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THE IMPACT OF APEC TRADE LIBERALISATION ON INDONESIAN ECONOMY AND ITS AGRICULTURAL SECTOR

By

Rina Oktaviani

A THESIS

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ABSTRACT

In an integrated world market, changing global and regional trade policies can affect the economic performance of individual countries. As the twentieth Century ends, nations have jointly agreed through various forums, including the General Agreement on Tariffs and Trade (now the World Trade Organisation) and the Asia-Pacific Economic Cooperation Forum (APEC), to implement trade liberalisation. In some instances, the extent of liberalisation is quite dramatic. Economists' capacity to explore and to make quantitative assessments of the effects of global and regional trade agreements on individual countries has also grown significantly in the late twentieth Century, principally through the development of national and global Computable General Equilibrium (CGE) models.

This thesis contributes to the empirical literature on trade liberalisation. The impacts of trade liberalisation by APEC member countries on the Indonesian macroeconomy, and its various sectors, especially the agricultural industries, are assessed and analysed in this thesis. The macroeconomic impacts of liberalisation on other APEC members are also derived. An Indonesian Forecasting Model is developed based on the ORANI-F general equilibrium model for Australia. The model is more detailed sector-wise than existing Indonesian CGE models and incorporates flexibility to capture alternative assumptions regarding land and investment behaviour. The effects of trade liberalisation on Indonesia are found by imposing changes in world market conditions resulting from trade liberalisation and relevant to Indonesia as exogenous shocks in the Indonesian Forecasting Model. The Global Trade Analysis Project (GTAP) model is used to estimate the impacts of APEC trade liberalisation on changes in global market conditions. Two specifications of trade liberalisation are studied on Indonesian economy, namely trade liberalisation by the developed APEC countries only, which is to be implemented by 2010 and second, full trade liberalisation by all APEC countries, which is to be implemented by 2020. The impacts are assessed under several alternative settings including several variations in the database, three scenarios for the tariff rate changes made by Indonesia and several prospective economic developments in Indonesia.

APEC trade liberalisation is found to be generally beneficial in enhancing growth in most APEC members in the short run and even more so in the long run, except for North America. The impacts of full APEC trade liberalisation with the same tariff change scenario on Indonesia's macroeconomy are generally in the same direction with APEC developed countries trade liberalisation with the first case affect either larger positive or smaller negative impacts. With the same version of trade liberalisation, the different scenarios for Indonesia's tariff response generate quite different impacts. The implication of these results is that the Indonesian government should avoid over-reductions in tariff barriers if it seeks development focussed on increasing investment and private consumption.

The pattern of winners and losers from trade liberalisation at the sectoral level varies across scenarios. The estate crops and mining sectors are amongst the biggest gainers in terms of industry output following full APEC trade liberalisation. In most simulations, the results suggest that Indonesia's comparative advantage under trade liberalisation will lie more in agricultural production than in agricultural processing. While Indonesia will be affected by trade liberalisation, the impacts appear to be relatively small compared with the impacts other prospective economic developments are likely to have.

DEDICATION

To my beloved husband "Abang" Ayip Yusron

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DISCLAIMER

I, Rina Oktaviani, certify that unless otherwise identified, all material contained in this thesis is my own original work, and has not been submitted for any degree nor has been published, elsewhere. All assistance received in the preparation of this thesis, whether oral or written, and all source materials, have been duly acknowledged at the appropriate places in this thesis.

Rina Oktaviani
February, 2000

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
AFTA	ASEAN Free Trade Area
APEC	Asia Pacific Economic Cooperation
ASEAN	Association of South-East Asian Nations
BULOG	Badan Urusan Logistik (Food Logistics Agency)
CAPs	Collective Action Plans
CES	Constant Elasticity of Substitution
CEPT	Common Effective Preferential Tariff
CER	Australia-New Zealand Closer Economic Relation Trade Agreement
CET	Constant Elasticity of Transformation
CGE	Computable General Equilibrium
CIF	Cost, Insurance and Freight
CRESH	Constant Ratio of Elasticities Substitution and Homothetic
CRETH	Constant Ratio of Elasticities Transformation and Homothetic
EPTE	Export Oriented Production Enterpot
FDI	Foreign Direct Investment
GATT	General Agreement on Tariffs and Trade
GATS	General Agreement on Trade in Services
GDP	Gross Domestic Product
GEMPACK	General Equilibrium Modelling Package
GNE	Gross National Expenditure
GTAP	Global Trade Analysis Project
IAP	Individual Action Plan
IMF	International Monetary Funds
I-O	Input-Output
LES	Linear Expenditure System
MAPA	Manila Action Plan for APEC
MFA	Multifibre Arrangement
NAFTA	North American Free Trade Agreement
MFN	Most Favoured Nation
MODHAR	A suite within GEMPACK used to create data files for TABLO-generated Programs
NTBs	Non-Trade Barriers
PECC	Pacific Economic Cooperation Council
PIDS	Philippine Institute for Development Studies
PMA	Foreign Direct Investment (*Penanaman Modal Asing*)
SAM	Social Accounting Matrix
TABLO	A suite within GEMPACK which translates the algebraic specification of an economic model into an executable program
UR	Uruguay Round
WTO	World Trade Organisation

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CHAPTER 1

INTRODUCTION

The 1990s have been a period of significant change in the world economy, marked by events such as the completion of the Uruguay Round of the General Agreement on Tariffs and Trade (GATT), trade policy liberalisation, the formation of regional trading blocks including the Asean Free Trade Area (AFTA) and the Asia Pacific Economic Cooperation (APEC), reforms in the former Soviet Union and Eastern Europe, and the opening-up of these countries and China to international trade. National policy makers need not only to assess the likely effects of these changes on their individual countries, but also to evaluate their own policy reactions to these changes. One of the possible consequences of these changes is a greater tendency towards specialisation in accordance with a nation's comparative and competitive advantage. This study is concerned with these consequences, in particular for Indonesia.

In the Asia Pacific region, the APEC forum has become an important vehicle for cooperation among member nations. The APEC forum consists of nine developing countries (Brunei, Chile, China, Indonesia, Malaysia, Mexico, Papua New Guinea, the Philippines and Thailand), four newly industrialised countries (Hong Kong, South Korea, Singapore and Taiwan) and five mature countries (Australia, Canada, Japan, New Zealand and United States). This forum declared a remarkable agreement in November 1994. It aimed to achieve free and open trade and investment in the Asia Pacific region by 2010 for industrialised countries and 2020 for developing countries. In order to raise incomes and standards of living, the commitment in this so-called "Bogor Declaration" is also "... to accelerate the implementation of the Uruguay Round agreement; active support for the multilateral trade system; continued unilateral trade investment liberalisation; and an endeavour to refrain from increasing in protection" (Bureau of Industry Economics, 1995, p.1).

Although the objective of the Bogor Declaration is to raise the income and standard of living of its members, some argue that it is difficult for firms in developing countries to do this and compete with those in developed countries. In many developing countries such as Indonesia, small and medium manufacturers and businesses depend more on natural resources than on human capital and sophisticated technology which makes them less labor efficient than those in developed countries. Moreover, developing countries often have limited capabilities to provide a favourable environment, such as adequate infrastructure and efficient government services, for business to be competitive. Often industries are protected by government to compete more strongly with imported commodities in the domestic market.

Most APEC members protect their domestic industries against imports with protection varying across countries and between commodities. Based on the GTAP (Global Trade Analysis Project) database (McDougall and Hertel, 1997), the highest levels of import protection in agricultural products in 1992 were in Japan. For example, the import tariffs (percentage of CIF value) in Japan for paddy rice, wheat and other grain were 500, 308 and 336 per cent respectively. High levels of agricultural protection were also applied in other APEC countries. Malaysia, the Philippines and Thailand had the same import tariffs on wheat in 1992, namely 272 per cent. Moreover, the agricultural sector has been subsidised by most APEC members, with the highest subsidies in the United States. The GTAP database for 1992 (McDougall and Hertel, 1997) shows that the output subsidies for paddy rice, wheat and other grain were 59, 45 and 31 per cent respectively. Given the existence of these substantial and widespread barriers, trade liberalisation, in the form of reduced protection and reduced subsidies across an extensive range of sectors, products and countries, can be expected to have a significant impact on the economies of the APEC countries.

1.1 Economic Performance of Indonesia and Other APEC Countries

Trade liberalisation within the APEC regional trading block will influence the regional economies. The recent economic performance of APEC countries is described in this section in terms of the economic growth (real GDP growth) of each country, the interdependency among the countries as reflected in trade, and the inward foreign direct investment of each country.

1.1.1 GDP Growth of the APEC countries

The economic growth of APEC members in the period of 1980-1996 has varied widely between and within countries. As can be seen in Table 1.1, the GDP growth of APEC countries varied from -0.1 per cent per annum in Papua New Guinea to 10.1 per cent per annum in Chile in 1995-1996. The most rapidly growing economies among developed countries in 1995-1996 were Australia and Japan, growing at 4.0 and 3.9 per cent per annum, respectively. This growth was above the average growth of developed countries in the world in the same period. The economic growth of most APEC developing countries (Mexico and Papua New Guinea were exceptions) was also bigger than the average economic growth of developing countries in 1995-1996. Of the developing economies, China has had the most rapid GDP growth. Its real GDP growth was 10.2 per cent (1980-1990), 12.4 per cent (1991-1994) and 10.1 per cent (1995-1996). Indonesia also had a high and relatively consistent real GDP growth: 6.1 per cent (1980-1990), 7.7 per cent (1991-1994) and 7.5 per cent (1995-1996).

The diversity of APEC members and their rapid growth creates complementarities and opportunities for trade. Large population countries with rapidly growing economies, such as China and Indonesia, offer potential markets and create trade interest for both APEC members and countries outside APEC. They also tend to be specialised in labour intensive manufacturing. On the other hand, the developed countries, which have more advanced technology and less population, tend to specialise in capital-intensive industries.

It is evident from Table 1.1 that the economic growth of the high-income APEC countries has been less than those of the developing APEC countries. Murtough *et al.* (1994) argued that the slower growth of high-income economies occurs because, in order to grow, developed countries must apply advanced technology and management practices, which takes time and investment. On the contrary, developing economies can grow relatively rapid by adopting existing technologies and reallocating resources between sectors. In the East Asia economies, macroeconomic stability has been a key factor facilitating economic growth. In the last three decades, East Asian economies have successfully stabilised inflation to around 6 per cent per year, operated a relatively small government budget deficit and maintained relatively stable real exchange rates (World Bank, 1999).

Table 1.1 Trend of Economic Growth of APEC Members (Real GDP Growth, as Percentage per Annum)

	1980-1990	1991-1994	1995-1996
World	3.1	1.5	3.2
High-Income Economies	3.2	1.7	2.7
APEC Economies :			
Australia	3.5	2.5	4.0
Canada	3.4	1.3	1.7
Japan	4.1	1.4	3.9
New Zealand	1.9	2.5	0.6
United States	3.0	1.9	2.3
Developing Economies	3.0	1.0	3.7
APEC Economies :			
Brunei	na	1.3	na
Chile	4.1	7.2	10.1
China	10.2	12.4	10.0
Hongkong	6.9	5.7	4.7
Indonesia	6.1	7.7	7.5
Korea	9.4	7.2	6.9
Malaysia	5.2	8.8	8.3
Mexico	1.0	2.9	6.6
Philippines	1.0	1.6	6.9
Papua New Guinea	1.9	11.9	-0.1
Singapore	6.4	8.5	7.6
Thailand	7.6	8.4	5.4

Sources: PEEC, PIDS and The Asia Foundation (1996), World Bank (1998)

Taken for a prolonged period of rapid growth, economic growth in East Asia had come to be granted until recently. Beginning in 1997, a financial crisis, which started as a currency crisis, has afflicted countries such as Indonesia, Malaysia, Thailand and the Philippines. Goldstein (1998) argues that the sources of the crisis for Indonesia and other ASEAN countries (Thailand, Malaysia and the Philippines) are the weakness of their financial sectors and their external-sector problems. The rapid transmission of the crisis between ASEAN countries is explained by Woo (1998) in terms of the weaknesses in some economies such as pegged exchange rates, weak banking system, asset bubbles in Thailand and political cronyism in Indonesia. The impact on Indonesia has been attributed to excessive investment in the property sector, poor banking supervision and management, an unstable current account deficit, and excessive foreign borrowing for the short term period (McLeod, 1998). The impact of the crisis on the economic performance of these countries can be seen in Table 1.2.

Table 1.2 Recent Economic Performance of Selected APEC Countries (per cent per annum)

	Indonesia	Malaysia	Thailand	Philippines
Growth in GDP				
1997	4.9	7.8	-0.4	5.1
Qrt 1 1998	-6.4	-1.8	na	1.7
Qrt 2 1998	-16.8	-6.8	na	-1.2
Inflation Rate				
1997	11.05	2.70	5.60	6.00
Qrt 1 1998	25.13	5.10	9.50	7.30
Qrt 2 1998	46.22	6.20	10.70	10.70
Qrt 3 1998	75.47	5.50	7.00	10.00

Source: http://www.bi.go.id/ind/datastatistik/, 5 Feb 1999

Table 1.2 shows that among the countries affected by the financial crisis, Indonesia has suffered the worst. The Indonesian exchange rate fell from Rp 2,110 per US$ in 1993 to Rp 14,900 per US$ in June 1998 (Bank Indonesia, 1998). Indonesia's economic growth decreased from 4.9 per cent per annum in 1997 to –16.8 per cent per annum in the second quarter of 1998. The inflation rate has also increased from 11.05 per cent per annum in 1997 to 75.47 per cent in the third quarter of 1998. Indonesia's inflation rate has increased dramatically compared to other countries in Asia. Malaysia, for example, had an inflation rate of 7.8 per cent per annum in 1997 and this had increased to 5.5 per cent per annum in the third quarter of 1998. High inflation rates will add to the volatility of real interest rates and real exchange rates (World Bank, 1999). This instability will have an impact on Asian countries, especially Indonesia in facing the world trade because the industrial output which has a big share of an importing intermediate input will be less competitive than other countries products. The developed countries such as USA and Japan and financial institutions such as the IMF and the World Bank have already provided funds to those countries, which have a monetary crisis in order to stabilise their economies.

1.1.2 Intra-APEC trade

The extent of the East Asian financial crisis serves to underline the economic interrelationship among countries in the APEC region. Intra-APEC trade, both imports and exports, has increased significantly over the period 1985-1994 from 67 per cent each of total exports and imports to 75 per cent and 76 per cent (PECC, PIDS and The Asia Foundation's Center for Asian Pacific Affairs, 1996). The high interdependency of trade among APEC members in 1992 can be seen in Table 1.3, which is based on the GTAP database. More than 50 per cent of exports from APEC members were to other APEC members. North America (NAM=United States, Canada and Mexico) and Japan are the important APEC members as export destinations. Some countries, such as Japan, NAM itself, ASEAN4 (Malaysia, Singapore, Thailand and the Philippines) and other APEC members, have their biggest export shares to NAM . Other countries, such as Australia and New Zealand (ANZ) and Indonesia have the largest share of their exports going to Japan. The large export share of APEC countries to NAM and Japan shows that the economic growth of these two countries will influence the export demand of other APEC countries.

Table 1.3 Percentages of Total Exports from the Country Source to the Various Countries Destinations and the Value of Total Export in 1992 (US$ Million)

	Destination									
Source	ANZ	JPN	INA	NAM	ASEAN4	OAPEC	EU	ROW	Total	Total Export
ANZ	7.87	27.59	2.40	11.45	7.07	16.67	15.22	11.73	100	60623.2
JPN	2.75	0.00	1.61	30.35	9.97	20.25	19.68	15.40	100	378371.3
INA	2.59	30.71	0.00	13.98	11.59	15.46	17.09	8.58	100	37285.1
NAM	1.85	10.42	0.60	37.25	3.41	7.79	22.65	16.01	100	769970.1
ASEAN4	2.31	14.71	1.51	20.90	15.86	12.43	19.49	12.79	100	173125.7
OAPEC	1.87	14.55	1.33	25.48	7.33	17.74	17.56	14.13	100	320144.6
EU	1.90	5.29	1.17	22.63	4.20	6.02	0.00	58.79	100	734057.7
ROW	0.82	8.49	0.44	13.11	2.60	4.68	45.69	24.18	100	858298.6

Source: Calculated from GTAP database version 3

Besides exporting commodities among APEC members, the APEC members also export to non-APEC countries. Most APEC members have a substantial share of their exports to the European Union (EU). Changes in economic and trade policy in the EU countries could thus affect the trade and wider economic performance of APEC countries.

On the import side, in 1992, the source of more than 60 per cent of imports by APEC countries came from APEC countries. Table 1.4 shows that NAM and Japan were again the important country import sources. The biggest import share for each of ANZ, NAM, and Japan came from North America. Meanwhile, Japan dominated the import source of ASEAN4 and other APEC countries. Unlike other APEC countries, the biggest import source of Indonesia was the EU, followed by Japan and North America. Clearly, there is a high interdependency among APEC countries.

As the biggest importer and exporter, NAM and Japan shows that these countries can be categorised as big countries which will significantly influence the world market. Indonesia on the other hand, in terms of the world market share, can be categorised as a small country, which would not generally influence the world market.

Table 1.4 Percentages of Total Imports by Destination Country from Various Countries Sources and the Value of Total Imports in 1992 (US$ Million)

	Destination							
Source	ANZ	JPN	INA	NAM	ASEAN4	OAPEC	EU	ROW
ANZ	7.87	5.77	4.77	0.87	2.48	3.26	1.27	0.81
JPN	16.82	0.00	19.45	14.03	21.30	24.19	9.84	6.45
INA	1.62	3.98	0.00	0.66	2.54	1.88	0.87	0.37
NAM	23.05	27.37	14.76	35.49	14.70	18.78	23.01	13.65
ASEAN4	6.59	8.76	8.37	4.47	15.63	6.91	4.49	2.49
OAPEC	10.06	16.19	13.95	10.34	13.50	18.48	7.64	5.17
EU	22.55	13.07	26.66	20.14	17.08	13.79	0.003	47.95
ROW	11.46	24.85	12.04	14.00	12.76	12.72	52.88	23.12
Total	100	100	100	100	100	100	100	100
Total Import	64302	309481	33058	857249	186848	339389	788851	944175

Source : Calculated from GTAP database version 3

The import and export market share of the various sectors of the Indonesia economy, from and to other APEC countries are reported in Tables 1.5 and 1.6 respectively. For example, 67 per cent of imported processed rice (PCR) came from other ASEAN countries. In this case, Thailand contributes the largest import share. In the livestock sector, the biggest import source is Australia and New Zealand, which made up 50 per cent of total imports. In the wheat market, Australia, New Zealand and North America are the biggest import sources, with 29 per cent coming from Australia and New Zealand and 36 per cent from North America.

Table 1.5 Share of Import Value from all Countries to Indonesia in 1992 (%) and Total Import to Indonesia (million US$)

Sector	ANZ	JPN	NAM	ASEAN4	OAPEC	EU	ROW	Total Import to Indonesia
PDR	0.00	0.00	32.14	67.86	0.00	0.00	0.00	2.8
WHT	29.24	0.00	36.06	0.00	0.00	1.32	33.39	378.3
GRO	3.28	0.00	8.20	4.92	80.33	0.00	3.28	6.1
NGC	21.54	0.43	33.06	2.58	16.60	1.49	24.31	989.4
LVS	50.52	0.17	20.91	1.39	14.98	8.54	3.66	57.4
FOR	0.00	0.48	94.20	0.48	0.97	2.42	1.45	20.7
FSH	4.05	6.94	2.31	5.78	44.51	26.59	9.83	17.3
C_M	6.17	2.23	10.69	4.66	4.91	5.78	65.56	435.8
O_G	17.88	0.00	0.00	15.12	0.10	0.01	66.89	1067.5
PCR	0.00	0.00	1.64	66.97	6.24	0.00	25.15	152.3
LVP	46.09	0.33	5.22	2.61	0.65	31.49	13.62	153.4
OFP	7.51	3.24	8.19	46.05	7.14	10.75	17.15	587.2
B_T	2.08	0.61	33.82	5.88	20.59	17.40	19.61	81.6
T_L	0.68	12.92	6.19	2.95	69.23	5.06	2.97	1932
LUM	6.69	39.52	18.43	8.08	6.44	17.55	3.16	79.2
OMF	1.68	31.21	17.69	5.43	10.46	28.61	4.91	13517
MIN	10.08	22.76	5.12	21.84	14.43	14.09	11.67	4166.3
CRP	4.65	18.49	14.22	9.34	18.92	20.88	13.51	3882.1
T_T	0.30	5.17	19.91	1.84	1.68	55.36	15.74	2352.6
SVC	1.15	3.38	15.46	1.87	6.33	61.49	10.33	3178.8

Source: Calculated from GTAP database version 3. The identification of each sector is provided in table 6.1.

Although the agricultural sector plays an important role in Indonesia's economy in terms of GDP share, some agricultural commodities are still imported. Among the agricultural commodities, the non-grain crops (NGC) and wheat (WHT) are the major imports. Meanwhile, the import value of processed rice (PCR) was $152.3 million in 1992. The import of agricultural commodities, particularly staple foods such as rice, has created some problems, especially during the period of financial crisis. The depreciation of the Indonesian exchange rate led to an increase in the domestic price of food, which caused serious food security concerns for low-income households in Indonesia. The Indonesian government has long given priority to ensuring that the staple food commodities, especially rice, are available at affordable prices. The Indonesian government increased the rice import target from 2.85 million tonnes to 3.1 million tonnes for 1998/1999 (April/March) (FAO, 1998). The government efforts also include an increase in food subsidies and an adequate food distribution system, especially during the recovery of the financial crisis.

Table 1.6 Share of Export Value from Indonesia to all Countries in 1992 (%) and Total Export from Indonesia (million US$)

Sector	ANZ	JPN	NAM	ASEAN4	OAPEC	EU	ROW	Total export from Indonesia
PDR	0.00	0.00	0.00	0.00	20.00	0.00	80.00	0.05
WHT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
GRO	0.00	10.11	0.00	87.77	2.13	0.00	0.00	18.8
NGC	1.34	7.90	32.56	19.12	5.74	21.05	12.28	2085.4
LVS	0.12	9.11	6.63	23.55	52.78	5.33	2.49	84.5
FOR	0.00	12.24	0.52	9.90	51.82	13.54	12.24	38.4
FSH	0.60	56.97	13.22	19.27	4.12	5.47	0.35	1123.5
C_M	1.48	49.24	9.24	9.38	17.01	8.53	5.12	1632.8
O_G	3.05	65.00	4.89	1.60	25.41	0.02	0.03	9396.2
PCR	0.00	0.00	0.00	0.00	0.00	1.16	98.84	8.6
LVP	0.34	3.44	8.95	10.67	6.37	53.70	16.52	58.1
OFP	2.15	7.03	13.78	12.76	9.25	47.94	7.09	1332.3
B_T	0.32	6.06	8.15	27.15	2.31	31.65	24.36	186.4
T_L	1.77	6.30	23.33	19.40	4.68	28.22	16.29	7559.4
LUM	1.07	26.60	12.56	4.06	31.03	17.60	7.07	4748.5
OMF	5.47	7.20	24.93	24.64	9.96	15.01	12.80	2644.5
MIN	1.38	24.27	10.21	29.52	11.50	12.77	10.34	1782.1
CRP	10.09	31.55	5.30	12.68	15.86	10.96	13.57	2100.9
T_T	1.10	31.81	4.88	0.75	4.23	44.53	12.69	1543.1
SVC	0.90	10.24	18.98	2.01	4.45	51.07	12.35	941.7

Source: Calculated from GTAP database version 3

The picture for Indonesian exports in 1992 is shown in Table 1.6. The largest export value from Indonesia was oil and gas, followed by textile and leather, lumber and wood product, and non-grain crops. It shows that Indonesian export earnings in 1992 were very dependent on the resource-based commodities.

The major destinations for exports differed between commodities. For Indonesia's oil and gas sector, the largest export value went to Japan. The European Union, other APEC countries, and North America were the principal destinations for textile and leather, lumber and wood, and non-grain crops, respectively. Clearly, there is considerable diversity in Indonesia's export destinations so Indonesia is not dependent on any one importing country. However, Japan is an important export market for fishing, coal and mining, and chemical, rubber and plastic products, all of which are large export earning sectors.

1.1.3 Foreign Direct Investment in APEC Countries

The economic development of APEC members has been accelerated by an increase in international capital mobility, particularly the inflow of foreign direct investment (FDI). According to the World Bank (1999), an increase of investment will shift the level of the sustainable growth path upwards. FDI inflows to APEC members in 1994 was four times larger than the annual average over the period 1981-86, although the percentage of APEC's share of world FDI inward flows remained constant at 55.6 per cent over this time (Table 1.7). The rapid growth of APEC developing economies was followed by a high increase in FDI, from 5.0 billion US $ in the period of 1981-86, to 57.6 billion US $ in 1994. In percentage of world FDI inward flows, the APEC developing economies' share was also increased dramatically from 8.7 per cent in 1981-86, to 25.5 per cent in 1994. Of the developing countries, China experienced the largest increase in FDI inflows, from 1.0 billion US$ in 1981-86 to 33.8 billion US$ in 1994. Part of this dramatic increase is due to the practice of "round tripping", whereby domestic Chinese investment is recycled principally through Hong Kong to create an incentive of foreign investment (Soesastro, 1996). In Indonesia, the amount of FDI inflow also increased significantly, around fifteen times from 0.2 billion US$ in the period 1981-86 to 3.0 billion US$ in 1994.

The availability of FDI funds facilitate investment in the particular industries in APEC countries. Each country has different perspectives and policies to mobilise its investment. For example, Korea and Malaysia favoured investment in high cost industries (World Bank, 1999). Meanwhile, the Indonesian government has been more concerned to invest in the strategic commodity industries such as fertiliser, steel, locomotive, ships and aircraft under the supervision either of the Ministry of Industry or the Strategic Industries Management Agency (BPIS) (Fane, 1996). The heavy and high technology industries absorbed a lot of funds and have not become profitable and internationally competitive, for example in the case of the aircraft industry (World Bank, 1999).

Table 1.7 Inward FDI Flows for Various Periods from 1981 to1994 (in billion US$)

	1981-86 (average)	1987-92 (average)	1993	1994
World	57.7	171.9	208.4	225.7
APEC	32.1	80.3	99.2	125.6
	(55.6)	(46.7)	(47.6)	(55.6)
Developing Asian Countries	5.0	18.0	47.1	57.6
	(8.7)	(10.5)	(22.6)	(25.5)
ASEAN [a]	3.0	9.5	16.5	19.6
	(5.2)	(5.5)	(7.9)	(8.7)
Indonesia	0.2	1.0	2.0	3.0
Malaysia	1.0	2.3	5.2	4.5
Philippines	0.1	0.5	0.8	1.5
Singapore	1.4	4.1	6.8	7.9
Thailand	0.3	1.6	1.7	2.7
Other East Asia	2.0	8.5	30.6	38.0
	(3.5)	(5.0)	(14.7)	(16.8)
China	1.0	4.7	27.5	33.8
Hongkong	0.6	1.9	1.7	2.0
South Korea	0.2	0.8	0.5	0.8
Taiwan	0.2	1.1	0.9	1.4

Source : UNCTAD, Division on Transitional Corporations and Investment FDI database in CSIS, 1996.

Notes: [a] Excluding Brunei and Vietnam where FDI inflows were less than US$ 0.1 billion.
Figures in parentheses denote percentage share of world inward FDI flows.

An increase of the foreign direct investment is parallel with an increase of the foreign debt in each country. For some countries, an increase of foreign debt generates an increase of net foreign interest payments on that debt. If in the one year there is a large net foreign interest payment on the debt and it is followed by a large trade deficit, the country will have a large current account deficit in that year. The current account can be defined as a difference between what a country produces and what a country spends (Roubini, 1999). Table 1.8 shows that the current account balance had been in deficit in some Asian countries such as Thailand, Malaysia, the

Philippines and Korea during the period of 1990-1996. This phenomenon is one of the causes of the currency and debt crisis in mid 1997.

Table 1.8 Current Account Balance for Selected APEC Countries (Percentage of GDP)

Country	1990	1991	1992	1993	1994	1995	1996
Korea	-1.24	-3.16	-1.70	-0.16	-1.45	-1.91	-4.89
Indonesia	-4.40	-4.40	-2.46	-0.82	-1.54	-4.25	-3.41
Malaysia	-2.27	-9.08	-4.06	-10.11	-11.51	-13.45	-5.99
Philippines	-6.30	-2.46	-3.17	-6.69	-3.74	-5.06	-5.86
Singapore	9.45	12.36	12.38	8.48	18.12	17.93	16.26
Thailand	-8.75	-8.61	-6.28	-6.50	-7.16	-9.00	-9.18
Hong Kong	8.40	6.58	5.26	8.14	1.98	-2.21	0.58
China	3.02	3.07	1.09	-2.17	1.17	1.02	-0.34

Source: Roubini (1999).

The macroeconomic performance of these countries remained stable after the exchange rate policy in many Asian countries was pegged to the US$. Stable currency values serve to attract capital inflows because of the associated low exchange rate risk (Roubini, 1999; Fane, 1996). However, the strong linkage of the domestic currencies of some Asian countries to the US$ has the consequence that the change in nominal and real value of US$ to other countries will affect the real exchange rate in the Asian currency. For example, the US$ appreciated by 56 percent compared with the Japanese Yen during 1995 to 1997. As a consequence, the Asian currencies pegged to the US$ also experienced a very rapid real appreciation (Roubini, 1999), leading to a decrease in the competitiveness of these Asian countries and worsening trade balances and increasing the net foreign interest payment on the debt. These countries (Thailand, Malaysia, the Philippines, Korea and Indonesia) later re-evaluated their exchange rate policy and scaled back those programs which relied heavily on foreign debt because of the financial crisis and the associated macroeconomic instability.

Although APEC members' economic growth performance, which has varied and grown rapidly, has been described in this section for the period of 1980-96, the performance figures have changed since the onset of the financial crisis in mid-1997. The changes in the nominal exchange rate and inflation rate will influence the changes in the real exchange rate significantly, which will have a big impact on Asian countries (especially Indonesia) facing world trade.

1.2 The Indonesian Economy and the Role of the Agricultural Sector

Indonesia has been part of the international changes in trading institutions, policy reform and economic events. For Indonesia, the changes come on top of important longer-term trends in its economy. Since 1980, the dependence of the Indonesian economy on oil and gas has declined. It is forecast that the oil and gas sector's share of the GNP will continue to decrease to about 6 per cent by the year 2010, compared to 18 per cent in 1990 and 28 per cent in 1980 (World Bank, 1994). The decrease is largely due to falling international prices for oil and gas. In response to declining oil and gas revenues, and in the face of a freer trade environment and the recent financial crisis, Indonesia has sought to diversify its export commodities and encourage the resource-based commodity. Precisely how these efforts will be affected by the changes in the world-trading environment remains unclear.

