (I), and 1.60 (II) higher than the base or 0.19 (I) and 0.68 (II) lower than in C. The trade deficit

contracted slightly in Model III. It was 0.23 (III) lower than the base and 0.07 (III) lower than the deficit in **C**, due mainly to higher agricultural exports and lower agricultural imports.

The outcomes of **Scenario IX** (ADLG with Optimistic Trade) may be summarized as follows: if the economy was subjected to increasing world agricultural prices the ADLG helped to stimulate agricultural growth and in turn overall economic growth. In contrast to Scenario V (without ADLG), agricultural growth and overall growth also increased, but the growth in Scenario V was less than the growth in Scenario IX. Even though income distribution in both scenarios shifted in favor of rural households, the indices in 'ADLG with Optimistic Trade' showed a greater measure of equitable growth. Thus, the ADLG (combined domestic policies) possibly stimulated economic growth when world agricultural prices increased.

Of all individual and combined policy experiments, each model had its merits and deficiencies. This depended on the assumptions about how the Thai economy functions and the magnitude of shocks. Since all models appeared to be feasible in all respects, the choice of model would depend on the perceptions of policy-makers with respect to the economy under investigation.

6.5 Comparison of Results with Other Studies

A development strategy that works well in one country may not do well in others. Various factors are involved, in many cases, these factors may not be purely economic. The development model for South Korea, advocated by the World Bank, was adopted

by other developing countries, including Thailand. Adelman (1984) analyzed the South Korean economy in the early 1960s, and strongly suggested that agricultural-demand-led-industrialization (ADLI) was very promising for developing countries, especially in the initial stages of industrialization.

Adelman used a huge 1963 data base for South Korea to build a CGE model and then conducted various policy experiments. The model constructed was consistent with the Korean situation, which at that time was characterized by scarce agricultural land and food shortages. This situation had forced the South Korean government to implement land reform and protect the agricultural sector since the outbreak of the Korean war in 1950. The results of this analysis were unavoidably conditional on the technical and theoretical framework of the CGE model and development issues after the Korean war.

The development strategy (conceptual formulation) tested in this thesis was partially drawn from Adelman (1984). The core of CGE model, derived from Dervis, de Melo, and Robinson (1982), was modified to be inconsistent with the Thai economy. The techniques used for modelling and simulations were drawn from Drud, Grais, and Pyatt (1986). Therefore, the CGE model constructed for Thailand was a hybrid of the above three components. It should be mentioned that even though the data base (SAM 1980) used in this study was taken from Drud, and others, the data was disaggregated such that it was compatible with the new modelling approach of GAMS/HERCULES. Drud, and others focused their attention only on the development of a modelling approach (TV form) rather than an analysis of data. Thus,there was no discussion of a Thai development strategy in their paper.

The CGE model for the Thai economy was based on the SAM data base for 1980. The model characterized the economy as having had food surpluses, an abundance of agricultural land, unsuccessful land reforms, and heavy taxation of the agricultural sector.

A comparison of the Korean model (Adelman 1984) with the Thailand model would cut across different time periods (1963 for Korea and 1980 for Thailand). There were both similarities and differences in both the modelling approaches used and the economic conditions in the two countries. The basic similarity existed in the core of the CGE model. However, the models were modified in accordance with the availability of data for each country. The Korean data base was large whereas the data for Thailand was scarce. Thus, the Korean model contained more detailed information for sectoral analysis than the Thailand model. This allowed the Korean model to be used for an analysis of a broader range of development issues while the Thailand model examined policy issues affecting the agricultural sector. As a result, definitive outcomes of policy simulations could not be drawn, and the two models could not be compared on the basis of individual and combined policy simulations per se.

Adelman (1984) defined two development strategies: export-led growth strategy in which trade was a **major source** of growth, and an open-development strategy in which trade was an **element** of growth. She suggested that the latter was an alternative development strategy by emphasizing that government investment in agriculture was a requisite for agriculturally driven growth rather than export driven growth. From various policy simulations of the Korean model, she argued that the latter strategy gave superior results and named it "agricultural-demand-led-industrialization" (ADLI).

Even though each policy simulation and multi-step combined simulation was designed to enhance agricultural growth in the Thailand model, it was not biased toward agriculture because all agricultural resources had not been fully utilized or properly managed properly.[51] The magnitude of each shock was chosen to reflect the capabilities for domestic adjustment to the possible outcomes of the multinational trade negotiations (pessimistic and optimistic trade).

A general finding of the Thailand model that supports Kuznets (1973) and Adelman (1984) was the declining contribution of the agricultural sector to GDP under the current development trend. This was due mainly to agriculture's comparative disadvantage over other sectors. The government could ameliorate the decline only through intervention, i.e., increasing subsidies and making huge investments in agriculture (as was the case in South Korea), or by removing agricultural export taxes and improving productivity in agriculture for the purposes of sustaining competitiveness in the world market. This implied that different economic conditions require different consideration in a development strategy. It should be emphasized that macroeconomic policy is a very important factor in any development strategy.

6.6 Conclusions

Policy simulations involved the evaluation of comparative static equilibria. They

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51 Each policy was designed with regard to available opportunities for the competitiveness of Thai agriculture under the current trends in the domestic and world environments. In contrast, government policies have been biased toward urban consumers (cheap food for urban workers) to promote industrial growth for more than two decades.

were concerned with questions of how the economy would differ, with or without the policy changes and shocks under consideration. The magnitude of shocks was arbitrarily chosen on the basis of the policy choices available to policy makers.

In the real world, combined policies are more realistic than individual policy changes. Combined policies, if implemented appropriately, can more or less insulate or stimulate the economy when it is subjected to external shocks. The impact of shocks transmitted through changes in relative prices which constituted the link between instrumental variables and the target variables such as the rates of GDP and income growth, income distribution, level of employment, and the pattern of foreign trade.

The last two scenarios (VIII and IX) confirmed that Thailand could continue to employ the ADLG, contingent on the availability of resources, to sustain economic growth and income distribution in the face of disturbances in the world economy. Prior to launching these policies, data reflecting the current state of the economy must be compiled for use as a reference or benchmark. When the economy is subjected to external shocks or policy intervention(s), the effectiveness of policies could be evaluated with respect to this benchmark.

The analysis in this thesis focused only on agriculture, and therefore did not investigate a full-scale development strategy. It is critical to combine agricultural policies with compatible with industrial and trade policies to achieve the multiple goals of growth and employment among production sectors, and equitable income distribution among various household groups.

VII. SUMMARY AND CONCLUSIONS

7.1 Introduction

The objective of this study was to construct a multisectoral general equilibrium model of the Thai economy. The model incorporated the key structural characteristics of the Thai economy making it possible to analyze the effects of policy changes on agriculture, as well as issues of growth, structural change, and income distribution in the overall economy. The model included three production sectors (agriculture, industry, and services), two types of capital and of labor (agricultural and nonagricultural), two household groups (rural and urban), a single aggregate firm, government, and the rest of the world.

The CGE model used a consistent data base (1980), organized within a social accounting matrix (SAM) that provided a concise representation of production, income generation and distribution, consumption, savings, investment and foreign trade. The SAM data base was expanded in accordance with the format of the GAMS/HERCULES software.

Three CGE models were designed to explore agriculture-led development in Thailand. Model I was based on the neoclassical assumption of full employment of labor. Model II imposed a fixed nonagricultural wage leading to the unemployment of nonagricultural labor. Model III incorporated under-utilization of nonagricultural capital into Model II.

Each model assumed that the SAM database represented the model's respective solution. All model parameters were then estimated by incorporating other parameters

external to the SAM framework (i.e., elasticities in **Table 4.3**). GAMS/HERCULES software was used to solve the CGE model and produced the results that replicated the SAM database (base solution). Individual and multi-step combined policy simulations were conducted and these results were then compared with the base solution.

The analysis of agriculture-led development in Thailand gave consideration to the competitiveness of Thai agriculture in the international economy. Domestic policy instruments included: increased agricultural productivity, government investment in agriculture, and the reduction of agricultural export taxes. The combination of these policies was viewed as constituting an agriculture-led development strategy or ADLG. The effects of protectionist measures afforded the agricultural sectors in industrial nations, which create distortions in world prices for agricultural commodities, were included in simulations. Revaluations and devaluations of the Thai currency (baht) were also considered. The analysis began with simulations of each policy shock, and then continued with further simulations of ADLG in combination with the international policy scenarios. The next section of this chapter discusses the major findings of this study, followed by the limitations of CGE model. The last section provides some concluding remarks.

7.2 Major Findings

Each domestic policy was expected to cause enhanced agricultural growth, and possibly have adverse effects on the nonagricultural sectors. Moreover, the combination of these policies (including external shocks, i.e., change of world prices for agricultural

commodities), may have stimulated, or insulated, the agricultural sector from shocks. A particular policy may be a substitute or complement with other policies. As a result, unintended or side effects were always accompanied by the intended effects of policy simulation.

The impacts of policy changes on the Thai economy depended on the magnitude of each policy and/or external shocks, or the magnitude of a combination of policy shocks, and the model assumptions. Each model had varying degrees of success. Model I rendered slightly different results from Models II and III which generally produced similar results. The following is a summary of the findings.

An increase in agricultural productivity in the base period stimulated agricultural growth and in turn overall economic growth in all three models. The observed shift in income distribution was ambiguous for Models II and III, but in Model I income distribution shifted in favor of urban households.

An increase of government investment in agriculture over the base period slightly stimulated overall economic growth, but slightly reduced agricultural growth for all three models. This was mainly due to disproportionate government investment (biased to industry) in the base period. Income distribution shifted in favor of rural households in Models II and III and against rural households in Model I. However, agricultural growth was possible if the government significantly increased its investments in agriculture (at the expense of other sectors).

A reduction of agricultural export taxes in the base period stimulated agricultural growth and slightly increased overall growth in all three models. Income distribution in

all three models shifted in favor of rural households.

Lower world prices for agricultural commodities in the base period had contractionary effects on agriculture and overall economic growth in all three models. Income distribution in all three models shifted in favor of urban households.

A rise in world prices for agricultural commodities in the base period had expansionary effects on agriculture and overall economic growth in all three models. Income distribution in all three model shifted in favor of rural households.

A revaluation (appreciation) of the baht in the base period had contractionary effects on agriculture for Model I and expansionary effects in Models II and III. Overall economic growth declined in all three models. Income distribution shifted in favor of urban households in all three models.

A devaluation of the baht in the base period had slight expansionary effects on agriculture in Model I and contractionary effects in Models II and III. Overall economic growth increased in all three models. Income distribution shifted in favor of rural households in all three models.

Agriculture-led development in Thailand (the simultaneous combination of increased agricultural productivity, government investment in agriculture, and the reduction of agricultural export taxes) effectively promoted agricultural growth and overall economic growth in all three models. Income distribution shifted in favor of rural households for Models II and III, and against rural households in Model I. When the agriculture-led development strategy was in place and world prices for agricultural commodities were assumed to be lower than in the base period, agriculture-led

development sustained agricultural growth in all three models. However, income distribution shifted in favor of urban households in all three models. In contrast, if world prices for agricultural commodities were assumed to be higher than in the base period, agriculture-led development again increased agricultural growth and overall growth, but income distribution shifted in favor of rural households in all three models. Thus, the agriculture-led development strategy appeared to be both plausible and feasible for Thailand.

In summary, each policy that enhanced agriculture generally also had positive effects on the contribution of the agricultural sector to GDP growth. Income distribution shifted in favor of rural households particularly in Models II and III and agricultural exports also increased. At the same time, the effects of these policies were more or less offset by growth in other sectors of the economy. When all production sectors of the economy were given equal opportunity to experience a positive shock, i.e., devaluation of the baht or an increase in world prices of all commodities, the contribution of agricultural sector to GDP and to foreign trade tended to decline relative to the rest of economy. As a consequence, the income distribution pattern shifted away from rural households.

Government policies can delay the decline of agriculture for a certain period of time. However agriculture is also affected by the world trade situation (trade liberalization vs. protectionism which in turn affects national and international comparative competitiveness among sectors/nations **or** managed trade). Since domestic and external conditions are closely linked, agriculture-led development strategy for

Thailand may be one of many options in dealing with the outcomes of the GATT negotiations.

From these findings, two important issues related to policy choices were revealed: the state of an economy when it is subjected to shock(s) and the magnitude of those shock(s). Aside from theoretical concerns with respect to CGE model, both of these issues determine success or failure in the implementation and/or effectiveness of policy. Policy-makers could analyze the state of the economy, intermittently, by updating the database, and respecifying the CGE model under multi-step combined policy simulations. This would track the current economic trends. The simulations would require policy-makers to select magnitudes of policy and external shocks. The general rule is that many intelligible policy simulation experiments are preferred over only a few experiments. Appropriate policy choices can be drawn from experiments in accordance with the prospects for the economy as perceived by policy-makers.

7.3 Limitations

The above findings were conditional on inductive-deductive arguments, which in turn were contingent on the researcher's knowledge of theory and model building. The limitations of the CGE framework are well-documented in Scarf and Shoven (1984), Decauwé and Martens (1987), and Shoven and Whalley (1992). In applied work, such as this study, the application of theory, vis-a-vis model building, is constrained by the availability of data. The following discusses certain aspects experienced from this study.

(i) The structure of the CGE model constructed for Thailand was of a standard

type. The SAM database was however too aggregated relative to the wide range of policy issues facing the Thai economy and the agricultural sector in particular. This issue required that a compromise be made with respect to the availability of data and model formulation. However, this model could be expanded in parallel with the content of the SAM database (if a more detailed database permits further disaggregation).

(ii) Although only one SAM database (1980) was used in this study, a SAM database can be compiled for any year. Therefore many different sets of data (SAMs) could be used in a study. Moreover, a SAM database may be compiled to test or support different assumptions of the model.

(iii) The qualitative interpretation of the results of simulations will reflect the underlying assumptions of each model. What is judged to be an appropriate policy for an economy at a point in time will depend on the perception of policy-makers/modellers. Theoretical issues affecting the selection of closure rules for CGE models are widely debated in the CGE literature.

(iv) Modelling approaches and model solving techniques may vary from one study to another. Each approach and technique has its pros and cons. In this study, the TV form via a SAM database was used and the model was solved by the GAMS/HERCULES software.

(v) A wide range of policy/shock experiments can be performed. However to accurately estimate the effects of a certain policy, the appropriate experiment must be designed. There are no specific criteria for this task, knowledge may be gained from repeated experimentation.

(vi) Aside from the magnitude of shocks, functional forms and model assumptions, the results of policy simulation depend crucially on the selection and values of parameters. Certain parameters used for calibration and policy simulation had to be drawn from outside the SAM framework since they could not be econometrically estimated. In these cases, the literature and the best guess method provided estimates of the parameters.

(vii) The results of simulations could not be statistically tested. Only a sensitivity analysis, which involved changing model's assumptions and/or certain parameters, could be conducted to determine the robustness of the results.

(viii) Most CGE applications, including this study, are limited with respect to the real sector. Theoretical arguments for incorporating aspects of the financial sector into dynamic CGE modelling have recently been developed.

(ix) A comparison of results from policy simulations across countries with different time horizons and level of economic development should not be made per se. Factors listed in points (i) - (viii), and the monetary and fiscal policy of individual countries must be taken into account. This is the reason why most of the literature focuses on the structural approach to modelling rather than model results.

In short, the CGE model in this study was a structural model designed for policy analysis.[52] The model's limitations which were translated into different outcomes and policy recommendations could be traced back to specific behavioral assumptions,

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52 A static CGE model was designed for short-run analysis. Thus, it is not used for forecasting [see Adelman and Robinson (1988); Grais (1981)].

empirical estimates, or fundamental differences in normative goals.

Above all, future applications of CGE modelling for Thailand should include a refined treatment of income distribution among household groups and sectoral investment with respect to the financial/capital market. This would require more data, modifications of the model, and finally a comprehensive interpretation of the results.

7.4 Concluding Remarks

The CGE model represents a useful tool to quantitatively explore the relative strengths of alternative policies on macroeconomic objectives such as sectoral growth, income distribution, and foreign trade. Based on the simulation results, an agriculture-led development strategy appeared to be plausible for Thailand under conditions prevalent in the early 1980s. However, any debate over the impacts of this strategy on the economy is conditional on the model specification (functional forms, assumptions, and predetermined values), the magnitude of shocks, and the method of data collection.[53]

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53 Morgenstern (1963) discusses a number of issues regarding the logic of scientific enquiry in economics.

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APPENDIX A

A Base Year SAM 1980

Economy-wide models, such as the CGE model, require a consistent database that provides a concise picture of production, income generation and distribution, consumption, savings, investments and foreign trade. The data are usually drawn from national income accounts, input-output tables, and socioeconomic surveys. Data must be compiled (aggregated or disaggregated) into production sectors, commodities, factors of production, and consumer groups according to issues to be investigated. The social account matrix (SAM) provides a useful framework for this purpose.[1]

A SAM presents a set of consistent data which contains elements mentioned above. This accounting framework is based on a matrix of receipts and expenditures. The SAM shown in **Table 4.2** is the SAM model, an expanded version the SAM database for 1980, which is compatible with the CGE model developed in **Chapter III**. The SAM database is expanded into a SAM model to reduce complications related to the specification of the non-empty cells which link the column and row totals of a SAM. This is a fundamental concept of the GAMS/HERCULES application to a SAM model.

This appendix explains how a SAM organizes data for a CGE model. It then goes on to describe how the model specification discussed in **Chapter III** (a two stage CES production function, **Figure 3.1**) is combined with the SAM model (**Table 4.2**) in the simulation using GAMS/HERCULES. In this illustration, only a part of the 'production

---

1 At the outset of this research, a tentative SAM database 1985 (78 x 78) had been complied under the outline mentioned above but the compilation could not be completed within a suitable time frame. Thus, the SAM database 1980 drawn from Drud, Grais, and Pyatt (1986) is used, and modified to be the SAM model (42 x 42), **Table 4.2**.

account' of **Table 4.2** is used to explain the entire process of commodity and financial flows.

Column 21 of the production account consists of two non-empty cells: 136 and 5 units represent the amount that the agricultural sector pays respectively to agricultural and nonagricultural labor in the 'factors-of-production account'; similarly in columns 22 and 23 the industrial sector pays 40 and 52 units and the services sector pays 64.5 and 126.5 units respectively to agricultural and nonagricultural labor. Total agricultural labor income is the summation of the values in the cells of row 1 (240.5 units) and total nonagricultural labor income is the summation of the values in the cells of row 2 (183.5 units). Labor income is then allocated to rural household (240.5 units) and urban household (183.5 units) in columns 1 and 2, based on their contribution to production. This constitutes only a portion of total household income. Total rural household income is the summation of the values in the cells of row 5 which equal to 289 units. Rural households spend their income along column 5: 253 units for consumption; 2 units for investment in firms; 4 units for income tax to government; and 30 units for savings. Consumption expenditures of rural households (253 units) are shown in column 6: agricultural commodities (103 units), industrial commodities (90 units), and services (60 units). These expenditures are in turn part of the income of producers (domestic and foreign). Thus, the circular flow of money and commodities is completed. Other accounts also follow a similar pattern. Some of these accounts represent transfer payments. It should be noted that in this representation the column account pays the row account.

As previously mentioned, the values in column 21 (136 and 5 units) represent agricultural and nonagricultural labor respectively. The two types of labor are combined in the first stage of the CES production function to become 'aggregate labor'. Aggregate labor (141 units) is then combined with agricultural capital (35 units) in the second stage of the CES production function in column 24 to become 'composite value-added' (labor and capital). Composite value-added (176 units) is then combined with the intermediate inputs in column 27 (22 units of agricultural commodities, 40 units of industrial commodities, and 63 units of services) under the assumption of fixed coefficients of production, to yield the final agricultural commodity. Thus, the two stage CES production function (**Figure 3.1**) is transformed into the SAM model (**Table 4.2**). To run the model using GAMS/HERCULES, each above mentioned non-empty cell must be specified. For example, **CES** is the specification for a constant elasticity of substitution function and **IO** is the specification for a fixed coefficient. Examples of a base solution and two policy simulations for Model III are provided in **Appendix C**.

APPENDIX B

Technological Change

In Scenario I, technological or productivity change in the agricultural sector are assumed to be Hicks-neutral at the stage where agricultural capital (K) and aggregate labor (L) are combined in the CES production function. This can be represented by equation (1).

$$Q = \overline{A}\,[\delta K^{-\rho} + (1-\delta) L^{-\rho}]^{-1/\rho} \qquad (1)$$

With respect to technological change, equation (1) can be rewritten as:

$$Q_*^{-\rho} = \overline{A}^{-\rho}\,[\delta \overline{K}^{-\rho} + (1-\delta)\,\overline{L}^{-\rho}] \qquad (2)$$

where $\overline{K}$ and $\overline{L}$ in equation (2) incorporate Hicks-neutral technological change governed by the specific forms (natural exponential functions) represented in equation (3). Over time both capital and labor become more efficient at the same rate.

$$\overline{K} = e^{mt} K$$
$$\overline{L} = e^{mt} L \qquad (3)$$

where: m = constant

t = time.