In studying the impact of the trading system developments on a developing country, it is important to recognise and address the role of the agricultural sector as a leading sector. This is so for Indonesia. Table 1.9 shows that the agricultural share of Indonesian GDP was 17.2 per cent in 1995, having declined from 21.2 per cent in 1988. The manufacturing sector's share increased from 18.2 per cent in 1988 to 24.3 per cent in 1995. Although agriculture's share of GDP declined over the period, the sector continued to grow in absolute terms: 4.9 per cent in 1988 down to 0.6 per cent in 1994 and back to 4.0 per cent in 1995 (Table 1.10), the latter increase being related to an increase of growth in food crops from -2.1 per cent in 1994 to 4.5 per cent in 1995.

Although the agricultural sector share in GDP is expected to continue to decline, the sector is still expected to provide a substantial share of the total employment. In 1985, the agricultural sector accounted for 56.7 per cent of the total employment. This declined to 43.98 per cent by 1995. As with GDP, its absolute contribution grew. Despite the fall in share, the number of workers employed slightly increased from 34.1 million in 1985 to 35.2 million in 1995 (Table 1.11).

Table 1.9 Distribution of GNP (per cent) in 1988 - 1995

Economic Sectors	1988	1989	1990	1991	1992	1993	1994	1995
Agriculture, forestry, fishery and livestock	21.2	20.4	19.4	18.4	18.5	17.9	17.4	17.2
Food crops	13.0	12.6	11.8	10.9	11.1	9.7	9.2	9.2
Estate crops	3.4	3.3	3.2	3.2	3.1	2.7	2.7	2.6
Livestock	2.2	2.1	2.0	2.0	2.0	1.9	1.9	1.8
Forestry	1.0	0.9	0.9	0.8	0.8	1.9	1.9	1.8
Fisheries	1.6	1.5	1.5	1.5	1.5	1.7	1.7	1.7
Mining and quarrying	15.9	15.5	15.2	15.7	14.4	10.0	8.8	8.5
Manufacturing	18.2	18.5	19.4	20.0	20.6	22.3	23.5	24.3
Electricity, gas and water	0.5	0.6	0.6	0.7	0.7	1.0	1.0	1.1
Construction	5.3	5.5	5.8	6.0	6.3	6.8	7.4	7.7
Trade, hotel and restaurant	15.6	16.1	16.1	15.9	16.0	16.8	16.4	16.4
Transport & communication	5.2	5.4	5.6	5.6	5.7	7.1	7.1	6.8
Other services	18.1	18.0	18.9	17.7	17.8	18.6	18.4	18.1
Gross Domestic Product	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source : Central Bureau of Statistics (1984-1996)

Within the agricultural sector, the estate-crops sub-sector has provided the second largest contribution to GDP after the food-crops sub-sector. Table 1.9 shows that the estate crops sub-sector share in 1988 was 3.4 per cent, decreasing slightly to 2.6 per cent in 1995. Although this contribution was low compared to that of the food crops sub-sector, which provided 9.2 per cent of the GDP in 1995, the GDP growth from the estate-crops sub-sector was larger and more stable compared to other sub-sectors of the agricultural sector. Table 1.10 shows that in 1988, the GDP growth from estate crops was 7.9 per cent, which was higher than food crops (4.5 per cent), livestock (4.8 per cent), forestry (4.7 per cent) and fisheries (5.8 per cent). The GDP growth from estate crops was 4.6 per cent in 1995, which was also higher than those from other agricultural sub-sectors. It is indicated that estate crops represent a potentially important sub-sector of the agricultural sector in terms of their contribution to GDP growth.

Table 1.10 Gross Domestic Product Growth by Sector of Origin in 1988 - 1995

Sector	1988	1989	1990	1991	1992	1993	1994	1995
Agricultural. livestock. forestry and fishery	4.9	3.3	2.0	1.6	6.7	1.7	0.6	4.0
Foodcrops	4.5	4.0	0.5	-0.5	7.7	-0.7	-2.1	4.5
Estate crops	7.9	5.3	6.5	5.4	4.8	6.3	5.3	4.6
Livestock	4.8	1.4	3.7	6.0	7.9	4.7	4.0	4.2
Forestry	4.7	-3.9	3.0	0.0	-2.2	1.3	0.4	0.1
Fishery	5.8	6.8	5.0	5.2	5.8	5.3	4.7	4.2
Mining and quarrying	-2.9	4.9	5.2	10.2	-1.9	3.4	5.6	5.7
Manufacturing Industry	12.0	9.2	12.5	10.1	9.7	11.4	12.5	11.1
Electricity, gas and water supply	11.0	12.2	17.9	16.1	10.1	11.1	12.7	15.5
Construction	9.5	11.8	13.5	11.3	10.8	14.5	14.9	13.0
Trade, hotel and restaurant	9.1	10.7	7.1	5.4	7.3	9.8	7.3	7.7
Transportation and Communication	5.5	11.5	9.6	7.9	10.0	7.5	7.8	8.3
Other Services	4.6	7.7	7.0	7.2	7.1	5.4	6.5	7.3
Gross Domestic Product	5.8	7.5	7.2	7.0	6.5	7.3	7.5	8.1

Source: Bank Indonesia (1993, 1994, 1995, and 1996), Central Bureau of Statistics in Soesastro and Basri (1998)

Table 1.11 Employment by Sector, 1985 - 1995

Sector	Labor Demand					
	1985		1990		1995	
	'000	(%)	'000	(%)	'000	(%)
Agriculture	34 141	(56.67)	35 450	(49.24)	35 233	(43.98)
Manufacturing	5 796	(9.28)	8 221	(11.42)	14 754	(18.41)
Trade	9 345	(14.96)	10 593	(14.72)	13 884	(17.33)
Services and Others	13 175	(21.09)	17 720	(24.62)	16 239	(20.27)
Total	62 457	(100.00)	71.984	(100.00)	80 110	(100.00)

Source : Department of Agriculture (1993) and Central Bureau of Statistics (1995)

In relation to trade, the agricultural sector and its estate-crops sub-sector are very important in terms of export value and share. Table 1.12 shows that the value of agricultural exports doubled from US$ 6,804 million in 1988/1989 to US$ 12,647 million in 1995/1996. The estate-crops export value also almost doubled from US$ 2,552 million in 1988/89 to US$ 4,495 million in 1995/1996. Furthermore, Table 1.13 shows that more than half of the non-oil and gas export value was derived from agricultural products in 1988/1989. This decreased to 39.37 per cent by 1995/1996.

Table 1.12 Export Value of Selected Commodities (Million US $)

Accounts	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96
Total Agriculture	6,804	6,955	7,127	7,695	8,682	10,635	12,593	12,647
Foodstuffs	357	347	445	502	579	596	746	828
Estate Crops	2,552	2,127	1,924	2,016	2,196	2,122	4,210	4,495
Rubber	1,229	956	887	932	1,054	905	1,518	2,001
Coffee	576	452	371	362	264	326	750	630
Palm oil	313	279	248	349	495	555	1,560	1,403
Tea	136	181	154	145	143	142	106	95
Pepper	144	94	78	69	55	23	81	160
Tobacco	43	44	72	65	79	63	65	89
Copra cakes	42	51	56	51	63	66	81	71
Hides	69	70	58	43	43	42	49	46
Total Forest and forest product	3,056	3,700	3,682	4,027	4,641	6,498	5,952	5,628
Wood and wood products	2,903	3,465	3,452	732	4,343	5,859	5,389	5,255
Rattan and rattan products	153	235	230	295	298	346	348	373
Shrimp and animal product	839	781	1,076	1,150	1,266	1,419	1,685	1696
Textiles and textile products	1,571	2,219	2,731	4,011	5,876	5,121	5,678	6,243
Other non -oil/gas	3,809	5,319	5,486	7,302	10,267	10,675	13,962	13,231
Total non-oil/gas export	12,184	14,493	15,344	19,008	24,825	26,431	32,233	32,121
Oil (crude and oil products)	5,007	6,288	8,053	6,869	6,363	5,512	6,237	6,061
Gas	2,633	3,049	4,710	3,837	4,117	3,822	4,088	4,114
Total Exports	19,824	23,830	28,143	29,714	35,305	36,504	42,161	42,296

Source : Bank Indonesia (1994, 1995 and 1996).

Within the agricultural sector, the estate crops and forestry sub-sectors are the biggest share of the export value. The estate crops sub-sector contributed 20.95 per cent of total non-oil and gas export value in 1988/89. Its share fluctuated and as with agriculture in totals, fallen down to 13.99 per cent in 1995/1996. The importance of the estate crops within the agricultural sector is reflected in its 37.5 per cent contribution to agricultural export earnings in 1988/89. This share fluctuated too, decreasing slightly to 35.5 per cent in 1995/1996. The fluctuations are due in part to fluctuations in the nominal prices of estate crops, especially rubber and coffee (Table 1.14). Although the export value of estate crops is very dependent on the price variability in the sub-sector's world prices, the actual production levels have been changing due to expansion and productivity improvement.

Table 1.13 Export Share of Selected Group of Commodities (per cent)

Accounts	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96
Total Agriculture	55.84	47.99	46.45	40.48	34.97	40.24	39.07	39.37
Foodstuffs	2.93	2.39	2.90	2.64	2.33	2.25	2.31	2.58
Estate crops	20.95	14.68	12.54	10.61	8.85	8.03	13.06	13.99
Total forest and forest product	25.08	25.53	24.00	21.19	18.69	24.58	18.47	17.52
Shrimp and animal product	6.89	5.39	7.01	6.05	5.10	5.37	5.23	5.28
Textiles and textile products	12.89	15.31	17.80	21.10	23.67	19.37	17.62	19.44
Other non -oil/gas	31.26	36.70	35.75	38.42	41.36	40.39	43.32	41.19
Total non-oil/gas export	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Bank Indonesia (1994, 1995 and 1996).

Table 1.14 Nominal Price of Non-Oil Exports, 1984/85 - 1995-96 (thousand US $/ ton)

Commodities	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96
Rubber	0.821	0.66	0.705	0.874	1.007	0.782	0.726	0.711	0.689	0.722	1.135	1.47
Palm oil	0.543	0.337	0.200	0.304	0.387	0.296	0.256	0.309	0.479	0.355	0.719	0.841
Coffee	1.844	2.241	2.437	1.814	1.786	1.133	0.871	0.885	0.981	0.984	2.788	2.423
Tea	2.319	1.313	1.140	1.214	1.245	1.534	1.375	1.275	1.126	1.183	1.218	1.158
Copra Cake	0.084	0.081	0.098	0.107	0.121	0.111	0.089	0.101	0.129	0.134	0.089	0.094

Source: World Bank (1994) and Bank Indonesia (1996)

The Indonesian Government has several development programs for estates and smallholders to improve production and productivity of estate crops. In 1976, the Indonesian government introduced the PBSN I (*Perkebunan Besar Swasta Nasional* or National Private Estate) Program to accelerate the private estate investment in the estate-crop sub-sector (Pasandaran *et al.*, 1993). The program was followed by PBSN II (beginning in 1981) and PBSN III (since 1987). The policies were to make credit accessible and to accelerate the adoption of new technology. Since 1983, the Indonesian government has promoted investment in estate crops by decreasing the rental cost of capital, which included decreasing the interest rate, improving loan terms and simplifying the investment and export procedures. These programs have been instrumental in increasing the investment from Rp 0.6 billion in 1985 to Rp 7.7 billion in 1994 (Herman and Susila, 1995).

To help the development of smallholders, in 1974 the Indonesian government introduced the 'activity approach', providing assistance, for example, to farmers in the plant nursery (Pasandaran, 1993). According to Barlow and Tomich (1991), the government interventions were to provide tree crop extension services, distribute improved planting materials from small-scattered nurseries and to make (limited) credit available. The government also provided subsidies on fertilisers, pesticides and other material inputs and regulated the marketing system. It introduced official marketing agencies and restrained private dealer activity (Barlow and Tomich, 1991).

Because intervention via the "activity approach" was unsuccessful, after 1979 the approach was changed to a "project approach" which was operated by groups of farmers in large contiguous blocks (Barlow and Tomich, 1991). In this approach, the government subsidised land and capital for estate companies as nuclei, which provide management and processing services to develop a 'plasma' of smallholders surrounding these nuclei. There were several projects under the block schemes including the North and West Sumatra Development Schemes, The Project Management Units (PMUs) and *Peremajaan Rehabilitasi dan Perluasan Tanaman Ekspor* or Undertaking for the Rehabilitation and Expansion of Export Crops (PRPTE Schemes), the smallholders' Rubber and Coconut Development Projects and *Perkebunan Inti Rakyat* (PIR) or the Nucleus Estate was the last project of the block schemes approach.

Other concerns meant that these policies required further amendment. The estate-crops sub-sector had to expect that its government protection and subsidies would not be maintained indefinitely. For example, expenditure on fertiliser/pesticide subsidies had been one third of total agricultural expenditure over the decade to 1988. In 1988/89, the government eliminated pesticide subsidies, due to environmental concerns, and has been phasing out fertiliser subsidies over the period from 1994/95 to 1998/1999 (World Bank, 1994). Reducing the role of the government will lower public investment and given the many other imperfections in the economy there is some question as to whether reduced government assistance will increase agricultural efficiency.

Government assistance was intended to encourage the production and marketing of all crops. However, only the planted areas and production of oil palm has increased significantly. It can be seen from Appendix 1 (Tables A.1.3 and A.1.6) that the planted areas and production of estate-crops have increased slowly or remained almost stable. The planted area of tea did not increase whereas rubber, coffee and oil palm areas increased slightly during the period of 1973 - 1993. In the case of cocoa, the planted area has grown steadily and increased slightly after 1986. Furthermore, the production of cocoa, tea, coffee and rubber was almost stable, and only oil palm has increased dramatically. Appendix 1 (Tables A.1.3 and A.1.6) also shows that the growth rate of production was smaller than that of planted areas of these commodities, except for oil palm, which is mostly planted in estates. These trends reflect the almost stable, indeed decreasing, productivity (yield/hectare) of these commodities, excluding oil palm.

In Indonesia, the estate-crops sub-sector includes government and private estates as well as smallholders. It can be seen in Appendix 1 (Tables A.1.1 and A.1.2) that most rubber and coffee are grown by smallholders whereas tea and oil palm are mainly grown by government and private estates. Until 1983, the planted area of cocoa in estates was almost the same as that in the smallholders sector. Since 1983 smallholders have increased the planted area of cocoa substantially. It should be noted that the technology used by smallholders is traditional and labor intensive. The yields of smallholder crops were low compared with those on estates (Appendix 1, Tables A.1.7 and A.1.8). The relative size (area) of the smallholder sector compared to estates, however, largely determines the total production of estate crops.

It is clear that estate-crops have a large share of the export earnings and this is very dependent on the world market price. On the other hand, the government has been reducing the assistance to the agricultural sector, including the estate-crops sub-sector. Unlike the market for rice and the other main crops such as corn and soybeans, which have domestic buffer stock schemes operated by the National Food Logistics Agency or BULOG (*Badan Urusan Logistik*), no stabilisation schemes have been established for the estate-crops. There is no government-supported agency that stores these internationally traded commodities to reduce the risk by market intervention and transferring goods through time. Instability in the world market prices can thus cause a major impact on the income of farmers, marketing agents and processors in the estate-crops sub-sector. Behrman *et al.* (1989) suggests that traded agriculture has a strong link to household incomes for both workers and owners. Achieving stable prices for agricultural commodities has become a key issue in order to achieve the ultimate development goal of Indonesian policies, namely growth, equity and stability. Moreover, the world market is moving towards freer trade through group and regional agreements such as the Uruguay Round of GATT, AFTA and APEC, all of which include Indonesia as a member. Those agreements may have a significant impact on the Indonesian economy and its agricultural sector as the world economy becomes more tightly integrated.

1.3 Problem Statement

In an integrated world market, changing global policies on regional trade can influence the economic performance of one country. The GATT, APEC and AFTA agreements for trade liberalisation will affect the trade and economic performance of all countries and in particular the members of the three groups because of a high interdependency in trade among member countries. The reduced intervention by government in some sectors following trade liberalisation will differentially influence the comparative advantage and competitiveness of national industries in the world market.

As Indonesia is a member of these trading blocs, its macro economy will be affected. Import and export performance, public and private consumption, investment, terms of trade and Gross Domestic Product will be affected in some degree. In the individual sectors, these changes will affect the price, production and producer revenue. It is important to examine the likely extent of these changes and to assess and evaluate proposed and possible government policy.

A number of economists have already attempted to estimate the impact of trade liberalisation on Indonesia's macroeconomy and its agricultural sector using either multi-country or single-country models. Erwidodo (1995) analysed trade liberalisation in agriculture by using a single-country computable general equilibrium model, INDOGEM (Indonesian General Equilibrium Model). In this model, Indonesia is isolated from other countries. The same general equilibrium model, with linked sectoral models, has been used in analysing domestic growth and stabilisation policies concerning Indonesian livestock (Trewin *et al.* 1995). These studies are necessarily limited as trade studies in that a single country model can only generate predicted responses to exogenously set shocks and cannot allow for any effects of changes within the one modelled economy on other economies or for those effects to feedback in turn to the particular economy. In effect, the modelled economy is assumed to be small. That is, its internal changes and aggregate change have no effect on the rest of the world. In the latter case, feedback effects have already been built in and allowed for in the model; and the issue of a further 'round' of feedback does not arise. The choice of settings for the exogenous shocks then becomes a serious question. The analysis is one of comparative statics. As well as the inherent limitations of these models, the particular studies refereed to are limited by their specific assumptions. For example, capital stocks in the various sectors are assumed fixed. Such an assumption is not adequate for investment and policy planning. A model that incorporates a dynamic mechanism of capital movements would be better able to forecast the long-term economic effects of policy changes.

Multi-country models to analyse the impact of trade liberalisation allow for the interaction between different economies. One such worldwide model is the Global Trade Analysis Project (GTAP) model. Murtough *et al.* (1994), and Erwidodo and Feridhanusetyawan (1997) have used the GTAP model to analyse the formation of APEC and its impact on the APEC countries, including Australia and Indonesia. Anderson *et al.* (1996), Anderson *et al.* (1997) and Strutt (1997) used projections of economic growth in the multi-country model to analyse the impact of trade liberalisation in APEC countries including Indonesia. A modified GTAP model has been used by Dee *et al.* (1996) (the IC 95 model) and another by Podbury *et al.* (1996) (MEGABARE) to study the impact of APEC trade liberalisation with emphasis on the Australian economy.

Because of the inevitable model size constraint, multi-country models used for global trade analysis may not permit sufficient disaggregation to represent every market adequately. One way to capture more detailed sector in an individual country without making the model excessively large, is to link a global trade with a detailed national model of an economy of particular interest. Linking between a multi-country model (GTAP) and a single-country model for Australia (MONASH) has been used by Huff *et al.* (1995) and Adams *et al.* (1997) to predict the prospects of the Australian economy under the APEC agreement.

The previously cited studies are but a few of a vast number of studies which have analysed the effects of trade liberalisation using national or global general equilibrium models. The Huff *et al.* (1995) and Adams *et al.* (1997) studies are two of the very few that have linked the two types of models. There have been no previous linked model studies for the Indonesia economy. In the present study, the researcher has sought to examine the impacts of trade liberalisation by making use of linked computable general equilibrium models. The study also differs from existing work in that, amongst the available Indonesian studies, there has been no computable general equilibrium model dealing with forecasting analysis, that is with the dynamic adjustment on capital and foreign debt accumulation, nor any which has paid much attention to the estate-crops sub-sector. Given the significance of agriculture and in particular the estate-crops sub-sector in the Indonesian economy and trade, it was taken as a working hypothesis that linked computable general equilibrium models would provide useful information on the implications for Indonesian of trade liberalisation.

1.4 Research objectives

The ultimate objectives established for the study were:

1. to develop an Indonesian CGE model, and to establish its linked to the Global CGE model;

2. to analyse the impacts of APEC trade liberalisation on the economies of APEC countries, particularly Indonesia; and

3. to analyse the impacts of APEC trade liberalisation on individual sectors of the Indonesian economy, especially the agricultural sector and the estate-crops sub-sector.

The impacts of trade liberalisation on production and trade in Indonesia are considered. As hypothesised above, and explained later in the section on methodology, general equilibrium modelling is used in seeking to fulfil these objectives. The construction of the linked models and their associated data bases were important intermediate objectives for the research.

1.5 Chapter Outline

In Chapter Two, trade theory, general equilibrium theory and trade policies are all briefly reviewed. The review of trade theory starts with a discussion on the advantages and disadvantages of autarky, free trade and trade restrictions. This is followed by a discussion of trade liberalisation and welfare. General equilibrium theory is also reviewed in this chapter to establish the basis for adopting a general equilibrium approach to trade analysis. The discussion addresses the choice between general equilibrium and partial equilibrium analysis, single-country versus multi-country models, linking a single country and multi-country model, and static versus dynamic models. Trade policy is reviewed in this chapter to understand the policies that are applied both in multi-countries as a group and in Indonesia in particular.

In Chapter Three, empirical research using general equilibrium models is reviewed. The review includes the development of Computable General Equilibrium (CGE) applications in Indonesia and in other APEC countries. For both applications, model dimensions, theoretical structures, policies simulation and results are discussed in order to recognise the gaps in knowledge from existing research. Issues of model building and the construction of appropriate databases are considered.

In Chapter Four, two CGE models are developed: an Indonesian General Equilibrium model and the GTAP model. The link between these models is formulated. The description of the Indonesian model covers the structure of production, investment, household consumption, government sector and market clearing conditions. Accounting relationships and behavioural equations are explained for the GTAP model. Finally the link between both models is described.

The construction of the Indonesian database is described in Chapter Five. It includes construction of the input-output accounts, construction of the tax matrices, disaggregation of labor, construction of the return to land, construction of the capital rentals and the parameters. This chapter is followed by a description of the construction of the GTAP database in Chapter Six and reconstruction of these benchmark databases for long-run analysis.

The main results relating to trade liberalisation are reported and analysed in Chapter Seven. Results relate to the APEC countries' economic performance, the use of an updated database in the Indonesian model, the argument for treating Indonesia as a small country, GTAP results for APEC countries, the GTAP results as shocks in the Indonesian model and the long run impact of trade liberalisation on the Indonesian economy, its agricultural sector and the estate crops sub-sector.

In Chapter Eight, the results of various policy experiments are reported and discussed. These include both macroeconomic policies, such as exchange rate policy and micro policies such as technological change. Finally, the conclusions arising from the research, the limitations of the work, along with recommendation for further research are presented in Chapter Nine.

CHAPTER 2

REVIEW OF TRADE THEORY, POLICY AND ANALYSIS

While the basic theory of trade dates at least from the time of the classical economists, there have been significant extensions and considerable development of empirical applications in the last few decades. The theory does not need re-explication here as it is readily available in text books and, as well, there are several useful, relatively recent, reviews of the theory and trade policy, e.g. MacLaren (1991), Markusen, *et al.* (1995). The introductory sections of this chapter therefore provide nothing more than a brief overview of theory. These are followed by a review of empirical trade modeling. The primary purpose of the review is to identify what theory has to say about the welfare implications of multi-country trade liberalisation. The finding is that the welfare implications of multi-country trade liberalisation for the individual country are not clear-cut. Sophisticated empirical modeling within a general equilibrium framework is needed; though as conventionally practised, this will not reveal the full implications of trade reform.

2.1 The Basis of Trade

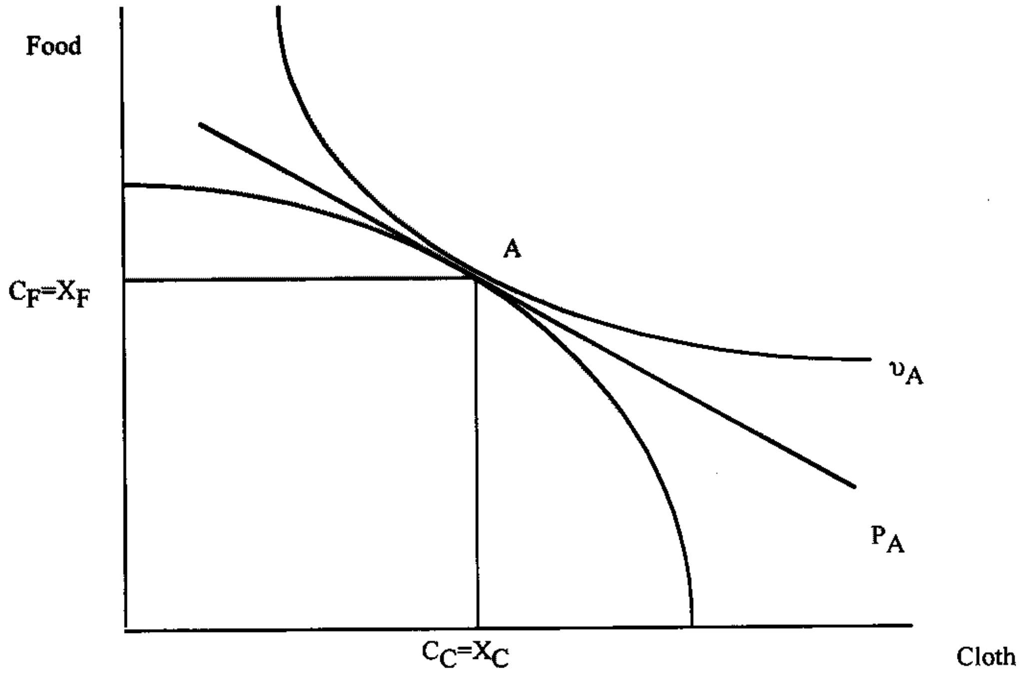
Countries, or more particularly the individual economic agents in those countries, engage in trade when there are differences between their domestic and international terms of trade. To understand the basis of trade one must understand these differences. There are several theories. Adam Smith initiated the formulation of a theory of absolute advantage in 1776. He argued that a country would export those commodities in which it had an absolute advantage (El-Agraa, 1983), that is commodities it could produce with less inputs than could its trading partner. However, the theory was incomplete, even wrong. Absolute advantage fails to explain trade when one country has an absolute advantage in all lines of production.

The basis of a fuller understanding of trade between nations lies in the classical theory of comparative advantage that was developed by Torrens in 1815 and Ricardo in 1817 (El-Agraa, 1983). A nation has a comparative advantage facing one another nation in the good that it can produce relatively more cheaply. They explained that trade could occur if there was a difference in comparative cost. The nation would export goods in which it has a comparative advantage, and import other goods in which it has a comparative disadvantage (Woodland, 1982). By specializing in producing and exporting those products that it produces more efficiently to a nation that is less efficient in producing those goods, and importing other goods from the latter, both nations benefit. Comparative advantage can arise in several ways. In the basic theory, it arises from relative differences between economies in their factor endowments.

The basic argument of the classical economists to 'prove' that trade is better than no trade is to show that the consumption possibilities under trade are greater than under autarky (Woodland, 1982). In the situation of autarky or self-sufficiency, the nation does not trade with the rest of the world. Equilibrium occurs when domestic consumer demand equals domestic producer supply (Voudsen, 1990). The conditions of autarky and trade are illustrated in figures 2.1 and 2.2, familiar figures in any text on trade.

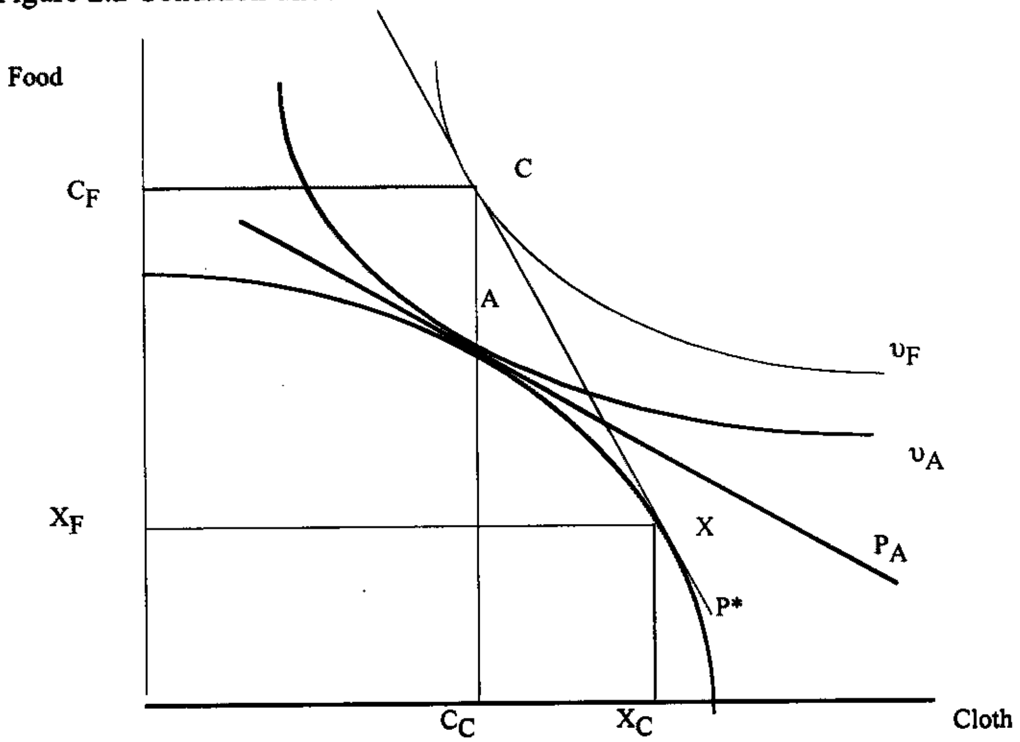
Figure 2.1 describes the autarky condition where P_A is the price line in the equilibrium price ratio for a two-good economy (for example food and cloth). In equilibrium, the marginal willingness of consumers to substitute cloth for food must be the same as that of producers; and supply must equal demand for both goods. Both the production frontier and the indifference curve are necessarily tangential at the same point to the price line. The equilibrium is at point A where both producer supply and consumer demand for food are C_F (=X_F) and cloth is C_C(=X_C).

Figure 2.1 Condition under Autarky



Source: Voudsen, 1990

Figure 2.2 Condition under Trade



Source: Voudsen, 1990

If the country is opened up to trade with the rest of the world, A is in general no longer equilibrium. The equilibrium price line will alter to equate the world supply and domestic demand of each good. The price line will change to P* which represents the market-clearing world price ratio. If there is no price distortion such as that due to tariffs, taxes and subsidies in the domestic economy, equilibrium is represented by two points, C and X. At this equilibrium, there is equality among relative prices, the marginal rate of substitution in consumption and the marginal rate of transformation in production. The country will produce X_C and X_F units of cloth and food, and consume C_C and C_F. Furthermore, it will export its excess supply (X_C-C_C) for cloth and will import excess demand (C_F-X_F) for food, earning exactly the same in export revenue as it spends on imports.

It is clear from the two figures that consumer utility is higher under trade than under autarky. With trade, the product availability will increase in the country because there is additional domestic product through the exchange. The consumer is not restricted to the domestic production frontier, but can consume at any point on the price line P*. The producer can specialise in the good in which it has a comparative advantage. El-Agraa (1983) pointed out that the gain from specialisation occur if the production combination could be adjusted. These circumstances will permit the nation to increase the country's potential welfare. It is consistent with the basic gains from trade that some trade is better than no trade (Bhagwati and Srinivasan, 1983; Parikh *et al.* 1988).

Although each nation gains from trade, some governments have sought to restrict trade to protect their domestic production. The arguments for protection can be divided into economic arguments and non-economic arguments (Johnson, 1981; El-Agraa, 1983; Lindert and Kindleberger, 1986).

The non-economic arguments relate to the notion that protection will (a) increase self-sufficiency in the main crops and that this is desirable for political and military reasons, and (b) diversify the economy to provide a richer way of life for the citizenry or to preserve a valued traditional way of life. In the agricultural sector, government interventions against free trade are usually to achieve one or more specific objectives. These objectives are food self-sufficiency, food security, mobilisation of resource endowment, maintaining the agricultural income, internal market stability, income redistribution, controlled structural adjustment and sustaining environmental balance (Parikh *et al.* 1988; MacLaren, 1991)

The principal economic arguments are (a) that tariffs may be needed to reduce distortions which would occur in world prices under free trade, (b) that trade restrictions are needed to reduce distortions which would otherwise exist in the domestic economy, and (c) that protective barriers are needed when an industry is being developed in a dynamic world economy, i.e. the infant industry argument. These three arguments, as indeed do the non-economic arguments, against free trade rest on recognizing that the real world is not as simple as that imagined in the simple demonstrations of the benefits of free trade.

Before examining each of the main arguments against free trade, it is worth returning to the simple figures and model of trade and trade benefits. Note that the benefit lies in the expanded set of commodity bundles that the country can access as a result of trade. This expansion occurs whenever the world prices differ from the marginal rate of substitution prevailing under autarky. The larger the difference between world prices and the autarkic marginal rate of substitution, the greater the extent of trade benefits. Thus trading partners need to have strong and different comparative advantages for trade to offer significant benefits. If a country's domestic terms of trade happened to be identical to the world terms of trade, trade would offer no benefits in this simple model. The simple model is essentially one of bilateral trade.

The trade versus no-trade comparison is a discrete comparison between two extremes in bilateral trade environment. In a multi-country framework, the benefits of free trade to an individual country depend on whether one is referring to free trade with all countries or with only some and on what is assumed about trade between other countries in making the comparison. Thus for example, does freeing up trade mean that trade between all countries is freed up or just the trade for the particular country? Once one recognizes the multiplicity of changes that may be made, one must recognize that the world prices, taken as given in the simple trade versus no trade comparison, may vary with the extent of trade restrictions. Some levels and patterns of trade restrictions in other countries may produce world prices more beneficial to the particular country than does fully free multilateral trade. Thus if a country can reduce its trade barriers only in association with reductions in other countries' barriers, in aggregate altering world prices, it is possible that a country could achieve greater utility with trade restrictions than with fully free and open trade.

To understand why a country may want to self-impose barriers to trade, one again needs to turn to the simple trade model. These models rely on a representative producer and consumer. It is implicitly assumed that all producers (and similarly for consumers) in a country are identical. When utility is raised by trade, it is raised for all. In reality of course, producers are different. Some domestic producers may produce (and be capable of producing) one good and others another. Indeed the theory of comparative advantage applied at the individual agent level suggests they should do different things if they are in any way different. Similarly consumers may differ. Increasing the total availability of goods for a country does not mean that all economic agents in that country will be better off. Those who produce goods that will suffer import competition under trade will be harmed. Trade thus offers only a potential Pareto gain to all in a country, not an actual Pareto improvement. To achieve the latter, income redistribution is necessary; and as governments may choose not to make such redistribution, not all within a country will support free trade. It is not surprising then that there is often strong opposition to liberalising trade and support for stronger restrictions. Governments may see trade restrictions that protect particular industries as a means of achieving an equitable outcome for human resources which have limited short term and even long term opportunities in other employment.

The first of the three principle arguments against free trade, as noted above, is that a tariff may be necessary to offset a distortion in the world market (Johnson, 1981). The world market distortion is the difference between the world market price for imports (or exports) and the marginal national cost of its import (or marginal national revenue from its export). The distortion occurs because the country has monopolistic or monopsonistic power in the world market. The optimum import tariff can be derived from the theory of optimal pricing by a monopsonist. With two goods, the optimum tariff is defined by tangency between trade indifference curve and the foreign offer curve. The mathematical calculations show that the optimum tariff is the inverse of the foreign country's supply elasticity (Dixit and Norman, 1980; Lindert and Kindleberger, 1986). The less the supply elasticity of the foreign country, the higher the tariff optimum will be and vice versa. If the exporting nation cannot influence the world price, that is supply elasticity of the foreign country is unlimited, the optimum import tariff is zero.

While an importer can impose an optimum tariff to maximize its welfare, it does so under threat of retaliation from other countries. In the case of retaliation, foreign countries can impose an import tariff on other commodities, which they import from the country that used the import tariff. In turn, the first country may further increase its import tariff or impose tariffs on other commodities. Consequently, the trade war becomes worse and reduces world welfare.

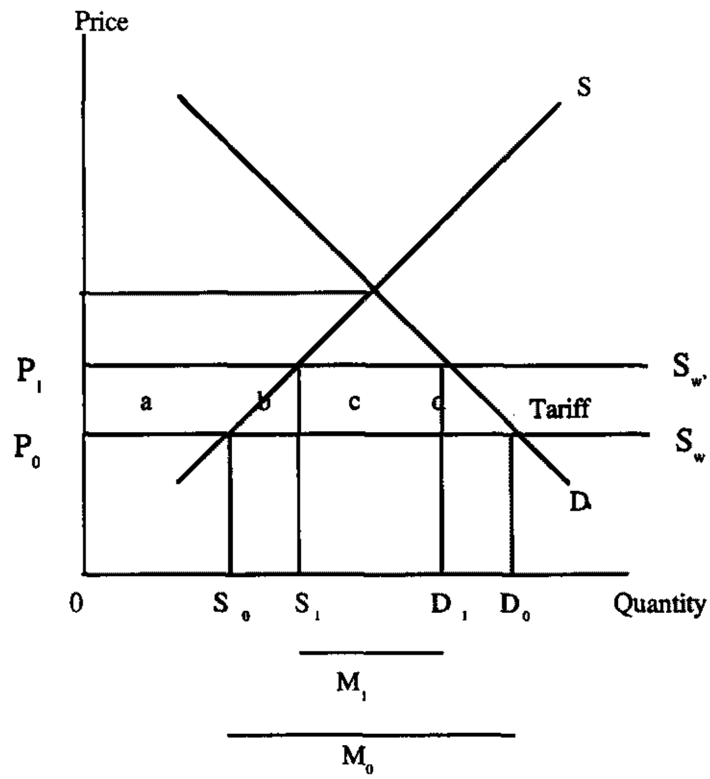
The economic arguments for protection in response to domestic distortions can be divided into those relating to distortions in commodity markets and those relating to distortions in factor markets. Distortion in commodity markets exists when the market price of the commodity is above its alternative opportunity cost (Johnson, 1981). The distortion can occur because of the presence of monopoly or oligopoly and the presence of external economies or diseconomies. Under monopoly or oligopoly, the consumer price may be set by firms, which are seeking maximum profits above the marginal cost of production. External economies or diseconomies cause the marginal private cost of production to be higher than the marginal social cost. Distortions in factor markets occur when the reward earned by a homogenous production factor is not at the same in all sectors of the economy (El-Agraa, 1983) due to some inefficiency in using the production factor in the sectors. Protection can eliminated the distortion.

The infant industry argument involves an assertion that a new and growing industry, unable to compete on equal terms with foreign producers in the domestic or world market at the time, would be able to once established (Johnson, 1981; Lindert and Kindleberger, 1986). For developing countries, whose industries may lag behind those of the developed nations, temporary tariff might thus be useful in decreasing import quantity while the infant industry learns to produce at the lower cost necessary to compete with the foreign country product. Tariff revenues can itself be used to finance the human investment to compete with producers from other countries (Baldwin, 1989). Such assistance might be considered successful if the temporary tariff protection enables a viable industry to establish. However, in practice, it often proves difficult to remove import tariffs once in place. It is also possible that the infant industry will never mature. The protection may reduce the incentives for the industry to become efficient and the industry may continue to require protection. With vested interests, the industry may successfully lobby government to continue the tariff protection. Baldwin (1989) argues that the failure of infant industry argument is the failure to induce socially optimal level of training, knowledge and factor endowment in new industries.

Government intervention to protect their national products can take various forms. Houck (1986) noted that specific protection against the full force of international competition can be provided by "... tariffs, import quotas, domestic content regulations, packing and labeling requirements, sanitary restrictions, variable import levies, export control and export subsidies" (p.20). Hillman (1989) provided a similar list of instruments to restrict imports: specific and ad valorem tariffs, import quotas, quota-tariff combinations, variable import levies, voluntary export restraints, domestic content requirement schemes, government purchasing restrictions and various other non tariff barriers to increase the cost of imports relative to domestically produced substitutes. To determine which form of protection to implement, if protection is judged appropriate, government must usually concern itself with other related institutions.

Trade policies determinations are influenced by several institutional objectives whether economic, non-economic, or both. Policies are also influenced by the institutional setting which is controlling the interaction between policy makers and the gainers and losers from protection (Hillman, 1989). Each decision maker has arguments to decide how far and what kind of protection will be appropriate in each commodity. The choice of the instrument of protection causes will have many effects on the economic welfare of the nation. Government must choose an instrument, or a combination of the protection measures, consistent with its objectives and economic conditions. To simplify the discussion, from all those restrictions, the basic theory of tariffs is the one that will be explained in this chapter.

Figure 2.3 The National Loss because of Tariff



Consumer loss : area a +b+c+d

Producer benefit : area a

Government revenue : area c

National loss : area b+d

Source : Lindert and Kindleberger, 1986.

The assumptions underlying basic tariff theory for one commodity (partial equilibrium framework) are (i) the importing country is small, (ii) the effect of the tariff on the balance of payment can be ignored and (iii) private cost and revenue are different from social cost and revenue because of the tariff (Lindert and Kindleberger, 1988). In the case of a small country, which faces a fixed world price, a tariff on imports will affect producer and consumer welfare and government revenue. Import tariffs cause the consumer price to be higher than the world price and the domestic consumption and import quantity to be less than the quantity under free trade.

Figure 2.3 shows that the world import supply curve and pricing faces domestic consumers increase from S_w and P_0 to $S_{w'}$ and P_1 (equal to $P_0(1+t)$), respectively. Therefore, the consumption and import of goods decline from $0D_0$ and S_0D_0 to $0D_1$ and S_1D_1, respectively. On the other hand, the producers will benefit because their products are protected, their production expands and they receive higher prices. Government will receive the revenue from the tariffs. However, as a whole, the producers and government gain less than the consumers lose. In net, the tariff will reduce the national welfare. The net loss is shown in diagram as area b and d. Area b shows that the production effect is a loss because the marginal cost of domestic product exceeds the foreign price. Area d shows that the consumption effect is the consumer loss because of a restriction in imports and consumption.

In the basic theory of the tariff, the country is assumed to be small and facing a fixed world price. The imports tariff only influences the domestic equilibrium price and cannot influence the international equilibrium price. The tariff causes a difference between the domestic rate of transformation between goods and the foreign rate of transformation. In this case, the economy will not maximise the domestic product value at world market prices and, consequently, social utility will not be maximised (Parikh *et al.*, 1988). These distortions of the market will retard trade and will cause economic welfare losses to the economies.

A further impact of trade protection is inefficiency in the use of factor endowments. Vines (1994) gives an example of the inefficiency of labor use due to trade protection in Australia. The protection increases the demand for domestic manufacturing relative to what it would be under free trade, leading to an increase of demand for labor. Under a full employment assumption, the wage rate will increase.

This causes inefficiency because labor is over-employed in manufacturing and its marginal value of product will be lower than that under free trade.

The implication of trade protection is different for a large country than for a small country. A large country is one that has market power. It can affect the world price. The large country's terms of trade can be improved by restricting trade. In the case of inelastic demand for the large country's exports, its export earnings can be increased relative to those under free trade by restricting exports (Parikh *et al.*, 1988), for example by levying an export tax. Not many countries possess such power in their own right. One example, at least in the past, was that of Australia in the case of wool. Various proposals for wool export taxes, and for destroying wool international stocks were put forward by economists (Hartmann *et al.,* 1998). To achieve market power, a group of major exporting countries would usually need to act together to limit supply, as for example in the case of OPEC and earlier restrictions on oil. In relation to imports, a large importing country may use an import tariff to reduce the quantity of imports, with the consumer price being higher than the foreign price and the foreign price pushed downwards to the benefit of the importer. Although applying tariffs will involve some costs, the benefit to the importer can be bigger than these costs. While the large country benefits, the tariff will reduce the economic welfare in the world as a whole.

2.2 The Gain from Trade Liberalisation

It is clear from the previous section that in the classical theory free trade is better than autarky and free trade is better than restricted trade for the small country. The classical theory rests on a number of assumptions, implicit if not explicit. These include an assumption of constant return to scale, the absence of externalities, the feasibility of lump-sum transfers, the flexibility of factor prices, and the market being perfectly competitive (MacLaren, 1991). Free trade for the small country in the classical theory satisfies the equalities among the (marginal) domestic rate of transformation (in production), the foreign rate of transformation (in external trade), and the domestic rate of substitution in consumption (DRT = FRT = DRS) (Bhagwati and Srinivasan, 1983). More recent research and literature on international trade has relaxed these assumptions and allowed for differentiated products in trade, economies of scale internal to the firm, oligopolistic domestic and international market structures, uncertainty and imperfect information, investment liberalisation and the dynamics of trade liberalisation. Under the new features of trade model, the gains from trade and economic welfare of the nation will be different.

The homogeneous product assumption often warrants relaxing because in practice, products are differentiated both in product characteristics and also on country of origin, a factor that is often relevant in consumer's preferences. Such differentiation can be allowed for, as for example in the Armington trade model (Armington, 1969).

In relation to economies of scale, an economy can exploit such effects by specializing in producing and trading the efficient product (Economic Committee APEC, 1997). In a review of literature on recent developments, MacLaren (1991) concludes that a trade model that emphasises product differentiation and economies of scale expands the range of explanations for gains from trade. Therefore the gains from trade may be larger than suggested by the constant returns model.

Relaxing the assumption of perfect competition to allow for oligopolistic domestic and international market structures in trade analysis provides a potentially fruitful extension of the theory. In practice, the international marketing (and importing) of a number of products is organised by a small number of firms or marketing boards. There are a variety of possible assumptions in modeling imperfect market structure, for example the degree of market power available to domestic and foreign firms in domestic and foreign markets, and the behavioral reactions of firms to other firms' behavior. Therefore, as MacLaren (1991) points out, it can be quite difficult to identify the appropriate trade policies in imperfect markets because of the lack of detailed firm-specific information. In the case of the two-good, two-country models in which the production of one good is monopolised in each country and in which Cournot-Nash behavior applies, trade will bring bilateral welfare improvements (Markusen *et al.*,1995).

The perfect competition assumption may also warrant modification by incorporating risk and uncertainty into the model. There are various risks and uncertainties in the domestic and international market, which should be recognized. MacLaren (1991) shows that the gains from trade depend on the effect of trade on risk sharing, on the risk source, and on whether factors of production have to be committed before uncertainties are resolved. The welfare analysis conclusions from including risk and uncertainty in the trade model are indeterminate because to some extent, the competitive outcome need not be Pareto-efficient. Government intervention will introduce the policy to reduce the risk and uncertainty in both the producer and the consumer.

Investment liberalisation can be analysed through the way capital flows to and from the country. Bhagwati and Srinivasan (1983) explained that the welfare analysis of international capital flows could be divided into the nondistortionary case and the distortionary case. In the nondistortionary case, a "small" inflow of foreign capital will have an indifferent impact on the welfare of the recipient country. If the inflow is "large", the recipient country will gain in welfare because of the presence of diminishing return. In the distortionary cases, the welfare possibly decreases due to differences between the private and social marginal value products of the capital. The welfare will increase only if the social return to the capital is larger than the private return due to taxes or externalities (Martin and Yanagishima, 1995). However, a country must recognize that extensive foreign ownership of the factor endowment might decrease welfare. This could happen, for example, if the real wage of foreign owned resources increases without increasing its productivity.

The recent developments of trade theory establish that gains from trade liberalisation arise not only from improved allocation of the resource endowment but also from the dynamic efficiencies of more innovation, faster productivity gains, greater investment and higher output growth (Baldwin, 1989). There are two sources of dynamic gains resulting from trade liberalisation (Backus, Kehoe and Kehoe, 1992).

First, new and specialised inputs from the world markets are continually available in the domestic market. Through trade, the domestic industry may access inputs that were not available in the domestic market before trade liberalisation. Second, the country will have a greater ability to specialise the production of particular outputs and get benefits from "learning by doing". Baldwin (1992) shows that the medium term welfare effects of capital accumulation can be measurable and rely on the deviation of social and private returns to capital. Considering empirical studies, Ferrantino *et al.* (1997) examine the proposition that the more open the economy on trade, the more rapid the growth of that economy. Therefore, there is a positive relationship between trade liberalisation and economic growth; and the dynamic gains from trade liberalisation can be bigger than suggested by static analysis.

The impact of trade liberalisation is often discussed without any quantitative framework. That is, the discussion is often qualitative, focussed on the directions of effects rather than on the precise size of these effects. Huang (1998) argues that a quantitative framework is important not only for economists to analyse the impact of various policy options but also for government to make decisions. Important forms of quantitative models for analysing the impact of trade liberalisation are simultaneous equation macroeconomic models, and partial and general equilibrium models. The macroeconomic models are generally interested in aggregate relationships, lack detail and usually fail to incorporate the theoretical restrictions suggested or implied by the microeconomic optimisation theory of individual behavior (McKibbin, 1996; Huang, 1998). Partial and general equilibrium models both generally give greater weight to micro level behavior, with general equilibrium models entailing the greatest effort to recognize the totality of the inter-relationships between economic agents in the economy.

2.3 Trade Policy

The application of trade policy in relation to Indonesia is reviewed in this section. Initially, the review is focussed on relevant multi regional agreements, namely the GATT Uruguay Round, APEC and the AFTA agreement. The second part of the section evaluates the application of these agreements, the Indonesian policy response to these agreements and Indonesian trade policies.

2.3.1 Multi Regional Agreements

2.3.1.1 The Uruguay Round Agreement

There were several rounds of multilateral trade negotiations under the General Agreement on Tariffs and Trade (GATT) before the Uruguay Round agreement that was signed in Marrakesh in April 1994. The Uruguay Round agreement was a prolonged trade negotiation having commenced in September 1986 in Punta del Este (Tanner, 1996). It was notable for finally putting national support policies for agriculture on the GATT agenda. Prior to the Uruguay Round, agricultural trade was largely kept off the agenda by the United States and other developed countries. Consequently, agricultural trade was afflicted with high levels of protection, increasing use of subsidies, aggravated fluctuations of world prices and an increasing cost of national budget to support the production. Especially for developing countries, often predominantly agricultural in export orientation, hoped that the agreement would reduce the agricultural trade restrictions. The Uruguay Round also included trade in services and intellectual property and was associated with the establishment of the World Trade Organisation (WTO). WTO facilitates the implementation, administration, operation and furthering of the objectives of the agreement (GATT, 1994).

The Uruguay Round Agreement on agriculture has three main components: markets access, export competition and domestic support outlays.

Market access

To improve market access, the agreement covers all non-tariff barriers such as quantitative import restrictions, variable import levies, minimum import prices, discretionary import licensing, intervention by state trading enterprises and voluntary export restraints and tariff measures. No new non-tariff measures are to be introduced.

Existing non-tariff border measures are to be converted to tariffs, based on 1986/1988 levels and reduced. However, the agreement provides special treatment for Japan and Korea in rice markets, allowing them to delay tariffication for a few years. Developing countries are exempted from the tariffication commitment on staple products in traditional diets (Annex 5: Special Treatment Clause in Agreement on Agriculture).

Following tariffication of border measures, all tariffs are to be phased down to improve market access. The agreement is as follows (GATT, 1994; Duncan *et al.*, 1995):

1. Developed countries will reduce tariffs by an average of 36 per cent over 6 years from 1995, with a minimum 15 per cent reduction in any tariff line;

2. Developing countries will reduce tariffs by an average of 24 per cent over 10 years from 1995, with a minimum 10 per cent reduction in any tariff line;

3. Less developed countries do not have to reduce tariffs but they are required not to raise them beyond present levels.

Furthermore, in the case of specific product categories, developed countries will cut tariffs by above-average amounts on oil seeds, flower and plants; and cut tariffs by below-average amounts on sugar and dairy products, with other product categories close to the average cut. Regarding tropical products, which account for half of the exports of agricultural products from developing countries, a 43 percent reduction in tariffs will be implemented by developed countries (GATT, 1994). The details on tariff reductions can be seen in Table 2.1.

Table 2.1 Developed Economy Imports and Tariff Reductions on Agricultural Products(Millions US $ and Per Cent)

Product categories	Value of imports		Percentage reduction in tariffs
	All sources	Developing economies	
All Agricultural Products	**84,240**	**38,030**	**37**
Coffee, tea, cocoa,	9,136	8,116	35
Fruit and vegetables	14,575	8,887	36
Oilseeds, fats and oils	12,584	6,833	40
Other agricultural product	15,585	4,233	48
Animals and products	9,596	2,690	32
Beverages and spirits	6,608	2,012	38
Flowers, plants, vegetable materials	1,945	1,187	48
Tobacco	3,086	1,135	36
Spices and cereal preparation	2,767	1,134	35
Sugar	1,730	1,030	30
Grains	5,310	725	39
Dairy products	1,317	48	26
Tropical Products	**24,022**	**18,744**	**43**
Tropical beverages	8,655	8,041	46
Tropical nuts and fruits	4,340	3,672	37
Certain oilseeds, oils	3,443	2,546	40
Root, rice, tobacco	4,591	2,497	40
Spices, flowers and plants	2,992	1,987	52

Source: GATT Secretariat (1994).

The actual reductions in non-tariff barriers following the Uruguay Round may be less than appears from these commitments. The required reductions were set in relation to the protection applying in a base period. The base period (periods in fact, since variations from the general base period were negotiated) was one, because of low prices at the time, in which the equivalent tariff support was greater than actually the case at the time of finalizing the Uruguay Round in 1994. Furthermore, the conversion process, that is the calculation of the tariff equivalent of a non-tariff barrier, was sometimes questionable. Conversions were sometimes appropriately described as "dirty" tariffication (Tanner, 1996), tariffs ending up higher than perhaps the real equivalents and certainly higher than the effective tariff applying in 1994. Reductions in tariffs are to be measured from the ceiling or bound, not from their actual 1994 levels. A country with a tariff below the bound at that time could in fact raise tariffs.

The implementation of tariff reductions on tropical products and other agricultural products in developed countries may or may not be beneficial for Indonesia. An increase of national welfare depends on the changes in terms of trade and the changes in economic distortions for the nation. Anderson (1997) showed that the welfare changes because of changes in terms of trade could be misleading. The overall welfare change depends on whether distortion effects add to or are in opposition to the terms of trade effects.

Export competition

Competitive subsidisation of agricultural exports, particularly by the United States and the European Community, severely disrupted world markets in the mid-1980s. Participants in the Uruguay Round agreement agreed that no new export subsidies should be introduced and that existing export subsidies would be reduced (Duncan *et al*., 1995):

1. Developed countries agreed to reduce budget expenditures on export subsidies by 36 per cent over 6 years from 1986/1990 levels while the volume of exports subsidised is to be reduced by 21 per cent;

2. Developing countries agreed to reduce expenditures on subsidies by 24 per cent over 10 years while the volume of export subsidies is to be reduced by 14 per cent.

The schedule of commitments (article 9) defines export subsidies as payment-in-kind, export from stocks with financial assistance, producer-financed export subsidies, export marketing cost subsidies, transportation subsidies, and subsidies incorporated into exports. Export credits and credit guarantees are to be covered in a separate agreement.

The agreement on export subsidies will cause a significant decline in budget expenditure on export subsidies and support by the United States and the European Countries. The effects will be greatest on grains, dairy and meat, which are exported by these two groups. Other exporters should obtain larger shares in the third world countries, which import these products. For the importers, prices will rise as the export subsidies will reduce and so export volumes fall, though the price rises may not be substantial (e.g. Goldin and van der Mensbrugghe, 1995).

Domestic support

The nature of agricultural markets and policies is such that domestic support schemes probably have as much effect on international trade as direct border measures. The Uruguay Round agreement is significant in that it included these domestic policies in a trade agreement. It requires countries to reduce domestic support policies by reducing expenditure by 20 per cent compared with the 1986/1988 base over the six-year implementation period from 1995 (Tanner, 1996). For developing countries, the expenditure on domestic support schemes is to be reduced by 13.3 per cent.

Certain domestic supports are, however, excluded from the agreed budgetary reductions. These policies, placed in the so-called 'Green Box', are deemed to be minimally trade distorting: research and extension, inspection, marketing and promotion, infrastructure, food security stocks, domestic food aid, crop insurance, income safety-net schemes, disaster payments, retirement programs, set-aside, structural adjustment programs, environmental programs and 'decoupled' income support. For developing countries, additional exceptions are granted for rural development programs, investment subsidies, input subsidies and diversification subsidies. This formidable list of exceptions raises serious doubts about the commitment of the trading nations to reduce domestic supports (Annex 2). It is difficult to accept that these polices would not materially affect quantities of products available for export, both as individual policies and certainly in totality.

Table 2.2 Summary of Indonesia's Uruguay Round Market Access Offer

	Tariff lines	
	No.	%
A. Tariff Binding		
1. Total bound manufacturers	7,537	80.3
- Existing bindings	823	8.8
- New bindings	6,714	71.6
2. Total Agriculture (all bound)	1,341	14.3
3. Exception	504	5.4
Total above	9,382	100

B. Agriculture

1. Tariffication and binding, or ceiling for all agricultural items
2. Duty reduction of 10 per cent by tariff lines over 10 years
3. Elimination of local content requirement for milk product and soybean oil cake
4. Agreed access of 70 000 tons of rice imports annually and of 414 700 tons of fresh milk imports
5. Reduction of rice export subsidies by 24 per cent

C. Removal of non tariff barriers (NTBs) on bound tariff items

Removal of NTBs on 81 agricultural and 98 industrial tariff lines affecting $358 million of imports (1992) within 10 years.

D. Elimination of import surcharges on bound tariff items

Removal of surcharges varying between 5 and 25 percent on 159 tariff lines affecting US$838 million of imports (1992) within 10 years

Sources: Stephenson (1994), Stephenson and Erwidodo (1995), GATT (1994)

The gains from the Uruguay Round trade liberalisation can be identified as coming from two sources (Stephenson, 1994). Trade liberalisation will increase the efficiency of using domestic resources and the access to other countries' markets. Indonesia has an opportunity to expand its trade under the Uruguay Round agreement. Indonesia's commitment to trade liberalisation, which covers the main element of market access, can be seen in Table 2.2.

Table 2.2 shows that Indonesia has committed to tariffy and binds tariffs on manufactured and agricultural commodities. The bindings cover 95 percent of tariff lines. In the agricultural sector, the tariffication and binding, and the reduction of tariffs by 10 percent per line item will be implemented over 10 years. Moreover, the tariff on rice, meat, some fruits and vegetables, tea, coffee, spices, margarine, sugar, alcoholic, beverages and cigarettes are to be bound at ceiling prices (Erwidodo and Suryana, 1997).

Non-tariff barriers (NTBs) will be removed within 10 years. These include 179 tariff lines, of which 81 apply to agricultural items and 98 to industrial items. Common NTBs that will be removed are Import Producer (IP) licenses, Approved Importer (IT) licenses and Approved Sole Agent (AT) licenses (Stephenson, 1994). Another Indonesian commitment under the Uruguay Round Agreement is the elimination of import surcharges. Prior to the Agreement, these applied to 220 tariff lines, of which 159 lines are included in Indonesia's market access offer (Stephenson, 1994).

Under the 'Green Box' commitment, Indonesia is allowed to support rice, which is the staple food (this is an exemption under the domestic support agreement). Therefore, BULOG (*Badan Urusan Logistik* - State Trading Agency) will still be able to operate a buffer stock scheme to stabilise food prices and encourage adequate food supply, especially for rice (Erwidodo and Feridhanusetyawan, 1997).

2.3.1.2 APEC Agreement

APEC has become a major focus of trade and investment liberalisation efforts in the Asia Pacific region. The visions of APEC are not the same as those of the European Union, which emphasise a customs union, or those of NAFTA, which represent a free trade area. APEC has a different approach, one that is sometimes described as *concentrated liberalisation*. The trade liberalisation lies between formal negotiations such as the Uruguay Round and a completely voluntary and unilateral process (Gosper *et al.*, 1996).

In November 1994, APEC country leaders committed to achieving free and open trade and investment in the region by the year 2020 for developing countries and 2010 for developed countries. This free and open trade and investment concept has a basis of open regionalism (Podbury *et al.*, 1996). The Bogor declaration 1994 represents an ambitious agenda, but one which leaves unresolved questions of implementation. Fane (1996) questions whether APEC trade reforms define a regional free trade area or rather represents a regional trade liberalisation which is based on a 'most favored nation' (MFN) to outsider and APEC members. He also questions the real meaning of 'free and open trade'. Indonesia and the majority of the members at the subsequent 1995 Osaka summit interpreted the free trade agreement of the Bogor declaration as a MFN basis.

In Osaka in 1995, the economic leaders endorsed the 'Osaka Action Agenda'. This central contribution set out the following (Gosper *et al.*, 1996):

- a mechanism by which economies will proceed with trade and investment liberalisation and facilitation;
- the general principles which will guide the process;
- detailed statement on objectives, guidelines and collective actions for each of the fifteen issues on which APEC is to liberalise and facilitate trade and investment; and
- detailed statement of the common policy concepts and joint activities envisaged on APEC's agenda on economical and technical cooperation.