The CES production function under Hicks-neutral technical change can therefore be represented by equation (4):

$$Q_*^{-\rho} = \bar{A}^{-\rho}\left[\delta e^{-mt\rho}K^{-\rho} + (1-\delta)\, e^{-mt\rho}L^{-\rho}\right]$$

$$Q_*^{-\rho} = \bar{A}^{-\rho}e^{-mt\rho}\left[\delta K^{-\rho} + (1-\delta)\, L^{-\rho}\right] \qquad (4)$$

$$Q_* = \bar{A}e^{mt}\left[\delta K^{-\rho} + (1-\delta)\, L^{-\rho}\right]^{-1/\rho}$$

and the efficiency parameter (A) becomes;

$$A = \bar{A}e^{mt} \qquad (5)$$

Since the CGE model in this study assumes static general equilibrium, it may be further assumed that e^{mt} is equivalent to a 5 percent change from the base value of efficiency parameter ($\bar{A}$). First order conditions of profit maximization with respect to capital and labor can be derived as follows:

for capital

$$P\frac{\partial Q_*}{\partial K} = r \quad ;$$

$$where \quad \frac{\partial Q_*}{\partial K} = \bar{A}^{-\rho}e^{-mt\rho}\delta\left(\frac{K}{Q_*}\right)^{-(\rho+1)}$$

$$then \quad \delta = \frac{r\bar{A}^{\rho}e^{mt\rho}}{P\left(\frac{K}{Q_*}\right)^{-(\rho+1)}} = \frac{r\bar{A}^{\rho}e^{mt\rho}\left(\frac{K}{Q_*}\right)^{\rho+1}}{P} \qquad (6)$$

and for labor

$$P\frac{\partial Q_*}{\partial L} = w \quad ;$$

$$\text{where} \quad \frac{\partial Q_*}{\partial L} = \overline{A}^{-\rho} e^{-mt\rho} (1-\delta) \left(\frac{L}{Q_*}\right)^{-(\rho+1)} \tag{7}$$

$$\text{then} \quad (1-\delta) = \frac{w\overline{A}^{\rho} e^{mt\rho}}{P\left(\frac{L}{Q_*}\right)^{-(\rho+1)}} = \frac{w\overline{A}^{\rho} e^{mt\rho} \left(\frac{L}{Q_*}\right)^{\rho+1}}{P}$$

δ and ρ are constants, K and L are fixed in the case of **Model I** but Q_* increases from the base value, Q, due to technological change. In order to keep δ constant in equations (6) and (7), either a decrease in output prices (P) or an increase input prices (r = rental rate, w = an aggregate wage rate) is required. This could happen within the general equilibrium framework since Q_*, P, r, and w are endogenous variables and simultaneously determined in the CGE model. The effects of technological change in the agricultural sector on other nonagricultural sectors are represented by the elasticity of substitution between agricultural and nonagricultural labor in the CES function. Similarly, the rental rate of nonagricultural capital is determined by the elasticity of substitution between nonagricultural capital and aggregate labor.

In **Model II** when the nonagricultural wage rate is fixed to allow unemployment; P, L, Q_* and w must adjust to maintain the constant value of δ [equation (7)]. This happens through changes in L and w; where L and w are the respective aggregates of combined agricultural and nonagricultural labor and wage rates in the CES function. Since w will likely increase, and thus is derived from the agricultural wage rate, the

demand for nonagricultural labor may increase to substitute agricultural labor. In sum, increases in L and w are caused by nonagricultural labor and the agricultural wage respectively whereas the output price will likely decrease or both are the case. In the same way, an increase in the rental rate of agricultural capital in equation (6) will have an impact on the substitution between aggregate labor and capital in the agricultural sector and in nonagricultural sectors through the elasticities of substitution. Under fixed nonagricultural capital, the rental rate will likely increase.

When the return on nonagricultural capital is determined on the basis of the fixed share of the total value of output produced (under the assumption that nonagricultural sectors produce below their capacities) and incorporated into Model II, the result is the structure of **Model III**. Thus, return on capital increases and corresponds with an increase in output. Again, the interaction between agricultural and nonagricultural sectors operates through the elasticities of substitution as a result of technological change in agricultural sector. As in the previous two models, P, L, Q_*, w, r in the agricultural sector must adjust; agricultural wages, and the level of employment in nonagricultural labor will likely increase as well as the rental rate in the agricultural sector in order to keep δ in equations (6) and (7) constant.

APPENDIX C

Base Solution and Simulations

The analysis is based on three different CGE models (Models I, II, III). These models are simulated by using GAMS/HERCULES software (Drud and Kendrick, 1990). Each model is subjected to seven individual policy simulations and two multi-step combined policy simulations. Altogether, there are twenty-seven scenarios. The results of policy simulation are analysed with respect to the base case and a comparison among models is made. This appendix provides three examples of the simulation of Model III.

Appendix C1: Base Solution of Model III

Since the base solution is identical for all models, the results from the base solution presented in **Tables 6.1 - 6.10**, under the column heading "**base**".

Appendix C2: Scenario III of Model III

In this case agricultural export taxes are reduced by 30 percent in the base period. Results of this simulation are presented in **Table 6.3**, under the column heading "**Model III**"

Appendix C3: Scenario VII of Model III

In this the Thai currency (baht) is devalued by 5 percent in the base period. The results of this simulation are presented in **Table 6.7**, under the column heading "**Model III**".

APPENDIX C1

Base Solution of Model III

```
2  *  THE AGRICULTURAL-DEMAND-LED-GROWTH FOR THAILAND.
3
4  SET ACC ACCOUNTS /
5             AG-LABOR     AGRICULTURAL LABOR
6             NG-LABOR     NONAGRICULTURAL LABOR
7             AGR-CAP      AGRICULTURAL CAPITAL
8             NONAG-CAP    NONAGRICULTURAL CAPITAL
9             RU-H-INC     RURAL HOUSEHOLD INCOME
10            RU-H-CON     RURAL HOUSEHOLD CONSUMPTION
11            UR-H-INC     URBAN HOUSEHOLD INCOME
12            UR-H-CON     URBAN HOUSEHOLD CONSUMPTION
13            FIRMS        FIRMS OR CORPORATES
14            GOVT-INC     GOVERNMENT INCOME
15            GOVT-CON     GOVERNMENT CONSUMPTION
16            INDR-TAX     INDIRECT TAX
17            RU-H-SAV     RURAL HOUSEHOLD SAVINGS
18            UR-H-SAV     URBAN HOUSEHOLD SAVINGS
19            FIRM-SAV     FIRM SAVINGS
20            GOVT-SAV     GOVERNMENT SAVINGS
21            RU-H-INV     RURAL HOUSEHOLD INVESTMENT
22            UR-H-INV     URBAN HOUSEHOLD INVESTMENT
23            FIRM-INV     FIRM INVESTMENT
24            GOVT-INV     GOVERNMENT INVESTMENT
25            VA-L-AGR     LABOR VALUE ADDED FOR AGRICULTURE
26            VA-L-IND     LABOR VALUE ADDED FOR INDUSTRY
27            VA-L-SER     LABOR VALUE ADDED FOR SERVICES
28            VA-KL-AG     VALUE ADDED FOR AGRICULTURE
29            VA-KL-IN     VALUE ADDED FOR INDUSTRY
30            VA-KL-SE     VALUE ADDED FOR SERVICES
31            ACT-AGR      AGRICULTURAL ACTIVITY
32            ACT-IND      INDUSTRIAL ACTIVITY
33            ACT-SER      SERVICE ACTIVITY
34            AGR-DOM      DOMESTIC AGRICULTURAL COMMODITIES
35            AGR-EXP      AGRICULTURAL COMMODITIES EXPORTED
36            AGR-IMP      AGRICULTURAL COMMODITIES IMPORTED
37            AGR-COMP     AGRICULTURAL COMPOSITE COMMODITIES
38            IND-DOM      DOMESTIC MANUFACTURED COMMODITIES
39            IND-EXP      MANUFACTURED COMMODITIES EXPORTED
40            IND-IMP      MANUFACTURED COMMODITIES IMPORTED
41            IND-COMP     MANUFACTURED COMPOSITE COMMODITIES
42            SER-DOM      DOMESTIC SERVICES
43            SER-EXP      SERVICES EXPORTED
44            SER-IMP      SERVICES IMPORTED
45            SER-COMP     COMPOSITE SERVICES
46            REST-O-W     REST OF THE WORLD /;
47
48 ALIAS (ACC,ACCP);
49
50 ACRONYMS   MF       MARKET FACTOR ACCOUNT
51            NMF      NON MARKET FACTOR
52            INST     INSTITUTIONS INCOME ACCOUNT
53            INSTC    INSTITUTIONS CONSUMPTION ACCOUNT
54            AC       ACTIVITY OR COMMODITY ACCOUNT
55            TAX      INDIRECT TAX ACCOUNT
56            ROW      REST OF THE WORLD ACCOUNT
```

```
57
58            Q         QUNATITY FIXED
59            NP        PRICE FIXED AS NUMERAIRE
60            P         PRICE EXOGENOUS
61
62            CES       CES PRODUCTION FUNCTION SPECIFICATION
63            EXPORT    EXPORT DEMAND FROM THE REST OF THE WORLD
64            FEXO      EXOGENOUS IN FOREIGN EXCHANGE
65            IDIST     INCOME DISTRIBUTION SPECIFICATION
66            IMPORT    PAYMENT FOR IMPORTS
67            IO        INPUT-OUTPUT SPECIFICATION
68            ITAX      INDIRECT TAX SPECIFICATION
69            LES       LINEAR EXPENDITURE SYSTEM SPECIFICATION
70            MARKUP    MARKUP OVER AND ABOVE COST
71            QEXO      FIXED QUANTITY CONSUMPTION SYSTEM
72            QSHR      FIXED QUANTITY SHARE CONSUMPTION SYSTEM
73            TEXO      EXOGENOUS TSOL
74            UNSPEC    UNSPECIFIED OR RESIDUAL;
75
76
77  TABLE SAM(ACC,ACC) SOCIAL ACCOUNTING MATRIX
78
79                AG-LABOR    NG-LABOR    AGR-CAP    NONAG-CAP    RU-H-INC
80
81  RU-H-INC         240.5                    25           20
82  RU-H-CON                                                          253
83  UR-H-INC                     183.5        10           41
84  FIRMS                                                 78           2
85  GOVT-INC                                               4           4
86  RU-H-SAV                                                          30
87
88  +             RU-H-CON    UR-H-INC    UR-H-CON    FIRMS    GOVT-INC
89
90  RU-H-INC                                             1          .5
91  UR-H-INC                                             3          .5
92  UR-H-CON                      190
93  FIRMS                           4                                10
94  GOVT-INC                        5                   10
95  GOVT-CON                                                         83
96  UR-H-SAV                       42
97  FIRM-SAV                                            80
98  GOVT-SAV                                                          3
99  AGR-COMP          103                      29
100 IND-COMP           90                     103
101 SER-COMP           60                      58
102
103 +             GOVT-CON    INDR-TAX    RU-H-SAV    UR-H-SAV    FIRM-SAV
104
105 GOVT-INC                       71
106 RU-H-INV                                   18
107 UR-H-INV                                                22
108 FIRM-INV                                                             60
109 GOVT-INV                                   12           20          20
110 IND-COMP            8
111 SER-COMP           75
```

MODEL3: A G R I C U L T U R A L - D E M A N D - L E D - G R O W T H

112							
113	+	GOVT-SAV	RU-H-INV	UR-H-INV	FIRM-INV	GOVT-INV	
114							
115	GOVT-INV	3					
116	AGR-COMP		4	1	5	9	
117	IND-COMP		14	21	55	80	
118							
119	+	VA-L-AGR	VA-L-IND	VA-L-SER	VA-KL-AG	VA-KL-IN	
120							
121	AG-LABOR	136	40	64.5			
122	NG-LABOR	5	52	126.5			
123	AGR-CAP				35		
124	NONAG-CAP					61	
125	VA-L-AGR				141		
126	VA-L-IND					92	
127							
128	+	VA-KL-SE	ACT-AGR	ACT-IND	ACT-SER	AGR-DOM	
129							
130	NONAG-CAP	82					
131	INDR-TAX					2	
132	VA-L-SER	191					
133	VA-KL-AG		176				
134	VA-KL-IN			153			
135	VA-KL-SE				273		
136	ACT-AGR					227	
137	AGR-COMP		22	47	12		
138	IND-COMP		40	232	49		
139	SER-COMP		63	89	114		
140							
141	+	AGR-EXP	AGR-IMP	AGR-COMP	IND-DOM	IND-EXP	
142							
143	INDR-TAX	3	1		29		
144	ACT-AGR	74					
145	ACT-IND				462	59	
146	AGR-DOM			229			
147	AGR-IMP			3			
148	REST-O-W		2				
149							
150	+	IND-IMP	IND-COMP	SER-DOM	SER-EXP	SER-IMP	
151							
152	INDR-TAX	19		17			
153	ACT-SER			416	32		
154	IND-DOM		491				
155	IND-IMP		201				
156	REST-O-W	182				26	
157							
158	+	SER-COMP	REST-O-W				
159							
160	RU-H-INC		2				
161	UR-H-INC		3				
162	GOVT-INC		3				
163	GOVT-INV		34				
164	AGR-EXP		77				
165	IND-EXP		59				
166	SER-DOM	433					

```
167  SER-EXP                    32
168  SER-IMP         26;
169
170  TABLE SPEC(ACC,ACC) SPECIFICATION TABLE
171
172            AG-LABOR    NG-LABOR    AGR-CAP    NONAG-CAP    RU-H-INC
173
174  RU-H-INC     IDIST                  IDIST       IDIST
175  RU-H-CON                                                    IDIST
176  UR-H-INC                 IDIST      IDIST       IDIST
177  FIRMS                                           IDIST       IDIST
178  GOVT-INC                                        IDIST       IDIST
179  RU-H-SAV                                                    IDIST
180
181  +          RU-H-CON    UR-H-INC    UR-H-CON    FIRMS     GOVT-INC
182
183  RU-H-INC                                        IDIST        TEXO
184  UR-H-INC                                        IDIST        TEXO
185  UR-H-CON                 IDIST
186  FIRMS                    IDIST                               TEXO
187  GOVT-INC                 IDIST                  IDIST
188  GOVT-CON                                                   UNSPEC
189  UR-H-SAV                 IDIST
190  FIRM-SAV                                        IDIST
191  GOVT-SAV                                                   UNSPEC
192  AGR-COMP       LES                   LES
193  IND-COMP       LES                   LES
194  SER-COMP       LES                   LES
195
196  +          GOVT-CON    INDR-TAX    RU-H-SAV    UR-H-SAV    FIRM-SAV
197
198  GOVT-INC                 IDIST
199  RU-H-INV                               IDIST
200  UR-H-INV                                           IDIST
201  FIRM-INV                                                       IDIST
202  GOVT-INV                               IDIST       IDIST       IDIST
203  IND-COMP       QEXO
204  SER-COMP       QEXO
205
206  +          GOVT-SAV    RU-H-INV    UR-H-INV    FIRM-INV    GOVT-INV
207
208  GOVT-INV     IDIST
209  AGR-COMP                  QSHR        QSHR        QSHR        QSHR
210  IND-COMP                  QSHR        QSHR        QSHR        QSHR
211
212  +          VA-L-AGR    VA-L-IND    VA-L-SER    VA-KL-AG    VA-KL-IN
213
214  AG-LABOR       CES         CES         CES
215  NG-LABOR       CES         CES         CES
216  AGR-CAP                                            CES
217  NONAG-CAP                                                     MARKUP
218  VA-L-AGR                                           CES
219  VA-L-IND                                                         IO
220
221  +          VA-KL-SE    ACT-AGR     ACT-IND     ACT-SER     AGR-DOM
```

```
222
223 NONAG-CAP    MARKUP
224 INDR-TAX                                                    ITAX
225 VA-L-SER        IO
226 VA-KL-AG                 IO
227 VA-KL-IN                          IO
228 VA-KL-SE                                  IO
229 ACT-AGR                                                     IO
230 AGR-COMP                 IO         IO         IO
231 IND-COMP                 IO         IO         IO
232 SER-COMP                 IO         IO         IO
233
234 +          AGR-EXP    AGR-IMP    AGR-COMP    IND-DOM    IND-EXP
235
236 INDR-TAX      ITAX       ITAX                  ITAX
237 ACT-AGR         IO
238 ACT-IND                                        IO         IO
239 AGR-DOM                           CES
240 AGR-IMP                           CES
241 REST-O-W              IMPORT
242
243 +          IND-IMP    IND-COMP    SER-DOM    SER-EXP    SER-IMP
244
245 INDR-TAX      ITAX                  ITAX
246 ACT-SER                             IO         IO
247 IND-DOM                  CES
248 IND-IMP                  CES
249 REST-O-W    IMPORT                                        IMPORT
250
251 +          SER-COMP     REST-O-W
252
253 RU-H-INC                   FEXO
254 UR-H-INC                   FEXO
255 GOVT-INC                   FEXO
256 GOVT-INV                 UNSPEC
257 AGR-EXP                  EXPORT
258 IND-EXP                  EXPORT
259 SER-DOM         CES
260 SER-EXP                  EXPORT
261 SER-IMP         CES;
262
263 SET  ACCEX(ACC)  EXPORT COMMODITIES /AGR-EXP,IND-EXP,SER-EXP /
264      COMPS(ACC)  COMMITTED CONSUMPTION /AGR-COMP,IND-COMP,SER-COMP/
265
266 PARAMETER  ETAS(ACCEX) ELASTICITIES OF DEMAND FOR EXPORTS  /AGR-EXP =
                                                                    6.0,
267                       IND-EXP = 2.6, SER-EXP = 2.3 /
268            ALPHARU(COMPS)  MINIMUM CONSUMPTION FOR RURAL HH /AGR-COMP =
                                                                   86.4,
269                             IND-COMP = 67.2, SER-COMP = 38.4 /
270            ALPHAUR(COMPS)  MINIMUM CONSUMPTION FOR URBAN HH /AGR-COMP =
                                                                   21.0,
271                             IND-COMP = 56.0, SER-COMP = 42.0 /
272
273 *  DEFINE AND FILL THE CELL TABLE:
```

```
274
275  PARAMETER CT(ACC,ACC,*) CELL TABLE;
276
277           CT(ACC,ACCP,"TBASE") = SAM(ACC,ACCP);
278           CT(ACC,ACCP,"SPECS") = SPEC(ACC,ACCP);
279           CT(ACCEX,"REST-O-W","ETA") = ETAS(ACCEX);
280           CT(COMPS,"RU-H-CON","ALPHA") = ALPHARU(COMPS);
281           CT(COMPS,"UR-H-CON","ALPHA") = ALPHAUR(COMPS);
282
283  TABLE AT(ACC,*) ACCOUNT TABLE
284
285                      TYPE       FIX        SIGMA      E
286       AG-LABOR        MF         Q
287       NG-LABOR        MF         P
288       AGR-CAP         MF         Q
289       NONAG-CAP       NMF
290       RU-H-INC        INST
291       RU-H-CON        INSTC
292       UR-H-INC        INST
293       UR-H-CON        INSTC
294       FIRMS           INST
295       GOVT-INC        INST
296       GOVT-CON        INSTC
297       INDR-TAX        TAX
298       RU-H-SAV        INST
299       UR-H-SAV        INST
300       FIRM-SAV        INST
301       GOVT-SAV        INST
302       RU-H-INV        INSTC
303       UR-H-INV        INSTC
304       FIRM-INV        INSTC
305       GOVT-INV        INSTC      Q
306       VA-L-AGR        AC                    0.4        EPS
307       VA-L-IND        AC                    0.6
308       VA-L-SER        AC                    0.5
309       VA-KL-AG        AC                    0.8        EPS
310       VA-KL-IN        AC
311       VA-KL-SE        AC
312       ACT-AGR         AC
313       ACT-IND         AC
314       ACT-SER         AC
315       AGR-DOM         AC
316       AGR-EXP         AC
317       AGR-IMP         AC
318       AGR-COMP        AC                    0.8
319       IND-DOM         AC
320       IND-EXP         AC
321       IND-IMP         AC
322       IND-COMP        AC                    1.5
323       SER-DOM         AC
324       SER-EXP         AC
325       SER-IMP         AC
326       SER-COMP        AC                    3.0
327       REST-O-W        ROW        NP;
328
```

```
329  PARAMETER  TOTALS(ACC,*)  ACCOUNT TOTALS AND IMBALANCES FOR THE SAM;
330
331     TOTALS(ACC,"ROW-TOTAL") = SUM(ACCP,SAM(ACC,ACCP));
332     TOTALS(ACCP,"COL-TOTAL") = SUM(ACC,SAM(ACC,ACCP));
333     TOTALS(ACC,"DIFFERENCE") = TOTALS(ACC,"ROW-TOTAL") -
                                                TOTALS(ACC,"COL-TOTAL");
334
335  *DISPLAY "CHECK FOR BALANCE OF BASE SAM:", TOTALS;
336
337  MODEL MODEL3 AGRICULTURAL DEMAND-LED-GROWTH FOR THAILAND
338       / ACC, AT, CT /;
339
340  *DISPLAY "ACCOUNT AND CELL TABLES BEFORE SOLVE:", AT, CT;
341
342  SOLVE MODEL3 USING HERCULES;
343
344  DISPLAY "ACCOUNT AND CELL TABLES AFTER FIRST SOLVE:", AT, CT;
345
```

SYMBOL LISTING

SYMBOL	TYPE	REFERENCES					
AC	ACRNM	DECLARED	54	DEFINED	54	REF	306
		307	308	309	310	311	312
		313	314	315	316	317	318
		319	320	321	322	323	324
		325	326				
ACC	SET	DECLARED	4	DEFINED	4	REF	48
		2*77	2*170	263	264	2*275	277
		278	283	329	331	332	2*333
		338	342	CONTROL	277	278	331
		332	333				
ACCEX	SET	DECLARED	263	DEFINED	263	REF	266
		279	CONTROL	279			
ACCP	SET	DECLARED	48	REF	277	278	331
		332	CONTROL	277	278	331	332
ALPHARU	PARAM	DECLARED	268	DEFINED	268	REF	280
ALPHAUR	PARAM	DECLARED	270	DEFINED	270	REF	281
AT	PARAM	DECLARED	283	DEFINED	283	IMPL-ASN	342
		REF	338	344			
CES	ACRNM	DECLARED	62	DEFINED	62	REF	3*214
		3*215	216	218	239	240	247
		248	259	261			
COMPS	SET	DECLARED	264	DEFINED	264	REF	268
		270	280	281	CONTROL	280	281
CT	PARAM	DECLARED	275	IMPL-ASN	342	ASSIGNED	277
		278	279	280	281	REF	338
		344					
ETAS	PARAM	DECLARED	266	DEFINED	266	REF	279
EXPORT	ACRNM	DECLARED	63	DEFINED	63	REF	257
		258	260				
FEXO	ACRNM	DECLARED	64	DEFINED	64	REF	253
		254	255				
IDIST	ACRNM	DECLARED	65	DEFINED	65	REF	3*174
		175	3*176	2*177	2*178	179	183
		184	185	186	2*187	189	190
		198	199	200	201	3*202	208
IMPORT	ACRNM	DECLARED	66	DEFINED	66	REF	241
		2*249					
INST	ACRNM	DECLARED	52	DEFINED	52	REF	290
		292	294	295	298	299	300
		301					
INSTC	ACRNM	DECLARED	53	DEFINED	53	REF	291
		293	296	302	303	304	305
IO	ACRNM	DECLARED	67	DEFINED	67	REF	219
		225	226	227	228	229	3*230
		3*231	3*232	237	2*238	2*246	
ITAX	ACRNM	DECLARED	68	DEFINED	68	REF	224
		3*236	2*245				
LES	ACRNM	DECLARED	69	DEFINED	69	REF	2*192
		2*193	2*194				
MARKUP	ACRNM	DECLARED	70	DEFINED	70	REF	217
		223					
MF	ACRNM	DECLARED	50	DEFINED	50	REF	286
		287	288				