The general principles of the Osaka Action Plan are comprehensiveness, WTO consistency, comparability, non-discrimination, timetable coordination, flexibility and cooperation. The details of these actions can be seen in Table 2.3.

The implementation of the Osaka meeting provides the process for liberalising trade in the APEC region. Many countries have already submitted their programs for trade and investment liberalisation. For example, in Osaka, China announced tariff reductions on over 4000 items in 1996, with the simple average tariff declining by no less than 30 per cent. China will also remove quota licensing and import control measures on about 170 tariff lines. A wide range of industrial and agricultural commodities will be covered by this policy (Gosper *et al.*, 1996).

Table 2.3 General Principles of Osaka Action Agenda

No	Principles	Essential meaning
1.	Comprehensiveness	All impediment to free and open trade and investment to be addressed
2.	WTO-consistency	All liberalisation and facilitation measures to be WTO-consistent
3.	Comparability	Contribution to trade and investment liberalisation by each economy to be comparable, taking into account the level of liberalisation/facilitation already achieved
4.	Non-discrimination	Economies to endeavor to apply non-discrimination among APEC economies and to reduce barriers with non APEC economies as well
5.	Transparency	Each economy to ensure transparency of laws, regulations and administrative procedures
6.	Standstill	APEC members to endeavor to refrain from measures which increase levels of protection
7.	Simultaneous start, continuous process and differentiated timetables	APEC economies to begin liberalisation at the same time and contribute continuously and significantly to the goal of free and open trade and investment
8.	Flexibility	Flexibility will be available during the liberalisation and facilitation process
9.	Cooperation	Economic and technical cooperation contributing to liberalisation and facilitation will be actively pursued

Source: Gosper, *et al.* (1996)

As a part of APEC, Indonesia encouraged the APEC trade liberalisation initiative by announcing a substantial package in May 1995. This package included tariff reductions in a number of agricultural sector products such as meat, milk, vegetables and fruit. Details of the tariff schedule is in Table 2.4

Table 2.4 Indonesian Schedule of Tariff Reductions

Previous	1995	1998	2000	2003
%	%	%	%	%
5	5		max 5	max 5
10	5		max 5	max 5
15	10		max 5	max 5
20	15		max 5	max 5
25	20	max 20		max 10
30	25	max 20		max 10
35	30	max 20		max 10
40	30	max 20		max 10

Source: Gosper, *et al.* (1996)

The table shows that existing tariffs of 20 per cent or less will be reduced to a maximum of 5 per cent by the year 2000 while tariffs of more than 20 per cent are to be reduced to a maximum of 10 per cent by the year 2003. This commitment indicates that the Indonesian Action Plan will accelerate the liberalisation agreed under the Uruguay Round agreement.

The Osaka Action Agenda formed the basis for developing APEC's next Action Plan. A meeting was held in Manila in 1996. The Manila Action Plan (MAPA) comprises Individual Action Plans (IAPs), Collective Action Plans (CAPs) and other joint activities in various APEC forums (PECC, PIDS and The Asia Foundation, 1996).

The main highlights of MAPA are trade and investment liberalisation, and reducing the cost of Business and Economic Technical Cooperation (PECC, PIDS and The Asia Foundation, 1996). The MAPA agreement will reinforce liberalisation in APEC countries. In this agreement, Brunei Darussalam, Chile, Hong Kong, China, New Zealand and Singapore have targeted a zero tariff by 2010/2020 (APEC Economic Committee, 1997). In regard to tariffs and NTBs, the important results are (PECC, PIDS and The Asia Foundation, 1996):

- Bogor goals in tariff reduction are defined progressively to specific targets;
- some economies have a time schedule shorter than the Bogor time frame;
- some economies go further than Uruguay Round commitment;
- the negotiation of the information Technology Agreement (ITA) has a broad support to be completed;
- NTBs reduction has started although definition of targets and time schedules are less prevalent; and
- an increase of transparency through the creation of an APEC database on customs and the applied tariffs, accessible in 1997, and the construction of a list of identified NTBs by 1998.

These various agreements are expected to lead to reduced transaction costs and simplified, harmonised, more efficient and transparent customs rules and operating procedures throughout the region (APEC Economic Committee, 1997).

2.3.1.3 AFTA and Other Sub-regional Agreements

ASEAN is a regional trading arrangement within the APEC region. The ASEAN arrangement contains a provision for the establishment of sub-regional zones. There are now three sub-regional zones of the ASEAN countries: the IMS Growth Triangle (Indonesia, Malaysia, and Singapore), IMT Growth Triangle (Indonesia, Malaysia, and Thailand) and BIMPEAGA (Brunei, Eastern Indonesia, Eastern Malaysia, and South Philippines). The countries in each sub-region are mutually complementary to produce location advantages. Indonesia is an active member of those regional and sub-regional zones.

As an ASEAN member, Indonesia is committed to follow the ASEAN Free Trade Area (AFTA) agreement. At the fourth ASEAN Summit in January 1992 in Singapore, it was agreed that an ASEAN free trade area would be set up within 15 years from 1 January 1993 (Soesastro, 1996). This schedule was accelerated at the 26th ASEAN Economic Ministers Meeting (AEM) in Chiang Mai, September 1994 with a revised completion date of 2003 (Soesastro, 1996; Erwidodo and Suryana, 1997). It is expected the commitment will be easy to fulfil in industrial countries such as Singapore, however, in some early industrial countries such as Indonesia, fulfilling the commitment may prove more difficult.

The mechanism by which tariffs are to be brought down under the AFTA agreement is the Common Effective Preferential Tariff (CEPT) scheme. Under this scheme, tariffs on agricultural product are excluded. Subsequently, at September 1994 in Chiang Mai, the 26^{th} ASEAN Economic Ministers Meeting (AEM) decided to include the unprocessed agricultural products in the CEPT scheme (Soesastro, 1996). In the implementation, the unprocessed agricultural products are classified into three groups (a) Immediate Inclusion List; (b) Temporary Exclusion List (TEL); and (c) Sensitive List. This classified is differentiated which products are immediately to be liberalise (Immediate Inclusion List), temporarily kept out of the CEPT scheme (TEL) or enjoy the tariff protection (Sensitive List). Because of the agreed acceleration of AFTA's implementation to 10 years, the TEL items are also to be included in CEPT by 5 years (1999).

As an agricultural producer, Indonesia subsequently expressed concerns that it would have difficulties in implementing this agreement. In the ASEAN Economic meeting in December 1995, Indonesia sought approval to transfer 15 unprocessed agricultural product items including rice, sugar, wheat, garlic, soybean meal and clove from the TEL to the Sensitive List (Soesastro, 1996). However, Thailand and some other countries did not support this change. The solution was to create a new category of TEL for unprocessed agricultural products to allow Indonesia to transfer from the old TEL list to the new list.

For Indonesia and the other ASEAN members, fulfilling the AFTA commitments represents an intermediate phase of a joint free trade area on route to the wider regional trade areas under APEC and the Uruguay Round. The individual member country can expand its trade liberalisation from the AFTA regional program to global trade. The opening up of trade within ASEAN should enhance the competitiveness of the member nations vis a vis the rest of the world.

Other sub-regional agreements that include some APEC members but exlude Indonesia are the Australia-New Zealand Closer Economic Relation Trade Agreement (CER), the Chile and Mexico Free Trade Agreement, and Chile and Canada Trade Agreement. The CER Agreement eliminated all tariffs, import licensing and quantitative restrictions on trans-Tasman trade as of July 1990. Under the Chile and Mexico Agreement, most products became tariff-free as of 1996 (APEC Economic Committee, 1997). In the Chile and Canada Free Trade Agreement, from July 1997, 92 percent of Chilean exports and 76 percent of Canadian exports are duty-free (APEC Economic Committee, 1997). Even though these agreements do not include Indonesian as a member, they are important in supporting the APEC agreements, and accelerating the reduction of tariff and non-tariff measures within the region.

2.3.2 The Indonesian Trade and Investment Policy

Indonesian economic policy has moved from protectionism (during the several years after independence in 1945), to outward orientation (late 1960s up to the 1980s) and deregulatory and openness (during the 1990s). This section is an overview of Indonesian trade and investment policy during these three periods, particularly in regard to the agricultural sector.

Government policy after Indonesian independence in 1945 focused on maintaining and increasing nationalism. A policy of nationalism and guided development was pursued from 1948 to 1966 (World Bank, 1993). During this period, the government focused on political rather than economic issues (GATT, 1991). The emphasise was on unification of a very diverse group of people in terms of culture, religion, and economic and social level, dispersed over thousands of islands. The government sought to build a political system, which it deemed appropriate for encouraging economic improvement given Indonesia's particular circumstances. Government policy, therefore became inward oriented and interventionist.

The country isolation from the world economy during 1948 to 1966 was supported by the high tariff and non-tariff barriers. During this period, the economy worsened with annual inflation almost 1200 per cent between 1965 and 1966 and average GDP growth slowing to 2 per cent during 1960 and 1966 (Fane, 1999). The fixed exchange rate system to US$ was applied in this period to support the inward looking strategy. The high inflation rate together with the appreciation and overvaluation of Rupiah (because of the fixed exchange rate system) would reduce the competitiveness of Indonesian exporting commodities.

The next stage of economic policy as identified in World Bank research (World Bank, 1993) was the outwardly oriented "new order" government associated with the Soeharto regime (1967 -1973). Because of political instability during the first stage of Indonesian development, the "new order" government initially faced some difficult economic problems including a large and inefficient public sector, high external debt, spiraling inflation and falling levels of private investment (GATT, 1991). The first steps of the new government were directed towards restoring monetary and fiscal stability and encouraging overseas and domestic private investment. The stabilisation program, sponsored by the IMF, helped Indonesia to reduce the inflation rate from almost hyperinflation to the annual average of 8 per cent (Rodgers, 1996). The government announced the Foreign Investment Law, Number of 1967 to encourage foreign direct investment and accelerate depreciation allowances and income tax holidays of approved projects (Fane, 1999). These programs tried to rebuild Indonesia's credibility in order to encourage the international investor.

During the second stage, there was the oil and commodity boom period (1974-1981). The Indonesian government benefited from the increase of oil prices because the export revenue increase dramatically. At this stage, Indonesian trade and investment was increasing (World Bank, 1993). The oil boom period which affected greater government revenue also increased the export growth and the economic performance of Indonesia. In order to support the export growth of oil and gas and non oil and gas commodities, the Rupiah was devalued by 30.9 per cent in November 1978 and from November 1978, the government changed the exchange rate system from fixed to a managed float (Bank Indonesia, 1993). The managed float exchange rate linked the Rupiah with major trading partners and prevent the stability of Rupiah because of the fluctuation on the US $. However, it still makes the domestic exchange rate less stable.

During the oil boom period, the export earning from oil and gas supported the capital-intensive industrial projects were invested directly by the government (GATT, 1991). The high revenue from oil and gas increased the capability of government to finance domestic investment and subsidise the strategic and small-scale industries. The supported strategic industries included petroleum refining, petrochemicals, fertilisers and cement. Subsidised small-scale sectors included rice and sugar farmers, and indigenous small-scale business (Fane, 1999). During this period, a structural transformation of Indonesia's economy began, with a shift from agricultural production to manufacturing.

Oil prices began to fall in 1982, reducing government revenues consideration. From 1982 to 1985, oil prices declined by 6 per cent per year and affected the current account deficits (Rodgers, 1996). The government responded by devaluing the Rupiah by 27.5 per cent against the US dollar, deregulating credit markets and reforming the tax system, in order to strengthen government revenues from the non-oil sector (GATT, 1991). Since the devaluation in 1986, the government has implemented a "less" managed float exchange rate system (Bank Indonesia, 1993) to reduce exchange rate fluctuation. The government cut expenditure on large capital-intensive projects, with the ratio between actual to planned capital expenditure falling from 1.54 in 1982 to 0.65 in 1986 (Rodgers, 1996).

In response to declining oil and gas prices, the government had tightened regulations on trade, foreign investment and private investment, and focused on improving other commodities, including agricultural commodities. The main policy objective in this period was to achieve food self-sufficiency, which is achieved in 1985, through the introduction of high yielding varieties. In order to support food self-sufficiency, the trade policy became more protectionist to meet the domestic interest. Domestic agricultural production was protected by introducing restrictive import licensing arrangements (Fane, 1996). BULOG (Food Logistics Agency) controlled price and quantity of imports, exports, and domestic marketing of major crops such as rice, sugar, soybeans, wheat and flour. BULOG monopolised these markets to stabilise the domestic price from the fluctuation on the world price. However, the effectiveness of the monopoly on products other than rice has been questionable in terms of fulfilling the domestic demand with the relatively low price. Tomich (1992) found that the domestic prices of sugar and soybeans were 35 to 45 percent and 50 per cent above the world prices, respectively. Furthermore, in the cases of wheat and soybeans, PT Bogasari Flour Mills and PT Sarpindo Soybean Industry respectively monopolised flour milling and soybean crushing on behalf of BULOG, earning significant profits.

Beside import restrictions, export taxes and non-tariff barriers were applied to exporting commodities. Bans on log exports were introduced in 1980 and extended to raw rattan in 1986 and semi-processed rattan in 1988 (Fane, 1999). The trade restriction on forestry products was applied to protect wood and rattan processing industries and to increase the value added of wood and rattan. Even though Barbier (1999) argues that the forest processing industries are high cost economic because a direct cost of subsidisation and an inefficiency of the processing operation, the government applied the policy in order to increase the value of the forest processed exports and to support the reduction of deforestation in the long run.

Another kind of non tariff barrier on export commodities is the requirement of having the license on export shipments and the requirement of approval from producer associations to get the license. The association can only be the registration devices such as for commodities rubber, cocoa, tea and essential oil, or the cartel such as for rattan, plywood and coffee (Fane, 1999). The export tax on crude palm oil (CPO) is varied to meet the demand of cooking oil at the avordable consumer price. Export restrictions were used by the government to fulfill the domestic demand, hence heavy restrictions were placed on the agricultural export commodities.

Indonesian trade policy since 1986 can be described as deregulatory and outwardly oriented (World Bank, 1993). In this period, the foreign debt increased to compensate for the declining oil and gas prices. It signaled future problems for Indonesia as a debtor country. The government recognized that the world was becoming more open and competitive and that Indonesia had to be a part of this. Hence, the government started its program of broad trade and regulatory reform. The World Bank (1993) and GATT (1991) compiled lists of the new policy stances and instruments for Indonesia. These included a package of export incentives, a major devaluation (in 1986), several programs to simplify import and export procedures, liberalising import licensing, substituting tariffs and surcharges for non-tariff barriers and broadening exemptions from duties. The 1986 devaluation was almost double from Rp 927/US$ to Rp 1 645/US$ and combined with lower inflation would create a doubling of non-oil exports and the GDP ratio (Rodgers, 1996). Monetary policy was directed to adjust the macroeconomic imbalance. Since 1986, the government also has deregulated domestic and foreign private investment and permitted private sector activity in the utility and other sectors servicing the majority of people, including electrical power, telecommunications, ports and roads.

Numerous trade and investment reform packages have been launched by the government since 1989 in order to face the more open and competitive world economy. A chronology of reforms is given in Table 2.5. Since 1989, the restrictions on trade, including the tariff and non tariff barriers, have been eliminated gradually. The trade regulation have followed investment regulations to encourage foreign direct investment. The year 1994 saw a significant change in investment: essentially unrestricted foreign direct investment was permitted for the first time in all sectors. It was hoped that the comprehensive economic reforms would improve the economic efficiency and lead to an expansion of the Indonesian economy, which would stimulate further investment and export trade activity.

Table 2.5 Chronology of Reform Packages of Trade and Investment in Indonesia, 1989 1996

Reforms	Contents	Objectives
May, 1989 : Investment	Removal of DSP and introduction of negative list	To improve the investment climate
June, 1989 : State Enterprise	• Categorisation of state enterprises • Alternatives to privatisation: go public, joint venture, merger, etc	
June, 1991	• Reduction in non tariff barriers • Removal of restrictions on palm oil Negative list reduces deregulation in automotive industries	
April 1992	• Permission for 100 per cent foreign ownership for investment above $50 million and in Eastern Indonesia	Olefines project first in line
July 1992	• Simplification of the negative list of investment, licensing and investment procedures • Exemption of various import goods from import licensing • Permission to import used machinery and capital goods • Reduction and removal of surcharged duties on particular import products	To reduce cost and reconditioning of existing equipment at lower cost To accelerate the domestic industries
June 1993	• Automotive deregulation: tariff-based system for building up motor vehicle, local content incentive in the form of tariff reductions. • Introduction EPTE and facilitation for EPZs: provision of facilities and reduction taxes in bounded zone and EPTEs.	• A stronger and more efficient automotive industry • Promotion of non-oil/gas manufacturing exports • Improve the competitiveness of non-oil/gas products • Shortened negative investment list

Table 2.5 (Continued)

Reforms	Contents	Objectives
June 1993 (continued)	• Reduction in NTBs, surcharges and tariffs: tariff cuts in import duties for 221 tariff items and in import surcharges for 76 tariff items, reduction in the number of tariff items. • Simplification negative list on investment: it was reduced from 34 to 6 listings, which are logging contractor, gambling/casino, sponge, marijuana, veneer, and dangerous chemical industry.	
October 1993	• Permission 100 per cent foreign ownership for investment with minimum capital depends on the company product and simplifying of the licensing procedures. • Export and import trade deregulation, for example the eliminating of the inspection of imported goods in bounded zone. • Deregulation in the pharmaceutical sector, for example to permit imports of manufactured medicines registered by pharmaceutical producers, wholesalers, and pharmacies • The simplification analysis of the environment impact	• To provide a more conducive investment climate • To increase the efficiency of domestic industries, develop downstream industries, support non-oil/gas exports • To facilitate broader distribution of medicines
May 1994 : Investment	• Foreign industry is allowed to operate in 30 years and can be continue as long as it provides beneficial to the national economy • 100 per cent foreign ownership is allowed with minimal divestment requirement after 15 years • Foreign investor can also come in as a joint venture with 95 per cent maximal ownership and no divestment required.	To increase the competitiveness, efficiency and productivity of the investment and expand the location and sector of industries

Table 2.5 (Continued)

Reforms	Contents	Objectives
May 1994 : Investment (continued)	• Foreign investment can build the industry in all regions of Indonesia • Opening up of previously closed sectors in joint ventures such as ports, electricity, water, mass media, shipping, civil aviation, railways, telecommunications • Foreign owner industries can be expanded.	
June, 1994: Trade	• Reduction of tariffs and removal of non-tariff barriers • Deregulation of marketing from 292 to 270 commodities • Import facility to allow the expansion of industries, which have the same product and input	Not a major change as expected, but continuation of the same approach to trade deregulation
May, 1995: Trade and Investment	• Reduction of tariffs on 6030 items and the schedules of reduction to 2003 • Reduction of restricting import trading schemes from 9398 items to 189 items • Some removal of NTBs • Elimination 10 businesses from negative investment list including automotive and cooking oil. • Export oriented production to promote investment in EPTE/bounded zones	To encourage export commodities to be more competitive To follow up the implementation of free trade
January, 1996: Trade	• Encouraging export oriented industries by allowing shipment of goods and machinery or factory equipment to/from EPTE/bounded zone or inter EPTE/bounded zones and providing import duty/surcharge exemption for automotive industries. • Reducing export and import barriers • Opening and expanding business opportunities for foreign investment	• To create a more attractive business climate for export promotion • To enhance export efficiency and competitiveness • To lower import duties of capital goods and raw material • To eliminate levies which could disrupt export activities

Table 2.5 (Continued)

Reforms	Contents	Objectives
June, 1996: Trade	• Filling in schedule tariff reduction between 1966-2003 • Removal of NTB for sugar used by processing industries • Removal of surcharges • Anti-dumping regulations • Administrative streamlining for some export sectors • Relaxation of importation of complementary products by foreign co-producing in Indonesia	The same as the trade regulation in January 1996

Source: Erwidodo and Achmad Suryana (1997), Bank Indonesia 1993, 1994, 1995 and 1996

Investment and trade regulations are affecting the agricultural sector. As mentioned before, the government policy for the agricultural sector has focused on food self-sufficiency; primarily on rice. On the other hand, assistance received by the major agricultural exporting industries was below average, often negative. Export commodities such as cassava, rubber, coconut oil, palm oil, coffee, pepper, nutmeg and tea were effectively taxed by the trade policies in Indonesia (GATT, 1991). However, there are some changes in the trade policy on export commodities since the mid-1980s. Quantitative trade restrictions (Qts) were eliminated on paper in October 1989, for cassiavera, nutmeg and mace in the policy package of May 1990 (*PakMei* 1990), for CPO, other palm oil, palm kernel oil, copra and coconut oil in the policy package of 3 June 1991 (*PakJun* 1991) (Tomich, 1992). Regulations on agricultural export commodities meant the assistance that was offered to those commodities was lower than the assistance provided to the other crop sectors and even to the manufacturing sector. Even though there is limited assistance for the estate crops, these commodities especially coffee, oil palm, cocoa and rubber have a lower cost than those in other exporting countries. In rubber production, for which Indonesia is not so prominent in the world market, the smallholder costs of production in rubber is lower than the cost for estates in Malaysia and Thailand (Tomich, 1992). Palm oil production in Indonesia also has the lowest cost in the world. Based on Sucofindo data, Larson (1996) shows that the production costs for crude palm oil, ex-factory, was US $127/ton in 1993. Compared to the 1995 average international price of US $600/ton and the historic low price in 1990 of US $290/ton, the Indonesian palm oil sector still profitable.

Beside the regulation in these commodities, there was re-regulation in some estate crops in 1992. The BPPC (*Badan Penyangga dan Pemasaran Cengkeh*) was established as a Clove Marketing Board and given monopoly rights for clove marketing. The BPPC was not successful in terms of increasing farmer incomes because according to field reports, the purchasing price was well below the floor price in the harvesting period (Tomich, 1992). The West Kalimantan citrus industry was also regulated, restricting inter-island trade and decreasing the local farmers' incomes.

Since mid-1997, there has been a dramatic change in monetary economy in Indonesia. The exchange rate depreciated from 2 658 Rupiah per US $ before August 1997 to a lowest point 15 000 Rupiah per US $ in January 1998 (Fane, 1999). The crisis worsened with the lack of confidence in the financial sector and overall economic activity. The financial crisis has acted as an inducement for the government to deregulate in several areas, including trade policy. The following steps in relation to trade regulation to be implemented as part of an agreement reached with the IMF for receiving international aid to help with the crisis (Soesastro and Basri, 1998):

- Gradual reduction of import tariffs to 5-10 percent by the year 2003, including those on chemical products, iron and steel, and fisheries products.

- Trade deregulation for various commodities.

    - Wheat and wheat flour, soybeans, and garlic would be able to be imported freely under a General Importer license from 1 January 1998.
    - With imports of soybeans and garlic subject to a 20 per cent tariff, and imports of wheat flour to a 10 per cent tariff, those tariff to be reduced to 5 per cent by the year 2003.
    - The government would provide a temporary subsidy for wheat flour to protect consumers.

- The administrative retail price of cement would be eliminated in the near future.

- Gradual reduction of barriers to exports, including export taxes.

- Elimination of the special tariff for automobile producers by the year 2000.

- Government review of investment and expenditure by the public sector.

The agreement was monitored by the government with the aid of experts from the IMF, the World Bank and the Asian Development Bank (ADB). However, the agreement was not likely to strengthen the financial sector. The government announced the closure of 16 commercial banks on 1 November 1997 (Soesastro and Basri, 1998). The agreement led to a further loss of created confidence in the domestic private banking sector.

The failure of the IMF Agreement led the IMF to reinforce the economic program. On 15 January 1998, the President signed a second agreement, the IMF II Agreement. The microeconomic reforms under IMF II included the following (Soesastro and Basri, 1998):

- Elimination of BULOG's monopoly over the import and distribution of sugar and over the distribution of wheat flours. In contrast to the November IMF reform package, in which wheat was to be distributed through BULOG for a 3 to 5 years transition period, the Letter of Intent deregulated the distribution of wheat, allowing flour millers to market it from 1 February 1998.

- Complete deregulation of domestic trade in all agricultural; Elimination of the Clove Marketing Board by June 1998.

- Abolishment of all other restrictive marketing arrangements by February 1998; specifically the dissolving of the cement, paper and plywood cartels.

- Elimination of internal and external trade restrictions on cement; permission for traders to buy and distribute all cements brands in all provinces and to export under the General Exporter License.

- With respect to the foreign investment, removal of formal and informal barriers to investment in palm oil plantations from 1 February 1998, and lifting all restrictions on investment in wholesale and retail trade in March 1998.

- Discontinue special taxes, customs and credit privileges to the National Car Project, as well as any budgetary and extra-budgetary support and credit privileges to IPTN projects (the state-owned aircraft industry).

- Reduction in tariffs on all food items to a maximum of 5 per cent in order to secure food supplies for lower income groups.

- Abolishment of local content rules on dairy products.

- Abolishment of import restriction on all new and used ships.

- Abolishment of export taxes on a wide range of products such as leather, cork, ores and waste aluminum from 1 February 1998.

- Reduction in export taxes on sawn timber, rattan and minerals to a maximum of 10 per cent. Elimination of quotas by the end of the year 2001.

- Exemption of export restrictions on palm oil to ensure adequate domestic supplies. This exception, however, was to be eliminated by March 1998.

Although referred to as reforms, the microeconomic policies changes in the IMF agreement do not represent radical changes. Many experts have suggested that the government must deregulate its trade policy and introduce greater competition. For example, the high non-tariff barrier associated with BULOG's monopoly on agricultural imports including rice and wheat had been criticised. In the international trade, the Indonesian Government was clearly committed through AFTA and APEC. Therefore, the IMF agreement serves to further encourage trade liberalisation in Indonesia.

2.4 Review of General Equilibrium Analysis of Trade Liberalisation

2.4.1 Partial versus General Equilibrium Trade Analyses

The impacts of trade liberalisation can be analysed through either partial or general equilibrium models. To understand the distinction between the two, it is useful to consider an essential aspect of a market economy, namely exchange. Goods are bought and sold in exchange for other goods, typically money. In equilibrium, individual agents must not only be content with their decisions in that they do not want to change their decision, but must be in balance with the rest of the economy. All opportunities must have been exploited. For example, a consumer's ability to acquire goods depends on having income to spend, and that income comes from the contribution of productive (and valued) resources. The consumer can contribute as a factor owner to the economy. As elementary textbooks in economics elaborate, there is a circular flow economy. Whereas partial equilibrium models entail little attempt to recognize the circularity, feedback and balance requirements, general equilibrium models do, though to varying extent.

2.4.1.1 Partial Equilibrium Analysis

Partial equilibrium models are generally focused on a single or a few commodities and typically look at price formation under explicit supply and demand relationships for these markets. Partial equilibrium analysis is appropriate if the market(s) studied is isolated (Tsakok, 1990) with no significant spill-oversee into non-modeled markets. That is, there should be no interdependence between modeled and non-modeled markets either in production or consumption. Adjustment to equilibrium in the partial equilibrium model for one or several commodities prices and quantities occurs while prices and or quantities of other goods and consumers' income are held constant (Cornwall, 1984). In essence, partial equilibrium models assume the rest of the economy as given and income is the independent variable. Therefore, partial equilibrium analysis is appropriate when an external shock from a national or international market is sector specific and has a small effect on total consumer income.

Partial equilibrium models have been widely used in analysing markets and policy, including trade studies. An example of a partial equilibrium model used in multi-country trade analysis is the SWOPSIM (the static world policy simulation) model. SWOPSIM is a static, multi-product, multi-region, and partial equilibrium model. Here, static model means that the amount of capital is fixed. Roningen *et al.* (1991) suggests that the SWOPSIM modeling framework can construct various types of simple standard global models of trade. However, if there are interactions among markets and significant spill-over and feedback effects, a general equilibrium model that links among markets or between a market and the broader economy is likely preferable.

2.4.1.2 General Equilibrium Analysis

A general equilibrium model looks at the economy as a complete system (Dixon *et al.*, 1992). The model can be constructed at the aggregate level, but typically are built with considerable micro-level detail with explicit interdependencies among the components of the economy: among industries, households, investors, governments, importers and exporters and between different markets. All markets clear in equilibrium and have a specific structure to underlie the equilibrium formulation. For example, market equilibrium is associated with a non-negative, homogenous and unique price, no excess demand, and efficiency in market pricing. The general model has two key properties: it operates on a relative price basis and fulfils Walras's law (Dinwiddy and Teal, 1988). The former means that the price of all goods except one can be expressed in terms of the price of this exceptional good (that is, this becomes the numeraire). Consequently, the model cannot establish absolute prices. Satisfying Walras's law means that the sum of excess demands over all the markets equals zero for a given set of prices.

General equilibrium models are multi-equation models, the solution to which represents the general equilibrium. With the detailed micro structure, the number of equations may be measured in the thousands. These equations describing micro behavior are in general non-linear. This suggests that solving for equilibrium will not be trivial task; and perhaps to be avoided if possible. Indeed, many general equilibrium analyses do not attempt to solve for the equilibrium. Fortunately, since it is often sufficient or even more important to know what effect a change in policy, or a change in one aspect of an economy will have on the equilibrium of the economy, rather than to know the equilibrium itself, analysis can focus on changes. Regardless of the non-linearities of the relationships between economic variables, relationships between changes in variables can be well approximated by linear relationships, at least for small changes. This was the key insight of Johansen (referenced in Dixon *et al.*, 1982) and has led to a class of models known as Johansen-type computable general equilibrium (CGE) models. Being linear (in percentage changes from an initial solution or equilibrium point), these are relatively simple to solve and manipulate. Further, even when interest lies in large changes from an initial solution point and it is not appropriate to assume a linear relationship between percentage change variables, estimates of the changes to a new solution point can be obtained by using an iterative process. By dividing the overall change in a variable into several shorter steps, and evaluating each step using a linear approximation, a better estimate of the overall change to the other variables can be obtained. By focusing on the limit of these estimates as the number of step increases, good estimates of the changes to solution values can be obtained. This approach allows both for non-linearity in the response of a variable to the original change and for dependence of a response on the levels of other variables.

Especially in developing countries, general equilibrium analyses of economy-wide policies are often more suitable than analyses based on alternative, simultaneous equation, econometric models of the economy. De Melo (1988) argues that there are problems in building and estimating econometric models for analysing the impacts of shocks in the macroeconomy in the case of developing countries. These include a lack of reliable time series data for sufficiently long periods, the consistency of the data, and the significant changes that occur in policy regimes.