SYMBOL LISTING

SYMBOL	TYPE	REFERENCES					
MODEL3	MODEL	DECLARED	337	DEFINED	338	REF	342
NMF	ACRNM	DECLARED	51	DEFINED	51	REF	289
NP	ACRNM	DECLARED	59	DEFINED	59	REF	327
P	ACRNM	DECLARED	60	DEFINED	60	REF	287
Q	ACRNM	DECLARED	58	DEFINED	58	REF	286
		288	305				
QEXO	ACRNM	DECLARED	71	DEFINED	71	REF	203
		204					
QSHR	ACRNM	DECLARED	72	DEFINED	72	REF	4*209
		4*210					
ROW	ACRNM	DECLARED	56	DEFINED	56	REF	327
SAM	PARAM	DECLARED	77	DEFINED	77	REF	277
		331	332				
SPEC	PARAM	DECLARED	170	DEFINED	170	REF	278
TAX	ACRNM	DECLARED	55	DEFINED	55	REF	297
TEXO	ACRNM	DECLARED	73	DEFINED	73	REF	183
		184	186				
TOTALS	PARAM	DECLARED	329	ASSIGNED	331	332	333
		REF	2*333				
UNSPEC	ACRNM	DECLARED	74	DEFINED	74	REF	188
		191	256				

SETS

ACC	ACCOUNTS
ACCEX	EXPORT COMMODITIES
ACCP	ALIASED WITH ACC
COMPS	COMMITTED CONSUMPTION

ACRONYMS

AC	ACTIVITY OR COMMODITY ACCOUNT
CES	CES PRODUCTION FUNCTION SPECIFICATION
EXPORT	EXPORT DEMAND FROM THE REST OF THE WORLD
FEXO	EXOGENOUS IN FOREIGN EXCHANGE
IDIST	INCOME DISTRIBUTION SPECIFICATION
IMPORT	PAYMENT FOR IMPORTS
INST	INSTITUTIONS INCOME ACCOUNT
INSTC	INSTITUTIONS CONSUMPTION ACCOUNT
IO	INPUT-OUTPUT SPECIFICATION
ITAX	INDIRECT TAX SPECIFICATION
LES	LINEAR EXPENDITURE SYSTEM SPECIFICATION
MARKUP	MARKUP OVER AND ABOVE COST
MF	MARKET FACTOR ACCOUNT
NMF	NON MARKET FACTOR
NP	PRICE FIXED AS NUMERAIRE
P	PRICE EXOGENOUS
Q	QUNATITY FIXED
QEXO	FIXED QUANTITY CONSUMPTION SYSTEM
QSHR	FIXED QUANTITY SHARE CONSUMPTION SYSTEM
ROW	REST OF THE WORLD ACCOUNT

SYMBOL LISTING

ACRONYMS

TAX	INDIRECT TAX ACCOUNT
TEXO	EXOGENOUS TSOL
UNSPEC	UNSPECIFIED OR RESIDUAL

PARAMETERS

ALPHARU	MINIMUM CONSUMPTION FOR RURAL HH
ALPHAUR	MINIMUM CONSUMPTION FOR URBAN HH
AT	ACCOUNT TABLE
CT	CELL TABLE
ETAS	ELASTICITIES OF DEMAND FOR EXPORTS
SAM	SOCIAL ACCOUNTING MATRIX
SPEC	SPECIFICATION TABLE
TOTALS	ACCOUNT TOTALS AND IMBALANCES FOR THE SAM

MODELS

MODEL3	AGRICULTURAL DEMAND-LED-GROWTH FOR THAILAND

COMPILATION TIME = 0.172 MINUTES

MODEL3: A G R I C U L T U R A L - D E M A N D - L E D - G R O W T H
MODEL STATISTICS SOLVE MODEL3 USING HERCULES FROM LINE 342

MODEL STATISTICS

ACCOUNTS	42
ELEMENTS IN ACCOUNT TABLE	56
ELEMENTS IN CELL TABLE	211

EXECUTION TIME = 0.222 MINUTES

MODEL3: A G R I C U L T U R A L - D E M A N D - L E D - G R O W T H
SOLUTION REPORT SOLVE MODEL3 USING6 HERCULES FROM LINE 342

H E R C U L E S --- Version 1.14 from 92/02/06

Serial number 166
Licensed to: Samart Nitsmer
Department of Agricultural Economics and
Farm Management, University of Manitoba

SAM STATISTICS:	ACCOUNTS	CELLS
BEFORE EXPANSION	42	101
AFTER EXPANSION	44	109

MODEL STATISTICS:

VARIABLES	TOTAL	EXPLICIT	IMPLICIT	EXOGENOUS
P-VARIABLES	34	32	2	2
Q-VARIABLES	33		33	3
Y-VARIABLES	44	44	0	0
T-VARIABLES	109	109		
C-VARIABLES	72		72	
RESIDUAL	1	1		
TOTAL	293	186	107	5

EQUATIONS	TOTAL	EXPLICIT	IMPLICIT
ROW EQUATIONS	44	44	
COLUMN EQUATIONS	35	35	
P*Q=Y EQUATIONS	33	3	30
T(I,J) EQUATIONS	104	104	
C(I,J) EQUATIONS	72		72
FIXED VARIABLES	4		4
NUMERAIRE	1		1
TOTAL	293	186	107

VARIABLE AND EQUATION BALANCE BY MAJOR ACCOUNT TYPE:
(CELLS ARE COUNTED WITH THEIR COLUMN, EXCEPT IN
REST OF WORLD ACCOUNTS WHERE CELLS IN INSTITUTIONS
ROWS ARE COUNTED WITH INSTITUTIONS)

	VARIABLES	EQUATIONS	IMBALANCE
FACTORS	18	18	0
INSTITUTIONS	93	93	0
ACTIVITIES/COMMODITIES/ REST-OF-WORLD	179	179	0
INDIRECT TAXES	2	2	0
NUMERAIRE/RESIDUAL	1	1	
TOTALS	293	293	0

SIZE OF LARGEST SIMULTANEOUS BLOCK: 167
TOTAL NUMBER OF SPIKES: 8

G D P SUMMARY

		SOLUTION		
	BASE	CURRENT PRICES	CONSTANT PRICES	PRICE INDEX
GDP AT FACTOR COST	602.000	602.000	602.000	1.000
NET INDIRECT TAXES	71.000	71.000	71.000	
INCOME EFFECT			.000	
FINAL USE	715.000	715.000	715.000	1.000
EXPORTS	168.000	168.000	168.000	1.000
IMPORTS	-210.000	-210.000	-210.000	1.000
GDP AT MARKET PRICES	673.000	673.000	673.000	1.000
TERMS OF TRADE			.000	
GROSS DOMESTIC INCOME	673.000	673.000	673.000	
RESOURCE GAP	42.000	42.000	42.000	

EXIT -- FINAL SOLUTION FOUND
TIME STEPS 4
NEWTON ITERATIONS 0

SOLUTION TIME .148 MINUTES

WORK SPACE USED -- 2642 WORDS.
WORK SPACE AVAILABLE -- 28880 WORDS.

S O L U T I O N S U M M A R Y

	PSOL	QSOL	YSOL	YBASE
AG-LABOR	1.000	240.500	240.500	240.500
NG-LABOR	1.000	183.500	183.500	183.500
AGR-CAP	1.000	35.000	35.000	35.000
NONAG-CAP			143.000	143.000
RU-H-INC			289.000	289.000
RU-H-CON	1.000	253.000	253.000	253.000
UR-H-INC			241.000	241.000
UR-H-CON	1.000	190.000	190.000	190.000
FIRMS			94.000	94.000
GOVT-INC			97.000	97.000
GOVT-CON	1.000	83.000	83.000	83.000
INDR-TAX			71.000	71.000
RU-H-SAV			30.000	30.000
UR-H-SAV			42.000	42.000
FIRM-SAV			80.000	80.000
GOVT-SAV			3.000	3.000
RU-H-INV	1.000	18.000	18.000	18.000
UR-H-INV	1.000	22.000	22.000	22.000

S O L U T I O N S U M M A R Y

	PSOL	QSOL	YSOL	YBASE
FIRM-INV	1.000	60.000	60.000	60.000
GOVT-INV	1.000	89.000	89.000	89.000
VA-L-AGR	1.000	141.000	141.000	141.000
VA-L-IND	1.000	92.000	92.000	92.000
VA-L-SER	1.000	191.000	191.000	191.000
VA-KL-AG	1.000	176.000	176.000	176.000
VA-KL-IN	1.000	153.000	153.000	153.000
VA-KL-SE	1.000	273.000	273.000	273.000
ACT-AGR	1.000	301.000	301.000	301.000
ACT-IND	1.000	521.000	521.000	521.000
ACT-SER	1.000	448.000	448.000	448.000
AGR-DOM	1.000	229.000	229.000	229.000
AGR-EXP	1.000	77.000	77.000	77.000
AGR-IMP	1.000	3.000	3.000	3.000
AGR-COMP	1.000	232.000	232.000	232.000
IND-DOM	1.000	491.000	491.000	491.000
IND-EXP	1.000	59.000	59.000	59.000
IND-IMP	1.000	201.000	201.000	201.000
IND-COMP	1.000	692.000	692.000	692.000
SER-DOM	1.000	433.000	433.000	433.000
SER-EXP	1.000	32.000	32.000	32.000
SER-IMP	1.000	26.000	26.000	26.000
SER-COMP	1.000	459.000	459.000	459.000
REST-O-W	1.000		210.000	210.000

---- 344 ACCOUNT AND CELL TABLES AFTER FIRST SOLVE:

---- 344 PARAMETER AT ACCOUNT TABLE

	TYPE	FIX	SIGMA	E	PSOL
AG-LABOR	MF	Q			1.000
NG-LABOR	MF	P			1.000
AGR-CAP	MF	Q			1.000
NONAG-CAP	NMF				
RU-H-INC	INST				
RU-H-CON	INSTC				1.000
UR-H-INC	INST				
UR-H-CON	INSTC				1.000
FIRMS	INST				
GOVT-INC	INST				
GOVT-CON	INSTC				1.000
INDR-TAX	TAX				
RU-H-SAV	INST				
UR-H-SAV	INST				
FIRM-SAV	INST				
GOVT-SAV	INST				
RU-H-INV	INSTC				1.000
UR-H-INV	INSTC				1.000
FIRM-INV	INSTC				1.000
GOVT-INV	INSTC	Q			1.000
VA-L-AGR	AC		0.400	EPS	1.000
VA-L-IND	AC		0.600		1.000
VA-L-SER	AC		0.500		1.000
VA-KL-AG	AC		0.800	EPS	1.000
VA-KL-IN	AC				1.000
VA-KL-SE	AC				1.000
ACT-AGR	AC				1.000
ACT-IND	AC				1.000
ACT-SER	AC				1.000
AGR-DOM	AC				1.000
AGR-EXP	AC				1.000
AGR-IMP	AC				1.000
AGR-COMP	AC		0.800		1.000
IND-DOM	AC				1.000
IND-EXP	AC				1.000
IND-IMP	AC				1.000
IND-COMP	AC		1.500		1.000
SER-DOM	AC				1.000
SER-EXP	AC				1.000
SER-IMP	AC				1.000
SER-COMP	AC		3.000		1.000
REST-O-W	ROW	NP			1.000

MODEL3: A G R I C U L T U R A L - D E M A N D - L E D - G R O W T H
E X E C U T I N G

344 PARAMETER AT ACCOUNT TABLE

+	QSOL	YSOL	YBASE
AG-LABOR	240.500	240.500	240.500
NG-LABOR	183.500	183.500	183.500
AGR-CAP	35.000	35.000	35.000
NONAG-CAP		143.000	143.000
RU-H-INC		289.000	289.000
RU-H-CON	253.000	253.000	253.000
UR-H-INC		241.000	241.000
UR-H-CON	190.000	190.000	190.000
FIRMS		94.000	94.000
GOVT-INC		97.000	97.000
GOVT-CON	83.000	83.000	83.000
INDR-TAX		71.000	71.000
RU-H-SAV		30.000	30.000
UR-H-SAV		42.000	42.000
FIRM-SAV		80.000	80.000
GOVT-SAV		3.000	3.000
RU-H-INV	18.000	18.000	18.000
UR-H-INV	22.000	22.000	22.000
FIRM-INV	60.000	60.000	60.000
GOVT-INV	89.000	89.000	89.000
VA-L-AGR	141.000	141.000	141.000
VA-L-IND	92.000	92.000	92.000
VA-L-SER	191.000	191.000	191.000
VA-KL-AG	176.000	176.000	176.000
VA-KL-IN	153.000	153.000	153.000
VA-KL-SE	273.000	273.000	273.000
ACT-AGR	301.000	301.000	301.000
ACT-IND	521.000	521.000	521.000
ACT-SER	448.000	448.000	448.000
AGR-DOM	229.000	229.000	229.000
AGR-EXP	77.000	77.000	77.000
AGR-IMP	3.000	3.000	3.000
AGR-COMP	232.000	232.000	232.000
IND-DOM	491.000	491.000	491.000
IND-EXP	59.000	59.000	59.000
IND-IMP	201.000	201.000	201.000
IND-COMP	692.000	692.000	692.000
SER-DOM	433.000	433.000	433.000
SER-EXP	32.000	32.000	32.000
SER-IMP	26.000	26.000	26.000
SER-COMP	459.000	459.000	459.000
REST-O-W		210.000	210.000

---- 344 PARAMETER CT CELL TABLE

	TBASE	SPECS	ETA	ALPHA	TSOL
AG-LABOR .VA-L-AGR	136.000	CES			136.000
AG-LABOR .VA-L-IND	40.000	CES			40.000
AG-LABOR .VA-L-SER	64.500	CES			64.500
NG-LABOR .VA-L-AGR	5.000	CES			5.000
NG-LABOR .VA-L-IND	52.000	CES			52.000
NG-LABOR .VA-L-SER	126.500	CES			126.500
AGR-CAP .VA-KL-AG	35.000	CES			35.000
NONAG-CAP.VA-KL-IN	61.000	MARKUP			61.000
NONAG-CAP.VA-KL-SE	82.000	MARKUP			82.000
RU-H-INC .AG-LABOR	240.500	IDIST			240.500
RU-H-INC .AGR-CAP	25.000	IDIST			25.000
RU-H-INC .NONAG-CAP	20.000	IDIST			20.000
RU-H-INC .FIRMS	1.000	IDIST			1.000
RU-H-INC .GOVT-INC	0.500	TEXO			0.500
RU-H-INC .REST-O-W	2.000	FEXO			2.000
RU-H-CON .RU-H-INC	253.000	IDIST			253.000
UR-H-INC .NG-LABOR	183.500	IDIST			183.500
UR-H-INC .AGR-CAP	10.000	IDIST			10.000
UR-H-INC .NONAG-CAP	41.000	IDIST			41.000
UR-H-INC .FIRMS	3.000	IDIST			3.000
UR-H-INC .GOVT-INC	0.500	TEXO			0.500
UR-H-INC .REST-O-W	3.000	FEXO			3.000
UR-H-CON .UR-H-INC	190.000	IDIST			190.000
FIRMS .NONAG-CAP	78.000	IDIST			78.000
FIRMS .RU-H-INC	2.000	IDIST			2.000
FIRMS .UR-H-INC	4.000	IDIST			4.000
FIRMS .GOVT-INC	10.000	TEXO			10.000
GOVT-INC .NONAG-CAP	4.000	IDIST			4.000
GOVT-INC .RU-H-INC	4.000	IDIST			4.000
GOVT-INC .UR-H-INC	5.000	IDIST			5.000
GOVT-INC .FIRMS	10.000	IDIST			10.000
GOVT-INC .INDR-TAX	71.000	IDIST			71.000
GOVT-INC .REST-O-W	3.000	FEXO			3.000
GOVT-CON .GOVT-INC	83.000	UNSPEC			83.000
INDR-TAX .AGR-DOM	2.000	ITAX			2.000
INDR-TAX .AGR-EXP	3.000	ITAX			3.000
INDR-TAX .AGR-IMP	1.000	ITAX			1.000
INDR-TAX .IND-DOM	29.000	ITAX			29.000
INDR-TAX .IND-IMP	19.000	ITAX			19.000
INDR-TAX .SER-DOM	17.000	ITAX			17.000
RU-H-SAV .RU-H-INC	30.000	IDIST			30.000
UR-H-SAV .UR-H-INC	42.000	IDIST			42.000
FIRM-SAV .FIRMS	80.000	IDIST			80.000
GOVT-SAV .GOVT-INC	3.000	UNSPEC			3.000
RU-H-INV .RU-H-SAV	18.000	IDIST			18.000
UR-H-INV .UR-H-SAV	22.000	IDIST			22.000
FIRM-INV .FIRM-SAV	60.000	IDIST			60.000
GOVT-INV .RU-H-SAV	12.000	IDIST			12.000
GOVT-INV .UR-H-SAV	20.000	IDIST			20.000
GOVT-INV .FIRM-SAV	20.000	IDIST			20.000
GOVT-INV .GOVT-SAV	3.000	IDIST			3.000

344 PARAMETER CT CELL TABLE

	TBASE	SPECS	ETA	ALPHA	TSOL
GOVT-INV .REST-O-W	34.000	UNSPEC			34.000
VA-L-AGR .VA-KL-AG	141.000	CES			141.000
VA-L-IND .VA-KL-IN	92.000	IO			92.000
VA-L-SER .VA-KL-SE	191.000	IO			191.000
VA-KL-AG .ACT-AGR	176.000	IO			176.000
VA-KL-IN .ACT-IND	153.000	IO			153.000
VA-KL-SE .ACT-SER	273.000	IO			273.000
ACT-AGR .AGR-DOM	227.000	IO			227.000
ACT-AGR .AGR-EXP	74.000	IO			74.000
ACT-IND .IND-DOM	462.000	IO			462.000
ACT-IND .IND-EXP	59.000	IO			59.000
ACT-SER .SER-DOM	416.000	IO			416.000
ACT-SER .SER-EXP	32.000	IO			32.000
AGR-DOM .AGR-COMP	229.000	CES			229.000
AGR-EXP .REST-O-W	77.000	EXPORT	6.000		77.000
AGR-IMP .AGR-COMP	3.000	CES			3.000
AGR-COMP .RU-H-CON	103.000	LES		86.400	103.000
AGR-COMP .UR-H-CON	29.000	LES		21.000	29.000
AGR-COMP .RU-H-INV	4.000	QSHR			4.000
AGR-COMP .UR-H-INV	1.000	QSHR			1.000
AGR-COMP .FIRM-INV	5.000	QSHR			5.000
AGR-COMP .GOVT-INV	9.000	QSHR			9.000
AGR-COMP .ACT-AGR	22.000	IO			22.000
AGR-COMP .ACT-IND	47.000	IO			47.000
AGR-COMP .ACT-SER	12.000	IO			12.000
IND-DOM .IND-COMP	491.000	CES			491.000
IND-EXP .REST-O-W	59.000	EXPORT	2.600		59.000
IND-IMP .IND-COMP	201.000	CES			201.000
IND-COMP .RU-H-CON	90.000	LES		67.200	90.000
IND-COMP .UR-H-CON	103.000	LES		56.000	103.000
IND-COMP .GOVT-CON	8.000	QEXO			8.000
IND-COMP .RU-H-INV	14.000	QSHR			14.000
IND-COMP .UR-H-INV	21.000	QSHR			21.000
IND-COMP .FIRM-INV	55.000	QSHR			55.000
IND-COMP .GOVT-INV	80.000	QSHR			80.000
IND-COMP .ACT-AGR	40.000	IO			40.000
IND-COMP .ACT-IND	232.000	IO			232.000
IND-COMP .ACT-SER	49.000	IO			49.000
SER-DOM .SER-COMP	433.000	CES			433.000
SER-EXP .REST-O-W	32.000	EXPORT	2.300		32.000
SER-IMP .SER-COMP	26.000	CES			26.000
SER-COMP .RU-H-CON	60.000	LES		38.400	60.000
SER-COMP .UR-H-CON	58.000	LES		42.000	58.000
SER-COMP .GOVT-CON	75.000	QEXO			75.000
SER-COMP .ACT-AGR	63.000	IO			63.000
SER-COMP .ACT-IND	89.000	IO			89.000
SER-COMP .ACT-SER	114.000	IO			114.000
REST-O-W .AGR-IMP	2.000	IMPORT			2.000
REST-O-W .IND-IMP	182.000	IMPORT			182.000
REST-O-W .SER-IMP	26.000	IMPORT			26.000

344 PARAMETER CT CELL TABLE

+	QCSOL	A-USED	BETA-USED	FQ-USED	FV-USED
AG-LABOR .VA-L-AGR	136.000	0.965			
AG-LABOR .VA-L-IND	40.000	0.435			
AG-LABOR .VA-L-SER	64.500	0.338			
NG-LABOR .VA-L-AGR	5.000	0.035			
NG-LABOR .VA-L-IND	52.000	0.565			
NG-LABOR .VA-L-SER	126.500	0.662			
AGR-CAP .VA-KL-AG	35.000	0.199			
NONAG-CAP.VA-KL-IN	61.000				
NONAG-CAP.VA-KL-SE	82.000				
RU-H-INC .AG-LABOR		1.000			
RU-H-INC .AGR-CAP		0.714			
RU-H-INC .NONAG-CAP		0.140			
RU-H-INC .FIRMS		0.011			
RU-H-INC .GOVT-INC					0.500
RU-H-INC .REST-O-W					2.000
RU-H-CON .RU-H-INC		0.875			
UR-H-INC .NG-LABOR		1.000			
UR-H-INC .AGR-CAP		0.286			
UR-H-INC .NONAG-CAP		0.287			
UR-H-INC .FIRMS		0.032			
UR-H-INC .GOVT-INC					0.500
UR-H-INC .REST-O-W					3.000
UR-H-CON .UR-H-INC		0.788			
FIRMS .NONAG-CAP		0.545			
FIRMS .RU-H-INC		0.007			
FIRMS .UR-H-INC		0.017			
FIRMS .GOVT-INC					10.000
GOVT-INC .NONAG-CAP		0.028			
GOVT-INC .RU-H-INC		0.014			
GOVT-INC .UR-H-INC		0.021			
GOVT-INC .FIRMS		0.106			
GOVT-INC .INDR-TAX		1.000			
GOVT-INC .REST-O-W					3.000
INDR-TAX .AGR-DOM	2.000				
INDR-TAX .AGR-EXP	3.000				
INDR-TAX .AGR-IMP	1.000				
INDR-TAX .IND-DOM	29.000				
INDR-TAX .IND-IMP	19.000				
INDR-TAX .SER-DOM	17.000				
RU-H-SAV .RU-H-INC		0.104			
UR-H-SAV .UR-H-INC		0.174			
FIRM-SAV .FIRMS		0.851			
RU-H-INV .RU-H-SAV		0.600			
UR-H-INV .UR-H-SAV		0.524			
FIRM-INV .FIRM-SAV		0.750			
GOVT-INV .RU-H-SAV		0.400			
GOVT-INV .UR-H-SAV		0.476			
GOVT-INV .FIRM-SAV		0.250			
GOVT-INV .GOVT-SAV		1.000			
VA-L-AGR .VA-KL-AG	141.000	0.801			
VA-L-IND .VA-KL-IN	92.000	0.601			

344 PARAMETER CT CELL TABLE

+		QCSOL	A-USED	BETA-USED	FQ-USED	FV-USED
VA-L-SER	.VA-KL-SE	191.000	0.700			
VA-KL-AG	.ACT-AGR	176.000	0.585			
VA-KL-IN	.ACT-IND	153.000	0.294			
VA-KL-SE	.ACT-SER	273.000	0.609			
ACT-AGR	.AGR-DOM	227.000	0.991			
ACT-AGR	.AGR-EXP	74.000	0.961			
ACT-IND	.IND-DOM	462.000	0.941			
ACT-IND	.IND-EXP	59.000	1.000			
ACT-SER	.SER-DOM	416.000	0.961			
ACT-SER	.SER-EXP	32.000	1.000			
AGR-DOM	.AGR-COMP	229.000	0.987			
AGR-EXP	.REST-O-W	77.000			77.000	
AGR-IMP	.AGR-COMP	3.000	0.013			
AGR-COMP	.RU-H-CON	103.000		0.272		
AGR-COMP	.UR-H-CON	29.000		0.113		
AGR-COMP	.RU-H-INV	4.000	0.222			
AGR-COMP	.UR-H-INV	1.000	0.045			
AGR-COMP	.FIRM-INV	5.000	0.083			
AGR-COMP	.GOVT-INV	9.000	0.101			
AGR-COMP	.ACT-AGR	22.000	0.073			
AGR-COMP	.ACT-IND	47.000	0.090			
AGR-COMP	.ACT-SER	12.000	0.027			
IND-DOM	.IND-COMP	491.000	0.710			
IND-EXP	.REST-O-W	59.000			59.000	
IND-IMP	.IND-COMP	201.000	0.290			
IND-COMP	.RU-H-CON	90.000		0.374		
IND-COMP	.UR-H-CON	103.000		0.662		
IND-COMP	.GOVT-CON	8.000			8.000	
IND-COMP	.RU-H-INV	14.000	0.778			
IND-COMP	.UR-H-INV	21.000	0.955			
IND-COMP	.FIRM-INV	55.000	0.917			
IND-COMP	.GOVT-INV	80.000	0.899			
IND-COMP	.ACT-AGR	40.000	0.133			
IND-COMP	.ACT-IND	232.000	0.445			
IND-COMP	.ACT-SER	49.000	0.109			
SER-DOM	.SER-COMP	433.000	0.943			
SER-EXP	.REST-O-W	32.000			32.000	
SER-IMP	.SER-COMP	26.000	0.057			
SER-COMP	.RU-H-CON	60.000		0.354		
SER-COMP	.UR-H-CON	58.000		0.225		
SER-COMP	.GOVT-CON	75.000			75.000	
SER-COMP	.ACT-AGR	63.000	0.209			
SER-COMP	.ACT-IND	89.000	0.171			
SER-COMP	.ACT-SER	114.000	0.254			
REST-O-W	.AGR-IMP	2.000				
REST-O-W	.IND-IMP	182.000				
REST-O-W	.SER-IMP	26.000				

344 PARAMETER CT CELL TABLE

+	WP-USED	THETA-USED
NONAG-CAP.VA-KL-IN		0.663
NONAG-CAP.VA-KL-SE		0.429
INDR-TAX .AGR-DOM		0.009
INDR-TAX .AGR-EXP		0.041
INDR-TAX .AGR-IMP		0.500
INDR-TAX .IND-DOM		0.063
INDR-TAX .IND-IMP		0.104
INDR-TAX .SER-DOM		0.041
AGR-EXP .REST-O-W	1.000	
IND-EXP .REST-O-W	1.000	
SER-EXP .REST-O-W	1.000	
REST-O-W .AGR-IMP	1.000	
REST-O-W .IND-IMP	1.000	
REST-O-W .SER-IMP	1.000	

**** FILE SUMMARY

INPUT C:\DISSERT\SAMSON1.GMS
OUTPUT C:\DISSERT\SAMSON1.LST

EXECUTION TIME = 0.223 MINUTES

APPENDIX C2

Scenario III of Model III:

A Reduction of Agricultural Export Taxes by 30 Percent

```
 2  *  THE AGRICULTURAL-DEMAND-LED-GROWTH FOR THAILAND.
 3
 4  SET ACC ACCOUNTS /
 5            AG-LABOR     AGRICULTURAL LABOR
 6            NG-LABOR     NONAGRICULTURAL LABOR
 7            AGR-CAP      AGRICULTURAL CAPITAL
 8            NONAG-CAP    NONAGRICULTURAL CAPITAL
 9            RU-H-INC     RURAL HOUSEHOLD INCOME
10            RU-H-CON     RURAL HOUSEHOLD CONSUMPTION
11            UR-H-INC     URBAN HOUSEHOLD INCOME
12            UR-H-CON     URBAN HOUSEHOLD CONSUMPTION
13            FIRMS        FIRMS OR CORPORATES
14            GOVT-INC     GOVERNMENT INCOME
15            GOVT-CON     GOVERNMENT CONSUMPTION
16            INDR-TAX     INDIRECT TAX
17            RU-H-SAV     RURAL HOUSEHOLD SAVINGS
18            UR-H-SAV     URBAN HOUSEHOLD SAVINGS
19            FIRM-SAV     FIRM SAVINGS
20            GOVT-SAV     GOVERNMENT SAVINGS
21            RU-H-INV     RURAL HOUSEHOLD INVESTMENT
22            UR-H-INV     URBAN HOUSEHOLD INVESTMENT
23            FIRM-INV     FIRM INVESTMENT
24            GOVT-INV     GOVERNMENT INVESTMENT
25            VA-L-AGR     LABOR VALUE ADDED FOR AGRICULTURE
26            VA-L-IND     LABOR VALUE ADDED FOR INDUSTRY
27            VA-L-SER     LABOR VALUE ADDED FOR SERVICES
28            VA-KL-AG     VALUE ADDED FOR AGRICULTURE
29            VA-KL-IN     VALUE ADDED FOR INDUSTRY
30            VA-KL-SE     VALUE ADDED FOR SERVICES
31            ACT-AGR      AGRICULTURAL ACTIVITY
32            ACT-IND      INDUSTRIAL ACTIVITY
33            ACT-SER      SERVICE ACTIVITY
34            AGR-DOM      DOMESTIC AGRICULTURAL COMMODITIES
35            AGR-EXP      AGRICULTURAL COMMODITIES EXPORTED
36            AGR-IMP      AGRICULTURAL COMMODITIES IMPORTED
37            AGR-COMP     AGRICULTURAL COMPOSITE COMMODITIES
38            IND-DOM      DOMESTIC MANUFACTURED COMMODITIES
39            IND-EXP      MANUFACTURED COMMODITIES EXPORTED
40            IND-IMP      MANUFACTURED COMMODITIES IMPORTED
41            IND-COMP     MANUFACTURED COMPOSITE COMMODITIES
42            SER-DOM      DOMESTIC SERVICES
43            SER-EXP      SERVICES EXPORTED
44            SER-IMP      SERVICES IMPORTED
45            SER-COMP     COMPOSITE SERVICES
46            REST-O-W     REST OF THE WORLD /;
47
48  ALIAS (ACC,ACCP);
49
50  ACRONYMS   MF       MARKET FACTOR ACCOUNT
51             NMF      NON MARKET FACTOR
52             INST     INSTITUTIONS INCOME ACCOUNT
53             INSTC    INSTITUTIONS CONSUMPTION ACCOUNT
54             AC       ACTIVITY OR COMMODITY ACCOUNT
55             TAX      INDIRECT TAX ACCOUNT
56             ROW      REST OF THE WORLD ACCOUNT
```

```
 57
 58            Q        QUNATITY FIXED
 59            NP       PRICE FIXED AS NUMERAIRE
 60            P        PRICE EXOGENOUS
 61
 62            CES      CES PRODUCTION FUNCTION SPECIFICATION
 63            EXPORT   EXPORT DEMAND FROM THE REST OF THE WORLD
 64            FEXO     EXOGENOUS IN FOREIGN EXCHANGE
 65            IDIST    INCOME DISTRIBUTION SPECIFICATION
 66            IMPORT   PAYMENT FOR IMPORTS
 67            IO       INPUT-OUTPUT SPECIFICATION
 68            ITAX     INDIRECT TAX SPECIFICATION
 69            LES      LINEAR EXPENDITURE SYSTEM SPECIFICATION
 70            MARKUP   MARKUP OVER AND ABOVE COST
 71            QEXO     FIXED QUANTITY CONSUMPTION SYSTEM
 72            QSHR     FIXED QUANTITY SHARE CONSUMPTION SYSTEM
 73            TEXO     EXOGENOUS TSOL
 74            UNSPEC   UNSPECIFIED OR RESIDUAL;
 75
 76
 77  TABLE SAM(ACC,ACC) SOCIAL ACCOUNTING MATRIX
 78
 79             AG-LABOR    NG-LABOR    AGR-CAP    NONAG-CAP    RU-H-INC
 80
 81  RU-H-INC      240.5                     25           20
 82  RU-H-CON                                                       253
 83  UR-H-INC                   183.5        10           41
 84  FIRMS                                                 78           2
 85  GOVT-INC                                               4           4
 86  RU-H-SAV                                                          30
 87
 88  +          RU-H-CON    UR-H-INC    UR-H-CON    FIRMS    GOVT-INC
 89
 90  RU-H-INC                                            1          .5
 91  UR-H-INC                                            3          .5
 92  UR-H-CON                    190
 93  FIRMS                         4                                10
 94  GOVT-INC                      5                   10
 95  GOVT-CON                                                       83
 96  UR-H-SAV                     42
 97  FIRM-SAV                                           80
 98  GOVT-SAV                                                        3
 99  AGR-COMP         103                      29
100  IND-COMP          90                     103
101  SER-COMP          60                      58
102
103  +          GOVT-CON    INDR-TAX    RU-H-SAV    UR-H-SAV    FIRM-SAV
104
105  GOVT-INC                     71
106  RU-H-INV                                 18
107  UR-H-INV                                                22
108  FIRM-INV                                                            60
109  GOVT-INV                                 12           20           20
110  IND-COMP           8
111  SER-COMP          75
```

112						
113	+	GOVT-SAV	RU-H-INV	UR-H-INV	FIRM-INV	GOVT-INV
114						
115	GOVT-INV	3				
116	AGR-COMP		4	1	5	9
117	IND-COMP		14	21	55	80
118						
119	+	VA-L-AGR	VA-L-IND	VA-L-SER	VA-KL-AG	VA-KL-IN
120						
121	AG-LABOR	136	40	64.5		
122	NG-LABOR	5	52	126.5		
123	AGR-CAP				35	
124	NONAG-CAP					61
125	VA-L-AGR				141	
126	VA-L-IND					92
127						
128	+	VA-KL-SE	ACT-AGR	ACT-IND	ACT-SER	AGR-DOM
129						
130	NONAG-CAP	82				
131	INDR-TAX					2
132	VA-L-SER	191				
133	VA-KL-AG		176			
134	VA-KL-IN			153		
135	VA-KL-SE				273	
136	ACT-AGR					227
137	AGR-COMP		22	47	12	
138	IND-COMP		40	232	49	
139	SER-COMP		63	89	114	
140						
141	+	AGR-EXP	AGR-IMP	AGR-COMP	IND-DOM	IND-EXP
142						
143	INDR-TAX	3	1		29	
144	ACT-AGR	74				
145	ACT-IND				462	59
146	AGR-DOM			229		
147	AGR-IMP			3		
148	REST-O-W		2			
149						
150	+	IND-IMP	IND-COMP	SER-DOM	SER-EXP	SER-IMP
151						
152	INDR-TAX	19		17		
153	ACT-SER			416	32	
154	IND-DOM		491			
155	IND-IMP		201			
156	REST-O-W	182				26
157						
158	+	SER-COMP	REST-O-W			
159						
160	RU-H-INC		2			
161	UR-H-INC		3			
162	GOVT-INC		3			
163	GOVT-INV		34			
164	AGR-EXP		77			
165	IND-EXP		59			
166	SER-DOM	433				

```
167  SER-EXP                    32
168  SER-IMP         26;
169
170  TABLE SPEC(ACC,ACC) SPECIFICATION TABLE
171
172             AG-LABOR    NG-LABOR    AGR-CAP     NONAG-CAP    RU-H-INC
173
174  RU-H-INC     IDIST                  IDIST        IDIST
175  RU-H-CON                                                     IDIST
176  UR-H-INC                 IDIST       IDIST        IDIST
177  FIRMS                                             IDIST       IDIST
178  GOVT-INC                                          IDIST       IDIST
179  RU-H-SAV                                                      IDIST
180
181  +          RU-H-CON    UR-H-INC    UR-H-CON     FIRMS      GOVT-INC
182
183  RU-H-INC                                         IDIST         TEXO
184  UR-H-INC                                         IDIST         TEXO
185  UR-H-CON                 IDIST
186  FIRMS                    IDIST                                 TEXO
187  GOVT-INC                 IDIST                   IDIST
188  GOVT-CON                                                      UNSPEC
189  UR-H-SAV                 IDIST
190  FIRM-SAV                                         IDIST
191  GOVT-SAV                                                      UNSPEC
192  AGR-COMP       LES                   LES
193  IND-COMP       LES                   LES
194  SER-COMP       LES                   LES
195
196  +          GOVT-CON    INDR-TAX    RU-H-SAV     UR-H-SAV     FIRM-SAV
197
198  GOVT-INC                 IDIST
199  RU-H-INV                               IDIST
200  UR-H-INV                                            IDIST
201  FIRM-INV                                                        IDIST
202  GOVT-INV                               IDIST        IDIST       IDIST
203  IND-COMP       QEXO
204  SER-COMP       QEXO
205
206  +          GOVT-SAV    RU-H-INV    UR-H-INV     FIRM-INV     GOVT-INV
207
208  GOVT-INV     IDIST
209  AGR-COMP                 QSHR        QSHR         QSHR         QSHR
210  IND-COMP                 QSHR        QSHR         QSHR         QSHR
211
212  +          VA-L-AGR    VA-L-IND    VA-L-SER     VA-KL-AG     VA-KL-IN
213
214  AG-LABOR       CES         CES         CES
215  NG-LABOR       CES         CES         CES
216  AGR-CAP                                             CES
217  NONAG-CAP                                                       MARKUP
218  VA-L-AGR                                            CES
219  VA-L-IND                                                          IO
220
221  +          VA-KL-SE    ACT-AGR     ACT-IND      ACT-SER      AGR-DOM
```

```
222
223  NONAG-CAP    MARKUP                                                ITAX
224  INDR-TAX                                                           ITAX
225  VA-L-SER        IO
226  VA-KL-AG                  IO
227  VA-KL-IN                            IO
228  VA-KL-SE                                      IO
229  ACT-AGR                                                            IO
230  AGR-COMP                  IO          IO          IO
231  IND-COMP                  IO          IO          IO
232  SER-COMP                  IO          IO          IO
233
234  +          AGR-EXP    AGR-IMP    AGR-COMP    IND-DOM    IND-EXP
235
236  INDR-TAX      ITAX       ITAX                   ITAX
237  ACT-AGR         IO
238  ACT-IND                                         IO          IO
239  AGR-DOM                              CES
240  AGR-IMP                              CES
241  REST-O-W               IMPORT
242
243  +          IND-IMP    IND-COMP    SER-DOM    SER-EXP    SER-IMP
244
245  INDR-TAX      ITAX                   ITAX
246  ACT-SER                               IO          IO
247  IND-DOM                   CES
248  IND-IMP                   CES
249  REST-O-W    IMPORT                                                 IMPORT
250
251  +          SER-COMP     REST-O-W
252
253  RU-H-INC                    FEXO
254  UR-H-INC                    FEXO
255  GOVT-INC                    FEXO
256  GOVT-INV                  UNSPEC
257  AGR-EXP                   EXPORT
258  IND-EXP                   EXPORT
259  SER-DOM         CES
260  SER-EXP                   EXPORT
261  SER-IMP         CES;
262
263  SET  ACCEX(ACC)  EXPORT COMMODITIES /AGR-EXP,IND-EXP,SER-EXP /
264       COMPS(ACC)  COMMITTED CONSUMPTION /AGR-COMP,IND-COMP,SER-COMP/
265
266  PARAMETER  ETAS(ACCEX) ELASTICITIES OF DEMAND FOR EXPORTS  /AGR-EXP =
                                                                    6.0,
267                         IND-EXP = 2.6, SER-EXP = 2.3 /
268             ALPHARU(COMPS)  MINIMUM CONSUMPTION FOR RURAL HH /AGR-COMP =
                                                                   86.4,
269                               IND-COMP = 67.2, SER-COMP = 38.4 /
270             ALPHAUR(COMPS)  MINIMUM CONSUMPTION FOR URBAN HH /AGR-COMP =
                                                                   21.0,
271                               IND-COMP = 56.0, SER-COMP = 42.0 /
272
273  *  DEFINE AND FILL THE CELL TABLE:
```

```
274
275  PARAMETER CT(ACC,ACC,*) CELL TABLE;
276
277           CT(ACC,ACCP,"TBASE") = SAM(ACC,ACCP);
278           CT(ACC,ACCP,"SPECS") = SPEC(ACC,ACCP);
279           CT(ACCEX,"REST-O-W","ETA") = ETAS(ACCEX);
280           CT(COMPS,"RU-H-CON","ALPHA") = ALPHARU(COMPS);
281           CT(COMPS,"UR-H-CON","ALPHA") = ALPHAUR(COMPS);
282
283  TABLE AT(ACC,*) ACCOUNT TABLE
284
285                      TYPE       FIX        SIGMA      E
286       AG-LABOR        MF         Q
287       NG-LABOR        MF         P
288       AGR-CAP         MF         Q
289       NONAG-CAP       NMF
290       RU-H-INC        INST
291       RU-H-CON        INSTC
292       UR-H-INC        INST
293       UR-H-CON        INSTC
294       FIRMS           INST
295       GOVT-INC        INST
296       GOVT-CON        INSTC
297       INDR-TAX        TAX
298       RU-H-SAV        INST
299       UR-H-SAV        INST
300       FIRM-SAV        INST
301       GOVT-SAV        INST
302       RU-H-INV        INSTC
303       UR-H-INV        INSTC
304       FIRM-INV        INSTC
305       GOVT-INV        INSTC      Q
306       VA-L-AGR        AC                    0.4        EPS
307       VA-L-IND        AC                    0.6
308       VA-L-SER        AC                    0.5
309       VA-KL-AG        AC                    0.8        EPS
310       VA-KL-IN        AC
311       VA-KL-SE        AC
312       ACT-AGR         AC
313       ACT-IND         AC
314       ACT-SER         AC
315       AGR-DOM         AC
316       AGR-EXP         AC
317       AGR-IMP         AC
318       AGR-COMP        AC                    0.8
319       IND-DOM         AC
320       IND-EXP         AC
321       IND-IMP         AC
322       IND-COMP        AC                    1.5
323       SER-DOM         AC
324       SER-EXP         AC
325       SER-IMP         AC
326       SER-COMP        AC                    3.0
327       REST-O-W        ROW        NP;
328
```

```
329  PARAMETER  TOTALS(ACC,*)  ACCOUNT TOTALS AND IMBALANCES FOR THE SAM;
330
331     TOTALS(ACC,"ROW-TOTAL") = SUM(ACCP,SAM(ACC,ACCP));
332     TOTALS(ACCP,"COL-TOTAL") = SUM(ACC,SAM(ACC,ACCP));
333     TOTALS(ACC,"DIFFERENCE") = TOTALS(ACC,"ROW-TOTAL") -
                                                TOTALS(ACC,"COL-TOTAL");
334
335  *DISPLAY "CHECK FOR BALANCE OF BASE SAM:", TOTALS;
336
337  MODEL MODEL3 AGRICULTURAL DEMAND-LED-GROWTH FOR THAILAND
338       / ACC, AT, CT /;
339
340  *DISPLAY "ACCOUNT AND CELL TABLES BEFORE SOLVE:", AT, CT;
341
342  SOLVE MODEL3 USING HERCULES;
343
344  *DISPLAY "ACCOUNT AND CELL TABLES AFTER FIRST SOLVE:", AT, CT;
345
346  *SCENARIO 3: CUT AGR. EXPORT TAX 30 %:
347  CT("INDR-TAX","AGR-EXP","THETA") =
                                  0.7*CT("INDR-TAX","AGR-EXP","THETA-USED");
348
349  SOLVE MODEL3 USING HERCULES;
350
351  DISPLAY "ACCOUNT AND CELL TABLES AFTER SOLVING SCENARIO 3:", AT, CT;
352
```