The structure of the simple general equilibrium model has been developed become the "workhorse" for most analyses of international trade. The simple general equilibrium model was used as long ago as 1965 (Jones, 1965) in an analysis of the impact of taxation on the distribution of income and the effect of technological change on the composition of outputs and the structure of prices. As Buehrer and Mauro (1995) point out, computable general equilibrium models are used to simulate the impact of trade policy changes and examine the economic effects of different government policy packages. They provide a mechanism to analyse the impact of trade policies implemented by a single country and the impact of trade liberalisation by a group of countries (Yeah *et al.*, 1994).

There has been extensive use of computable general equilibrium models, not only in the international trade area, but also in the development of planning, public finance, environmental and resource management, structural adjustment, and the transition to a market economy (Yeah *et al.*, 1994). A good example of a general equilibrium model and potential applications is provided by the ORANI model, a disaggregated model of the Australian economy. Dixon *et al.* (1982) explained that the analysis using this model had included "the effect on industries, occupations and regions of changes in tariffs, the exploitation for export of mineral resources, changes in world commodity prices, changes in exchange rate, changes in pricing policies for domestic crude oil, subsidies to ailing industries, the movement towards equal pay for women, changes in the cost of employing labor, the adoption of Keynesian demand stimulation policies and the adoption of home price schemes for agricultural export commodities" (p.1).

The ORANI model, with further development and refinement, continues to be used in Australian economic policy analysis. For example, an extension of the model (ORANI-F) is used for medium-term forecasts of the Australian economy (Horridge *et al.*, 1993). In contrasts to the original static ORANI model, ORANI-F contains dynamic elements to accumulate variables such as capital stock and foreign debt in the medium-run period. The most recent development in this line of models is a dynamic computable general equilibrium model known as the MONASH model. It can be sued to forecast and predict the long-run period of the Australian economy (Dixon and Rimmer, 1998). There seems little doubt that the computable general equilibrium model has become a dominant tool for economic policy analysis.

Compared to partial equilibrium analysis, the general equilibrium approach is a better approach for analysing intersectoral links and links between sectors and macroeconomic conditions. Specifically, general equilibrium is considered more appropriate for analysing the issue of foreign trade policy and the interaction between the domestic economy and the foreign-trade sector because the model can capture the sensitivity of the domestic resource allocation to the developments in the external sector (de Melo, 1988; Yeah *et al.* 1994). Partial equilibrium model treats the factor endowment as given. The capability to link between the domestic economy and the foreign-trade sector also facilitates analysis of foreign exchange policy. Furthermore, the microeconomic foundations of general equilibrium models, which include micro-level behavioral relationships and their parameters and national accounts input-output data, makes the general equilibrium model a better experimental tool to analyse the economics changing. If the macroeconomic changes will affect not only one sector, the general equilibrium is also more informative than partial equilibrium. For example, in the case of the food sector, Hertel (1992) argues that the change in patterns of food production and trade is difficult to predict in a partial equilibrium model when reforms affect both food and non-food sectors. Hertel (1992) clarifies further that the CGE framework accounts for theoretical consistency, the treatment of inter-industry effect, and the welfare analysis

Equilibrium models and analysis, both partial and general, are not without their critics. Criticisms of computable general equilibrium analysis include the dependence of the results on the assumed equilibrium structure, the assumed functional forms, and the assumed elasticity and share parameters (Harrison, 1993; de Melo 1988). In terms of functional forms, there is a trade-off between general equilibrium analysis using convenient functional forms such as the Cobb-Douglas and constant elasticity of substitution (CES) production function, and partial equilibrium analysis using less restrictive, flexible functional forms (Hertel, 1985). Elasticities and share parameters, required for Johansen-type computable general equilibrium, are not always easy to estimate, especially in developing countries, which often lack databases for many years. Harrison (1993) argued that to allow for the lack of reliable information on this aspects of a CGE model sensitivity analysis should be a part of policy analysis. While simple in concept, in reality the large number of equations in CGE models makes running the sensitivity analysis a non-trivial exercise. Researchers with limited time and resources thus have a difficult choice to make between general and partial types of model. While general equilibrium analysis is conceptually the more attractive approach to analysis, it may not always be the most cost-effective approach.

By using the general equilibrium model, policy makers can quantify the effects of trade policy on resource allocation and economic structure, on welfare and on distribution of income. But there is a question as to whether one can legitimately analyse trade liberalisation using a single country or national economic model, or whether one needs to explicitly recognize that the country is a part of a larger regional, even the global economy. Arguably, a multi-country, general equilibrium model is required to analyse the impact of changes in trade policy. The two kinds of general equilibrium models are described in the following section.

2.4.2 Single Country versus Multi Country Models

In both partial and general equilibrium models, two types of model can be used to analyse trade liberalisation: the single-country model and the multi-country model. The single-country model can be used to investigate the impact of trade and trade policies on the individual economy (Shoven and Whalley, 1984), while the multi-country models are suitable for analysing the global issues of trade in a group of countries. The choice between the two depends on the research objective and the availability of time and data.

The single-country model usually treats all other countries as one group, the "rest of the world", which is treated as a given. It is suitable to analyse the full effects on one country because of domestic policy change and to analyse the detailed sectoral effects in that country. Yeah *et al.* (1994) believe that the single country approach is better to characterise the distribution of gains and losses by specifying the social structure.

A single country model can make little contribution to the analysis of the interrelationship between that country and other countries. It does not capture the reactions of each foreign country on the supply and demand side of markets. It then cannot model or predict movement of the country's export demand function as foreign countries respond. On the supply side, the single country model cannot predict the import supply from an individual foreign exporting country to the nation or the export supply share from the nation to each foreign country export destination. Neither can the single country approach deal well with policy changes occurring in multiple countries, for instance a bilateral variation in protection between countries (Hertel *et al.*,1997). Finally, the usefulness of the single-country model is especially limited when examining the long-run, that is for response periods long enough for per capita income, taste, preference, technology and capital stock to change significantly as a result of trade reform. Then, input and output reallocations take place not only within the country but also between countries (Dervis *et al.*, 1982). The global trade and development then cannot be analysed properly with a single-country model. In brief, the single country model is necessarily limited for studying multilateral trade policy issues.

On the other hand, in a multi-country trade model, individual countries are linked through trade flows and prices are linked through transportation costs, taxes, and subsidies (Thompson, 1981). The model captures the simultaneity of trade determination across countries and lends itself to studying the impacts of multilateral trade negotiations and tariff agreements. However, detailed sectoral modeling of firms, households, occupations, etc. for each country in a multi-country model means it is larger and more complex to interpret (Hertel *et al.*, 1997). Global modeling and analysis needs considerable researcher effort. Fortunately, researchers needing to use a multi-country approach trade analysis can take advantage of the considerable investment that has already been made in building such models. For example, the Global Trade Analysis Project (Hertel *et al.*, 1997) has made available to researchers base models of international trade along with detailed and well-maintained data bases. Researchers can tailor and append the model to suit their particular research needs.

2.4.3 Linking Single Country and Multi-Country Models

A multi-country model allows simulation of the impacts of changes in policy in one country on other countries, including the effects on various sectors. However, a multi-country model with a detailed sectoral description for each country would not be required for most analyses. Constructing such a model would usually involve a mis-direction, if not a waste, of effort in modeling countries for which detail is not important to the analysis of interest. Modelers, as much as any economic agents, need to be granted the principle of equi-marginal return. When specific interest lies in the trade policy effects on one country, a better approach would be to adapt a multi-country model by inserting the desired sectoral sophistication for the particular country into the global model. In essence one would replace that part of the multi-country model, which represent the particular country by a more sophisticated sub-model.

An alternative approach, similar in spirit to expanding the particular country component of the global model is to link the multi-country model with a separate national model of the country of interest. Specifically, one could use the multi-country model, which would include the country of interest, to estimate the likely effects on international prices and trade quantities of multi-lateral changes in trade policy. These estimated international effects could then be taken as changes impacting on the particular country and their detailed effects on the country simulated through the national model. To be fully consistent as an overall model, the detailed trade changes emerging from the national model would need to match those estimated in aggregate for the particular country through the multi-country model. Even if not fully consistent, the impacts of trade liberalisation simulated using a national model linked to the global trade model will likely be more realistic and informative than estimates using a national model isolated from any global modeling of liberalisation or from using a global model alone.

When the main focus is on the detailed impacts of trade liberalisation on a particular small country, the national model reveals those effects provided the trade liberalisation price changes exogenously imposed on it are good estimates of the price changes that would occur. Further discussion of the procedures for linkage is postponed until section 4.3. Here, linkage as used by Adams *et al.* (1997) is described for this study.

2.4.4 Static versus Dynamic Models

Static CGE models, that is CGE models which make no explicit reference to time, have become a dominant tool for domestic and trade policy analysis. In Australia, for example, the IMPACT project, established to assist government in evaluating tariff policy, has spawned a series of CGE models of which the key one is the static ORANI model (Dixon *et al.*, 1982, Horridge *et al.*, 1997). Variants have been developed both by the project team and its descendants as well as by outside groups, for analysing issues as diverse as the enhanced greenhouse effect and carbon emission control polices (Hinchy, *et al.*, 1998) and the relationship between trade liberalisation and pollution (Dessus and Bussolo, 1996). Static models have similarly been the basis of CGE modeling in many other countries including APEC countries (e.g. The Philippines and Singapore), Vietnam, South Korea, South Africa and European countries. For example, Buetre (1996) modify ORANI-F model to explain the structural change in Philippines and Siriwardana (1997) uses ORANI model to analyse the impact of exchange rate policy and market power in Singapore. Dynamic CGE models, that is CGE models which not only designate variables in relation to time (time subscripted variables) but, more importantly, involve relationships between endogenous variables from different time periods, are less commonly used.

Once time is recognized, the question of how individuals allocate over time immediately arises. Dynamic models in economics can be classified based on the period over which decisions are optimized, that is whether one or several periods simultaneously. There are two classes: single period "sequential solution" or "recursive" models; and "fully dynamic" or "multi-period" models in which decisions are optimized over several periods. In the context of CGE modeling, this distinction has been discussed by Ferrantino et *al.* (1997).

The nature of static CGE models and associated analysis is widely described in the literature (e.g. Dixon *et al.*, 1982). As with the single equation model, static CGE models are properly seen as emerging from an underlying dynamic CGE model. Mathematically, a static general equilibrium model is a set of simultaneous equations describing the equilibrium of an economy without explicit reference to time. With a sufficient number of equations relative to variables, and appropriate conditions on those equations, the system can be solved for a unique set of equilibrium values for the variables. Usually, static general equilibrium models with their focus on the structure of microeconomic behavior and market equilibrium are incomplete in that there are often less equations than there are variables; and a unique equilibrium is not defined. For example, these models usually do not contain equations to determine technology, though economists would frequently consider technology to be determined endogenously, at least in part. Similarly, while the models typically contain equations that determine the allocation of aggregate investment between industries, the models may not contain equations to determine the actual level of investment itself. With an excess of variables over equations, it is only by setting some variables, such as aggregate investment and technology, at particular exogenous levels, that the system can be solved for an "equilibrium". Such exogenous settings, which amount to adding further equations, effectively "complete" or "close" the model mathematically if not economically.

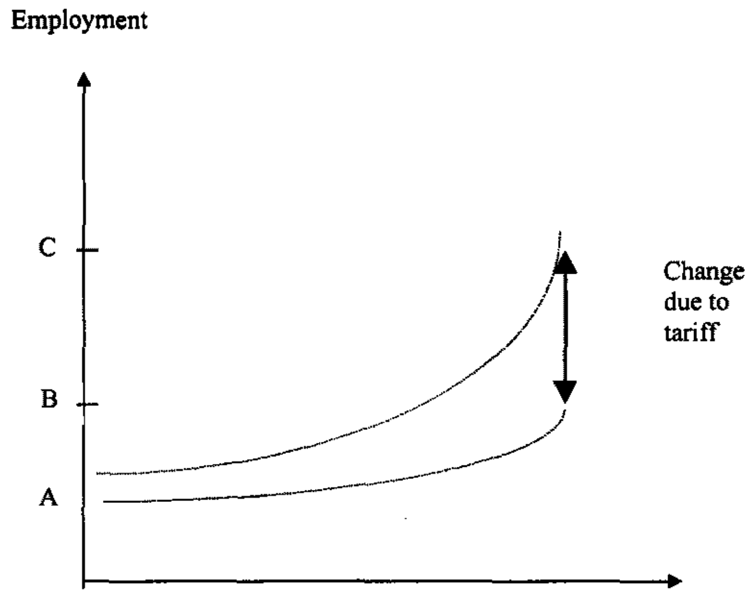
In most cases, the analysis undertaken with these static models has been a comparative static analysis. In a comparative static analysis, comparison is made between two equilibrium positions, the two being different from each other because one or more exogenous variables are set at different values. The different exogenous variable levels lead to differing values of the endogenous variables, as in the simple single equation static models outlined above. While comparative static analysis can focus on the actual equilibrium positions, and then the difference between the two, usually (particularly so with Johansen type CGE models) the analysis identifies directly the extent of changes in the endogenous in response to changes in the exogenous variables without determining the actual equilibrium. Importantly, comparative static analysis does not identify how the economy would move from one equilibrium to a new equilibrium, how rapidly it would move there or along what path. In a timeless model, all changes happen without reference to time.

Although time is not formally explicit in a static model, time is brought into comparative static analysis first by the analyst specifying for the incomplete model which variables are endogenous (or response variables) and which variables are to be set exogenously, and second through the interpretation given to the results. As explained for the single equation case, a static model could arise from a dynamic model in two ways; and the same applies to the CGE static model: the static model could reflect current period reactions to changes or long run reactions. For example, suppose a CGE model includes industry variables for investment and existing capital. In an actual economy, capital changes over time through net investment. Thus if a model includes both existing capital and investment variables, it is potentially a dynamic model since the model could then include a relationship between current and future capital stocks. However, by not explicitly focussing on the dynamic relationship, by treating industry capital levels as exogenous, and solving for other variables, the model becomes a short run static model. On the other hand, a long run static model could be built by accumulating the effects of an exogenous change through time.

Descriptions of static CGE models rarely make explicit reference to whether they are short run static or long run static models. They are almost invariably short run models. Yet when CGE modelers explain them, they do talk about time; and to confuse matters further, they often use the same static model for both short and long run analyses.

The interpretation of the comparative static analysis of a change in trade policy, for example the effect of a tariff on employment, is illustrated (following Horridge *et al.*, 1993) in Figure 2.4.

Figure 2.4 The Interpretation of Comparative Static Results



Source: Horridge *et al.* (1993)

Here A is the level of employment at time 0 (say, the present). If there is no policy change, the employment at some particular future time T is taken to be at B. The impact of a tariff change is to increase employment at time T from B to C. Time T is not precisely specified, but is an adequate time for equilibrium (which could be short run or long run) to be restored following the tariff change. In a static model this should happen instantaneously, or at least in the current period. That a period T is involved reflects the reality that many responses to exogenous changes cannot actually occur instantaneously. The detail of these is simply not included in the model. Then, even though the explicit model is static, one must view the new equilibrium position as emerging after some (short) period of time due to implicit lagged responses. By the time these changes have occurred, the actual values of the formally explicit variables, including the exogenous variables, in the model may have altered. If these have changed, then even in the absence of the tariff policy change, the endogenous variables will have changed, i.e. from A to B. In comparative static analysis, the focus is usually on identifying the change C-B, not on the individual levels B and C. Furthermore, CGE analysis usually identifies the percentage change (100(C-B)/B) in employment caused by the tariff change rather than the absolute change C-B.

In CGE modeling, the period of time T may represent either the short run or the long run. In CGE modeling, the short run is used to refer to the period over which the capital stock in each industry can be assumed to remain constant. Thus if the short run static model solution requires an allocation of investment in an industry in response to an exogenous change, that investment takes place to the extent that the current period implications for demand for inputs occur are recognized but not to the extent that the increased capital stock itself begins to affect economic activity. In this short run, the profitability of industries operating with their fixed capital is endogenous and it changes in response to exogenous shocks on the economy. There is no specific calendar time corresponding to the short run, this depending on the frictions and flexibilities within the particular modeled economy. For Australia, researchers have suggested that the short run is around 2 years (Dixon *et al.*, 1982).

While short run analyses of policies are important in indicating the pressures for adjustment, often it is the long run effects of policies, which are of more importance. Conceptually, these long run effects are the accumulation of resultant effects over time, as explained for the single equation case. Comparative static analysis with a static CGE model would reveal these effects, provided the static model is constructed to relate long run equilibrium values of endogenous variables to sustained exogenous variables, or to relate changes in long run endogenous variables to changes in exogenous variables. As the single equation example illustrates, the parameters of the equations of a static model may differ depending on whether it is a short run or a long run model. However, the practice in CGE modeling, exemplified by applications of the ORANI model, is to use the same model for both short run and the long run comparative static analyses, the only difference being in the choice of endogenous and exogenous variables. Is this appropriate?

Economically, the long run is a sufficient time for all agents to have responded to exogenous changes and to have come to new equilibrium positions from which there is no further pressure for change. Whereas in the short run, rates of return to investment in various industries may alter in response to policy or other exogenous changes with capital stocks remaining fixed, in the long run, rates of return must be equalized across industries (Horridge *et al.*, 1993). Within the (short run) static

ORANI model, the "long run solution" defines the altered levels of *initial* capital stocks which would be consistent with the specified exogenous changes and the requirement that rates of return to investment be equalized across industries. The static model, of course, does not define how the economy would get to this new set of industry capital stocks, though by definition it would require differential investment across industries. As with the short run, there is no specific calendar correspondence to the long run. For the Australian economy, research suggests it to be about 10 to 20 years (Horridge *et al.*, 1993).

The concept of the long run in the comparative static analysis relates to an equilibrium condition reflecting competitive investment actions of agents. This differs from the long run in a dynamic model where the long run is defined in relation to the accumulation of responses, e.g. accumulation of capital stock, over time. Yet the two solution concepts do not necessarily yield different solutions.

Suppose the economy was in a stationary state which would mean, amongst others, that all rates of return were equal, capital stocks were unchanging, and that there was no net investment. Then an exogenous change occurs, say in tariff rates. A comparative static long run analysis done assuming zero net aggregate investment, would reveal the altered initial capital stocks which would be consistent with equal rates of return to investment and no further net investment. The economy would thus again be in equilibrium. From the perspective of a dynamic model, suppose that, in the first period, aggregate investment just sufficient to change aggregate capital stocks to that implied by the comparative static long run solution was specified exogenously. The general equilibrium model would allocate this in a short run solution to various industries. The allocation would almost certainly not be that consistent with the industry capital stocks implied by the long run comparative static solution. In the second period and thereafter, suppose no aggregate net investment is allowed. Since the capital stocks are not those consistent with equal rates of return to investment, there will necessarily be incentives to reallocate investment: those industries with too much capital would disinvest, those with insufficient would invest. Over a period of time, the economy would move to the position defined by the comparative static solution. Had the exogenous sequence of aggregate period net investments been different from that imagined above, the same equilibrium would still have been reached.

If the economy were not initially at a steady state, but were subject to a non-zero exogenous net investment, then the long run comparative static solution would define the capital stocks consistent with the policy change, equal rates of return to investment and the exogenous level of aggregate net investment. If the industry investments implied by a short run solution were made, and the model run again for a second period, at some point the aggregate capital stocks will have accumulated (approximately in general, since investment is made in discrete lumps) to the level implied by the comparative static long run solution. It is unlikely that the allocation of capital across sectors would match exactly that of the comparative static solution. With more time, aggregate capital stocks will exceed the long run level. Thus, in this non-steady state case, there is no necessary equivalence between the comparative static long run solution and that of the dynamic model for any point in time. At the time when the two aggregate capital stocks are closest, one would anticipate that the changes in other endogenous variables would be similar; but this is not guaranteed. Thus long run analysis can give different answers depending on how it is done.

To summarize, although ORANI (and other static CGE models) includes industry investment amongst its variables, these investments are not those required to move from the existing capital stocks to achieve the new equilibrium level of *initial* capital stocks identified in a long run analysis. The ORANI model determines only the allocation of investment across sectors and not the aggregate investment. The latter bears no relation to the long run change in *initial* capital stocks. The calculated industry investments may move the economy towards the required stocks, but would not in general be the exact amounts required. It could take a number of years for the capital stocks to actually accumulate to their long run equilibrium values; and this would in any case only happen if aggregate investment were exogenously set to reach the required level of capital stocks.

In applications of CGE modeling, it has been common to do both short run and long run analyses, so getting estimates, as already noted, of the more immediate adjustment pressures on the economy due to policy changes and of the implied impacts of those changes for investment pressures to subside. In many cases, the long run analysis may be more useful than the short run analysis. Dee (1994), for example, explains why the Australian Industry Commission has found this so.

Although the static model can predict the change for long run equilibrium, the model is generally considered more appropriate for analysing the impact of policy changes on relative prices and resource allocation over the short-term period (Kahoe, 1994). In the long run, with capital flow between sectors and, potentially, internationally, (e.g. Dee *et al.*, 1996) issues of dynamics of capital accumulation and technological change become more important. Failure to recognize these formally may reduce the usefulness of the long run comparative static results.

A dynamic CGE model with time-subscripted variables and equations relating endogenous variables in different periods would allow the state of the modeled system to be tracked over time. These were not common until relatively recently. Dynamic versions of static CGE models are now being created. For example, Dixon and Rimmer (1998) use the MONASH model, a more recent dynamic variant of the ORANI model, to forecast and analyse the policy implication of the Australian motor vehicle industry over the period 1987 to 2016. Another variant, which also has involve some dynamic elements, is the ORANI-F model.

Strictly, however, ORANI-F, is *not* a dynamic model. It does attempt to account explicitly for the dynamics of both physical capital accumulation and foreign debt accumulation over time, but does so only in that it is a static model derived from an underlying dynamic model. In terms of the single equation model illustration used earlier, the ORANI-F model is a static model of "intermediate run". That is, the model includes an equation (one for each industry) relating capital stocks at a specified future time period T to investment at that time and to current period capital stocks and current investment; and a parallel one for accumulated debt and the balance of trade.

In general, a dynamic capital model would have future period T capital stocks explicitly dependent on all investments in all periods 1 to T. Only if some restrictions were placed on the pattern of investments over time (for example, that investment was the same in all periods as done for the single equation illustration above), would the time subscripts become redundant. The developers of ORANI-F did this. They assumed that investment over time changes from the initial to the final period in an exogenously set manner (linear in fact) with investment dependent only on initial and final investment levels (Horridge *et al.*, 1993). Thus, although the ORANI-F model is intended to address lack of consistency between investment that may occur over time and the accumulated capital stocks at the end of this time, it does so only if the investment follows the assumed pattern. Here is nothing in the ORANI-F model to ensure that the underlying path to the new equilibrium would entail a linear investment pattern, or at least if it did, that the path of the economy would be realistic. Thus the ORANI-F model has to be viewed as an attempt to achieve consistency with the dynamics of capital accumulation, but one which is less than fully dynamic, there is further discussion on this in section 4.1, Block 16.

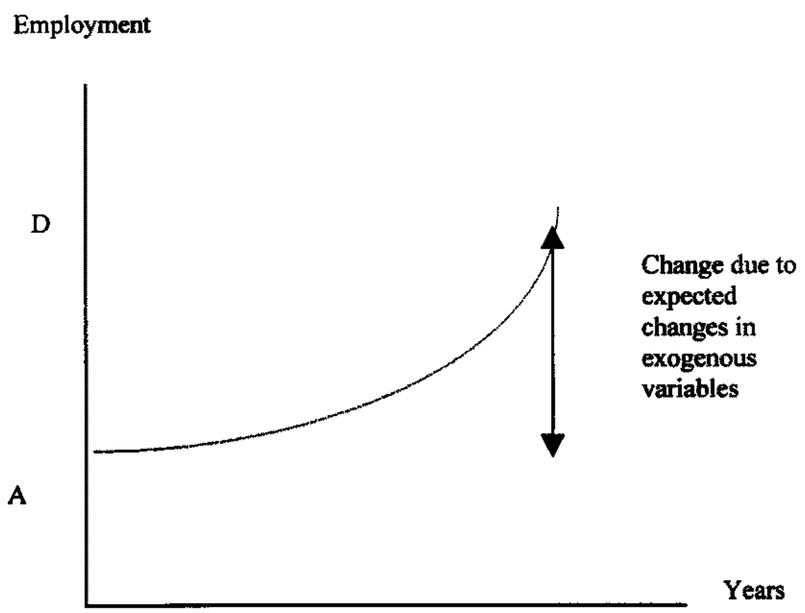
The ORANI-F model also deals with the dynamics of trade deficits and the foreign account (Horridge *et al.*, 1993). Precisely the same limitations apply here.

Notwithstanding these limitations, the ORANI-F model can predict the long run (period T) state of the economy corresponding to movements in exogenous variables. That is, the model is used in a comparative static analysis of expected changes in all exogenous variables; and with knowledge of the current period endogenous variable levels, the future (period T) values can be found. For example, using values for exogenous variables such as employment growth, labor-saving technical change, decline in terms of trade, and growth in public consumption, ORANI-F has been used to predict the Australian economy at the end of a six-year period from 1989-90 to 1995-1996 (Horridge *et al.*, 1993). Because of this capacity to forecast, the model is sometimes called a forecasting CGE model.

How to interpret the results from the CGE forecasting model has been explained by Horridge *et al.* (1993) and is illustrated in Figure 2.5. In the forecasting model, the employment at time 0 is A. As a result of movements in all exogenous variables over the period to T and the implied investment and capital accumulation, employment changes to D at time T. The change in exogenous variables cause a percentage change of 100(D-A)/A in employment.

While forecasting CGE models can be used to forecast the future state of the economy conditional on exogenous variable settings, its prime use in policy analysis will be in providing better estimates of the long run effects of policy changes. In essence, because of the long period of time involved in reaching long run equilibrium following a policy change, it is argued that it is important to recognize that the economy will have altered because of many exogenous changes, and that the particular policy of interest should be evaluated as an additional change. This is easy to do, using two runs of the model. The first run is used to forecast the economy at time T. Essentially this provides an updated data base for period T. From this equilibrium position, a policy change implemented in period T can be evaluated in the usual comparative static analysis using the short run static model, e.g. ORANI itself; or if implemented in period 0, by doing the usual comparative static analysis using the intermediate run static model, i.e. ORANI-F. In the latter, the effect of the policy on investment and capital accumulation is taken into account, albeit with the assumed (likely unjustified) pattern of investment.

Figure 2.5 The Interpretation of Forecasting Result



Source: Horridge, *et al.* (1993)

Despite these attempts to recognize dynamics in CGE models, these fall short of a full representation of the dynamics of economies. Economies do not move instantly to new equilibrium positions following imposed exogenous changes or shocks. At the micro level, production processes take time. For example, it takes several months to grow an agricultural crop. It can then take time for producers to respond to altered price signals because production runs already in process have first to be completed. Furthermore, because production takes time, decisions on production then have to be based on anticipated or expected future product prices. Producers have to form their expectations, perhaps via a learning process, and this can introduce further delays. When price changes signal firms to expand production, new capital equipment and structures may be required. This can take time to install. When prices fall, firms may find that it would be uneconomic to continue production if they were buying capital equipment, but that in the short term it is worthwhile continuing production with low-opportunity cost existing physical capital while it remains operative. Contraction in production is then delayed because of the asset fixity. When firms change industry in response to price signals, or adopt new technology, there is inevitably a learning curve, so creating dynamics. Similar, though probably less significant lags can occur in consumer behavior, associated with evolving preferences with experience. Overarching all of this is the realization that agents will need to allocate their resources over time in accordance with opportunities and time preferences. Static models ignore all these potentially important lags and broader behavioral motivations at the micro level. Ideally they would be explicitly recognized in the modeling of production and consumption decisions giving rise to a fully dynamic general equilibrium model.

Beyond the individual behavior, further potential dynamics arise at the market level. When production takes time, and future supply and demand levels cannot be known with certainty, future prices become uncertain and economic agents may recognize opportunities for arbitraging between markets across time. Storage of commodities becomes a relevant economic activity. Static models make no mention of this aspect of the real world, it having no relevance to a timeless world. Ideally, storage and equilibrium in market across time would be recognized in a dynamic general equilibrium model.

Devarajan and Go (1995) provide a formal introduction to fully dynamic CGE models. They have the advantage of accounting for transitional changes with more regularity and completeness than the sequential models. Their results are more internally consistent for long run analysis, with capital accumulating overtime in response to the exogenous shock. However, the disadvantages of the full dynamic model are rigidity and simplified theoretical foundations that imposes the rigidity of optimising behavior and predetermined rates of time preferences on the producer and the consumer in each period (Ferrantino, *et al.* 1997). It is also more time consuming because the model incorporates techniques of dynamic optimisation. In practice, CGE modelers have rarely built fully dynamic models.

Ferrantino *et al.* (1993) identifies a number of dynamic CGE studies for both domestic economic analysis and trade liberalisation. Most of these are of the sequential or recursive type, in essence involving repeated (and updated) application of the short run static CGE model. This has the obvious advantage of being able to exploit existing comparative static models and their solution procedures. The dominant multi-country, comparative static model, GTAP, has been extended to a sequential dynamic version (McDougall and Ianchovichina, 1996). This entailed the addition of equations which both (a) relate expected changes in rates of returns on capital to the current investment and current capital and also (b) establish the required investment in relation to how far current "central" (my term - McDougall and Ianchovichina use "expected") rates of return depart from a long term world target rate of return, in particular according to a partial adjustment error correction process. Here the current "central" rates are themselves also progressively updated as an adaptive expectations error correction process. That is, recent actual rates of return define the "central" rate for the economy, and investment occurs in relation to deviations of this central rate from the world rate. With capital stocks evolving over time endogenously, it is potentially important to allow capital to flow between economies as investment occurs, that is savings in a given economy have to be allocated to investment both domestically and internationally. Ownership of factors determines to whom the benefits of growth in an economy will flow. In assessing the welfare implications of trade liberalisation, an expansion of economic activity as reflected in GDP would not necessarily be a good indicator of the benefits for the particular county if factors are owned by foreign investors and if investment arising from liberalisation changes that ownership. McDougall and Ianchovichina (1996) add equations to GTAP for long run capital mobility and for measuring welfare changes.