SYMBOL LISTING

SYMBOL	TYPE	REFERENCES					
AC	ACRNM	DECLARED	54	DEFINED	54	REF	306
		307	308	309	310	311	312
		313	314	315	316	317	318
		319	320	321	322	323	324
		325	326				
ACC	SET	DECLARED	4	DEFINED	4	REF	48
		2*77	2*170	263	264	2*275	277
		278	283	329	331	332	2*333
		338	342	349	CONTROL	277	278
		331	332	333			
ACCEX	SET	DECLARED	263	DEFINED	263	REF	266
		279	CONTROL	279			
ACCP	SET	DECLARED	48	REF	277	278	331
		332	CONTROL	277	278	331	332
ALPHARU	PARAM	DECLARED	268	DEFINED	268	REF	280
ALPHAUR	PARAM	DECLARED	270	DEFINED	270	REF	281
AT	PARAM	DECLARED	283	DEFINED	283	IMPL-ASN	342
		349	REF	338	351		
CES	ACRNM	DECLARED	62	DEFINED	62	REF	3*214
		3*215	216	218	239	240	247
		248	259	261			
COMPS	SET	DECLARED	264	DEFINED	264	REF	268
		270	280	281	CONTROL	280	281
CT	PARAM	DECLARED	275	IMPL-ASN	342	349	
		ASSIGNED	277	278	279	280	281
		347	REF	338	347	351	
ETAS	PARAM	DECLARED	266	DEFINED	266	REF	279
EXPORT	ACRNM	DECLARED	63	DEFINED	63	REF	257
		258	260				
FEXO	ACRNM	DECLARED	64	DEFINED	64	REF	253
		254	255				
IDIST	ACRNM	DECLARED	65	DEFINED	65	REF	3*174
		175	3*176	2*177	2*178	179	183
		184	185	186	2*187	189	190
		198	199	200	201	3*202	208
IMPORT	ACRNM	DECLARED	66	DEFINED	66	REF	241
		2*249					
INST	ACRNM	DECLARED	52	DEFINED	52	REF	290
		292	294	295	298	299	300
		301					
INSTC	ACRNM	DECLARED	53	DEFINED	53	REF	291
		293	296	302	303	304	305
IO	ACRNM	DECLARED	67	DEFINED	67	REF	219
		225	226	227	228	229	3*230
		3*231	3*232	237	2*238	2*246	
ITAX	ACRNM	DECLARED	68	DEFINED	68	REF	224
		3*236	2*245				
LES	ACRNM	DECLARED	69	DEFINED	69	REF	2*192
		2*193	2*194				
MARKUP	ACRNM	DECLARED	70	DEFINED	70	REF	217
		223					
MF	ACRNM	DECLARED	50	DEFINED	50	REF	286
		287	288				

SYMBOL LISTING

SYMBOL	TYPE	REFERENCES					
MODEL3	MODEL	DECLARED	337	DEFINED	338	REF	342
		349					
NMF	ACRNM	DECLARED	51	DEFINED	51	REF	289
NP	ACRNM	DECLARED	59	DEFINED	59	REF	327
P	ACRNM	DECLARED	60	DEFINED	60	REF	287
Q	ACRNM	DECLARED	58	DEFINED	58	REF	286
		288	305				
QEXO	ACRNM	DECLARED	71	DEFINED	71	REF	203
		204					
QSHR	ACRNM	DECLARED	72	DEFINED	72	REF	4*209
		4*210					
ROW	ACRNM	DECLARED	56	DEFINED	56	REF	327
SAM	PARAM	DECLARED	77	DEFINED	77	REF	277
		331	332				
SPEC	PARAM	DECLARED	170	DEFINED	170	REF	278
TAX	ACRNM	DECLARED	55	DEFINED	55	REF	297
TEXO	ACRNM	DECLARED	73	DEFINED	73	REF	183
		184	186				
TOTALS	PARAM	DECLARED	329	ASSIGNED	331	332	333
		REF	2*333				
UNSPEC	ACRNM	DECLARED	74	DEFINED	74	REF	188
		191	256				

SETS

ACC	ACCOUNTS
ACCEX	EXPORT COMMODITIES
ACCP	ALIASED WITH ACC
COMPS	COMMITTED CONSUMPTION

ACRONYMS

AC	ACTIVITY OR COMMODITY ACCOUNT
CES	CES PRODUCTION FUNCTION SPECIFICATION
EXPORT	EXPORT DEMAND FROM THE REST OF THE WORLD
FEXO	EXOGENOUS IN FOREIGN EXCHANGE
IDIST	INCOME DISTRIBUTION SPECIFICATION
IMPORT	PAYMENT FOR IMPORTS
INST	INSTITUTIONS INCOME ACCOUNT
INSTC	INSTITUTIONS CONSUMPTION ACCOUNT
IO	INPUT-OUTPUT SPECIFICATION
ITAX	INDIRECT TAX SPECIFICATION
LES	LINEAR EXPENDITURE SYSTEM SPECIFICATION
MARKUP	MARKUP OVER AND ABOVE COST
MF	MARKET FACTOR ACCOUNT
NMF	NON MARKET FACTOR
NP	PRICE FIXED AS NUMERAIRE
P	PRICE EXOGENOUS
Q	QUNATITY FIXED
QEXO	FIXED QUANTITY CONSUMPTION SYSTEM
QSHR	FIXED QUANTITY SHARE CONSUMPTION SYSTEM

SYMBOL LISTING

ACRONYMS

ROW	REST OF THE WORLD ACCOUNT
TAX	INDIRECT TAX ACCOUNT
TEXO	EXOGENOUS TSOL
UNSPEC	UNSPECIFIED OR RESIDUAL

PARAMETERS

ALPHARU	MINIMUM CONSUMPTION FOR RURAL HH
ALPHAUR	MINIMUM CONSUMPTION FOR URBAN HH
AT	ACCOUNT TABLE
CT	CELL TABLE
ETAS	ELASTICITIES OF DEMAND FOR EXPORTS
SAM	SOCIAL ACCOUNTING MATRIX
SPEC	SPECIFICATION TABLE
TOTALS	ACCOUNT TOTALS AND IMBALANCES FOR THE SAM

MODELS

MODEL3	AGRICULTURAL DEMAND-LED-GROWTH FOR THAILAND

COMPILATION TIME = 0.178 MINUTES

MODEL STATISTICS

ACCOUNTS	42
ELEMENTS IN ACCOUNT TABLE	56
ELEMENTS IN CELL TABLE	211

EXECUTION TIME = 0.221 MINUTES

H E R C U L E S --- Version 1.14 from 92/02/06

Serial number 166
Licensed to: Samart Nitsaer
Department of Agricultural Economics and
Farm Management, University of Manitoba

SAM STATISTICS:

	ACCOUNTS	CELLS
BEFORE EXPANSION	42	101
AFTER EXPANSION	44	109

MODEL STATISTICS:

VARIABLES	TOTAL	EXPLICIT	IMPLICIT	EXOGENOUS
P-VARIABLES	34	32	2	2
Q-VARIABLES	33		33	3
Y-VARIABLES	44	44	0	0
T-VARIABLES	109	109	-	
C-VARIABLES	72		72	
RESIDUAL	1	1		
TOTAL	293	186	107	5

EQUATIONS	TOTAL	EXPLICIT	IMPLICIT
ROW EQUATIONS	44	44	
COLUMN EQUATIONS	35	35	
P*Q=Y EQUATIONS	33	3	30
T(I,J) EQUATIONS	104	104	
C(I,J) EQUATIONS	72		72
FIXED VARIABLES	4		4
NUMERAIRE	1		1
TOTAL	293	186	107

VARIABLE AND EQUATION BALANCE BY MAJOR ACCOUNT TYPE:
(CELLS ARE COUNTED WITH THEIR COLUMN, EXCEPT IN
REST OF WORLD ACCOUNTS WHERE CELLS IN INSTITUTIONS
ROWS ARE COUNTED WITH INSTITUTIONS)

	VARIABLES	EQUATIONS	IMBALANCE
FACTORS	18	18	0
INSTITUTIONS	93	93	0
ACTIVITIES/COMMODITIES/ REST-OF-WORLD	179	179	0
INDIRECT TAXES	2	2	0
NUMERAIRE/RESIDUAL	1	1	
TOTALS	293	293	0

SIZE OF LARGEST SIMULTANEOUS BLOCK: 167
TOTAL NUMBER OF SPIKES: 8

G D P SUMMARY

		SOLUTION		
	BASE	CURRENT PRICES	CONSTANT PRICES	PRICE INDEX
GDP AT FACTOR COST	602.000	602.000	602.000	1.000
NET INDIRECT TAXES	71.000	71.000	71.000	
INCOME EFFECT			.000	
FINAL USE	715.000	715.000	715.000	1.000
EXPORTS	168.000	168.000	168.000	1.000
IMPORTS	-210.000	-210.000	-210.000	1.000
GDP AT MARKET PRICES	673.000	673.000	673.000	1.000
TERMS OF TRADE			.000	
GROSS DOMESTIC INCOME	673.000	673.000	673.000	
RESOURCE GAP	42.000	42.000	42.000	

EXIT -- FINAL SOLUTION FOUND
TIME STEPS 4
NEWTON ITERATIONS 0

SOLUTION TIME .152 MINUTES

WORK SPACE USED -- 2642 WORDS.
WORK SPACE AVAILABLE -- 28880 WORDS.

S O L U T I O N S U M M A R Y

	PSOL	QSOL	YSOL	YBASE
AG-LABOR	1.000	240.500	240.500	240.500
NG-LABOR	1.000	183.500	183.500	183.500
AGR-CAP	1.000	35.000	35.000	35.000
NONAG-CAP			143.000	143.000
RU-H-INC			289.000	289.000
RU-H-CON	1.000	253.000	253.000	253.000
UR-H-INC			241.000	241.000
UR-H-CON	1.000	190.000	190.000	190.000
FIRMS			94.000	94.000
GOVT-INC			97.000	97.000
GOVT-CON	1.000	83.000	83.000	83.000
INDR-TAX			71.000	71.000
RU-H-SAV			30.000	30.000
UR-H-SAV			42.000	42.000
FIRM-SAV			80.000	80.000
GOVT-SAV			3.000	3.000
RU-H-INV	1.000	18.000	18.000	18.000
UR-H-INV	1.000	22.000	22.000	22.000

S O L U T I O N S U M M A R Y

	PSOL	QSOL	YSOL	YBASE
FIRM-INV	1.000	60.000	60.000	60.000
GOVT-INV	1.000	89.000	89.000	89.000
VA-L-AGR	1.000	141.000	141.000	141.000
VA-L-IND	1.000	92.000	92.000	92.000
VA-L-SER	1.000	191.000	191.000	191.000
VA-KL-AG	1.000	176.000	176.000	176.000
VA-KL-IN	1.000	153.000	153.000	153.000
VA-KL-SE	1.000	273.000	273.000	273.000
ACT-AGR	1.000	301.000	301.000	301.000
ACT-IND	1.000	521.000	521.000	521.000
ACT-SER	1.000	448.000	448.000	448.000
AGR-DOM	1.000	229.000	229.000	229.000
AGR-EXP	1.000	77.000	77.000	77.000
AGR-IMP	1.000	3.000	3.000	3.000
AGR-COMP	1.000	232.000	232.000	232.000
IND-DOM	1.000	491.000	491.000	491.000
IND-EXP	1.000	59.000	59.000	59.000
IND-IMP	1.000	201.000	201.000	201.000
IND-COMP	1.000	692.000	692.000	692.000
SER-DOM	1.000	433.000	433.000	433.000
SER-EXP	1.000	32.000	32.000	32.000
SER-IMP	1.000	26.000	26.000	26.000
SER-COMP	1.000	459.000	459.000	459.000
REST-O-W	1.000		210.000	210.000

MODEL STATISTICS

ACCOUNTS	42
ELEMENTS IN ACCOUNT TABLE	203
ELEMENTS IN CELL TABLE	478

EXECUTION TIME = 0.282 MINUTES

H E R C U L E S --- Version 1.14 from 92/02/06

Serial number 166
Licensed to: Samart Nitsmer
Department of Agricultural Economics and
Farm Management, University of Manitoba

SAM STATISTICS:	ACCOUNTS	CELLS
BEFORE EXPANSION	42	101
AFTER EXPANSION	44	109

MODEL STATISTICS:

VARIABLES	TOTAL	EXPLICIT	IMPLICIT	EXOGENOUS
P-VARIABLES	34	32	2	2
Q-VARIABLES	33		33	3
Y-VARIABLES	44	44	0	0
T-VARIABLES	109	109		
C-VARIABLES	72		72	
RESIDUAL	1	1		
TOTAL	293	186	107	5

EQUATIONS	TOTAL	EXPLICIT	IMPLICIT
ROW EQUATIONS	44	44	
COLUMN EQUATIONS	35	35	
P*Q=Y EQUATIONS	33	3	30
T(I,J) EQUATIONS	104	104	
C(I,J) EQUATIONS	72		72
FIXED VARIABLES	4		4
NUMERAIRE	1		1
TOTAL	293	186	107

VARIABLE AND EQUATION BALANCE BY MAJOR ACCOUNT TYPE:
(CELLS ARE COUNTED WITH THEIR COLUMN, EXCEPT IN
REST OF WORLD ACCOUNTS WHERE CELLS IN INSTITUTIONS
ROWS ARE COUNTED WITH INSTITUTIONS)

	VARIABLES	EQUATIONS	IMBALANCE
FACTORS	18	18	0
INSTITUTIONS	93	93	0
ACTIVITIES/COMMODITIES/ REST-OF-WORLD	179	179	0
INDIRECT TAXES	2	2	0
NUMERAIRE/RESIDUAL	1	1	
TOTALS	293	293	0

SIZE OF LARGEST SIMULTANEOUS BLOCK: 167
TOTAL NUMBER OF SPIKES: 8

MODEL3: A G R I C U L T U R A L - D E M A N D - L E D - G R O W T H
SOLUTION REPORT SOLVE MODEL3 USING HERCULES FROM LINE 349

G D P SUMMARY

		SOLUTION		
	BASE	CURRENT PRICES	CONSTANT PRICES	PRICE INDEX
GDP AT FACTOR COST	602.000	606.254	601.956	1.007
NET INDIRECT TAXES	71.000	70.396	71.065	
INCOME EFFECT			-.007	
FINAL USE	715.000	719.577	716.173	1.005
EXPORTS	168.000	168.228	167.996	1.001
IMPORTS	-210.000	-211.155	-211.155	1.000
GDP AT MARKET PRICES	673.000	676.650	673.014	1.005
TERMS OF TRADE			.231	
GROSS DOMESTIC INCOME	673.000	676.650	673.246	
RESOURCE GAP	42.000	42.928	42.928	

EXIT -- FINAL SOLUTION FOUND
TIME STEPS 4
NEWTON ITERATIONS 4

SOLUTION TIME .163 MINUTES

WORK SPACE USED -- 2642 WORDS.
WORK SPACE AVAILABLE -- 28880 WORDS.

S O L U T I O N S U M M A R Y

	PSOL	QSOL	YSOL	YBASE	RESIDUAL
AG-LABOR	1.012	240.500	243.498	240.500	
NG-LABOR	1.000	183.719	183.719	183.500	
AGR-CAP	1.018	35.000	35.627	35.000	
NONAG-CAP			143.410	143.000	
RU-H-INC			292.506	289.000	
RU-H-CON	1.006	254.552	256.069	253.000	
UR-H-INC			241.524	241.000	
UR-H-CON	1.004	189.577	190.413	190.000	
FIRMS			94.256	94.000	
GOVT-INC			96.494	97.000	
GOVT-CON	1.004	83.000	83.321	83.000	
INDR-TAX			70.396	71.000	
RU-H-SAV			30.364	30.000	
UR-H-SAV			42.091	42.000	
FIRM-SAV			80.218	80.000	
GOVT-SAV			2.173	3.000	
RU-H-INV	1.005	18.134	18.218	18.000	
UR-H-INV	1.004	21.971	22.048	22.000	

MODEL3: A G R I C U L T U R A L - D E M A N D - L E D - G R O W T H
SOLUTION REPORT SOLVE MODEL3 USING HERCULES FROM LINE 349

S O L U T I O N S U M M A R Y

	PSOL	QSOL	YSOL	YBASE	RESIDUAL
FIRM-INV	1.004	59.938	60.164	60.000	
GOVT-INV	1.004	89.000	89.344	89.000	
VA-L-AGR	1.012	141.657	143.360	141.000	
VA-L-IND	1.005	91.684	92.180	92.000	
VA-L-SER	1.004	190.875	191.677	191.000	-0.002
VA-KL-AG	1.013	176.657	178.988	176.000	
VA-KL-IN	1.005	152.474	153.299	153.000	
VA-KL-SE	1.004	272.822	273.968	273.000	
ACT-AGR	1.010	302.124	305.043	301.000	
ACT-IND	1.005	519.209	521.576	521.000	
ACT-SER	1.004	447.708	449.574	448.000	
AGR-DOM	1.010	229.169	231.384	229.000	
AGR-EXP	0.998	77.995	77.828	77.000	
AGR-IMP	1.000	3.025	3.025	3.000	
AGR-COMP	1.010	232.194	234.409	232.000	
IND-DOM	1.005	489.834	492.067	491.000	
IND-EXP	1.005	58.306	58.572	59.000	
IND-IMP	1.000	201.896	201.896	201.000	
IND-COMP	1.003	691.727	693.963	692.000	-0.003
SER-DOM	1.004	433.013	434.818	433.000	
SER-EXP	1.004	31.695	31.827	32.000	
SER-IMP	1.000	26.327	26.327	26.000	
SER-COMP	1.004	459.340	461.146	459.000	
REST-O-W	1.000		211.155	210.000	

---- 351 ACCOUNT AND CELL TABLES AFTER SOLVING SCENARIO 3:

---- 351 PARAMETER AT ACCOUNT TABLE

	TYPE	FIX	SIGMA	E	PSOL
AG-LABOR	MF	Q			1.012
NG-LABOR	MF	P			1.000
AGR-CAP	MF	Q			1.018
NONAG-CAP	NMF				
RU-H-INC	INST				
RU-H-CON	INSTC				1.006
UR-H-INC	INST				
UR-H-CON	INSTC				1.004
FIRMS	INST				
GOVT-INC	INST				
GOVT-CON	INSTC				1.004
INDR-TAX	TAX				
RU-H-SAV	INST				
UR-H-SAV	INST				
FIRM-SAV	INST				
GOVT-SAV	INST				
RU-H-INV	INSTC				1.005
UR-H-INV	INSTC				1.004
FIRM-INV	INSTC				1.004
GOVT-INV	INSTC	Q			1.004
VA-L-AGR	AC		0.400	EPS	1.012
VA-L-IND	AC		0.600		1.005
VA-L-SER	AC		0.500		1.004
VA-KL-AG	AC		0.800	EPS	1.013
VA-KL-IN	AC				1.005
VA-KL-SE	AC				1.004
ACT-AGR	AC				1.010
ACT-IND	AC				1.005
ACT-SER	AC				1.004
AGR-DOM	AC				1.010
AGR-EXP	AC				0.998
AGR-IMP	AC				1.000
AGR-COMP	AC		0.800		1.010
IND-DOM	AC				1.005
IND-EXP	AC				1.005
IND-IMP	AC				1.000
IND-COMP	AC		1.500		1.003
SER-DOM	AC				1.004
SER-EXP	AC				1.004
SER-IMP	AC				1.000
SER-COMP	AC		3.000		1.004
REST-O-W	ROW	NP			1.000

351 PARAMETER AT ACCOUNT TABLE

+	QSOL	YSOL	YBASE	RESIDUAL
AG-LABOR	240.500	243.498	240.500	
NG-LABOR	183.719	183.719	183.500	
AGR-CAP	35.000	35.627	35.000	
NONAG-CAP		143.410	143.000	
RU-H-INC		292.506	289.000	
RU-H-CON	254.552	256.069	253.000	
UR-H-INC		241.524	241.000	
UR-H-CON	189.577	190.413	190.000	
FIRMS		94.256	94.000	
GOVT-INC		96.494	97.000	
GOVT-CON	83.000	83.321	83.000	
INDR-TAX		70.396	71.000	
RU-H-SAV		30.364	30.000	
UR-H-SAV		42.091	42.000	
FIRM-SAV		80.218	80.000	
GOVT-SAV		2.173	3.000	
RU-H-INV	18.134	18.218	18.000	
UR-H-INV	21.971	22.048	22.000	
FIRM-INV	59.938	60.164	60.000	
GOVT-INV	89.000	89.344	89.000	
VA-L-AGR	141.657	143.360	141.000	
VA-L-IND	91.684	92.180	92.000	
VA-L-SER	190.875	191.677	191.000	-0.002
VA-KL-AG	176.657	178.988	176.000	
VA-KL-IN	152.474	153.299	153.000	
VA-KL-SE	272.822	273.968	273.000	
ACT-AGR	302.124	305.043	301.000	
ACT-IND	519.209	521.576	521.000	
ACT-SER	447.708	449.574	448.000	
AGR-DOM	229.169	231.384	229.000	
AGR-EXP	77.995	77.828	77.000	
AGR-IMP	3.025	3.025	3.000	
AGR-COMP	232.194	234.409	232.000	
IND-DOM	489.834	492.067	491.000	
IND-EXP	58.306	58.572	59.000	
IND-IMP	201.896	201.896	201.000	
IND-COMP	691.727	693.963	692.000	-0.003
SER-DOM	433.013	434.818	433.000	
SER-EXP	31.695	31.827	32.000	
SER-IMP	26.327	26.327	26.000	
SER-COMP	459.340	461.146	459.000	
REST-O-W		211.155	210.000	

---- 351 PARAMETER CT CELL TABLE

	TBASE	SPECS	ETA	ALPHA	TSOL
AG-LABOR .VA-L-AGR	136.000	CES			138.313
AG-LABOR .VA-L-IND	40.000	CES			40.190
AG-LABOR .VA-L-SER	64.500	CES			64.994
NG-LABOR .VA-L-AGR	5.000	CES			5.047
NG-LABOR .VA-L-IND	52.000	CES			51.989
NG-LABOR .VA-L-SER	126.500	CES			126.683
AGR-CAP .VA-KL-AG	35.000	CES			35.627
NONAG-CAP.VA-KL-IN	61.000	MARKUP			61.119
NONAG-CAP.VA-KL-SE	82.000	MARKUP			82.291
RU-H-INC .AG-LABOR	240.500	IDIST			243.498
RU-H-INC .AGR-CAP	25.000	IDIST			25.448
RU-H-INC .NONAG-CAP	20.000	IDIST			20.057
RU-H-INC .FIRMS	1.000	IDIST			1.003
RU-H-INC .GOVT-INC	0.500	TEXO			0.500
RU-H-INC .REST-O-W	2.000	FEXO			2.000
RU-H-CON .RU-H-INC	253.000	IDIST			256.069
UR-H-INC .NG-LABOR	183.500	IDIST			183.719
UR-H-INC .AGR-CAP	10.000	IDIST			10.179
UR-H-INC .NONAG-CAP	41.000	IDIST			41.117
UR-H-INC .FIRMS	3.000	IDIST			3.008
UR-H-INC .GOVT-INC	0.500	TEXO			0.500
UR-H-INC .REST-O-W	3.000	FEXO			3.000
UR-H-CON .UR-H-INC	190.000	IDIST			190.413
FIRMS .NONAG-CAP	78.000	IDIST			78.224
FIRMS .RU-H-INC	2.000	IDIST			2.024
FIRMS .UR-H-INC	4.000	IDIST			4.009
FIRMS .GOVT-INC	10.000	TEXO			10.000
GOVT-INC .NONAG-CAP	4.000	IDIST			4.011
GOVT-INC .RU-H-INC	4.000	IDIST			4.049
GOVT-INC .UR-H-INC	5.000	IDIST			5.011
GOVT-INC .FIRMS	10.000	IDIST			10.027
GOVT-INC .INDR-TAX	71.000	IDIST			70.396
GOVT-INC .REST-O-W	3.000	FEXO			3.000
GOVT-CON .GOVT-INC	83.000	UNSPEC			83.321
INDR-TAX .AGR-DOM	2.000	ITAX			2.021
INDR-TAX .AGR-EXP	3.000	ITAX			2.148
INDR-TAX .AGR-IMP	1.000	ITAX			1.008
INDR-TAX .IND-DOM	29.000	ITAX			29.063
INDR-TAX .IND-IMP	19.000	ITAX			19.085
INDR-TAX .SER-DOM	17.000	ITAX			17.071
RU-H-SAV .RU-H-INC	30.000	IDIST			30.364
UR-H-SAV .UR-H-INC	42.000	IDIST			42.091
FIRM-SAV .FIRMS	80.000	IDIST			80.218
GOVT-SAV .GOVT-INC	3.000	UNSPEC			2.173
RU-H-INV .RU-H-SAV	18.000	IDIST			18.218
UR-H-INV .UR-H-SAV	22.000	IDIST			22.048
FIRM-INV .FIRM-SAV	60.000	IDIST			60.164
GOVT-INV .RU-H-SAV	12.000	IDIST			12.146
GOVT-INV .UR-H-SAV	20.000	IDIST			20.043
GOVT-INV .FIRM-SAV	20.000	IDIST			20.055
GOVT-INV .GOVT-SAV	3.000	IDIST			2.173

351 PARAMETER CT CELL TABLE

		TBASE	SPECS	ETA	ALPHA	TSOL
GOVT-INV	.REST-O-W	34.000	UNSPEC			34.928
VA-L-AGR	.VA-KL-AG	141.000	CES			143.360
VA-L-IND	.VA-KL-IN	92.000	IO			92.180
VA-L-SER	.VA-KL-SE	191.000	IO			191.677
VA-KL-AG	.ACT-AGR	176.000	IO			178.988
VA-KL-IN	.ACT-IND	153.000	IO			153.299
VA-KL-SE	.ACT-SER	273.000	IO			273.968
ACT-AGR	.AGR-DOM	227.000	IO			229.363
ACT-AGR	.AGR-EXP	74.000	IO			75.680
ACT-IND	.IND-DOM	462.000	IO			463.004
ACT-IND	.IND-EXP	59.000	IO			58.572
ACT-SER	.SER-DOM	416.000	IO			417.747
ACT-SER	.SER-EXP	32.000	IO			31.827
AGR-DOM	.AGR-COMP	229.000	CES			231.384
AGR-EXP	.REST-O-W	77.000	EXPORT	6.000		77.828
AGR-IMP	.AGR-COMP	3.000	CES			3.025
AGR-COMP	.RU-H-CON	103.000	LES		86.400	104.335
AGR-COMP	.UR-H-CON	29.000	LES		21.000	29.185
AGR-COMP	.RU-H-INV	4.000	QSHR			4.068
AGR-COMP	.UR-H-INV	1.000	QSHR			1.008
AGR-COMP	.FIRM-INV	5.000	QSHR			5.043
AGR-COMP	.GOVT-INV	9.000	QSHR			9.086
AGR-COMP	.ACT-AGR	22.000	IO			22.293
AGR-COMP	.ACT-IND	47.000	IO			47.285
AGR-COMP	.ACT-SER	12.000	IO			12.107
IND-DOM	.IND-COMP	491.000	CES			492.067
IND-EXP	.REST-O-W	59.000	EXPORT	2.600		58.572
IND-IMP	.IND-COMP	201.000	CES			201.896
IND-COMP	.RU-H-CON	90.000	LES		67.200	90.919
IND-COMP	.UR-H-CON	103.000	LES		56.000	103.093
IND-COMP	.GOVT-CON	8.000	QEXO			8.026
IND-COMP	.RU-H-INV	14.000	QSHR			14.150
IND-COMP	.UR-H-INV	21.000	QSHR			21.040
IND-COMP	.FIRM-INV	55.000	QSHR			55.121
IND-COMP	.GOVT-INV	80.000	QSHR			80.259
IND-COMP	.ACT-AGR	40.000	IO			40.279
IND-COMP	.ACT-IND	232.000	IO			231.950
IND-COMP	.ACT-SER	49.000	IO			49.126
SER-DOM	.SER-COMP	433.000	CES			434.818
SER-EXP	.REST-O-W	32.000	EXPORT	2.300		31.827
SER-IMP	.SER-COMP	26.000	CES			26.327
SER-COMP	.RU-H-CON	60.000	LES		38.400	60.816
SER-COMP	.UR-H-CON	58.000	LES		42.000	58.135
SER-COMP	.GOVT-CON	75.000	QEXO			75.295
SER-COMP	.ACT-AGR	63.000	IO			63.484
SER-COMP	.ACT-IND	89.000	IO			89.043
SER-COMP	.ACT-SER	114.000	IO			114.374
REST-O-W	.AGR-IMP	2.000	IMPORT			2.017
REST-O-W	.IND-IMP	182.000	IMPORT			182.811
REST-O-W	.SER-IMP	26.000	IMPORT			26.327

351 PARAMETER CT CELL TABLE

+	QCSOL	THETA	A-USED	BETA-USED	FQ-USED
AG-LABOR .VA-L-AGR	136.610		0.965		
AG-LABOR .VA-L-IND	39.696		0.435		
AG-LABOR .VA-L-SER	64.194		0.338		
NG-LABOR .VA-L-AGR	5.047		0.035		
NG-LABOR .VA-L-IND	51.989		0.565		
NG-LABOR .VA-L-SER	126.683		0.662		
AGR-CAP .VA-KL-AG	35.000		0.199		
NONAG-CAP.VA-KL-IN	60.790				
NONAG-CAP.VA-KL-SE	81.946				
RU-H-INC .AG-LABOR			1.000		
RU-H-INC .AGR-CAP			0.714		
RU-H-INC .NONAG-CAP			0.140		
RU-H-INC .FIRMS			0.011		
RU-H-CON .RU-H-INC			0.875		
UR-H-INC .NG-LABOR			1.000		
UR-H-INC .AGR-CAP			0.286		
UR-H-INC .NONAG-CAP			0.287		
UR-H-INC .FIRMS			0.032		
UR-H-CON .UR-H-INC			0.788		
FIRMS .NONAG-CAP			0.545		
FIRMS .RU-H-INC			0.007		
FIRMS .UR-H-INC			0.017		
GOVT-INC .NONAG-CAP			0.028		
GOVT-INC .RU-H-INC			0.014		
GOVT-INC .UR-H-INC			0.021		
GOVT-INC .FIRMS			0.106		
GOVT-INC .INDR-TAX			1.000		
INDR-TAX .AGR-DOM	2.001				
INDR-TAX .AGR-EXP	3.039	0.028			
INDR-TAX .AGR-IMP	1.008				
INDR-TAX .IND-DOM	28.931				
INDR-TAX .IND-IMP	19.085				
INDR-TAX .SER-DOM	17.001				
RU-H-SAV .RU-H-INC			0.104		
UR-H-SAV .UR-H-INC			0.174		
FIRM-SAV .FIRMS			0.851		
RU-H-INV .RU-H-SAV			0.600		
UR-H-INV .UR-H-SAV			0.524		
FIRM-INV .FIRM-SAV			0.750		
GOVT-INV .RU-H-SAV			0.400		
GOVT-INV .UR-H-SAV			0.476		
GOVT-INV .FIRM-SAV			0.250		
GOVT-INV .GOVT-SAV			1.000		
VA-L-AGR .VA-KL-AG	141.657		0.801		
VA-L-IND .VA-KL-IN	91.684		0.601		
VA-L-SER .VA-KL-SE	190.875		0.700		
VA-KL-AG .ACT-AGR	176.657		0.585		
VA-KL-IN .ACT-IND	152.474		0.294		
VA-KL-SE .ACT-SER	272.822		0.609		
ACT-AGR .AGR-DOM	227.168		0.991		
ACT-AGR .AGR-EXP	74.956		0.961		

MODEL3: A G R I C U L T U R A L - D E M A N D - L E D - G R O W T H
E X E C U T I N G

351 PARAMETER CT CELL TABLE

+	QCSOL	THETA	A-USED	BETA-USED	FQ-USED
ACT-IND .IND-DOM	460.903		0.941		
ACT-IND .IND-EXP	58.306		1.000		
ACT-SER .SER-DOM	416.012		0.961		
ACT-SER .SER-EXP	31.695		1.000		
AGR-DOM .AGR-COMP	229.169		0.987		
AGR-EXP .REST-O-W	77.995				77.000
AGR-IMP .AGR-COMP	3.025		0.013		
AGR-COMP .RU-H-CON	103.349			0.272	
AGR-COMP .UR-H-CON	28.910			0.113	
AGR-COMP .RU-H-INV	4.030		0.222		
AGR-COMP .UR-H-INV	0.999		0.045		
AGR-COMP .FIRM-INV	4.995		0.083		
AGR-COMP .GOVT-INV	9.000		0.101		
AGR-COMP .ACT-AGR	22.082		0.073		
AGR-COMP .ACT-IND	46.838		0.090		
AGR-COMP .ACT-SER	11.992		0.027		
IND-DOM .IND-COMP	489.834		0.710		
IND-EXP .REST-O-W	58.306				59.000
IND-IMP .IND-COMP	201.896		0.290		
IND-COMP .RU-H-CON	90.626			0.374	
IND-COMP .UR-H-CON	102.761			0.662	
IND-COMP .GOVT-CON	8.000				8.000
IND-COMP .RU-H-INV	14.104		0.778		
IND-COMP .UR-H-INV	20.972		0.955		
IND-COMP .FIRM-INV	54.944		0.917		
IND-COMP .GOVT-INV	80.000		0.899		
IND-COMP .ACT-AGR	40.149		0.133		
IND-COMP .ACT-IND	231.202		0.445		
IND-COMP .ACT-SER	48.968		0.109		
SER-DOM .SER-COMP	433.013		0.943		
SER-EXP .REST-O-W	31.695				32.000
SER-IMP .SER-COMP	26.327		0.057		
SER-COMP .RU-H-CON	60.577			0.354	
SER-COMP .UR-H-CON	57.907			0.225	
SER-COMP .GOVT-CON	75.000				75.000
SER-COMP .ACT-AGR	63.235		0.209		
SER-COMP .ACT-IND	88.694		0.171		
SER-COMP .ACT-SER	113.926		0.254		
REST-O-W .AGR-IMP	2.017				
REST-O-W .IND-IMP	182.811				
REST-O-W .SER-IMP	26.327				

+	FV-USED	WP-USED	THETA-USED
NONAG-CAP.VA-KL-IN			0.663
NONAG-CAP.VA-KL-SE			0.429
RU-H-INC .GOVT-INC	0.500		
RU-H-INC .REST-O-W	2.000		
UR-H-INC .GOVT-INC	0.500		
UR-H-INC .REST-O-W	3.000		
FIRMS .GOVT-INC	10.000		

351 PARAMETER CT CELL TABLE

+	FV-USED	WP-USED	THETA-USED
GOVT-INC .REST-O-W	3.000		
INDR-TAX .AGR-DOM			0.009
INDR-TAX .AGR-EXP			0.028
INDR-TAX .AGR-IMP			0.500
INDR-TAX .IND-DOM			0.063
INDR-TAX .IND-IMP			0.104
INDR-TAX .SER-DOM			0.041
AGR-EXP .REST-O-W		1.000	
IND-EXP .REST-O-W		1.000	
SER-EXP .REST-O-W		1.000	
REST-O-W .AGR-IMP		1.000	
REST-O-W .IND-IMP		1.000	
REST-O-W .SER-IMP		1.000	

**** FILE SUMMARY

INPUT C:\DISSERT\SAMSON5.GMS
OUTPUT C:\DISSERT\SAMSON5.LST

EXECUTION TIME = 0.222 MINUTES

APPENDIX C3

Scenario VII of Model III:

A Devaluation of Thai Currency by 5 Percent

```
 2 *  THE AGRICULTURAL-DEMAND-LED-INDUSTRIALIZATION FOR THAILAND.
 3
 4 SET ACC ACCOUNTS /
 5            AG-LABOR     AGRICULTURAL LABOR
 6            NG-LABOR     NONAGRICULTURAL LABOR
 7            AGR-CAP      AGRICULTURAL CAPITAL
 8            NONAG-CAP    NONAGRICULTURAL CAPITAL
 9            RU-H-INC     RURAL HOUSEHOLD INCOME
10            RU-H-CON     RURAL HOUSEHOLD CONSUMPTION
11            UR-H-INC     URBAN HOUSEHOLD INCOME
12            UR-H-CON     URBAN HOUSEHOLD CONSUMPTION
13            FIRMS        FIRMS OR CORPORATES
14            GOVT-INC     GOVERNMENT INCOME
15            GOVT-CON     GOVERNMENT CONSUMPTION
16            INDR-TAX     INDIRECT TAX
17            RU-H-SAV     RURAL HOUSEHOLD SAVINGS
18            UR-H-SAV     URBAN HOUSEHOLD SAVINGS
19            FIRM-SAV     FIRM SAVINGS
20            GOVT-SAV     GOVERNMENT SAVINGS
21            RU-H-INV     RURAL HOUSEHOLD INVESTMENT
22            UR-H-INV     URBAN HOUSEHOLD INVESTMENT
23            FIRM-INV     FIRM INVESTMENT
24            GOVT-INV     GOVERNMENT INVESTMENT
25            VA-L-AGR     LABOR VALUE ADDED FOR AGRICULTURE
26            VA-L-IND     LABOR VALUE ADDED FOR INDUSTRY
27            VA-L-SER     LABOR VALUE ADDED FOR SERVICES
28            VA-KL-AG     VALUE ADDED FOR AGRICULTURE
29            VA-KL-IN     VALUE ADDED FOR INDUSTRY
30            VA-KL-SE     VALUE ADDED FOR SERVICES
31            ACT-AGR      AGRICULTURAL ACTIVITY
32            ACT-IND      INDUSTRIAL ACTIVITY
33            ACT-SER      SERVICE ACTIVITY
34            AGR-DOM      DOMESTIC AGRICULTURAL COMMODITIES
35            AGR-EXP      AGRICULTURAL COMMODITIES EXPORTED
36            AGR-IMP      AGRICULTURAL COMMODITIES IMPORTED
37            AGR-COMP     AGRICULTURAL COMPOSITE COMMODITIES
38            IND-DOM      DOMESTIC MANUFACTURED COMMODITIES
39            IND-EXP      MANUFACTURED COMMODITIES EXPORTED
40            IND-IMP      MANUFACTURED COMMODITIES IMPORTED
41            IND-COMP     MANUFACTURED COMPOSITE COMMODITIES
42            SER-DOM      DOMESTIC SERVICES
43            SER-EXP      SERVICES EXPORTED
44            SER-IMP      SERVICES IMPORTED
45            SER-COMP     COMPOSITE SERVICES
46            REST-O-W     REST OF THE WORLD /;
47
48 ALIAS (ACC,ACCP);
49
50 ACRONYMS   MF       MARKET FACTOR ACCOUNT
51            NMF      NON MARKET FACTOR
52            INST     INSTITUTIONS INCOME ACCOUNT
53            INSTC    INSTITUTIONS CONSUMPTION ACCOUNT
54            AC       ACTIVITY OR COMMODITY ACCOUNT
55            TAX      INDIRECT TAX ACCOUNT
56            ROW      REST OF THE WORLD ACCOUNT
```

```
57
58            Q         QUNATITY FIXED
59            NP        PRICE FIXED AS NUMERAIRE
60            P         PRICE EXOGENOUS
61
62            CES       CES PRODUCTION FUNCTION SPECIFICATION
63            EXPORT    EXPORT DEMAND FROM THE REST OF THE WORLD
64            FEXO      EXOGENOUS IN FOREIGN EXCHANGE
65            IDIST     INCOME DISTRIBUTION SPECIFICATION
66            IMPORT    PAYMENT FOR IMPORTS
67            IO        INPUT-OUTPUT SPECIFICATION
68            ITAX      INDIRECT TAX SPECIFICATION
69            LES       LINEAR EXPENDITURE SYSTEM SPECIFICATION
70            MARKUP    MARKUP OVER AND ABOVE COST
71            QEXO      FIXED QUANTITY CONSUMPTION SYSTEM
72            QSHR      FIXED QUANTITY SHARE CONSUMPTION SYSTEM
73            TEXO      EXOGENOUS TSOL
74            UNSPEC    UNSPECIFIED OR RESIDUAL;
75
76
77  TABLE SAM(ACC,ACC) SOCIAL ACCOUNTING MATRIX
78
79                AG-LABOR    NG-LABOR    AGR-CAP    NONAG-CAP    RU-H-INC
80
81  RU-H-INC         240.5                    25           20
82  RU-H-CON                                                          253
83  UR-H-INC                     183.5        10           41
84  FIRMS                                                 78           2
85  GOVT-INC                                               4           4
86  RU-H-SAV                                                          30
87
88  +             RU-H-CON    UR-H-INC    UR-H-CON    FIRMS    GOVT-INC
89
90  RU-H-INC                                             1          .5
91  UR-H-INC                                             3          .5
92  UR-H-CON                      190
93  FIRMS                           4                                10
94  GOVT-INC                        5                   10
95  GOVT-CON                                                         83
96  UR-H-SAV                       42
97  FIRM-SAV                                            80
98  GOVT-SAV                                                          3
99  AGR-COMP          103                      29
100 IND-COMP           90                     103
101 SER-COMP           60                      58
102
103 +             GOVT-CON    INDR-TAX    RU-H-SAV    UR-H-SAV    FIRM-SAV
104
105 GOVT-INC                        71
106 RU-H-INV                                    18
107 UR-H-INV                                                22
108 FIRM-INV                                                            60
109 GOVT-INV                                    12          20          20
110  IND-COMP            8
111 SER-COMP           75
```