In the context of multi-country models, long run analysis is likely more appropriate than short run comparative static for analysing the impact of trade liberalisation agreed by a group of countries for implementation over time. For example, the implementation of the APEC agreement becomes effective in 2010 for developed countries and 2020 for developing countries. By 2020, the policy on trade will not be the only thing to have changed: the endowment factors of each economy will also have changed. Short run effects or trade liberalisation is of relatively less interest. Thus McDougall and Ianchovichina's (1996) extension of the GTAP model is potentially useful. Notwithstanding this, most long run analyses of trade liberalisation within the GTAP framework have relied on a long run comparative static analysis.

As in the case of long run analysis with the domestic ORANI model, the closure conditions must reflect long run equilibrium. The specification of long run equilibrium in the multi-country case needs to reflect economic notions of a long run steady state. These are not unequivocal. Francois *et al.* (1996) provides the basic requirements in terms of equilibrium relationships between current period and expected (future) rates of return on capital (these must be equal), between growth rates of capital across regions (these must be equal) and between changes in capital stocks and investment. Walmsley (1998), following McDougall and Ianchovichina (1996), draws attention to the need to allow for capital mobility across regions. Thus in a steady state, there are potentially two conditions that must be fulfilled in relation to rates of return (Walmsley, 1998):

1. equalisation of the current and expected rates of return within regions, and
2. equalisation of the expected rates of return across regions.

However, Walmsley recognizes that there may be reasons for steady state rates of return to differ across regions. In particular risk levels may differ across regions and so, by virtue of risk premiums, may equilibrium rates of return. Walmsley then empirically investigates trade liberalisation under two alternative views of long run equilibrium, one in which rates of return are equated across regions, and one where they may differ. Which is the better approach remains unclear. Walmsley ended up favoring risk-adjusted rates (i.e. allowing rates to differ across countries), but a final assessment should depend on being able to defend the implied risk premiums. In Walmsley's case, these were sometimes surprising. Ideally, risk should be endogenized in the CGE model itself.

Walmsley (1998) has also drawn attention to the need to ensure in long run comparative static analysis of policy that the comparison made is actually between two long run equilibrium position. Typically, an available data base for any given year would not reflect long run equilibrium because lags in the world economy mean there has been incomplete adjustment to past shocks, e.g. cross-country rates of return may not be in long run equilibrium. Walmsley argues that adjustments to the analysis are needed, effectively the construction of a steady state or equilibrium pre-policy database. These matters are discussed fully in Chapter 4.

Since changes in the physical capital, the labor force, the population and the total factor productivity cannot be predicted endogenously through GTAP simulations (Gehlhar, 1997), these factor endowments must be obtained from econometric estimation separate from the GTAP model and taken as exogenous variables in the GTAP long run analyses. For example, Anderson *et al.* (1996) treats agricultural land, physical capital, human capital, and the state of technology, population and the labor force as exogenous variables to project the food market in 2005; and Arndt *et al.* (1997) apply forecasts of changes to physical and human capital, agricultural land, population, the labor force and the Uruguay Round tariff reductions as exogenous shocks to determine the long run effects of China's economy.

2.4.5 Implementing General Equilibrium Models

Even with their simplifying assumptions, CGE models, by virtue of their detailed industry and product composition, are large models. Thousands of equations are usually involved and the equations are often non-linear. For the economic analyst, this poses several problems. First the tasks of constructing a CGE model and compiling the necessary data base is time consuming, at least if these tasks have to be done from "scratch". Second, the task of actually solving a set of non-linear equations for an equilibrium solution is daunting.

One of the great achievements of the CGE modeling community has been the development and public release of generic models, modules and computer programs and solution methods, which can be adopted and adapted across countries, from single to multi-equation models, and to a variety of analyses. Furthermore, the major models have been well supported by associated modeler networks, facilitated today via information technology and communications, and by training programs for model users. The IMPACT project, which led to the development of ORANI, deserves credit for initiating and maintaining the open CGE modeling approach. Not only has this facilitated Australian studies, but the generic structure, and the software implementation (GEMPACK) has been designed to service CGE modeling in general. In the multi-country and multi-sectoral model, the Industry Commission staff developed the SALTER model (Jomini *et al.*, 1994) which provided the starting point for the GTAP model. Similarly with the IMPACT project, the GTAP team has actively pursued this open approach drawing on the ORANI modeling approach, using the GEMPACK software, and making the model publicly available. Much of the research and publication effort of these groups has been directed to the procedures for efficiently building and solving CGE models. Because of this, it is relatively easy for analysts with no past connection to the developers or other involvement in CGE modeling to undertake CGE analyses.

This benefit comes at a potential cost. Because it is relatively, but not trivially, easy to implement CGE analysis, there is the real danger that inadequate thought will be given to the nature of the model, to the many assumptions involved, and to ensuring that decisions made by the analyst (for example, on model closure) are appropriate. These dangers are likely increasing. Not only does the progressive development of user interfaces make the use of models easier and so prone to careless use, so too does the increasing array of model versions and variants pose a problem.

While it was relatively easy for a potential CGE analyst to develop familiarity with a base model and the many assumptions of which he or she should be aware, with extensions, it has become more difficult to be assured one is aware of the many pitfalls. It is clear from their publications that the ORANI and GTAP team modelers themselves go to considerable lengths to ensure that their own understanding of their models and results is profound. Economic principles of optimality may mean it is appropriate for other user-analysts, who have less regular involvement with CGE modeling, to invest less effort in understanding and ensuring their actions are appropriate; but it is unclear how high is and how quickly does the marginal value product of effort decline. Other analysts would probably do well to try to follow the example of the developers, but in practice they will not always succeed.

2.5 Conclusion

The theory of trade and general equilibrium, and Indonesian trade policy in relation to other countries agreements was reviewed in this chapter. The review of the trade theory is started from the classical free trade theory which states that free trade is better than autarky and free trade is better than restricted trade for the small country. There have been significant developments in trade theory which relaxes the classical theory assumptions regarding constant return to scale, the absence of externalities and a perfectly competitive market. The relaxation of these assumptions may affect the impacts of trade liberalisation.

There are some methods to measure the impact of trade liberalisation. Quantitative methods to analyse the impacts are reviewed in this chapter such as the partial versus general equilibrium models, single country versus multi country models, linking between single country and multi country models, and static versus dynamic of general equilibrium models. The choice of using a general equilibrium approach to the trade analysis has been discussed in this chapter.

The general equilibrium approach is a better approach compared to partial equilibrium in order to analyse the inter-sectoral links and links between sectors and macroeconomic conditions. Even though both approaches have some weaknesses, compared to other approach such as a macroeconomic model, a general equilibrium model has been chosen in many studies to quantify the effect of trade liberalisation on macroeconomics and sectoral variable of one country or multi countries.

The single country and multi country approach has been used in the partial and general equilibrium model. A single country model can not capture the interrelationship among countries while the multi-country model can link the individual countries through the trade flows in product and input factors. A link between the multi regional and single country model of general equilibrium model is one alternative to analyse the impact of trade liberalisation.

The choice between static and dynamic models to analyse the impact of trade librealisation is reviewed in this chapter. The dynamic general equilibrium model has an advantage over the static model especially in the long run closure because the dynamic model recognizes the variable changing through time. However, the full dynamic model have a disadvantage in simplifying the theoretical foundation that imposed the rigidity of optimising behaviour and predetermined rate of time preferences on the producer and consumer in each period. The sequential solution, that is putting the dynamic equation in the comparative static model have an advantage because the data and behavioral parameters can be updated before running the model to the next period. In the multi-country model, the updated database into the steady state database is one of the alternatives to analyse the long run impact of trade liberalisation. In the single country model, the forecasting model of the comparative static general equilibrium is a better choice in order to updated database which is appropriate in the recent condition of one country before calculate the long run impact of trade liberalisation.

Having reviewed trade theory and the relevant regional trade agreements, the next chapter is devoted to a review of empirical studies of trade liberalisation using single country and multi country models. The review is concentrrated on the empirical studies that are related to Indonesia

CHAPTER 3

PREVIOUS GENERAL EQUILIBRIUM MODELING OF APEC AND THE INDONESIAN ECONOMY

A number of general equilibrium studies relevant to the Indonesian economy have already been completed. These include some research analysing the impacts of trade liberalisation using an Indonesian CGE model and studies of trade liberalisation in APEC using the GTAP multi-country model. These existing applications are reviewed in sections 3.1 and 3.2 with a view to establishing what extensions or alternatives to these would be needed to accomplish the aims of the present project.

3.1 Development of CGE Applications in Indonesia

There are three branches of development of general equilibrium models for Indonesia: the Lewis model, the inter-regional Lewis model and the ORANI-type model. The Lewis model and the inter-regional Lewis model are specified in terms of the levels of economic variables and determine absolute changes in variables in response to exogenous shocks, while the ORANI-type model is, as explained in chapter 2, linearised and focused on determining responses as percentage changes in variables. Lewis (1991) and Ratnawaty (1996) used the Lewis model. The inter-regional variant of the Lewis model was developed by Temenggung (1995) and Wuryanto (1996). Dee (1991) and Trewin *et al.* (1993) used the ORANI-type model.

The details of the equations and the construction of the database for the Lewis model are described in Lewis (1991). Ratnawaty (1996) used the Lewis model to analyse the impact of reducing tariffs and taxes on the Indonesian economy, the agricultural sector and income distribution. An early version or precursor of the Lewis model was developed and used by Behrman *et al.* (1989) to analyse the impact of oil and agricultural export price fluctuations on the macroeconomy, sectoral economy and income distribution of the Indonesian economy.

While the ORANI model is a multi-sectoral model of the Australian economy of dating from 1977 (Dixon, *et al.* 1982), it has been adapted for use in many countries and many studies. Dee (1991) applied the ORANI model to Indonesia, introducing a steady state treatment of forestry and allowing for an intertemporal treatment of capital accumulation. Trewin *et al.* (1993) also used the ORANI model, having adapted it by introducing fertiliser as a primary sector, simplifying the investment and capital creation and dissaggregating more detail in agriculture sector.

Temenggung (1995) and Wuryanto (1996) developed the Inter-regional Computable General Equilibrium (IRCGE) model for Indonesia. This is a single-period, multi-sectoral and comparative static CGE model. The model incorporated two primary regions of Indonesia: the "inner island" (Java) and the "outer islands" (the rest of Indonesia). Temenggung (1995) used the IRCGE model with the focus on the real side of the regional economies without consider on the financial sector. Using the IRCGE model, Temenggung (1995) analysed the consequence of national tax policy, which is tax-sharing system on the structural features of the Indonesian regional economies. Using the same model, Wuryanto (1996) analysed fiscal decentralisation and economic performance in Indonesia.

General equilibrium studies rely on comprehensive databases. The Indonesian Statistical Bureau periodically releases new input-output tables and the more general social accounting matrices. Usually there is a considerable lag in the release of statistics, making timely empirical analysis difficult. Thus the latest versions of both the input-output tables and social accounting matrices available to Ratnawaty (1996) and Wuryanto (1996) at the time of their studies in the mid-1990s were for 1990. Subsequently, a 1993 version of Social Accounting Matrix has been released. By 1998, no later version of the Input-Output tables had been released.

These Indonesian general equilibrium models are explained further in the next section. The description covers the database; the model dimensions; the theoretical structure, including demand and production structure; the market structure and the standard model closure; and the major policy findings.

3.1.1 The Model Dimension

Model dimension in computable general equilibrium modeling relates to the number of sectors explicitly identified. CGE models are inherently "multi-sector models", but this term is also used to imply some equality of model construction effort across sectors. Those models which give emphasis to or highlight one or a few sectors in the economy might be referred to as "sector-focused models" (Francois and Shiells, 1994). Dimension choice depends on which sectors are the focus of the research and on the time and resource capacity available to the researcher for handling the technical complexity.

The dimension and degree of sectors in the Indonesian general equilibrium model can be seen in Table 3.1. All of the models that are used by Behrman *et al.* (1989), Lewis (1991), Dee (1991), Trewin *et al.* (1993), Temenggung (1995), Wuryanto (1996) and Ratnawaty (1996) are multisectoral models although some of the research is focused on one sector. Those models have a dimension that ranges between 8 and 18 sectors. Behrman *et al.* (1989) focused on 12 sectors including food agriculture, traded agriculture, food industries, textiles, wood products, chemical and refining, metal industries, utilities, construction, trade and transport, and services. This research explored the impact of commodity price instability on the macroeconomy, as well as the sectoral and distribution consequences. The models that were used by Ratnawaty (1996) and Trewin *et al.* (1993) emphasised the agricultural sector but captured the economic structure for 14 and 16 sectors respectively. Trewin's (1993) study used a model that closely followed that of Dee (1991), although with a high degree of disagregation for the agricultural sector. In both the Temenggung (1995) and Wuryanto (1996) studies, each region (the inner and outer regions) had 9 sectors and 15 sectors, respectively.

The model that was used by Dee (1991) was more specifically directed towards exploring the forestry sector. Dee introduced a steady state treatment of forestry and an intertemporal treatment of capital accumulation. Therefore, the model could capture the short and long run impact changes in forestry policy instruments. Other models are the comparative static models and simulate the short-run impact of the economy.

On the demand side, households are disaggregated into a number of categories, varying from one to ten. Dee (1991) and Trewin *et al.* (1993) made the strong assumption that all households were sufficiently homogenous that behavior could be characterised by a single representative household. Trewin *et al.* (1993) argued that the simplification was acceptable because the focus of their studies was on the impact of incentive distortions on the agricultural sector. Meanwhile, Behrman, *et al.* (1989) and Ratnawaty (1996) used four and eight categories of households respectively in analysing welfare distribution impacts. In both regions of their multi-region models, Temenggung (1995) and Wuryanto (1996) divided households into ten and seven categories, respectively.

Whether or not the single-consumer assumption is adequate depends both on the aims of the analysis and on whether the simulations exogenous changes have a major impact on income distribution. The disaggregation of household groups is important if the research is to focus on welfare distribution and income structure. When model simulations relate to forecasts of the very long-run, which includes large demographic changes and major change in income distribution, the single household is likely inadequate (Dixon *et al.*, 1982).

3.1.2 Theoretical Structure

As noted in Chapter 2, applied general equilibrium analysis has been facilitated by the ready availability of "off-the-shelf" models and computing packages. This allows the economic analyst to focus on the particular analysis and problem being studied. Nevertheless, it is inappropriate, even reckless, to treat the model as a "black box". It is important to know the structure of the general equilibrium model in order to interpret and understand the results of simulated policy changes and other exogenous changes. The common structure of general equilibrium models consists of the demand and production structures, market structure, intertemporal structure and closure rules (Francois and Shiells, 1994).

Demand and production structure

The results of general equilibrium analyses are sensitive to the specification of demand and supply behavior. Pagan and Shannon (1987) found that the variation of supply parameter tends to be more sensitive than the demand parameter. In the tariff changes simulations, they demonstrated that the export supply elasticity is the most important set of the parameter in their model. The selection of demand and production functions is constrained by theory on the one hand and the ease of evaluation on the other (Shoven and Whalley, 1984). The theoretical constraint is on choosing the functional form, which satisfies the general equilibrium models such as Walras' law of demand function. This constraint explains why the simple demand and production functions are applied in general equilibrium model. These simple functions are the power function (namely the Cobb-Douglas function in the context of production functions), the constant elasticity of substitution (CES) function, the linear expenditure system (LES), and constant ratio of elasticities of substitution and homothetic (CRESH) function and the translog function. Each function has different characteristics to explained the production and demand function.

The power ("Cobb-Douglas") utility function is simple, parameter-wise and easy to use. It implies a unitary income elasticity, a unitary own price elasticity, and zero cross-price elasticity (Shoven and Whalley, 1984). With the CES utility function, the unitary own price elasticity is relaxed, while the LES utility function relaxes the assumption of unitary income elasticity (Shoven and Whalley, 1984). The choice of the utility function in the model depends on how elasticities to be used in the model.

The production function in the ORANI model (Dixon, *et al.*, 1982) consists of the relationship between input and activity level and the relationship between activity level and output. The CES and CRESH functions are often used in the input-activity level. The CES production function has two properties (Debertin, 1986). Firstly, the elasticity of substitution between two inputs is between zero and infinity; and secondly, for a given set of parameters, the elasticity of substitution is the same at all points on the production function. Although the CES production function has an advantage over the Cobb-Douglas production function, which has a unitary elasticity of substitution everywhere regardless of parameter values, it is still restrictive. When extended beyond two inputs, elasticities of substitution between each pair of inputs are all equal. Greater flexibility can be attained by moving beyond a single-stage production process and conceiving inputs as being combined in multiple stages. That is, a hierarchy based on CES functions can be used if the production function has more than two inputs (Shoven and Whalley, 1984). In many general equilibrium models, a two-stage process is modeled. In the first stage, there is a substitution among primary factors. At the second stage, primary and intermediate inputs are combined using a fixed coefficient production function. The generalisation of the CES production function is the CRESH production function. The advantage of using the CRESH over the CES is that it allows the variations of substitution elasticities over the different pairs of inputs (Dixon *et al.*, 1982). For example, in the case of agricultural product, it is allowed that the substitution elasticity between labor and land different from those between labor and capital.

In the output-activity function, the CET and CRESH production functions are used. The CET property is same as the CES property with the elasticity of substitution replaced by the elasticity of transformation. CRETH is a generalisation of CET, which allows the transformation elasticity between one pair of outputs to differ from that from another pair. In the ORANI model, Dixon, *et al.* (1982) assumed that each non-agricultural industry produces a single product and some agricultural commodities are used to produce the multiple outputs. CRETH is used in the agricultural production function. The lack of availability of time series data for output and prices, especially in developing countries, makes it difficult to estimate the CRESH parameter.

As shown in Table 3.1, the demand and production functions of the Indonesian models have simple functional forms. Behrman *et al.* (1989), Lewis (1991), Temenggung (1995), Ratnawaty (1996), and Wuryanto (1996) all used a CES demand function and thus a single-stage demand function. Dee (1991) and Trewin *et al.* (1993) who, as noted above, had opted for a single representative household in contrast to the other modelers who had used multiple households, adopted a two-stage demand function. The first stage was a linear expenditure system capturing the choice of commodity composition in consumption. The second stage was a CES function allowing for substitution and choice between different sources for each commodity, in particular domestic versus imported product.

Market structure

The market structure assumed in all the Indonesian general equilibrium models is that of competitive markets. That is, the representative firm for each industry/product has been modeled as if it were a price-taking profit-maximizing firm, with prices being determined to clear all markets. Imperfectly competitive behavior, which can be accommodated in CGE models by altering the relevant product supply, input demand and price relationship equations (see for example Francois and Roland-Host (1997)), has not been modeled in the existing Indonesian CGE models.

Changing the market structure and behavior can significantly influence the results obtained from general equilibrium models (Francois and Shiells, 1994). For example, with a monopoly in an industry, it would be expected that the price of the product would be raised and its supply would be reduced relative to perfect competition. This would alter the demand for inputs in its production and so potentially their prices. If the product is an intermediate input in the production of other products, the higher price would cause some changes in their supply and price levels. The extent of these general equilibrium effects would depend on how significant the monopolised sector was to the overall economy. A monopoly in the production of a minor product would affect that particular product and sector, but perhaps not much more. On the other hand, a monopoly in a key basic materials sector is likely to alter the equilibrium position for many sectors.

Even if the market structure would affect the equilibrium for the economy, it may still be acceptable to assume a competitive market structure in CGE modeling. If the aim is to determine the effects of exogenous changes via a comparative static (or dynamics) analysis rather than to specify equilibrium positions per se, the key issue is whether the implications of the change would be different under a fully competitive economy from those under an economy with some imperfections. While the equilibrium under different structures may be very different, it might be argued that the changes in equilibrium caused by an exogenous change may not differ from one structure to another.

One case in which formal attention clearly has to be given to imperfect competition is that of an analysis intended to examine the effects of altered market structure. Thus an analysis of deregulation of a monopolised industry would need to compare equilibrium with and without the monopoly structure. This was the case for example in the Australian study of wheat trade (Purcell and Beard, 1998). Potentially, changes in market structure are also important to a study of trade liberalisation where the liberalisation involves dismantling regulations and structures designed to protect and support domestic industries. Francois and Roland-Holst (1997) show that in the case of Korea in the Uruguay Round simulations, the imperfect competition can influence the assessments of trade liberalisation although the result is sensitive to the assumption of cournot conjectural variation. However, in the Australian study, Abayasiri and Horridge (1996) found that the result of a trade liberalisation simulation from the original ORANI-F model (perfect competition) did not differ and using the scale economies and imperfect competition of ORANIF.

As noted in section 2.3.2, Indonesia does have some government inspired monopolies, which are to be dismantled under the trade liberalisation. These include wheat and soybean which are monopolised by BULOG (*Badan Urusan Logistic* or Food Logistic Agency). The fact that they are to be dismantled by agreement does suggest that they could have a significant effect on trade; and that their removal could add to the benefits of lower tariffs under trade liberalisation. Failing to allow for the required change in market structure may thus lead to an underestimation of the impacts of trade liberalisation.

Modeling and allowing for changes in market structure is potentially more difficult than modeling the usual changes studied in CGE models. Changing structure means that the equations of the general equilibrium model, and not just the levels of variables in those equations, need changing. The problem is solved if the corresponding equations in the models for the two different structures can be seen as particular cases of a more general encompassing equations, that is if additional parameters can be introduced such that particular parameter values represent the two structures. The effects of changing the parameter value can then be captured as for any exogenous change in a comparative static analysis, provided care is taken to use a multi-step Johansen procedure to allow for non-linearities of the economy's response to potentially "large" changes in the new parameter(s).

None of the Indonesian CGE studies referenced have addressed the question of market structure in detail. Under Indonesian regulations, monopolies are forbidden except for government monopolies. In recent years, after the monetary crisis in mid 1997 as mentioned in section 2.3.2, regulations have been introduced to eliminate government monopolies, such as BULOG's monopoly for sugar and wheat. Therefore, the market behavior tends to be competitive, though in practice, some markets still operate as near monopolies, eg. clove and lemon.

Closure rules

The closure rules used in the Indonesian studies to complete the models from a macroeconomic perspective are shown in Table 3.2. The closure rules address the labor market, international capital mobility and exchange rate determination.

In all the models it is assumed that aggregate labor supply is fixed. Thus labor cannot move in or out of Indonesia from or to other countries. Labor is able to move freely between sectors. Dee (1991) and Trewin *et al.* (1993) divided labor into two categories: skilled and unskilled. In both studies, the CRESH technology is used to choose the composition of primary factors, including the type of labor. Each industry can use both type of labor. For unskilled labor, real wages are treated as exogenous and employment levels are determined endogenously. Conversely, for skilled labor, the employment levels were treated as exogenous and the real wages were endogenous. The closure assumed surplus unskilled labor, but scarce skilled labor (Trewin *et al.*, 1993).

As described in section 2.4.4, there are two approaches to the treatment of capital in closing CGE models, effectively defining short and long run analyses. First, one can fix the aggregate capital stock and allow the rental rate of capital to adjust (short run) and second, the rental rate of capital can be fixed, allow capital stocks to adjust (the long run) (Francois and Shiells, 1994). In most of the Indonesian general equilibrium models it was assumed that capital stock was fixed in order to study the short run impact of exogenous shocks. In her model which is emphasized on the forestry sector, Dee (1991) assumed a fixed rental rate of capital, allowing for intertemporal capital accumulation, thereby capturing long run impacts of the economy.

There are two alternatives for the government in terms of exchange rate policy which are flexible and fixed exchange rate. The macro economic closure of exchange rate options (flexible versus fixed exchange rate), together with the wages options (fixed versus flexible wages) is examined by Behrman *et al.* (1989).

3.1.3 Policy Simulation and Results

The Indonesian models reviewed above have been used to explore the effects of a diverse range of exogenous shocks. Behrman *et al.* (1989) examined exogenous petroleum and traded agricultural price shocks under various macroeconomic closures including fixed versus flexible exchange rates, and fixed versus flexible wages for skilled labor. Ratnawaty (1996) explored the effects of exogenous changes in import tariffs, export taxes and combinations of the two. Dee (1991) examined the implications of exogenously increasing the minimum age at which trees could be harvested. As well as applying exogenous tariff cuts, Trewin *et al.* (1993) studied the impacts of exogenous shocks to a technology improvement variable and the world price for fertiliser. Temenggung (1995) altered exogenous settings for tax sharing and Wuryanto (1996) exogenously set a change in the ratio of the central budget to regional government budgets. The results of the various policy simulations for the Indonesian models in each research are summarised in Table 3.3.

Lewis (1991) was the first to describe the model equations in detail and construct a database. Although the model used a multi-sector and comparative static framework to analyse the impact of exogenous shocks, no policy simulation and results were given. The policy results of the other models are based on comparative static analysis and short run closure. Most models assume that the capital stocks are fixed across sectors in any given period, and hence are not sufficient for investment and policy planning. The forecasting model incorporates the dynamic mechanism making it more capable in predicting the future economic performance of the Indonesian economy.

With respect to macroeconomic results, most of the studies looked at the impact of their various external shocks or policy reforms on employment, wages, output, trade, income and welfare. The size of the exogenous shocks imposed was not based on empirical evidence. One must thus question the meaning of the results. The result simulations could be close to reality, which will be faced if the exact amount is used in the shock. In relation to trade analysis, all the studies potentially suffer the disadvantage of using a single-country model which precludes responses by other countries to Indonesian changes. The reaction from other countries could not be captured using a single country model and there is no allowance for capital or labor mobility among countries. If Indonesia is a small country, it would not affect world markets. The fixed labor assumption is reasonable for the short run and perhaps even in the long run. Fixed capital is reasonable for the short run, but probably not for the long run.

In all Indonesian general equilibrium models, no test has been done to measure for the consistency of the model and database. The test to measure the consistency of model is the nominal and real homogeneity test. The nominal homogeneity test is used to test whether the model is consistent with the homogeneity of degree zero in the price variable for the real variable solution. The real homogeneity test is used to observe constant returns to scale on the supply side of the economy (War, 1997). The database is consistent with the general equilibrium model if the database represents the equilibrium condition in the economy. Misleading results would be avoided and reasonable values would be obtained if the requirement on the general equilibrium assumptions were fulfilled.

Table 3.1 Demand and Production Structure of Single Country Model for Indonesia

Author	Model	Data Base	Demand Side		Production Side	
			Demand Function	Disaggregation	Production Function	Disaggregation
Behrman, J.R, Lewis, J.D and Lofti, S (1989)	Indonesian CGE model	Input-output table 1980, Social Accounting Matrix 1980	Fixed input-output coefficient determining intermediate input demand	4 categories of household	Fixed input-output coefficients determining intermediate input use	12 sectors
Lewis, Jeffrey D (1991)	Lewis	Social Accounting Matrix 1985	CES demand function	4 categories of household	CES production function for combining intermediate inputs. Cobb Douglas for combining the primary factors	18 sectors
Ratnawaty, Any (1996)	Lewis	Input-output table 1990, Social Accounting Matrix 1985 and 1990	CES demand function	8 categories of household	CES production function for combining intermediate inputs. Cobb Douglas for combining the primary factors	14 sectors

Table 3.1 (Continued)

Author	Model	Data Base	Demand Side		Production Side	
			Demand Function	Disaggregation	Production Function	Disaggregation
Dee, Philippa (1991)	ORANI (modified)	Input-output table 1985, Social Accounting Matrix 1980	Stone-Geary Utility function to choose commodity composition. CES substitution possibilities to choose commodity by source	1 household	CES production function to combine the intermediate from different sources. CRESH technology to combine the primary factors. Fixed coefficient production function to combine intermediate and primary inputs	8 sectors
Trewin, R, Erwidodo and Huang, Y (1993)	INDOGEM (Orani modified)	Input-output table 1985 Social Accounting Matrix 1985	Linear expenditure system to choose commodity composition. CES substitution possibilities to choose commodity by source	1 household	CES production function to choose the composition of intermediate inputs and fertiliser from sources. CRESH technology to choose the composition of primary factors. Fixed coefficient production function to combine intermediate and primary inputs	16 sectors

Table 3.1 (Continued)

Author	Model	Data Base	Demand Side		Production Side	
			Demand Function	Disaggregation	Production Function	Disaggregation
Temenggung, Yuswandi Arsyad (1995)	Interregional Computable general equilibrium for Indonesia	Social Accounting Matrix 1985	Armington rule in the sectoral composite demand to allow imperfect substitution between domestic and imported goods.	household groups are divided into ten categories	CES production function in each sector and each region	each regions has 9 sectors
Wuryanto, Luky Eko (1996)	Interregional Computable general equilibrium for Indonesia	Input-output table 1990 Social Accounting Matrix 1990	Armington rule in the sectoral composite demand to allows imperfect substitution between domestic and imported goods. Armington rule at the sectoral level, which allows imperfect substitution between interregional, domestic and imported goods.	household groups are divided into seven categories	CES production function in each sector and each region	15 sectors

Table 3.2 Market Structure and Model Closure

Author	Market Structure	Model Closure			
	Firm Behavior	Balance of Payments	Capital Market	Labor Market	Land
Behrman, J.R, Lewis, J.D and Lofti, S	Perfect competition	Flexible exchange rate, total expenditure on imports would be equal to the sum of total export, net foreign capital flows and reserve changes. Government expenditure is divided exogenously into private and government consumption, and investment. Five sources of government revenue: oil, household tax, corporate tax, indirect tax, tariff and government borrowing.	Capital stocks are fixed in the period	Four labor types: two types (paid workers and unpaid proprietors) for agricultural sectors and two types (blue and collar) for all sectors. Supply of labor is fixed and wages adjust to clear the market	
Lewis, Jeffrey D (1991)	Perfect competition	Current account is fixed; foreign reserve changes will be determined by the balance of payments. Balance of payments flows are fixed in foreign currency	Capital stock is specified exogenously	For each labor type, total factor supply is fixed. Labor is freely mobile across sectors but not between labor types.	

Table 3.2 (Continued)

Author	Market Structure Firm Behavior	Model Closure			
		Balance of Payments	Capital Market	Labor Market	Land
Ratnawaty, Any (1996)	Perfect competition	Current account is fixed; foreign reserve changes will be determined by the balance of payments. Balance of payments flows are fixed in foreign currency	Capital stock is specified exogenously	For each labor type, total factor supply is fixed. Labor is freely mobile across sectors but not between labor types.	
Dee, Philippa (1991)	Perfect competition	na	intertemporal treatment of capital accumulation	Real wages for unskilled agricultural and production occupations are exogenous and their employment levels are endogenous. Employment level for skilled administrative and professional occupations are exogenous and their real wages are endogenous	Land mobile between agriculture and forestry
Trewin,R, Erwidodo and Huang, Y (1993)	Perfect competition	na	Industry rate of return on capital are fixed and capital stocks allowed to adjust through investment and inter-industry capital flows	Real wages for unskilled agricultural and production occupations are exogenous and their employment levels are endogenous. Employment level for skilled administrative and professional occupations are exogenous and their real wages are endogenous	Land mobile between agriculture and forestry

Table 3.2 (Continued)

Author	Market Structure Firm Behavior	Model Closure			
		Balance of Payments	Capital Market	Labor Market	Land
Temenggung, Yuswandi Arsyad (1995)	Perfect competition	The foreign exchange rate is fixed exogenously, and foreign exchange reserves as a result of balance of trade are used as the equilibrating variables for any excess payments to the rest of the world.	Total supply of capital is fixed. Rental rate of capital adjusts until capital supplies are fully utilised and clear the market.	Regional labor supply assumption and specification in the model is not fully utilised due to the fixed wage level in each sector.	
Wuryanto, Luky Eko (1996)	Perfect competition		Capital stocks in each sector are assumed to be fixed and immobile both interregional and inter-sectoral	Seven categories for labor demand Aggregate labor demand is assumed to be mobile inter-sectoral, but not interregional	

Table 3.3 Major Policy Findings of the Models

Author	Policy simulations	Policy data used	Policy Conclusion
Behrman, J.R, Lewis, J.D and Lofti, S (1989)	Output price shock to petroleum and traded agricultural product (-50%, -20%, 20% and 50%) in the alternative specification: fixed versus flexible exchange rate, and fixed versus flexible wages for skilled labor.	na	With the rice shock under fixed exchange rate, the effect on real GDP is small because the capital and employment is fixed. With a fixed exchange rate, the total change in traded agricultural exports averaged around 70 percent more than the initial impacts; with the flexible exchange rate, this drops to around 40 percent. With a flexible exchange rate, the sectoral origin of the shock is far less important, since movement in the exchange rate spreads the adjustment throughout the economy. The oil shock is bigger than the trade agricultural shock on export changes. There is added asymmetry due to the rigid wages for high-wage workers. This results in a larger impact of price fluctuations on some important outcomes (e.g. GDP). The price shocks usually reduce GDP and investment, and increase consumption and foreign reserves with a fixed exchange rate. The fixed exchange rate leads to the better set of outcomes for the price shock cycle, but the opposite is the case for the traded agriculture price shock cycle.

Table 3.3 (Continued)

Author	Policy simulations	Policy data used	Policy Conclusion
Lewis, Jeffrey D (1991)	na	na	na
Ratnawaty, Any (1996)	1. Import tariff for all industries set to be 5% 2. Export tax for all industries set to be 5 % 3. Import tariff and export tax for all industries set to be 5% 4. Import tariff for all industries and export tax for forestry and agroindustry set to be 5% 5. Import tariff for all industries set to be 5% and export tax set to be 0% 6. Import tariff and export tax for all industries set to be 0%	Deregulation packages at 23 May 1995 and 4 June 1996 to reduce import tariff and export tax	1. A decrease in income in simulation 1 and vice versa in simulation 2-6. 2. Simulation 5 and 6 decrease the income distribution and vice versa in simulation 1.
Dee, Philippa (1991)	Five percent increase in MINAGE, the minimum age at which trees can be harvested in the forestry sector	na	Annual output decreases and the price of domestically produced forest products increases Forestry net revenue and the stock value of forestland increases, providing the price signals to attract the additional land to forestry.

Table 3.3 (Continued)

Author	Policy simulations	Policy data used	Policy Conclusion
Trewin, R, Erwidodo and Huang, Y (1993)	1. 25 per cent tariff cut 2. 1 per cent improvement of the technical efficiency of the fertiliser production (and distribution) 3. 1 per cent improvement in the efficiency of application of fertiliser for the food sector 4. 40 per cent increase in the world fertiliser prices	1. The changing assistance to various sectors along the tariff compensation. 2. Improvement in the cost of distributing fertiliser 3. Improvement in the efficiency of fertiliser application 4. Increases in the world fertiliser	1. Industry activity levels, demand for labor and land increase for relatively lightly assisted sectors such as mining and decrease for relatively heavily assisted sectors such as soybean. Real GDP, exports and imports increase while the GDP deflator, government expenditure and public sector borrowing decline. 2. Industry activity levels increase for fertiliser production and irrigated rice off-Java. Agricultural employment, real GDP, GDP deflator, imports, and government expenditure increase while the sector borrowing requirement declines. 3. Industry activity levels increase for all food commodities, and for fertiliser production. Demand for fertiliser increases in the rice sector off-Java and increases in on-Java. Real GDP, export and real sector borrowing decrease, while GDP deflator, imports and government expenditure increase. 4. Industry activity levels decrease for irrigated rice off-Java but increase for local fertiliser production. Demand for fertiliser decrease while export demand increase. Real GDP, exports, government revenue, and the real public sector borrowing increase while agricultural employment, GDP deflator, imports and nominal total revenue decrease.

Table 3.3 (Continued)

Author	Policy simulations	Policy data used	Policy Conclusion
Temenggung, Yuswandi Arsyad (1995)	Simulations of exogenous shocks are 10%, 20% and 30% of tax sharing	Tax sharing system is on the structural features of the regional economies of Indonesia	In all simulations : The real GDP growth and current account balance increase. Regional deficits can be significantly reduced although employment creation may decrease because of decreases in government subsidies. It is important to have a criteria by which tax collections are allocated to the regions.
Wuryanto, Luky Eko (1996)	All simulations start from the assumption of a 20% decrease in the central budget for economic infrastructure. There are 12 simulations of changes in regional government. Those simulations are the combination of transfers of respective funds to of Java, outer islands or regional governments to finance economic infrastructure expenditures, specified INPRES for road improvement or specifies INPRES for primary education and health facilities.	The actual fiscal setting in 1990 shows that the government strongly dominated investment activities in both the Java and the outer islands region. Economic infrastructure was the main investment activity in both the central and regional government	The decentralising of the fiscal system, mainly the INPRES programs, would generate greater national economic growth and lesser amount of government borrowing. Some INPRES programs would improve economic performance.

3.2 Development of CGE Applications to APEC Countries

The use of multi-country multi-commodity general equilibrium models to analyse the impact of APEC trade liberalisation has become increasingly common in recent years. These studies include those of Dee and Welsh (1994), World Bank (1994), Hertel *et al.* (1995), Lewis and Robinson (1995), Dee *et al.* (1996), McKibbin (1996), Podbury *et al.* (1996), Erwidodo and Feridhanusetyawan (1997), APEC Economic Committee (1997) and Walmsley (1998). The general finding of most studies is an increase of both real income and overall trade for most countries participating in APEC trade liberalisation. A more detailed elaboration and analysis of this recent research is presented in this section.

Murtough *et al.* (1994), Hertel *et al.* (1995), Erwidodo and Feridhanusetyawan (1997), APEC Economic committee (1997) and Walmsley (1998) all used a GTAP-based model. The standard comparative static GTAP model was used by Murtough *et al.* (1994) and Erwidodo and Feridhanusetyawan (1997). Murtough, *et al.* (1994) examined and compared the impact of trade liberalisation based on Uruguay Round agreement and APEC agreement using the 7 sector and 15 countries. The result shows that all countries have a potential gain if the further trade liberalisation is completely implemented. Murtough *et al.* (1994) suggest to incorporate productivity improvements and capital stock mobility in the GTAP model to obtain a better estimate for the welfare gain arising from trade liberalisation. Erwidodo and Feridhanusetyawan (1997) also study the impact of APEC and the Uruguay Round tariff reduction. The result shows that the welfare gain from one country is bigger in the country, which has more progressive and bigger tariff reduction.

Hertel *et al.* (1995) used the standard GTAP model and the 2005 data. The 2005 data is projected from 1992 by incorporating the capital stock and human capital projections as a comparative advantage gain in the East Asian economies. However, any dynamic gains of trade liberalisation arising from capital mobility and productivity improvements are not included. The study is likely to underestimate the welfare benefits, which is calculated from the Hicksian equivalent variation of freer trade.

Dynamic versions of the GTAP model were developed and used by the APEC Economic Committee (1997) and Walmsley (1998) to achieve a better representation of the endogenous nature of capital accumulation over time. To capture the dynamic effects, the APEC Economic Committee (1997) incorporated a medium-term income-savings-investment linkage: trade liberalisation stimulates savings and investment and capital accumulates accordingly. The economies are assumed to reach a steady state in the new equilibrium in which investment equals depreciation. The model also tries to incorporate scale economies and increasing return to scale. However, due to the high regional and sectoral disaggregation, a stable result for the individual country and sector could not be achieved. Walmsley (1998) also incorporates an investment and capital accumulation linkage and assumes steady state growth in the long run closure. Instead of modifying the GTAP model to fulfill the steady state growth assumption, she modified the GTAP database. Walmsley (1998) adjusted the GTAP database to form a steady state database with, alternatively, risk adjusted and non-risk-adjusted rates of return to capital. The need to do so for consistency in CGE modeling was explained in section 2.6. Both Walmsley and the APEC Economic Committee compared results from their modified models with those from more standard static analyses. In both cases, they concluded that the impact of APEC trade liberalisation is larger in the modified model and database (for the Wamsley model) rather than using the standard GTAP model and database.

Not all the APEC trade liberalisation studies have been based on the GTAP model. Other multi-country models used in research include the Salter model (used in Dee and Welsh (1994)), the APEC-CGE model (used in Lewis and Robinson (1995)), the IC 95 model (used in Dee *et al.* (1996)), and the Asia-Pacific G-Cubed Model (APCUBED) (used in McKibbin (1996)). The World Bank (1994) used an unspecified multi-commodity and multi-country model. It is not discussed further here. Each of the other models is briefly discussed below.

The APEC-CGE model contains twelve sectors and nine regions or countries and has two particular features (Lewis, *et al.*, 1995). First, the adoption of the Almost Ideal Demand System (AIDS) specification for modeling the import demand. The

AIDS model specification allows the cross-country substitution elaticities to differ and allows for non-unitary import expenditure elasticities (Green and Alston, 1990). Second, it capturing of the potential dynamic linkage between trade expansion and productivity. In this case it does not mean that the model is dynamic, since the model only captures the dynamic-externalities experiments which is the net cumulative effect over time of productivity externalities from regional integration (Lewis, *et al.*, 1995).

As noted in section 2.7, the Salter (Sectoral Analysis of Liberalisation of Trade in the East Asian region) model, developed in Australia by the Industry Commission, was an early multi-country CGE model and in fact a precursor to the GTAP model. Dee and Welsh (1994) used the Salter model to analyse the impact of free trade with other APEC bloc members on the manufactures and agricultural sectors only on Australia economy. Unlike in the GTAP model, in the Salter model, capital is assumed to be perfectly mobile between countries. If the government imposed constraints and market imperfections exist, changes in capital movements and debt obligations will overstate in the result. Another assumption in the Salter model is that Australia behaves like a monopolist and restricts its supply in order to increase its net income from manufactured exports. This treatment will limit the degree of substitutability between similar products, which is produced in different countries, and is even more limited than using standard GTAP model.

The IC 95 (Dee *et al.*, 1996) is a hybrid model of international trade which incorporates capital accumulation and international capital mobility from Salter models (Jomini *et al.* 1994) and the imperfectly competitive, monopolistic competition treatment of resources, food processing and other manufacturing industries. The database in the model is based on GTAP 1992 database and updated in order to incorporate information from GATT/WTO. Dee *et al.* (1996) used the model in a study of the 'long-run snapshot' view of the impact of APEC trade liberalisation.

The Asia-Pacific G-Cubed Model (APCUBED), as used by McKibbin (1996) is different from other studies such as Dee and Welsh (1994), Hertel *et al.* (1995) and Murtough, *et al.* (1994) because the model has an intertemporal macroeconomic approach focussing on the dynamic approach. The specification of the model involves solving the model with full rational expectation equilibrium at an annual frequency from 1995 to 2100. However, it only covered a small amount of sectors (six sectors). It was not sufficient to analyse the detailed sectoral especially in more aggregation of agricultural sector.

Empirical CGE studies differ not only in their models and objectives but also in their databases. Those studies which used the GTAP model, and which are noted above, all used a 1992 database with the except of the Murtough (1994) study, which was based on 1984 data. In some models, the base year database is projected to one or more future years for assessing the long run impacts of policy reforms: 2005 (Hertel *et al.*, 1995), and 2000 and 2010 (APEC Economic Committee, 1997). The projections are made by simulating exogenous shocks for the state of the economy, including physical and human capital. The necessary shocks are determined by first projecting growth rates outside the GTAP model. However, the projected databases were not adjusted to satisfy steady-state assumptions, except in Walmsley (1998).

Those entire models are based on GTAP database except for database which is used in McKibbin (1996). The GTAP project has a success attempt to be a center of global database. The GTAP database contains bilateral trade, transport and protection data, as well as the individual country input-output database (Hertel, 1997). The complicated task has been done in order to satisfy the similar sector aggregation and year in each country. The balancing of the database has also been checked in each country and in the global to satisfy Walras' Law (Gehlhar *et al.*, 1997). The latest version of GTAP database (released in 1998) is the version 4, which contains 45 regions and 50 sectors. McKibbin (1996) uses The AP-GCUBED data which is based on several sources. These sources are from the Institute of Developing Economies for Asia-Pacific input-output tables, US table for the aggregate ROECD input-output tables, United Nations SITC (Standard Industry Trade Classification) for trade shares which is provided from the International Economic Databank ANU (McKibbin, 1996).

The various APEC studies, even those using the same model, differ in the scenarios investigated and details of the simulations. Differences relate to the detail and definition of sectors, country blocs, and length of analysis. Some studies have examined trade liberalisation in specific sectors and compared the impacts to those from wider liberalisation of the trading system. Dee and Welsh (1994) used two scenarios, namely those of APEC trade liberalisation on manufactures only, and that of liberalised trade for both manufactures and agriculture. Meanwhile, Dee *et al.* (1996) investigated four scenarios: liberalisation on a non-discriminatory basis which is consistent with the notions of open regionalism; liberalisation of all sectors excluding the agricultural sector; liberalisation of services only; and liberalisation of trade facilitation (equivalent to 5 and 10 percent of the import value). Podbury *et al.* (1996) had two different scenarios: one in which all sectors are liberalised and another in which all except the agricultural sector is liberalised.

Instead of examining the impact the varying levels of sector participation in trade liberalisation across all APEC countries, some studies have examined the impacts of varying blocs of member countries undertaking trade liberalisation beside APEC bloc members. World Bank (1994) studied trade liberalisation by East Asian countries, while Murtough *et al.* (1994) compared full APEC liberalisation with full liberalisation by just the advanced APEC members. McKibbin (1996) compared APEC countries' liberalisation with ASEAN countries' liberalisation.

The research findings from these studies cannot easily be compared with each other because of the different countries and sectors involved. The general findings of the research are that most countries have real income gains from trade liberalisation and increase their overall trade. In general, the more countries that participate in the liberalisation, the more benefits most countries will get. In terms of time, the long-run impact of trade is greater than the short-run impact, as expected.

One of the findings with important methodological implications for the assessment of impacts in CGE modeling is that the nature of the database influences the long-run results. Walmsley (1998) found that the long-run changes in the capital stock and in the real GDP tended to be greater when estimated using a steady state database than those based on the standard, non-steady-state, benchmark database.

The APEC Economic Committee (1997) concluded that all APEC members gained from trade liberalisation, but in different magnitudes. The committee found that the differences among APEC members related to the relative sizes of the economies, the degree of liberalisation and the expected interaction among the economies. The relative size of the economies means that the larger the economy in one country, the larger the real income gain because of trade liberalisation. The degree of liberalisation means that the implementation of the Uruguay Round and MAPA agreement simultaneously will increase, for example, the export volume of APEC economics more than the implementation of Uruguay Round agreement.

The results from each of the studies briefly reviewed above are summarized in some detail in Table 3.4.

Table 3.4 Characteristics of Model Used and Scenario for APEC Trade Analysis

Author	Model	Base Year	Coverage	Scenario	Analysis
Dee and Welsh (1994)	Salter	1988	37 sectors 16 regions	1.All tariffs and non-tariff barriers to manufactures trade with other APEC bloc members only are removed. 2.All tariffs and non-tariff barriers to manufactures trade with other APEC bloc members only are removed and all agricultural assistance is eliminated on an MFN basis.	In scenario 1: Australia's aggregate production and exports would be higher by 2.5 percent and 26 percent, respectively. Australia's real income falls by 0.7 percent because of deterioration of Australia's terms of trade. In scenario 2: Australia's real income rises by 0.4 per cent. Australia's agricultural production rises while manufacturing output slightly decreases.
World Bank (1994)	Multi - country, multi - commodity (not specified)	2000	7 sectors 19 regions	1.East Asian MFN liberalisation Tariffs are reduced by 50 per cent. Foreign direct investment is exogenously increased by 100 per cent. 2.East Asian preferential liberalisation Tariffs are reduced by 50 per cent for trade with other East Asian bloc members only. Foreign direct investment in developing economies in East Asia is exogenously increased by 50 per cent.	In scenario 1: East Asian countries would increase global welfare by 0.4 percent in the year 2000. In scenario 2: The benefit for East Asian economies would be significantly lower than in scenario 1(0.2 percent). In both scenarios, East Asian economies have the greatest income growth.

Table 3.4 (Continued)

Author	Model	Base Year	Coverage	Scenario	Analysis
Murtough *et al.* (1994)	GTAP	1988	7 sectors 15 regions	1.Uruguay Round Tariff equivalents for the non-agricultural and the non-service sectors are reduced by 40 per cent. Minimum market access and reduction in subsidised exports for agricultural product have been implemented 2.Full APEC liberalisation All distortions are removed on an MFN basis by APEC economies. 3.Full liberalisation by advanced APEC members (Australia, Canada, Japan, South Korea, New Zealand, Taiwan and United States).	In the first and second simulation, the volume and value of Australian net exports of agricultural, mineral and energy, and processed food products will increase while resource based manufactures and services will decrease. In the third simulation, the volume and value of net exports in European Union increase except in mineral and energy production. It is beneficial for all APEC members to liberalise trade on a regional basis. The APEC developing countries would be better off by not delaying the liberalisation of trading arrangements.
Hertel *et al.* (1995)	GTAP	2005	10 sectors 15 regions	1.Uruguay Round tariff reductions Tariff reductions and reduction in subsidised exports for agricultural products 2.Elimination of the MFA in 2005 All export quotas associated with the MFA are removed	Agricultural output in most East Asian economies would decrease in scenario 1. However food processing would expand in South Korea, Taiwan, Malaysia and the Philippines. Textile production would fall in most economies except South Korea. In scenario 2, all countries increase their welfare gains, which the biggest increase is in Malaysia.

Table 3.4 (Continued)

Author	Model	Base Year	Coverage	Scenario	Analysis
Lewis and Robinson (1995)	APEC-CGE	1992	9 regions 12 sectors	1. Trade liberalisation under Uruguay Round and regional free trade initiative 2. Realignment in international exchange rates	The gains from the Uruguay Round are greater for countries that eliminate all protection where their trading partner also opens their market. The MFA provides significant gains from trade for Asian developing countries. APEC provides a significant gain for the APEC members. ASEAN free trade provides little benefit to its members Changes in exchange rates have significant effects on bilateral trade balances and on the volume and direction of trade, but less effect on allocate efficiency across sectors.

Table 3.4 (Continued)

Author	Model	Base	Coverage	Scenario	Analysis
Dee et al (1996)	IC 95	1992	14 regions 4 sectors	1. APEC trade liberalisation of non-discriminatory 2. Excluding agriculture from the liberalisation package 3. APEC trade liberalisation for services only 4. Trade facilitation measures equivalent to 5 and 10 per cent of the value of imports	In scenario 1: • the real GDP in all APEC economies rises • the average world price of agricultural and food product, conversely of resources, manufacturing and services rises • terms of trade improve in agricultural exporting regions, and fall in the agricultural importing regions and, in regions with significant levels of tariff protection in resource and/or non-food manufacturing . • all regions are projected to gain their real income. In scenario 2: • the real income tends to be lower than full liberalisation except China. The drop off because of very efficient agricultural exporters and very highly assisted agricultural sectors. In scenario 3: • There is a greater share of the total gains in economies where the services sector accounts for a relatively large share of GDP initially, and/or where services trade barriers have been assessed as relatively high. In scenario 4: • Real income gains can be as great or greater than those achieved through trade liberalisation, but with significantly less relative movement in the sectoral composition of output.

Table 3.4 (Continued)

Author	Model	Base Year	Coverage	Scenario	Analysis
McKibbin (1996)	Asia-Pacific G-Cubed Model (APGCUBED)	1995 and 2020	16 regions 6 sectors	1.Non discriminatory reduction in trade barriers by APEC economies (MFN liberalisation) 2.Preferential basis reduction in trade barriers by APEC members (APEC free trade area) 3.ASEAN economies cut their level of protection in a non preferential way (Asean Free Trade Area)	In scenario 1, by 2020 : • Production in all economies is higher (in terms of GDP and consumption). • The consumption gains larger than production gains • The longer run gains are positive. In the very short run, some country have negative effects In scenario 2: • Income and capital investment rise by less than in the scenario 2. In scenario 3: • The gains are less than in the scenario 2 and 1.
Erwidodo and Feridhanusetyawan, Tubagus (1997)	GTAP	1992	10 regions 10 sectors	1.APEC tariff reduction based on IAP 2.Uruguay Round tariff reduction 3.Combination between the first and second criteria	The more progressive and larger removal of all border tariffs between APEC and Non-APEC countries (scenario 3) leads to the biggest welfare gain. The countries' welfare gain in the UR/WTO agreement is bigger than under APEC-IAP agreement. In Indonesia and Korea, trade liberalisation through the UR/WTO and APEC-IAP will increase manufacturing exports, decrease the labor and capital demands in the agricultural and services sectors, and increase imports of agricultural and services product.

Table 3.4 (Continued)

Author	Model	Base Year	Coverage	Scenario	Analysis
Podbury, T, et al (1996)	MEGABARE with GTAP data base	1992	15 Region 19 sectors	1. All sectors of APEC economies were liberalised 2. All sectors with the exception of agriculture were liberalised	An increase of real gross national expenditure is generally smaller in the APEC economy compare to those under comprehensive liberalisation. The production effect is varies among economies because of variety in economic structure and protection regime. For Australia, output of agriculture and manufacturing sector would grow under both scenarios. However, under full liberalisation, growth in agriculture increases and growth in manufactures decreases.
APEC Economic Committee (1997)	GTAP	1992	19 regions 14 sectors	1. Full implementation of Uruguay Round (UR) measures 2. The implementation of Uruguay Round and MAPA	UR agreements will increase the volume of merchandise exports of APEC economics and the world about 9.1 percent and 7.3 percent, respectively. UR and MAPA agreements will increase the volume of merchandise exports of APEC economics and the world about 12.1 percent and 9.1 percent, respectively. MAPA agreement will increase the production, exports and imports of APEC economies. the GDP of APEC and the world will increase by about 0.4 percent and 0.2 percent, respectively.

Table 3.4 (Continued)

Author	Model	Base Year	Coverage	Scenario	Analysis
Walmsley (1998)	GTAP	1992	11 regions 8 regions	APEC shock (reduce all tariff in APEC countries) in the : 1. Standard Benchmark Database : • short-run closure • long-run closure 2. Steady state database with risk adjusted and non-risk adjusted long run closure with • rate of return shock • capital growth shock	Using the standard benchmark data : In most cases, excluding North America and Rest of the World, APEC trade liberalisation will improve real GDP. The improvement in the long run is greater than in the short run. There is a positive change in the current rate of return in the short run and long run closure. Using the steady state database : The incorporation of risk premium had relatively little effect on the long run results, while use of a steady state database will affect the long run results. The changes in capital stock and in real GDP tended to be even greater than those based on the standard benchmark database.

3.3 Implications for the Direction of the Present Study

The main objective of this study is to examine the impacts of trade liberalisation on Indonesia, and in particular on agriculture. The literature review in chapters 2 and 3 show that there has been relatively little empirical research addressing this.

In section 3.2, the Global Trade Analysis Project (GTAP) model was described. It is a multi-regional model that has been used extensively for studying trade liberalisation. Because agricultural exports remain significant to Indonesia (see chapter 1) and because the main agricultural exports come from estate crops, it is hypothesised that the agricultural sector, and its estate crops sub-sector, will both be affected by and will influence the effects of trade liberalisation on other sectors of the Indonesian economy. The GTAP Version 3 database, the most recently available at the time of this study, covers 37 sectors. However, the agricultural sector, and in particular the estate crops sub-sector was not disaggregated. This is not surprising given the inevitable constraint of model size. Multi-country models used for global trade analysis cannot easily accommodate a highly disaggregated representation of every market.

One way to capture more detail in an individual country without making the model excessively large, is to link a global trade model with a detailed national model of an economy of particular interest as briefly discussed in section 2.5. Linking between a multi-country (GTAP) and a single country model for Australia (MONASH) has been used by Huff *et al.* (1995) and Adams *et al.* (1997) to predict the prospects of the Australian economy under the APEC agreement. The literature review in this chapter provided no evidence that such an approach has been used for Indonesia.

To study the effects of trade liberalisation on a particular economy, it is necessary to consider both the impacts of global markets on the country, and whether the country itself affects the global markets. A one-way linking of models would only be appropriate if the individual country was small, for then the analysis of the impacts of trade liberalisation on the country can be based on taking the estimated changes in global market conditions as given in a study of the economy of the particular country. That is, the GTAP model can be used to make these predictions. As will be explained in section 4.3, there are ways of determining whether a country can be treated as small. There are reasons to believe, and some evidence (as discussed in section 2.5), that Indonesia is small. Further examination of this issue will be possible in the empirical work in this study making use of the GTAP model and an Indonesian national model.

The review of Indonesian general equilibrium models suggests that there is no existing model ideally suited to examining the effects of trade liberalisation. There are a number of deficiencies. Two which seem worthy of attention are (a) the very limited attention given to dynamic aspects and (b) the lack of detail in the models and their databases in relation to the agricultural sector.

The review has established that most of the models have been of the standard comparative static type. Studies with these models have all focused on short run analyses in which capital stocks are assumed fixed. The one exception to the standard comparative static framework is Dee's (1991) study of the forestry sector. Her model, which is specifically focussed on the forestry sector and unusual in that it treats the forestry sector as being in a steady state (the forest stock is sustained with an optimal harvest age which varies with rates of return on capital), also includes some endogenous capital accumulation as the economy reaches a long run steady-state condition. To the extent that the long run effects of policy reforms such as trade liberalisation usually include capital accumulation. Capital accumulation throughout the economy should be endogenized if the effects of those reforms are to be properly captured. The fact that Indonesian analysts have chosen to avoid long run analysis within their comparative static models suggests that the proper treatment of capital accumulation is seen as important in reaching long run estimates.

In chapter 2, various approaches being taken towards developing dynamic CGE models were outlined. One relatively simple way, short of a full dynamic model, to allow for endogeneity of capital accumulation is that taken by Horridge *et al.*

(1993) in the ORANI-F Australian model. The model is not dynamic per se, but includes variables from two distinct points in time, the present and a future specified time, such that capital and investment at the future time are forced, when altered by exogenous shocks, to be steady-state consistent and consistent with the present level of investment. In the present study, this same approach is taken in building a simple "dynamic" general equilibrium model of the Indonesian economy. This model can then be used to forecast the future position of the Indonesian economy, both with and without trade liberalisation, and thus to forecast the long-run impact of trade liberalisation. Beside the ORANI-F type of investment, the Indonesian model in this research has a flexibility to capture other investment types which are the comparative static ORANI type of investment and the Walmsley type of investment.

The existing Indonesian models have not been developed for studying trade liberalisation specifically, and therefore do not give particular attention to those sectors that are dominant in trade. Accordingly, the model to be developed in this study will not only be more detailed sector wise than the existing Indonesian models, but especially so for the agricultural sector. Because the model is also focused on the agricultural sector, the model has a flexibility to capture the variation of land type mobility.

The latest database used in Indonesian general equilibrium models are the input-output tables and social accounting matrices for 1990. While these remained (at the time this study was initiated) the most recent databases, it is possible to update (in estimate form at least) the database using a "dynamic" model of the type described by Horridge *et al.* (1993) and to be developed in this study. This will be done in the empirical work in this study in order to base estimates of trade liberalisation impacts on a less dated economy.

Because the Indonesian model is to be developed on the basis of the ORANI-F model, the generic structure of the latter is outlined in the next chapter. The Indonesian model extends the ORANI-F model to embrace alternative specifications of land mobility and investment. The GTAP model is also described, though not in the detail as for the ORANI-F model. Its investment specification is also extended.

CHAPTER 4

THE GENERAL EQUILIBRIUM MODELS OF THE INDONESIAN AND GLOBAL ECONOMIES

The impacts of trade liberalisation are explored in later chapters with two computable general equilibrium models, namely the GTAP model (Hertel, 1997), which focuses on global trading relations among countries, and an Indonesian Forecasting Model, which focuses on the detailed sectoral structure (especially agriculture and estate-crop commodities) and occupational dimensions of the Indonesian economy. The Indonesian Forecasting Model is developed in this study. It is based on the Australian ORANI-F model (Horridge et al., 1993). This chapter is primarily a description of the two models and how it is proposed to link results from the GTAP model to simulations with the forecasting model.

The major section, section 4.1, relates to the Indonesian model. Since the model has a similar structure as ORANI-F, the description is largely a restatement of that provided by Horridge *et al.* (1993). However, the description uses slightly modified notation, presents and explains some aspects and components of the model differently, and largely avoids any reference to the computing language associated with the GEMPACK computer package commonly used in manipulating ORANI-F and CGE models. The model does differ from the ORANI-F model in the flexibility it provides the analyst in dealing with investment, drawing in particular on ideas used by Walmsley (1998) in her modifications of the global GTAP model to introduce a steady-state database for long run analysis. The model also differs from the ORANI-F in the treatment of the land used in each industry. The Indonesian Forecasting Model has a flexibility to capture the land mobility among sector in estate crops and food crops groups or among industries instead of fixing the land used in each industry.

Section 4.2, which concerns the GTAP model, is similarly a restatement of existing published material. Again, however, the treatment of investment differs from the standard GTAP model, drawing on and adapting Walmsley's adaptations of the GTAP model.

Aside from the modifications to the investment and the land used components of the models, there is nothing new in these descriptions apart from comments on the appropriateness of the assumptions for the Indonesian case. The descriptions of those components of the models, which are identical to ORANI-F and GTAP respectively, have been included here for completeness.

Although sections 4.1.2 and 4.1.3 fall within the section on the Indonesian Forecasting Model, they are in fact devoted to several more general, but basic, considerations in CGE modelling concerning the specification of variables and their coefficients to achieve model flexibility and to ensure the model matches the database. They are included here to facilitate understanding of a number of the equations in the Indonesian model. Section 4.1.5, while providing information of specific relevance to the Indonesian Forecasting Model, also contains some material of a more general nature on coefficient and solution updating procedures in CGE modelling.