112						
113	+	GOVT-SAV	RU-H-INV	UR-H-INV	FIRM-INV	GOVT-INV
114						
115	GOVT-INV	3				
116	AGR-COMP		4	1	5	9
117	IND-COMP		14	21	55	80
118						
119	+	VA-L-AGR	VA-L-IND	VA-L-SER	VA-KL-AG	VA-KL-IN
120						
121	AG-LABOR	136	40	64.5		
122	NG-LABOR	5	52	126.5		
123	AGR-CAP				35	
124	NONAG-CAP					61
125	VA-L-AGR				141	
126	VA-L-IND					92
127						
128	+	VA-KL-SE	ACT-AGR	ACT-IND	ACT-SER	AGR-DOM
129						
130	NONAG-CAP	82				
131	INDR-TAX					2
132	VA-L-SER	191				
133	VA-KL-AG		176			
134	VA-KL-IN			153		
135	VA-KL-SE				273	
136	ACT-AGR					227
137	AGR-COMP		22	47	12	
138	IND-COMP		40	232	49	
139	SER-COMP		63	89	114	
140						
141	+	AGR-EXP	AGR-IMP	AGR-COMP	IND-DOM	IND-EXP
142						
143	INDR-TAX	3	1		29	
144	ACT-AGR	74				
145	ACT-IND				462	59
146	AGR-DOM			229		
147	AGR-IMP			3		
148	REST-O-W		2			
149						
150	+	IND-IMP	IND-COMP	SER-DOM	SER-EXP	SER-IMP
151						
152	INDR-TAX	19		17		
153	ACT-SER			416	32	
154	IND-DOM		491			
155	IND-IMP		201			
156	REST-O-W	182				26
157						
158	+	SER-COMP	REST-O-W			
159						
160	RU-H-INC		2			
161	UR-H-INC		3			
162	GOVT-INC		3			
163	GOVT-INV		34			
164	AGR-EXP		77			
165	IND-EXP		59			
166	SER-DOM	433				

```
167  SER-EXP                    32
168  SER-IMP         26;
169
170  TABLE SPEC(ACC,ACC) SPECIFICATION TABLE
171
172             AG-LABOR    NG-LABOR    AGR-CAP    NONAG-CAP    RU-H-INC
173
174  RU-H-INC      IDIST                  IDIST        IDIST
175  RU-H-CON                                                     IDIST
176  UR-H-INC                  IDIST       IDIST        IDIST
177  FIRMS                                                IDIST       IDIST
178  GOVT-INC                                             IDIST       IDIST
179  RU-H-SAV                                                         IDIST
180
181  +          RU-H-CON    UR-H-INC    UR-H-CON    FIRMS     GOVT-INC
182
183  RU-H-INC                                         IDIST        TEXO
184  UR-H-INC                                         IDIST        TEXO
185  UR-H-CON                IDIST
186  FIRMS                   IDIST                                 TEXO
187  GOVT-INC                IDIST                IDIST
188  GOVT-CON                                                   UNSPEC
189  UR-H-SAV                IDIST
190  FIRM-SAV                                         IDIST
191  GOVT-SAV                                                   UNSPEC
192  AGR-COMP        LES                   LES
193  IND-COMP        LES                   LES
194  SER-COMP        LES                   LES
195
196  +          GOVT-CON    INDR-TAX    RU-H-SAV    UR-H-SAV    FIRM-SAV
197
198  GOVT-INC                IDIST
199  RU-H-INV                              IDIST
200  UR-H-INV                                          IDIST
201  FIRM-INV                                                      IDIST
202  GOVT-INV                              IDIST        IDIST       IDIST
203  IND-COMP       QEXO
204  SER-COMP       QEXO
205
206  +          GOVT-SAV    RU-H-INV    UR-H-INV    FIRM-INV    GOVT-INV
207
208  GOVT-INV      IDIST
209  AGR-COMP                  QSHR        QSHR        QSHR        QSHR
210  IND-COMP                  QSHR        QSHR        QSHR        QSHR
211
212  +          VA-L-AGR    VA-L-IND    VA-L-SER    VA-KL-AG    VA-KL-IN
213
214  AG-LABOR        CES         CES         CES
215  NG-LABOR        CES         CES         CES
216  AGR-CAP                                              CES
217  NONAG-CAP                                                     MARKUP
218  VA-L-AGR                                             CES
219  VA-L-IND                                                        IO
220
221  +          VA-KL-SE    ACT-AGR     ACT-IND     ACT-SER     AGR-DOM
```

```
222
223  NONAG-CAP    MARKUP
224  INDR-TAX                                                  ITAX
225  VA-L-SER        IO
226  VA-KL-AG                  IO
227  VA-KL-IN                            IO
228  VA-KL-SE                                      IO
229  ACT-AGR                                                   IO
230  AGR-COMP                  IO          IO          IO
231  IND-COMP                  IO          IO          IO
232  SER-COMP                  IO          IO          IO
233
234  +          AGR-EXP    AGR-IMP    AGR-COMP    IND-DOM    IND-EXP
235
236  INDR-TAX      ITAX       ITAX                   ITAX
237  ACT-AGR         IO
238  ACT-IND                                         IO         IO
239  AGR-DOM                             CES
240  AGR-IMP                             CES
241  REST-O-W               IMPORT
242
243  +          IND-IMP    IND-COMP    SER-DOM    SER-EXP    SER-IMP
244
245  INDR-TAX      ITAX                   ITAX
246  ACT-SER                               IO         IO
247  IND-DOM                  CES
248  IND-IMP                  CES
249  REST-O-W    IMPORT                                        IMPORT
250
251  +          SER-COMP     REST-O-W
252
253  RU-H-INC                   FEXO
254  UR-H-INC                   FEXO
255  GOVT-INC                   FEXO
256  GOVT-INV                 UNSPEC
257  AGR-EXP                  EXPORT
258  IND-EXP                  EXPORT
259  SER-DOM         CES
260  SER-EXP                  EXPORT
261  SER-IMP         CES;
262
263  SET  ACCEX(ACC)  EXPORT COMMODITIES /AGR-EXP,IND-EXP,SER-EXP /
264       COMPS(ACC)  COMMITTED CONSUMPTION /AGR-COMP,IND-COMP,SER-COMP/
265
266  PARAMETER  ETAS(ACCEX) ELASTICITIES OF DEMAND FOR EXPORTS  /AGR-EXP =
                                                                    6.0,
267                        IND-EXP = 2.6, SER-EXP = 2.3 /
268             ALPHARU(COMPS)  MINIMUM CONSUMPTION FOR RURAL HH /AGR-COMP =
                                                                   86.4,
269                             IND-COMP = 67.2, SER-COMP = 38.4 /
270             ALPHAUR(COMPS)  MINIMUM CONSUMPTION FOR URBAN HH /AGR-COMP =
                                                                   21.0,
271                             IND-COMP = 56.0, SER-COMP = 42.0 /
272
273  *  DEFINE AND FILL THE CELL TABLE:
```

```
274
275  PARAMETER CT(ACC,ACC,*) CELL TABLE;
276
277           CT(ACC,ACCP,"TBASE") = SAM(ACC,ACCP);
278           CT(ACC,ACCP,"SPECS") = SPEC(ACC,ACCP);
279           CT(ACCEX,"REST-O-W","ETA") = ETAS(ACCEX);
280           CT(COMPS,"RU-H-CON","ALPHA") = ALPHARU(COMPS);
281           CT(COMPS,"UR-H-CON","ALPHA") = ALPHAUR(COMPS);
282
283  TABLE AT(ACC,*) ACCOUNT TABLE
284
285                      TYPE       FIX        SIGMA      E
286      AG-LABOR         MF         Q
287      NG-LABOR         MF         P
288      AGR-CAP          MF         Q
289      NONAG-CAP        NMF
290      RU-H-INC         INST
291      RU-H-CON         INSTC
292      UR-H-INC         INST
293      UR-H-CON         INSTC
294      FIRMS            INST
295      GOVT-INC         INST
296      GOVT-CON         INSTC
297      INDR-TAX         TAX
298      RU-H-SAV         INST
299      UR-H-SAV         INST
300      FIRM-SAV         INST
301      GOVT-SAV         INST
302      RU-H-INV         INSTC
303      UR-H-INV         INSTC
304      FIRM-INV         INSTC
305      GOVT-INV         INSTC      Q
306      VA-L-AGR         AC                    0.4        EPS
307      VA-L-IND         AC                    0.6
308      VA-L-SER         AC                    0.5
309      VA-KL-AG         AC                    0.8        EPS
310      VA-KL-IN         AC
311      VA-KL-SE         AC
312      ACT-AGR          AC
313      ACT-IND          AC
314      ACT-SER          AC
315      AGR-DOM          AC
316      AGR-EXP          AC
317      AGR-IMP          AC
318      AGR-COMP         AC                    0.8
319      IND-DOM          AC
320      IND-EXP          AC
321      IND-IMP          AC
322      IND-COMP         AC                    1.5
323      SER-DOM          AC
324      SER-EXP          AC
325      SER-IMP          AC
326      SER-COMP         AC                    3.0
327      REST-O-W         ROW        NP;
328
```

```
329  PARAMETER  TOTALS(ACC,*)  ACCOUNT TOTALS AND IMBALANCES FOR THE SAM;
330
331     TOTALS(ACC,"ROW-TOTAL") = SUM(ACCP,SAM(ACC,ACCP));
332     TOTALS(ACCP,"COL-TOTAL") = SUM(ACC,SAM(ACC,ACCP));
333     TOTALS(ACC,"DIFFERENCE") = TOTALS(ACC,"ROW-TOTAL") -
                                                TOTALS(ACC,"COL-TOTAL");
334
335  *DISPLAY "CHECK FOR BALANCE OF BASE SAM:", TOTALS;
336
337  MODEL MODEL3 AGRICULTURAL DEMAND-LED-INDUSTRIALIZATION FOR THAILAND
338       / ACC, AT, CT /;
339
340  *DISPLAY "ACCOUNT AND CELL TABLES BEFORE SOLVE:", AT, CT;
341
342  SOLVE MODEL3 USING HERCULES;
343
344  *DISPLAY "ACCOUNT AND CELL TABLES AFTER FIRST SOLVE:", AT, CT;
345
346  *SCENARIO VII: INCREASE WORLD PRICES OF ALL COMMODITIES;
347
348  CT("AGR-EXP","REST-O-W","WP") = 1.05;
349  CT("REST-O-W","AGR-IMP","WP") = 1.05;
350
351  CT("IND-EXP","REST-O-W","WP") = 1.05;
352  CT("REST-O-W","IND-IMP","WP") = 1.05;
353
354  CT("SER-EXP","REST-O-W","WP") = 1.05;
355  CT("REST-O-W","SER-IMP","WP") = 1.05;
356
357  SOLVE MODEL3 USING HERCULES;
358
359  DISPLAY "ACCOUNT AND CELL TABLES AFTER SOLVING SCENARIO VII:", AT, CT;
360
```

SYMBOL LISTING

SYMBOL	TYPE	REFERENCES					
AC	ACRNM	DECLARED	54	DEFINED	54	REF	306
		307	308	309	310	311	312
		313	314	315	316	317	318
		319	320	321	322	323	324
		325	326				
ACC	SET	DECLARED	4	DEFINED	4	REF	48
		2*77	2*170	263	264	2*275	277
		278	283	329	331	332	2*333
		338	342	357	CONTROL	277	278
		331	332	333			
ACCEX	SET	DECLARED	263	DEFINED	263	REF	266
		279	CONTROL	279			
ACCP	SET	DECLARED	48	REF	277	278	331
		332	CONTROL	277	278	331	332
ALPHARU	PARAM	DECLARED	268	DEFINED	268	REF	280
ALPHAUR	PARAM	DECLARED	270	DEFINED	270	REF	281
AT	PARAM	DECLARED	283	DEFINED	283	IMPL-ASN	342
		357	REF	338	359		
CES	ACRNM	DECLARED	62	DEFINED	62	REF	3*214
		3*215	216	218	239	240	247
		248	259	261			
COMPS	SET	DECLARED	264	DEFINED	264	REF	268
		270	280	281	CONTROL	280	281
CT	PARAM	DECLARED	275	IMPL-ASN	342	357	
		ASSIGNED	277	278	279	280	281
		348	349	351	352	354	355
		REF	338	359			
ETAS	PARAM	DECLARED	266	DEFINED	266	REF	279
EXPORT	ACRNM	DECLARED	63	DEFINED	63	REF	257
		258	260				
FEXO	ACRNM	DECLARED	64	DEFINED	64	REF	253
		254	255				
IDIST	ACRNM	DECLARED	65	DEFINED	65	REF	3*174
		175	3*176	2*177	2*178	179	183
		184	185	186	2*187	189	190
		198	199	200	201	3*202	208
IMPORT	ACRNM	DECLARED	66	DEFINED	66	REF	241
		2*249					
INST	ACRNM	DECLARED	52	DEFINED	52	REF	290
		292	294	295	298	299	300
		301					
INSTC	ACRNM	DECLARED	53	DEFINED	53	REF	291
		293	296	302	303	304	305
IO	ACRNM	DECLARED	67	DEFINED	67	REF	219
		225	226	227	228	229	3*230
		3*231	3*232	237	2*238	2*246	
ITAX	ACRNM	DECLARED	68	DEFINED	68	REF	224
		3*236	2*245				
LES	ACRNM	DECLARED	69	DEFINED	69	REF	2*192
		2*193	2*194				
MARKUP	ACRNM	DECLARED	70	DEFINED	70	REF	217
		223					
MF	ACRNM	DECLARED	50	DEFINED	50	REF	286

SYMBOL LISTING

SYMBOL	TYPE	REFERENCES					
		287	288				
MODEL3	MODEL	DECLARED	337	DEFINED	338	REF	342
		357					
NMF	ACRNM	DECLARED	51	DEFINED	51	REF	289
NP	ACRNM	DECLARED	59	DEFINED	59	REF	327
P	ACRNM	DECLARED	60	DEFINED	60	REF	287
Q	ACRNM	DECLARED	58	DEFINED	58	REF	286
		288	305				
QEXO	ACRNM	DECLARED	71	DEFINED	71	REF	203
		204					
QSHR	ACRNM	DECLARED	72	DEFINED	72	REF	4*209
		4*210					
ROW	ACRNM	DECLARED	56	DEFINED	56	REF	327
SAM	PARAM	DECLARED	77	DEFINED	77	REF	277
		331	332				
SPEC	PARAM	DECLARED	170	DEFINED	170	REF	278
TAX	ACRNM	DECLARED	55	DEFINED	55	REF	297
TEXO	ACRNM	DECLARED	73	DEFINED	73	REF	183
		184	186				
TOTALS	PARAM	DECLARED	329	ASSIGNED	331	332	333
		REF	2*333				
UNSPEC	ACRNM	DECLARED	74	DEFINED	74	REF	188
		191	256				

SETS

ACC	ACCOUNTS
ACCEX	EXPORT COMMODITIES
ACCP	ALIASED WITH ACC
COMPS	COMMITTED CONSUMPTION

ACRONYMS

AC	ACTIVITY OR COMMODITY ACCOUNT
CES	CES PRODUCTION FUNCTION SPECIFICATION
EXPORT	EXPORT DEMAND FROM THE REST OF THE WORLD
FEXO	EXOGENOUS IN FOREIGN EXCHANGE
IDIST	INCOME DISTRIBUTION SPECIFICATION
IMPORT	PAYMENT FOR IMPORTS
INST	INSTITUTIONS INCOME ACCOUNT
INSTC	INSTITUTIONS CONSUMPTION ACCOUNT
IO	INPUT-OUTPUT SPECIFICATION
ITAX	INDIRECT TAX SPECIFICATION
LES	LINEAR EXPENDITURE SYSTEM SPECIFICATION
MARKUP	MARKUP OVER AND ABOVE COST
MF	MARKET FACTOR ACCOUNT
NMF	NON MARKET FACTOR
NP	PRICE FIXED AS NUMERAIRE
P	PRICE EXOGENOUS
Q	QUNATITY FIXED
QEXO	FIXED QUANTITY CONSUMPTION SYSTEM

SYMBOL LISTING

ACRONYMS

QSHR	FIXED QUANTITY SHARE CONSUMPTION SYSTEM
ROW	REST OF THE WORLD ACCOUNT
TAX	INDIRECT TAX ACCOUNT
TEXO	EXOGENOUS TSOL
UNSPEC	UNSPECIFIED OR RESIDUAL

PARAMETERS

ALPHARU	MINIMUM CONSUMPTION FOR RURAL HH
ALPHAUR	MINIMUM CONSUMPTION FOR URBAN HH
AT	ACCOUNT TABLE
CT	CELL TABLE
ETAS	ELASTICITIES OF DEMAND FOR EXPORTS
SAM	SOCIAL ACCOUNTING MATRIX
SPEC	SPECIFICATION TABLE
TOTALS	ACCOUNT TOTALS AND IMBALANCES FOR THE SAM

MODELS

MODEL3	AGRICULTURAL DEMAND-LED-INDUSTRIALIZATION FOR THAILAND

COMPILATION TIME = 0.174 MINUTES

MODEL3: A G R I C U L T U R A L - D E M A N D - L E D - G R O W T H
MODEL STATISTICS SOLVE MODEL3 USING HERCULES FROM LINE 342

MODEL STATISTICS

ACCOUNTS	42
ELEMENTS IN ACCOUNT TABLE	56
ELEMENTS IN CELL TABLE	211

EXECUTION TIME = 0.219 MINUTES

H E R C U L E S --- Version 1.14 from 92/02/06

Serial number 166
Licensed to: Samart Nitsmer
Department of Agricultural Economics and
Farm Management, University of Manitoba

SAM STATISTICS:	ACCOUNTS	CELLS
BEFORE EXPANSION	42	101
AFTER EXPANSION	44	109

MODEL STATISTICS:

VARIABLES	TOTAL	EXPLICIT	IMPLICIT	EXOGENOUS
P-VARIABLES	34	32	2	2
Q-VARIABLES	33		33	3
Y-VARIABLES	44	44	0	0
T-VARIABLES	109	109		
C-VARIABLES	72		72	
RESIDUAL	1	1		
TOTAL	293	186	107	5

EQUATIONS	TOTAL	EXPLICIT	IMPLICIT
ROW EQUATIONS	44	44	
COLUMN EQUATIONS	35	35	
P*Q=Y EQUATIONS	33	3	30
T(I,J) EQUATIONS	104	104	
C(I,J) EQUATIONS	72		72
FIXED VARIABLES	4		4
NUMERAIRE	1		1
TOTAL	293	186	107

VARIABLE AND EQUATION BALANCE BY MAJOR ACCOUNT TYPE:
(CELLS ARE COUNTED WITH THEIR COLUMN, EXCEPT IN
REST OF WORLD ACCOUNTS WHERE CELLS IN INSTITUTIONS
ROWS ARE COUNTED WITH INSTITUTIONS)

	VARIABLES	EQUATIONS	IMBALANCE
FACTORS	18	18	0
INSTITUTIONS	93	93	0
ACTIVITIES/COMMODITIES/ REST-OF-WORLD	179	179	0
INDIRECT TAXES	2	2	0
NUMERAIRE/RESIDUAL	1	1	
TOTALS	293	293	0

SIZE OF LARGEST SIMULTANEOUS BLOCK: 167
TOTAL NUMBER OF SPIKES: 8

G D P SUMMARY

		SOLUTION		
	BASE	CURRENT PRICES	CONSTANT PRICES	PRICE INDEX
GDP AT FACTOR COST	602.000	602.000	602.000	1.000
NET INDIRECT TAXES	71.000	71.000	71.000	
INCOME EFFECT			.000	
FINAL USE	715.000	715.000	715.000	1.000
EXPORTS	168.000	168.000	168.000	1.000
IMPORTS	-210.000	-210.000	-210.000	1.000
GDP AT MARKET PRICES	673.000	673.000	673.000	1.000
TERMS OF TRADE			.000	
GROSS DOMESTIC INCOME	673.000	673.000	673.000	
RESOURCE GAP	42.000	42.000	42.000	

EXIT -- FINAL SOLUTION FOUND
TIME STEPS 4
NEWTON ITERATIONS 0

SOLUTION TIME .145 MINUTES

WORK SPACE USED -- 2642 WORDS.
WORK SPACE AVAILABLE -- 28154 WORDS.

S O L U T I O N S U M M A R Y

	PSOL	QSOL	YSOL	YBASE
AG-LABOR	1.000	240.500	240.500	240.500
NG-LABOR	1.000	183.500	183.500	183.500
AGR-CAP	1.000	35.000	35.000	35.000
NONAG-CAP			143.000	143.000
RU-H-INC			289.000	289.000
RU-H-CON	1.000	253.000	253.000	253.000
UR-H-INC			241.000	241.000
UR-H-CON	1.000	190.000	190.000	190.000
FIRMS			94.000	94.000
GOVT-INC			97.000	97.000
GOVT-CON	1.000	83.000	83.000	83.000
INDR-TAX			71.000	71.000
RU-H-SAV			30.000	30.000
UR-H-SAV			42.000	42.000
FIRM-SAV			80.000	80.000
GOVT-SAV			3.000	3.000
RU-H-INV	1.000	18.000	18.000	18.000
UR-H-INV	1.000	22.000	22.000	22.000

MODEL3: A G R I C U L T U R A L - D E M A N D - L E D - G R O W T H
SOLUTION REPORT SOLVE MODEL3 USING HERCULES FROM LINE 342

S O L U T I O N S U M M A R Y

	PSOL	QSOL	YSOL	YBASE
FIRM-INV	1.000	60.000	60.000	60.000
GOVT-INV	1.000	89.000	89.000	89.000
VA-L-AGR	1.000	141.000	141.000	141.000
VA-L-IND	1.000	92.000	92.000	92.000
VA-L-SER	1.000	191.000	191.000	191.000
VA-KL-AG	1.000	176.000	176.000	176.000
VA-KL-IN	1.000	153.000	153.000	153.000
VA-KL-SE	1.000	273.000	273.000	273.000
ACT-AGR	1.000	301.000	301.000	301.000
ACT-IND	1.000	521.000	521.000	521.000
ACT-SER	1.000	448.000	448.000	448.000
AGR-DOM	1.000	229.000	229.000	229.000
AGR-EXP	1.000	77.000	77.000	77.000
AGR-IMP	1.000	3.000	3.000	3.000
AGR-COMP	1.000	232.000	232.000	232.000
IND-DOM	1.000	491.000	491.000	491.000
IND-EXP	1.000	59.000	59.000	59.000
IND-IMP	1.000	201.000	201.000	201.000
IND-COMP	1.000	692.000	692.000	692.000
SER-DOM	1.000	433.000	433.000	433.000
SER-EXP	1.000	32.000	32.000	32.000
SER-IMP	1.000	26.000	26.000	26.000
SER-COMP	1.000	459.000	459.000	459.000
REST-O-W	1.000		210.000	210.000

MODEL STATISTICS SOLVE MODEL3 USING HERCULES FROM LINE 357

MODEL STATISTICS

ACCOUNTS	42
ELEMENTS IN ACCOUNT TABLE	203
ELEMENTS IN CELL TABLE	483

EXECUTION TIME = 0.277 MINUTES

MODEL3: A G R I C U L T U R A L - D E M A N D - L E D - G R O W T H
SOLUTION REPORT SOLVE MODEL3 USING HERCULES FROM LINE 357

H E R C U L E S --- Version 1.14 from 92/02/06

Serial number 166
Licensed to: Samart Nitsaer
Department of Agricultural Economics and
Farm Management, University of Manitoba

SAM STATISTICS:	ACCOUNTS	CELLS
BEFORE EXPANSION	42	101
AFTER EXPANSION	44	109

MODEL STATISTICS:

VARIABLES	TOTAL	EXPLICIT	IMPLICIT	EXOGENOUS
P-VARIABLES	34	32	2	2
Q-VARIABLES	33		33	3
Y-VARIABLES	44	44	0	0
T-VARIABLES	109	109		
C-VARIABLES	72		72	
RESIDUAL	1	1		
TOTAL	293	186	107	5

EQUATIONS	TOTAL	EXPLICIT	IMPLICIT
ROW EQUATIONS	44	44	
COLUMN EQUATIONS	35	35	
P*Q=Y EQUATIONS	33	3	30
T(I,J) EQUATIONS	104	104	
C(I,J) EQUATIONS	72		72
FIXED VARIABLES	4		4
NUMERAIRE	1		1
TOTAL	293	186	107

VARIABLE AND EQUATION BALANCE BY MAJOR ACCOUNT TYPE:
(CELLS ARE COUNTED WITH THEIR COLUMN, EXCEPT IN
REST OF WORLD ACCOUNTS WHERE CELLS IN INSTITUTIONS
ROWS ARE COUNTED WITH INSTITUTIONS)

	VARIABLES	EQUATIONS	IMBALANCE
FACTORS	18	18	0
INSTITUTIONS	93	93	0
ACTIVITIES/COMMODITIES/ REST-OF-WORLD	179	179	0
INDIRECT TAXES	2	2	0
NUMERAIRE/RESIDUAL	1	1	
TOTALS	293	293	0

SIZE OF LARGEST SIMULTANEOUS BLOCK: 167
TOTAL NUMBER OF SPIKES: 8

G D P SUMMARY

	BASE	SOLUTION CURRENT PRICES	CONSTANT PRICES	PRICE INDEX
GDP AT FACTOR COST	602.000	633.350	610.852	1.037
NET INDIRECT TAXES	71.000	74.471	71.678	
INCOME EFFECT			-.118	
FINAL USE	715.000	749.107	720.461	1.040
EXPORTS	168.000	177.232	170.063	1.042
IMPORTS	-210.000	-218.518	-208.113	1.050
GDP AT MARKET PRICES	673.000	707.821	682.411	1.037
TERMS OF TRADE			-1.271	
GROSS DOMESTIC INCOME	673.000	707.821	681.140	
RESOURCE GAP	42.000	41.286	39.320	

EXIT -- FINAL SOLUTION FOUND
TIME STEPS 5
NEWTON ITERATIONS 7

SOLUTION TIME .178 MINUTES

WORK SPACE USED -- 2642 WORDS.
WORK SPACE AVAILABLE -- 28154 WORDS.

S O L U T I O N S U M M A R Y

	PSOL	QSOL	YSOL	YBASE	RESIDUAL
AG-LABOR	1.068	240.500	256.857	240.500	
NG-LABOR	1.000	189.555	189.555	183.500	
AGR-CAP	1.069	35.000	37.425	35.000	
NONAG-CAP			149.514	143.000	
RU-H-INC			308.040	289.000	
RU-H-CON	1.043	258.605	269.668	253.000	-0.003
UR-H-INC			249.738	241.000	
UR-H-CON	1.039	189.583	196.889	190.000	-0.002
FIRMS			97.830	94.000	
GOVT-INC			101.505	97.000	
GOVT-CON	1.029	83.000	85.428	83.000	
INDR-TAX			74.471	71.000	
RU-H-SAV			31.977	30.000	
UR-H-SAV			43.523	42.000	
FIRM-SAV			83.259	80.000	
GOVT-SAV			5.077	3.000	
RU-H-INV	1.043	18.392	19.186	18.000	
UR-H-INV	1.041	21.905	22.798	22.000	

MODEL3: A G R I C U L T U R A L - D E M A N D - L E D - G R O W T H
SOLUTION REPORT SOLVE MODEL3 USING HERCULES FROM LINE 357

S O L U T I O N S U M M A R Y

	PSOL	QSOL	YSOL	YBASE	RESIDUAL
FIRM-INV	1.041	59.970	62.444	60.000	
GOVT-INV	1.042	89.000	92.694	89.000	
VA-L-AGR	1.066	141.392	150.663	141.000	-0.004
VA-L-IND	1.029	93.710	96.451	92.000	-0.030
VA-L-SER	1.023	194.871	199.298	191.000	-0.047
VA-KL-AG	1.066	176.392	188.088	176.000	
VA-KL-IN	1.029	155.845	160.402	153.000	
VA-KL-SE	1.023	278.533	284.861	273.000	
ACT-AGR	1.054	301.671	317.936	301.000	
ACT-IND	1.036	530.687	549.849	521.000	
ACT-SER	1.027	457.080	469.341	448.000	
AGR-DOM	1.054	231.326	243.799	229.000	
AGR-EXP	1.054	75.298	79.358	77.000	
AGR-IMP	1.050	3.040	3.191	3.000	
AGR-COMP	1.054	234.366	246.991	232.000	
IND-DOM	1.036	499.085	517.107	491.000	
IND-EXP	1.036	61.079	63.284	59.000	
IND-IMP	1.050	200.269	210.282	201.000	
IND-COMP	1.040	699.335	727.389	692.000	-0.019
SER-DOM	1.027	440.697	452.518	433.000	
SER-EXP	1.027	33.686	34.589	32.000	
SER-IMP	1.050	24.748	25.986	26.000	
SER-COMP	1.028	465.427	478.503	459.000	-0.018
REST-O-W	1.000		218.518	210.000	

MODEL3: A G R I C U L T U R A L - D E M A N D - L E D - G R O W T H
E X E C U T I N G

---- 359 ACCOUNT AND CELL TABLES AFTER SOLVING SCENARIO VII:

---- 359 PARAMETER AT ACCOUNT TABLE

	TYPE	FIX	SIGMA	E	PSOL
AG-LABOR	MF	Q			1.068
NG-LABOR	MF	P			1.000
AGR-CAP	MF	Q			1.069
NONAG-CAP	NMF				
RU-H-INC	INST				
RU-H-CON	INSTC				1.043
UR-H-INC	INST				
UR-H-CON	INSTC				1.039
FIRMS	INST				
GOVT-INC	INST				
GOVT-CON	INSTC				1.029
INDR-TAX	TAX				
RU-H-SAV	INST				
UR-H-SAV	INST				
FIRM-SAV	INST				
GOVT-SAV	INST				
RU-H-INV	INSTC				1.043
UR-H-INV	INSTC				1.041
FIRM-INV	INSTC				1.041
GOVT-INV	INSTC	Q			1.042
VA-L-AGR	AC		0.400	EPS	1.066
VA-L-IND	AC		0.600		1.029
VA-L-SER	AC		0.500		1.023
VA-KL-AG	AC		0.800	EPS	1.066
VA-KL-IN	AC				1.029
VA-KL-SE	AC				1.023
ACT-AGR	AC				1.054
ACT-IND	AC				1.036
ACT-SER	AC				1.027
AGR-DOM	AC				1.054
AGR-EXP	AC				1.054
AGR-IMP	AC				1.050
AGR-COMP	AC		0.800		1.054
IND-DOM	AC				1.036
IND-EXP	AC				1.036
IND-IMP	AC				1.050
IND-COMP	AC		1.500		1.040
SER-DOM	AC				1.027
SER-EXP	AC				1.027
SER-IMP	AC				1.050
SER-COMP	AC		3.000		1.028
REST-O-W	ROW	NP			1.000

MODEL3: A G R I C U L T U R A L - D E M A N D - L E D - G R O W T H
E X E C U T I N G

359 PARAMETER AT ACCOUNT TABLE

+	QSOL	YSOL	YBASE	RESIDUAL
AG-LABOR	240.500	256.857	240.500	
NG-LABOR	189.555	189.555	183.500	
AGR-CAP	35.000	37.425	35.000	
NONAG-CAP		149.514	143.000	
RU-H-INC		308.040	289.000	
RU-H-CON	258.605	269.668	253.000	-0.003
UR-H-INC		249.738	241.000	
UR-H-CON	189.583	196.889	190.000	-0.002
FIRMS		97.830	94.000	
GOVT-INC		101.505	97.000	
GOVT-CON	83.000	85.428	83.000	
INDR-TAX		74.471	71.000	
RU-H-SAV		31.977	30.000	
UR-H-SAV		43.523	42.000	
FIRM-SAV		83.259	80.000	
GOVT-SAV		5.077	3.000	
RU-H-INV	18.392	19.186	18.000	
UR-H-INV	21.905	22.798	22.000	
FIRM-INV	59.970	62.444	60.000	
GOVT-INV	89.000	92.694	89.000	
VA-L-AGR	141.392	150.663	141.000	-0.004
VA-L-IND	93.710	96.451	92.000	-0.030
VA-L-SER	194.871	199.298	191.000	-0.047
VA-KL-AG	176.392	188.088	176.000	
VA-KL-IN	155.845	160.402	153.000	
VA-KL-SE	278.533	284.861	273.000	
ACT-AGR	301.671	317.936	301.000	
ACT-IND	530.687	549.849	521.000	
ACT-SER	457.080	469.341	448.000	
AGR-DOM	231.326	243.799	229.000	
AGR-EXP	75.298	79.358	77.000	
AGR-IMP	3.040	3.191	3.000	
AGR-COMP	234.366	246.991	232.000	
IND-DOM	499.085	517.107	491.000	
IND-EXP	61.079	63.284	59.000	
IND-IMP	200.269	210.282	201.000	
IND-COMP	699.335	727.389	692.000	-0.019
SER-DOM	440.697	452.518	433.000	
SER-EXP	33.686	34.589	32.000	
SER-IMP	24.748	25.986	26.000	
SER-COMP	465.427	478.503	459.000	-0.018
REST-O-W		218.518	210.000	

MODEL3: A G R I C U L T U R A L - D E M A N D - L E D - G R O W T H
E X E C U T I N G

---- 359 PARAMETER CT CELL TABLE

	TBASE	SPECS	ETA	ALPHA	TSOL
AG-LABOR .VA-L-AGR	136.000	CES			145.520
AG-LABOR .VA-L-IND	40.000	CES			42.560
AG-LABOR .VA-L-SER	64.500	CES			68.776
NG-LABOR .VA-L-AGR	5.000	CES			5.143
NG-LABOR .VA-L-IND	52.000	CES			53.891
NG-LABOR .VA-L-SER	126.500	CES			130.522
AGR-CAP .VA-KL-AG	35.000	CES			37.425
NONAG-CAP.VA-KL-IN	61.000	MARKUP			63.951
NONAG-CAP.VA-KL-SE	82.000	MARKUP			85.563
RU-H-INC .AG-LABOR	240.500	IDIST			256.857
RU-H-INC .AGR-CAP	25.000	IDIST			26.732
RU-H-INC .NONAG-CAP	20.000	IDIST			20.911
RU-H-INC .FIRMS	1.000	IDIST			1.041
RU-H-INC .GOVT-INC	0.500	TEXO			0.500
RU-H-INC .REST-O-W	2.000	FEXO			2.000
RU-H-CON .RU-H-INC	253.000	IDIST			269.668
UR-H-INC .NG-LABOR	183.500	IDIST			189.555
UR-H-INC .AGR-CAP	10.000	IDIST			10.693
UR-H-INC .NONAG-CAP	41.000	IDIST			42.868
UR-H-INC .FIRMS	3.000	IDIST			3.122
UR-H-INC .GOVT-INC	0.500	TEXO			0.500
UR-H-INC .REST-O-W	3.000	FEXO			3.000
UR-H-CON .UR-H-INC	190.000	IDIST			196.889
FIRMS .NONAG-CAP	78.000	IDIST			81.553
FIRMS .RU-H-INC	2.000	IDIST			2.132
FIRMS .UR-H-INC	4.000	IDIST			4.145
FIRMS .GOVT-INC	10.000	TEXO			10.000
GOVT-INC .NONAG-CAP	4.000	IDIST			4.182
GOVT-INC .RU-H-INC	4.000	IDIST			4.264
GOVT-INC .UR-H-INC	5.000	IDIST			5.181
GOVT-INC .FIRMS	10.000	IDIST			10.407
GOVT-INC .INDR-TAX	71.000	IDIST			74.471
GOVT-INC .REST-O-W	3.000	FEXO			3.000
GOVT-CON .GOVT-INC	83.000	UNSPEC			85.428
INDR-TAX .AGR-DOM	2.000	ITAX			2.129
INDR-TAX .AGR-EXP	3.000	ITAX			3.092
INDR-TAX .AGR-IMP	1.000	ITAX			1.064
INDR-TAX .IND-DOM	29.000	ITAX			30.542
INDR-TAX .IND-IMP	19.000	ITAX			19.877
INDR-TAX .SER-DOM	17.000	ITAX			17.766
RU-H-SAV .RU-H-INC	30.000	IDIST			31.977
UR-H-SAV .UR-H-INC	42.000	IDIST			43.523
FIRM-SAV .FIRMS	80.000	IDIST			83.259
GOVT-SAV .GOVT-INC	3.000	UNSPEC			5.077
RU-H-INV .RU-H-SAV	18.000	IDIST			19.186
UR-H-INV .UR-H-SAV	22.000	IDIST			22.798
FIRM-INV .FIRM-SAV	60.000	IDIST			62.444
GOVT-INV .RU-H-SAV	12.000	IDIST			12.791
GOVT-INV .UR-H-SAV	20.000	IDIST			20.725
GOVT-INV .FIRM-SAV	20.000	IDIST			20.815
GOVT-INV .GOVT-SAV	3.000	IDIST			5.077

MODEL3: A G R I C U L T U R A L - D E M A N D - L E D - G R O W T H
E X E C U T I N G

359 PARAMETER CT CELL TABLE

		TBASE	SPECS	ETA	ALPHA	TSOL
GOVT-INV	.REST-O-W	34.000	UNSPEC			33.286
VA-L-AGR	.VA-KL-AG	141.000	CES			150.663
VA-L-IND	.VA-KL-IN	92.000	IO			96.451
VA-L-SER	.VA-KL-SE	191.000	IO			199.298
VA-KL-AG	.ACT-AGR	176.000	IO			188.088
VA-KL-IN	.ACT-IND	153.000	IO			160.402
VA-KL-SE	.ACT-SER	273.000	IO			284.861
ACT-AGR	.AGR-DOM	227.000	IO			241.670
ACT-AGR	.AGR-EXP	74.000	IO			76.266
ACT-IND	.IND-DOM	462.000	IO			486.565
ACT-IND	.IND-EXP	59.000	IO			63.284
ACT-SER	.SER-DOM	416.000	IO			434.751
ACT-SER	.SER-EXP	32.000	IO			34.589
AGR-DOM	.AGR-COMP	229.000	CES			243.799
AGR-EXP	.REST-O-W	77.000	EXPORT	6.000		79.358
AGR-IMP	.AGR-COMP	3.000	CES			3.191
AGR-COMP	.RU-H-CON	103.000	LES		86.400	109.896
AGR-COMP	.UR-H-CON	29.000	LES		21.000	30.394
AGR-COMP	.RU-H-INV	4.000	QSHR			4.307
AGR-COMP	.UR-H-INV	1.000	QSHR			1.049
AGR-COMP	.FIRM-INV	5.000	QSHR			5.267
AGR-COMP	.GOVT-INV	9.000	QSHR			9.485
AGR-COMP	.ACT-AGR	22.000	IO			23.237
AGR-COMP	.ACT-IND	47.000	IO			50.453
AGR-COMP	.ACT-SER	12.000	IO			12.903
IND-DOM	.IND-COMP	491.000	CES			517.107
IND-EXP	.REST-O-W	59.000	EXPORT	2.600		63.284
IND-IMP	.IND-COMP	201.000	CES			210.282
IND-COMP	.RU-H-CON	90.000	LES		67.200	95.776
IND-COMP	.UR-H-CON	103.000	LES		56.000	106.790
IND-COMP	.GOVT-CON	8.000	QEXO			8.321
IND-COMP	.RU-H-INV	14.000	QSHR			14.879
IND-COMP	.UR-H-INV	21.000	QSHR			21.748
IND-COMP	.FIRM-INV	55.000	QSHR			57.178
IND-COMP	.GOVT-INV	80.000	QSHR			83.209
IND-COMP	.ACT-AGR	40.000	IO			41.697
IND-COMP	.ACT-IND	232.000	IO			245.793
IND-COMP	.ACT-SER	49.000	IO			51.999
SER-DOM	.SER-COMP	433.000	CES			452.518
SER-EXP	.REST-O-W	32.000	EXPORT	2.300		34.589
SER-IMP	.SER-COMP	26.000	CES			25.986
SER-COMP	.RU-H-CON	60.000	LES		38.400	63.997
SER-COMP	.UR-H-CON	58.000	LES		42.000	59.705
SER-COMP	.GOVT-CON	75.000	QEXO			77.107
SER-COMP	.ACT-AGR	63.000	IO			64.914
SER-COMP	.ACT-IND	89.000	IO			93.202
SER-COMP	.ACT-SER	114.000	IO			119.578
REST-O-W	.AGR-IMP	2.000	IMPORT			2.128
REST-O-W	.IND-IMP	182.000	IMPORT			190.405
REST-O-W	.SER-IMP	26.000	IMPORT			25.986

MODEL3: A G R I C U L T U R A L - D E M A N D - L E D - G R O W T H
E X E C U T I N G

359 PARAMETER CT CELL TABLE

+		QCSOL	WP	A-USED	BETA-USED	FQ-USED
AG-LABOR	.VA-L-AGR	136.254		0.965		
AG-LABOR	.VA-L-IND	39.850		0.435		
AG-LABOR	.VA-L-SER	64.397		0.338		
NG-LABOR	.VA-L-AGR	5.143		0.035		
NG-LABOR	.VA-L-IND	53.891		0.565		
NG-LABOR	.VA-L-SER	130.522		0.662		
AGR-CAP	.VA-KL-AG	35.000		0.199		
NONAG-CAP	.VA-KL-IN	62.134				
NONAG-CAP	.VA-KL-SE	83.662				
RU-H-INC	.AG-LABOR			1.000		
RU-H-INC	.AGR-CAP			0.714		
RU-H-INC	.NONAG-CAP			0.140		
RU-H-INC	.FIRMS			0.011		
RU-H-CON	.RU-H-INC			0.875		
UR-H-INC	.NG-LABOR			1.000		
UR-H-INC	.AGR-CAP			0.286		
UR-H-INC	.NONAG-CAP			0.287		
UR-H-INC	.FIRMS			0.032		
UR-H-CON	.UR-H-INC			0.788		
FIRMS	.NONAG-CAP			0.545		
FIRMS	.RU-H-INC			0.007		
FIRMS	.UR-H-INC			0.017		
GOVT-INC	.NONAG-CAP			0.028		
GOVT-INC	.RU-H-INC			0.014		
GOVT-INC	.UR-H-INC			0.021		
GOVT-INC	.FIRMS			0.106		
GOVT-INC	.INDR-TAX			1.000		
INDR-TAX	.AGR-DOM	2.020				
INDR-TAX	.AGR-EXP	2.934				
INDR-TAX	.AGR-IMP	1.013				
INDR-TAX	.IND-DOM	29.478				
INDR-TAX	.IND-IMP	18.931				
INDR-TAX	.SER-DOM	17.302				
RU-H-SAV	.RU-H-INC			0.104		
UR-H-SAV	.UR-H-INC			0.174		
FIRM-SAV	.FIRMS			0.851		
RU-H-INV	.RU-H-SAV			0.600		
UR-H-INV	.UR-H-SAV			0.524		
FIRM-INV	.FIRM-SAV			0.750		
GOVT-INV	.RU-H-SAV			0.400		
GOVT-INV	.UR-H-SAV			0.476		
GOVT-INV	.FIRM-SAV			0.250		
GOVT-INV	.GOVT-SAV			1.000		
VA-L-AGR	.VA-KL-AG	141.392		0.801		
VA-L-IND	.VA-KL-IN	93.710		0.601		
VA-L-SER	.VA-KL-SE	194.871		0.700		
VA-KL-AG	.ACT-AGR	176.392		0.585		
VA-KL-IN	.ACT-IND	155.845		0.294		
VA-KL-SE	.ACT-SER	278.533		0.609		
ACT-AGR	.AGR-DOM	229.306		0.991		
ACT-AGR	.AGR-EXP	72.365		0.961		

359 PARAMETER CT CELL TABLE

+	QCSOL	WP	A-USED	BETA-USED	FQ-USED
ACT-IND .IND-DOM	469.608		0.941		
ACT-IND .IND-EXP	61.079		1.000		
ACT-SER .SER-DOM	423.395		0.961		
ACT-SER .SER-EXP	33.686		1.000		
AGR-DOM .AGR-COMP	231.326		0.987		
AGR-EXP .REST-O-W	75.298	1.050			77.000
AGR-IMP .AGR-COMP	3.040		0.013		
AGR-COMP .RU-H-CON	104.279			0.272	
AGR-COMP .UR-H-CON	28.840			0.113	
AGR-COMP .RU-H-INV	4.087		0.222		
AGR-COMP .UR-H-INV	0.996		0.045		
AGR-COMP .FIRM-INV	4.998		0.083		
AGR-COMP .GOVT-INV	9.000		0.101		
AGR-COMP .ACT-AGR	22.049		0.073		
AGR-COMP .ACT-IND	47.874		0.090		
AGR-COMP .ACT-SER	12.243		0.027		
IND-DOM .IND-COMP	499.085		0.710		
IND-EXP .REST-O-W	61.079	1.050			59.000
IND-IMP .IND-COMP	200.269		0.290		
IND-COMP .RU-H-CON	92.082			0.374	
IND-COMP .UR-H-CON	102.671			0.662	
IND-COMP .GOVT-CON	8.000				8.000
IND-COMP .RU-H-INV	14.305		0.778		
IND-COMP .UR-H-INV	20.910		0.955		
IND-COMP .FIRM-INV	54.973		0.917		
IND-COMP .GOVT-INV	80.000		0.899		
IND-COMP .ACT-AGR	40.089		0.133		
IND-COMP .ACT-IND	236.313		0.445		
IND-COMP .ACT-SER	49.993		0.109		
SER-DOM .SER-COMP	440.697		0.943		
SER-EXP .REST-O-W	33.686	1.050			32.000
SER-IMP .SER-COMP	24.748		0.057		
SER-COMP .RU-H-CON	62.248			0.354	
SER-COMP .UR-H-CON	58.074			0.225	
SER-COMP .GOVT-CON	75.000				75.000
SER-COMP .ACT-AGR	63.140		0.209		
SER-COMP .ACT-IND	90.655		0.171		
SER-COMP .ACT-SER	116.311		0.254		
REST-O-W .AGR-IMP	2.026	1.050			
REST-O-W .IND-IMP	181.338	1.050			
REST-O-W .SER-IMP	24.748	1.050			

+	FV-USED	WP-USED	THETA-USED
NONAG-CAP.VA-KL-IN			0.663
NONAG-CAP.VA-KL-SE			0.429
RU-H-INC .GOVT-INC	0.500		
RU-H-INC .REST-O-W	2.000		
UR-H-INC .GOVT-INC	0.500		
UR-H-INC .REST-O-W	3.000		
FIRMS .GOVT-INC	10.000		

MODEL3: A G R I C U L T U R A L - D E M A N D - L E D - G R O W T H
E X E C U T I N G

359 PARAMETER CT CELL TABLE

+	FV-USED	WP-USED	THETA-USED
GOVT-INC .REST-O-W	3.000		
INDR-TAX .AGR-DOM			0.009
INDR-TAX .AGR-EXP			0.041
INDR-TAX .AGR-IMP			0.500
INDR-TAX .IND-DOM			0.063
INDR-TAX .IND-IMP			0.104
INDR-TAX .SER-DOM			0.041
AGR-EXP .REST-O-W		1.050	
IND-EXP .REST-O-W		1.050	
SER-EXP .REST-O-W		1.050	
REST-O-W .AGR-IMP		1.050	
REST-O-W .IND-IMP		1.050	
REST-O-W .SER-IMP		1.050	

**** FILE SUMMARY

INPUT C:\DISSERT\SAMSON2.GMS
OUTPUT C:\DISSERT\SAMSON2.LST

EXECUTION TIME = 0.226 MINUTES