The final section of the chapter, section 4.3, provides some information on why and how the global and the national models are to be linked in this study.

4.1 The General Equilibrium Model of Indonesian Economy

As explained in Chapter 3, long run analyses with general equilibrium models ideally would use dynamic models, but there are no such models available for Indonesia, at least at the level of disaggregation sought for this study. A simple approach towards a dynamic model is that employed in ORANI-F. This model contains dynamic elements, "...arising from stock/flow accumulation relations: between capital stocks and investment, and between foreign debt and trade deficits..." (Horridge *et al.*, 1993, p.71). Aside from the capability of forecasting the changes of the economy in the long run following policy changes, the ORANI-F model can be used to produce updated databases following imposition of uncontrolled exogenous changes, for example demographic and economic developments. The use of seriously outdated databases in CGE analyses can cast doubt on the relevance of results of policy experiments. The ability to update a database with ORANI-F provides one way of dealing with delays in the production of national input-output tables.

The theoretical structure of the Indonesian Forecasting Model, following ORANI-F, consists of a set of (generally) non-linear equations describing demands for labor, demands for primary factors, demands for intermediate inputs, demands for composite primary factor and intermediate input, commodity composite of industry output, demands for investment goods, household demands, export and other final demands, demand for margins, purchaser's prices, market clearing equations, equations for indirect taxes, GDP from both the income and expenditure sides, the trade balance and other aggregates, rates of return and wage indexation, investment-capital accumulation equations and debt accumulation equations.

The model is non-linear and can be described by specifying those equations. The forms of these, as used in ORANI-F, are outlined in this section. In many respects, describing the non-linear equations is the most efficient way of presenting a CGE model. However, for operational purposes, the model is linearized by writing equations in terms of percentage changes in variables. An individual equation in the linearized model is specified by the variables in the equation and the coefficients attaching to those variables. Presenting the linearized equations and information about the coefficients provides an alternative way of presenting a CGE model.

The coefficient values in these linear equations depend on the non-linear equations and the initial values of the variables. Through the judicious choice of forms of behavioral functions, the coefficients in the ORANI-F model and other CGE models not only have simple interpretations but, furthermore, the formulae for calculating them are typically quite simple and dependent on relatively few underlying behavioral parameters and on a relatively small database pertaining to the initial position of the economy. These formulae become part of the operational model specification.

The linear equations provide only local approximations of the underlying non-linear model and thus of how the economy responds to exogenous changes.

Nevertheless, the new equilibrium position of the economy arising from a small exogenous change can be calculated using the linear equations. Further changes from this new position can again be described approximately by linear equations. The values of the coefficients of the latter equations will differ from the initial values for the coefficients. The "updated" coefficients can be calculated from an updated database of the economy following the initial small change. Formulae for updating the database are therefore also part of the overall operational model.

The linearized equations, the formulae for calculating the coefficients of those equations and for updating the database constitute an operational model equivalent to the underlying non-linear model. The derivations of the linearized equations, of the formulae for the coefficients and of the updating formulae are available in Dixon *et al.* (1982) and Horridge *et al.* (1993) and no details are provided here. Only the equations and, where useful, coefficient formulae, are included here.

Because one of the aims in ORANI type modelling (and CGE modelling more generally) is to provide models for exploring how changes in one part of the economy affect other parts, not only are these models disaggregated by industry and commodity, but commodities are also differentiated by source (often just domestic and imported in a national model) and by type (in particular, the models differentiate current-use goods from capital goods).

For each differentiated good, there will be various supply mechanisms (that is, production processes in various industries) and various utilization or demand mechanisms. For each differentiated good, there must be a balance between supply and demand. While in theory every differentiated commodity could be used in every defined way, in practice the specification of models usually rules out some combinations from the beginning. Thus in the Indonesian model described here, following ORANI-F, there is no provision for imported goods to be exported; and by definition, capital goods are not available for current uses. Neither imported goods nor current-use goods are used directly as capital, but may be used in producing capital goods. The model does not make provision for the import or export of capital goods.

Capital use goods have only a single use. Current-use goods, however, have multiple uses. Each current-use good, for which as noted above there must be supply and demand balance, is differentially priced and accounted for separately by use. Thus, for example, the good generically called "chemical", which can be sourced domestically or by importing and is first differentiated accordingly, is further separated into as many as five use categories: immediate household consumption, intermediate good in producing other goods for current consumption, intermediate good for producing capital goods, good for exporting (except there is no exporting of imported goods), and a good for other purposes. Current-use chemical is therefore actually represented as nine separate goods (imported chemical for household consumption, imported chemical for current production, imported chemical for capital, etc. and similarly for domestically produced chemicals), even though physically the nine goods would be identical. While physically the same, the prices to the user of these use-separated goods for each source-differentiated good may differ. The prices of use-separated goods are, however, directly linked, differing from the market clearing price for the differentiated good only to the extent of any different taxes or other price margins applying to the good in particular uses.

Similarly, each domestically produced good is separately priced and accounted for depending on the industry in which it is produced. For example, were tea to be produced by the coffee industry, it would be distinguished from tea produced by the tea industry. Prices to producers may vary due to differential taxation or margins, but again are directly related to the market-clearing price for the differentiated commodity. While the Indonesian model allows an industry to produce multiple products, empirically each industry produces its unique product.

The prices of commodities differentiated by source are not directly linked. Each price is determined by its own supply and demand situation. However, the supply and demands of the differentiated commodities do depend not only their own price but also on the prices of their related forms, so the prices are necessarily indirectly related by virtue of this substitutability in demand.

The differentiation of goods by source and separation by use or by industry of production facilitates analysis of quite specific policy (and other changes) relating to specific commodity production and use processes.

The model identifies only four factors of production: land, labor, capital and "other cost items". Labor is further differentiated by occupation, four in the analyses in this study (farmer, professional, administration and operator, as discussed in section 5.4). No distinction is made between "imported" factors and domestic factors, all factors in fact being domestic in origin. The only use for factors is in production of current-use commodities. Each industry, however, represents a separate use of factors, and nominally the factors are differentiated accordingly. There are then 8*I primary factors included in the model for the current study, where I is the number of industries. These are separately priced for each industry.

How prices of factors in use are related varies from one factor to the next depending on whether or not the factor is mobile between industries. If a factor is mobile between sectors, the only difference in prices to the user in different uses would be industry specific factor use taxes or subsidies. On the other hand, if a factor is not mobile but specific to industry, then the prices across industries would not be directly related, but being rents determined by common and/or related product prices, would still be indirectly related.

Assumptions about factor mobility are important in CGE modelling. As economic incentives in an economy change, for example the relative prices of commodities alter, the ability of the economy to respond is two-fold. First, each industry can alter the composition of commodities it produces from its resources, producing more of those which have become relatively more valuable. Second, resources can be transferred between industries to those industries which are more efficient at producing commodities whose prices have increased relatively. Typically, individual industries will have strong absolute advantages in producing one or several commodities. Then the scope for response within industries will be small. Only if resources can be transferred between such industries with differing commodity strengths, will the responses to changed price signals be substantial. As already alluded to, for Indonesia, the industries included in the model are essentially single commodity industries, and even though substitution between commodities is theoretically possible, the scope for significant shifts in the commodity orientation is small.

The equations and variables in the Indonesian model, following ORANI-F, allow labor to be specified in various ways. These are:

(i) fully mobile between industries and occupations (all labor prices then change in proportion),

(ii) mobile only between industries within an occupation (all prices of a given labor type move in proportion, but not in any direct relation to prices of other types),

(iii) mobile only between occupations within an industries (all prices of labor in an industry move in proportion, but not in any direct relation to prices in other industries), and

(iv) all labor in each occupation in each industry is specific to that industry (labor prices have no direct relationship one to another)

As explained in later chapters, the analyses in this study involve the first of these possible assumptions. Regardless of what mobility assumptions are made about other factors, labor mobility will facilitate some change in the significance of industries in response to an exogenous change in the economic environment.

The ORANI-F model as described by Horridge *et al.* (1993) assumes that land is specific to each industry. Land prices are established without any direct relationship. The appropriateness of this assumption depends in part on the industry aggregation. As industries become more narrowly defined, it would be increasingly possible for land to be transferred between industries. Thus land might be reallocated from the corn industry to the soybeans industry for example, but not so easily from an estate crop industry to a grain industry. It also depends on whether the industries are significant users of land. Apart from the agricultural industries, no industries have significant land needs. Thus if the agriculture sector is highly aggregated and differentiated on geographical or topographical bases, land is appropriately modeled as immobile. The assumption of land immobility, while it may appear unrealistic, is tempered in the Australian applications of ORANI-F by the opportunities for within-industry switches of commodity. Multi-commodity industries are significant in the major Australian agricultural industries. This is not so empirically in the Indonesian model.

For the Indonesian model, particularly with a relatively disaggregated agricultural sector and with no multi-commodity industries, it is important that the model allows for land mobility between industries. Accordingly, the Indonesian model differs from ORANI-F through the inclusion of equations and variables that facilitate making various assumptions about land:

(i) fully mobile between all industries (all land prices then change in proportion),

(ii) fully mobile between industries within three defined sets of industries, namely estate crops and forestry, food crops and other industries.

(iii) land is specific to an industry (land prices have no direct relationship one to another)

With fully mobile land, the responses to price signals almost surely overstate the extent of adjustment possible in reality. Not all land is suitable for all industries. On the other hand the assumption of industry specificity is likely to lead to an understatement of the extent of adjustment. The constrained mobility assumption (case ii) is perhaps the most appropriate, especially for long run analysis. As reported later (section 7.6), runs are made to examine the significance of the land mobility assumption. Most of the analysis of trade liberalisation in the study is based on the constrained mobility land assumption.

"Other costs" capture a variety of unspecified inputs required in production. These are likely to be unique to each industry and are treated as industry specific in the model.

The mobility of capital across industries is a vexed question. Capital takes various forms, some of which is readily transferable between industries. Mobile equipment, for example is often readily transferable, at least between related industries. Existing fixed capital infrastructure is less transferable, except perhaps where the land to which it is attached is also transferred. In the longer term, of course, as existing capital is replaced, capital is mobile between industries. In the model, capital is assumed to be fully mobile.

The demand for commodities establishes a derived demand for each differentiated factor. No supply function for factors is included in the model. Assumptions about the supply of factors are implicit in the analyst's choice of closure for the model. In the case of each differentiated factor category, supply can be fixed by setting the demand for these factors exogenously. Price will then be determined endogenously. On the other hand a perfectly elastic supply of a factor is modeled by making factor demand endogenous. Price can then be set exogenously, or, since the model includes, for each differentiated factor, a price equation in which price is independent of quantity, also endogenously. The model then ensures a consistent price-quantity demanded pair of values with supply elastic but at a price determined by the model. Exogenously set fixed supplies of differentiated labour and land are likely to be reasonable for all analyses and particularly so for short run analyses; and this assumption is made in this study. Perfectly elastic supply of industry-differentiated "other costs" is taken as reasonable, given the relatively small contribution of these to overall costs (see section 5.9). Capital is the factor for which the appropriate assumption is most open. In the short run, industry-differentiated capital is assumed fixed. The model then determines the user or rental prices of capital. These prices influence investment behaviour which does not contribute to capital supply in the current period but does to the following period. In the long run, capital supply can alter to achieve equilibrium between rental prices in different industries and between the current and expected future rates of return on investment.

Before briefly explaining each of the elements of the Indonesian Forecasting Model, the variables, coefficients and parameters of the model, with their notation as used in this thesis, are first introduced.

4.1.1 Indices, Variables, Coefficients and Parameters of the Model

The notation system in the model parallels the ORANI-F system. It was established by the ORANI modelers to be both efficient in use and easy to interpret. The system of notation uses lower case letters for names of variables in the linear equations and upper case for the coefficients of these equations. Upper case is also used to refer to other coefficients and parameters and for the names of sets of items. Lower case is used for the indices of items, which form a set. Finally, in presenting the model, it is often convenient to present the underlying non-linear equations themselves, and thus in terms of the levels of variables rather than percentage changes. Variables in this form are written in upper case but in bold. Names may be shown in italics or non-italics, with no change in meaning, as convenient for presentation.

Sets and indices

Variables and coefficients often apply to sets of items. There are nine major sets, all with upper case names. The sets and the indices, which are generally used to refer to an item from the sets, are as follows:

industries (IND)	i
source (namely domestic or foreign) (SRC)	s
occupation (OCC)	o
commodities (COM)	c

There are three sets defining subsets of industries:

estate crops and forestry (ESTATE)	e

food crops industries (CROPS)	r
other industries (OTHIND)	h

There are four sets defining subsets of commodities:

margin type commodities (MAR) (ie., commodities facilitating flows of other commodities)	m
non-margin type commodities (NONMAR)	n
traditional export commodities (TRADEXP)	c
non-traditional export commodities (NTRADEXP)	c

Finally, there is a sequence set:

a sequential list of integers (YEARS)	t

Variables

Each variable name is alphanumeric. The generic form of a name is "$\text{basicname}_{\text{subscripts\_sets}}$". Here "basicname" is the primary indicator of the meaning of the variable. It follows a general structure as described below. Often a variable is applicable to a set of items. To refer to the individual item from a set, one or more subscripts specifying the element are added to the "basicname". For example, "basicname_{cs}" refers to a variable applying to a commodity c from a particular source s. Rather than identifying a particular individual item by its index, an individual items may itself be named. For example, a commodity can be sourced from domestic or foreign sources. For referring to a variable pertaining to, say, the domestically sourced commodity, "$\text{basicname}_{c\text{"dom"}}$" is sometimes used, where dom is the name of the source. The item name, enclosed in "", is used as the subscript. Finally, some variables are aggregates or averages over the various items in a set. This type of variable is indicated by appending an underscore character (as a subscript) with one or more following indices identifying the set or sets of items over which the aggregate or average is formed. For example "basicname_{ci_s}" refers to a variable applying to a commodity c in a particular industry i and it has been formed by aggregating or averaging over all sources

The basicname component of the names of most variables consists of two or three parts, as follows:

1) The type of variable is indicated in a letter or letters. The main ones are:

a	technical change
del	ordinary or absolute (rather than percentage) change
f	shift variable
p	price (000 Rp)
pf	price, foreign currency
t	tax
w	monetary value(000 Rp)
x	quantity

Additionally, a number of minor variable types have more limited application. These are

employ	employment
lev	actual level rather than change of variable value
phi	exchange rate
q	number of households
r	rate of return
utility	household utility level

2) The digits 0 to 6 indicate the activity or purpose of use.

1	current production
2	investment
3	consumption
4	export
5	other (government)
6	inventories
0	either all users, or user distinction irrelevant

Including the digit, even when its use is irrelevant (the 0 digit) to the variable, serves to separate the alphabetic characters from components (1) above and (3) below.

3) Three or more letters forming a descriptor for the variable. The descriptor adds clarity of meaning to a name where necessary.

accum	accumulation

bas	basic, not including margins or taxes
cap	capital
cif	import at border price
imp	imports (duty paid)
lab	labor
lnd	land
lux	linear expenditure system (supernumerary part)
mar	margins
oct	other cost tickets (eg, miscellaneous production cost)
prim	primary factors as a group (land, labor or capital)
pur	at purchasers' prices
sub	linear expenditure system (subsistence part)
tar	tariffs
tax	indirect taxes
tot	total or average over all inputs for some use or activity

There are a number of exceptions in the ORANI-F variable list, and so in the Indonesian Forecasting Model, to this naming convention, e.g. variable f5tot2, in which the final 2 is used specifically to differentiate the variable from f5tot. There are also several names which use the underscore "_" within the basicname for clarity, and there are several other "descriptors" which are used in only one or two instances each and which are partly capitalized: B, Debt, Debt_Ratio, BT, Fudge, and Unity.

The variables in the Indonesian Forecasting Model are listed in Table 4.1. These variables are arranged in an order related to the components of the database as depicted in Figure 4.1. For example, the basic demand quantity of commodity c, from source s, by industry i for current production is related to the VIBAS in the basic flow of database in Figure 4.1. All quantities are valued at basic prices, p0, in billion Rupiah.

The name notation used here is not substantially different from the ORANI-F notation used by Horridge *et al.* (1993). However, because their notation serves both to describe the model and as the names in the computer implementation in which subscripts as such cannot be used, they avoid the use of subscripts by writing indexing subscripts within brackets. For aggregates, they use the underscore character followed by indices as her, but the aggregation information (e.g. "_cs") is not subscripted. Also, contrary to here, their notation places any aggregation information of this type in front of any bracketed subscripts. Thus variable $x2_{ci\_s}$ as used here is written as x2_s(c,i) in the ORANI-F notation. With this understanding, interchanging between the present notation and that used for the ORANI-F model is straightforward.

Coefficients and parameters

The coefficients in the operational model are the "constants" in the linear approximation equations. They are either supplied directly from the database or computed from the database. The database includes values of flows, of various types, between industries, as shown in Figure 4.1; and also a number of basic behavioral parameters. Details of the database itself are provided in Chapter 5.

The convention for naming coefficients and parameters follows that for the variables, except that upper case letters are used. Several new types are used for the "basicname" part of a coefficient name:

H	indexing parameter
S	input share
σ	elasticity of substitution
V	levels value (000 Rp)

As with variables, there are a number of exceptions. Thus $SALES_C$, which is not a share coefficient, is used.

A list of the coefficients in the linear equations, and other database parameters is provided in Table 4.2. The table also provides the formulae for calculating the coefficients from the database. Horridge *et al.* (1993) provide further details.

Figure 4.1 Input-Output Data Base in the Indonesian Forecasting Model

		Absorption Matrix					
		1 Producers	2 Investors	3 Household	4 Export	5 Other	6 Inventori es Change
	Size	← I →	← I →	← 1 →	← 1 →	← 1 →	← 1 →
Basic Flows	↑ CxS ↓	V1BAS	V2BAS	V3BAS	V4BAS	V5BAS	V6BAS
Margins	↑ CxSxM ↓	V1MAR	V2MAR	V3MAR	V4MAR	V5MAR	n/a
Taxes	↑ CxS ↓	V1TAX	V2TAX	V3TAX	V4TAX	V5TAX	n/a
Labor	↑ O ↓	V1LAB					
Capital	↑ 1 ↓	V1CAP					
Land	↑ 1 ↓	V1LND					
Other Costs	↑ 1 ↓	V1OCT					

C=Number of commodities
I =Number of industries

S=Source of commodities
O=Number of occupation type
M=Number of Commodities as Margins

	Joint Production Matrix
Size	← I →
↑ C ↓	MAKE

	Import Duty
Size	← I →
↑ C ↓	V0TAR

Source: Horridge *et al.* (1993)

Table 4.1 List of Variables in the Indonesian Forecasting Model

Variable	Set	Description
$x1_{csi}$	COM x SRC x IND	Demand for commodity c, from source s, by industry i for current production
$x2_{csi}$	COM x SRC x IND	Demand for commodity c, from source s, by industry i for capital formation
$x3_{cs}$	COM x SRC	Demand for commodity c, from source s, by household
$x4_{c}$	COM	Export demand for commodity c
$x5_{cs}$	COM x SRC	Demand for commodity c, from source c by "others"
$delx6_{c}$	COM	Ordinary change for commodity c by inventories
$p0_{cs}$	COM x SRC	Basic price of commodity c, source s
$a1_{csi}$	COM x SRC x IND	Input-augmenting technical change for commodity c, from source s for current production in industry i
$a2_{csi}$	COM x SRC x IND	Input-augmenting technical change for commodity c, from source s for capital formation
$a3_{cs}$	COM x SRC	Taste changes variable for commodity c from source s
$f5_{cs}$	COM x SRC	Shifter for commodity c from source s for "other" demand
$x1mar_{csim}$	COM x SRC x IND x MAR	Margin usage for commodity c from source s for current production in industry i and margin m
$x2mar_{csim}$	COM x SRC x IND x MAR	Margin usage for commodity c from source s for capital formation in industry i and margin m
$x3mar_{csm}$	COM x SRC x MAR	Margin usage for commodity c from source s for household and margin m
$x4mar_{cm}$	COM x MAR	Export margin usage for commodity c and margin m
$x5mar_{csm}$	COM x SRC x MAR	Margin usage for commodity c from source s for "others" and margin m
$t1_{csi}$	COM x SRC x IND	Power of sales tax on commodity c from source s for current production in industry i
$t2_{csi}$	COM x SRC x IND	Power of sales tax on commodity c from source s for capital formation in industry i
$t3_{cs}$	COM x SRC	Power of sales tax on commodity c from source s for household consumption
$t4_{c}$	COM	Power of sales tax on commodity c for export
$t5_{cs}$	COM x SRC	Power of sales tax on commodity c from source s for "other" demand
$p1_{csi}$	COM x SRC x IND	Purchaser's price of commodity c from source s for current production in industry i
$p2_{csi}$	COM x SRC x IND	Purchaser's price of commodity c from source s for capital formation in industry i
$p3_{cs}$	COM x SRC	Purchaser's price of commodity c from source s for household consumption
$p4_{c}$	COM	Export price of commodity c

Table 4.1 (Continued)

Variable	Set	Description
$p5_{cs}$	COM x SRC	Purchaser's price of commodity c from source s for consumption by "other"
$x1lab_{io}$	IND x OCC	Employment of occupation o in industry i
$p1lab_{io}$	IND x OCC	Wage of occupation o in industry i
$a1lab_{i\_o}$	IND	Labor augmenting technical change of industry i
$f1lab_{io}$	IND x OCC	Wage shift variable of occupation o in industry i
$x1cap_i$	IND	Current capital stock in of industry i
$p1cap_i$	IND	Rental price of capital of industry i
$a1cap_i$	IND	Capital augmenting technical change of industry i
$r1cap_i$	IND	Net rates of return on fixed capital of industry i
$x1lnd_i$	IND	Use of land for industry i
$p1land_i$	IND	Rental price of land for industry i
$a1lnd_i$	IND	Land augmenting technical change for industry i
$f1lnd_i$	IND	Industry's land shifter
$x1oct_i$	IND	Demand for "other cost" tickets for industry i
$p1oct_i$	IND	Price of "other cost" tickets for industry i
$a1oct_i$	IND	"other cost" tickets augmenting technical change for industry i
$f1oct_i$	IND	Shift in price of "other cost" tickets for industry i
$q1_{ci}$	COM x IND	Output of commodity c by industry i
$t0imp_c$	COM	Power of tariff of industry i
$x1_{ci\_s}$	COM x IND	Demand for import/domestic commodity composite c for current production in industry i
$x2_{ci\_s}$	COM x IND	Demand for import/domestic commodity composite c for capital formation in industry i
$x3_{c\_s}$	COM	Household demand for import/domestic commodity composite c
$x3lux_c$	COM	Household–supernumerary demands for import/domestic commodity composite c
$x3sub_c$	COM	Household – subsistence demands for import/domestic commodity composite c
$p1_{ci\_s}$	COM x IND	Effective prices of import/domestic commodity composite c for current production in industry i
$p2_{ci\_s}$	COM x IND	Effective prices of import/domestic commodity composite c for capital formation in industry i
$p3_{c\_s}$	COM	Effective prices of import/domestic commodity composite c for household
$a1_{ci\_s}$	COM x IND	Technical change for import/domestic composite commodity c for current production i
$a2_{ci\_s}$	COM x IND	Technical change for import/domestic composite commodity c for capital formation in industry i

Table 4.1 (Continued)

Variable	Set	Description
$a3_{c\_s}$	COM	Technical change for import/domestic composite commodity c for household
$a3lux_c$	COM	Technical change for import/domestic composite commodity c for household – supernumerary demand
$a3sub_c$	COM	Technical change for import/domestic composite commodity c for household – subsistence demands
$f0tax_{c\_s}$	COM	General sale sax shifter
$f4p_c$	COM	Price (upward) shift in export demand schedule
$f4q_c$	COM	Quantity (right) shift in export demands
$pf0cif_c$	COM	C.I.F. foreign currency import prices
$x0dom_c$	COM	Total supplies of domestic goods
$x0imp_c$	COM	Total supplies of imported goods
$a1prim_i$	IND	All factor augmenting technical change
$a1tot_i$	IND	All input augmenting technical change
$a2tot_i$	IND	Neutral technical change-investment
$employ_i$	IND	Employment by industry
$f1lab_{i\_o}$	IND	Industry-specific wage shifter
f_accum_i	IND	Capital accumulation shifter
$f1ret_i$	IND	Rate of return shifter
$p1lab_{i\_o}$	IND	Price of labor composite
$p1prim_i$	IND	Effective price of primary factor composite
$p1tot_i$	IND	Average input/output price
$p2tot_i$	IND	Cost of unit of capital
$x1lab_{o\_i}$	IND	Effective labor input
$x1prim_i$	IND	Primary factor composite
$x1tot_i$	IND	Activity level of value-added
$x2tot_i$	IND	Investment by using industry
$f1lab_{o\_i}$	OCC	Occupation-specific wage shifter
$x1lab_{o\_i}$	OCC	Employment by occupation
delB	1	(Balance of Trade)/GDP
del Debt	1	Ordinary change in real foreign debt
delDebt_Ratio	1	Ordinary change in Debt/GDP ratio
delBT	1	Ordinary change in real trade deficit
delFudge	1	"Fudge Factor": set to unity for dynamic simulation
delUnity	1	Dummy variable. Always exogenously set to unity
levDebt_Ratio	1	Level Debt/GDP ratio
$employ\_i$	1	Aggregate employment-wage bill weights
$f1labo\_io$	1	Overall wage shifter
$f1lnd\_i$	1	Overall land rental shifter
$f1lnd\_e$	1	Overall estate crops and forestry land rental shifter

Table 4.1 (Continued)

Variable	Set	Description
$f1lnd\_r$	1	Overall food crops land rental shifter
$f1lnd\_h$	1	Overall other industries land rental shifter
$f1tax\_csi$	1	Uniform % change in power of taxes on intermediate usage
$f2tax\_csi$	1	Uniform % change in power of taxes on investment
$f3tax\_cs$	1	Uniform % change in power of taxes on household usage
$f4\_ntrad$	1	Demand shift, non-traditional export aggregate
$f4tax\_ntrad$	1	Uniform % change in power of taxes on non-traditional exports
$f4tax\_trad$	1	Uniform % change in power on taxes on traditional export
$f5tax\_cs$	1	Uniform % change in power of taxes on "other" usage
$f5tot$	1	Overall shift term for "other" demands
$f5tot2$	1	Ratio between f5tot and x3tot
$p0cif\_c$	1	Import price index, CIF, billion Rp
$p0gdpexp$	1	GDP price index, expenditure side
$p0imp\_c$	1	Duty-paid import price index, billion Rp
$p0realdev$	1	Real devaluation
$p0toft$	1	Terms of trade
$p1cap\_i$	1	Average capital rental
$p2tot\_i$	1	Aggregate investment price index
$delr1rsk_i$	IND	Ordinary change of net rate of return with risk premium
$delr1frsk_i$	IND	Ordinary change of risk free net rate of return
$delr1rsk\_i$	1	Aggregate ordinary change of net rate of return with risk premium
$delr1frsk\_i$	1	Aggregate ordinary change of risk free net rate of return
$r1caprsk_i$	IND	Net rate of return with risk premium
$r1capfrsk_i$	IND	Risk free net rate of return
$r1capfi_i$	IND	Future period expected rate of return
$r1capfi\_i$	1	Aggregate expected rate of return
$slackapf_i$	IND	Ordinary change of slack variable of expected rate of return
$slackapf2_i$	IND	Slack variable of expected rate of return
$x1grow_i$	IND	The power of the net rate of capital growth
$x1grow\_i$	1	Aggregate to the power of the net rate of capital growth
$x1capf_i$	IND	Future period capital stocks
$slackgrow\_i$	1	Slack variable of the power of the net rate capital growth

Table 4.1 (Continued)

Variable	Set	Description
$slackgrow_i$	IND	Slack variable of the power of the net rate capital growth
$slackgrow2_i$	IND	Slack variable of the power of the net rate capital growth
$slackorwalm_i$	IND	Slack variable to not applied the ORANI investment equation
$slackstat_i$	IND	Slack variable to relax stationarity condition
$slackstat2_i$	IND	Slack variable to remove stationarity condition if not wanted.
$slackrisk_i$	IND	Slack variable to remove the equal change of risk premium
slackautorf_i	1	Slack variable in the future average risk free rate of return equation
slackautor_i	1	Slack variable in the future average rate of return equation
p3tot	1	Consumer price index
p4_ntrad	1	Price, non-traditional export aggregate
p4tot	1	Exports price index
p5tot	1	"Other" demands price index
p6tot	1	Inventories price index
phi	1	Exchange rate
q	1	Number of households
r1cap_i	1	Average rate of return
utility	1	Utility per households
w0cif_c	1	CIF value of imports
w0gdpexp	1	Nominal GDP from expenditure side
w0gdpinc	1	Nominal GDP from income side
w0imp_c	1	Value of imports plus duty
w0tar_c	1	Aggregate tariff revenue
w0tax_csi	1	Aggregate revenue from all Indirect taxes
w1cap_i	1	Aggregate payments to capital
w1lab_io	1	Aggregate payments to labor
w1lnd_i	1	Aggregate payments to land
w1oct_i	1	Aggregate other cost ticket payments
w1tax_csi	1	Aggregate revenue from indirect taxes on intermediate
w2tax_csi	1	Aggregate revenue from indirect taxes on investment
w2tot_i	1	Aggregate nominal investment
w3lux	1	Total nominal supernumerary household expenditure
w3tax_cs	1	Aggregate revenue from indirect taxes on households
w3tot	1	Nominal total household consumption
w4tax_c	1	Aggregate revenue from indirect taxes on "other" demands

Table 4.1 (Continued)

Variable	Set	Description
w4tot	1	Billion Rp Border Value of Exports
w5tax_cs	1	Aggregate revenue from indirect taxes on "other" demands
w5tot	1	Aggregate nominal value of "other" demands
w6tot	1	Aggregate nominal value of inventories
x0cif_c	1	Import volume index, CIF weights
x0gdpexp	1	Real GDP from expenditure side
x0imp_c	1	Import volume index, duty-paid weights
x1cap_i	1	Aggregate capital stock, rental weights
x1prim_i	1	Aggregate output: value-added weights
x1lnd_i	1	Aggregate land over industries
x1lnd_e	1	Aggregate land over estate crops and forestry industries
x1lnd_r	1	Aggregate land over food crops industries
x1lnd_h	1	Aggregate land over other industries
x2tot_i	1	Aggregate real investment expenditure
x3tot	1	Real household consumption
x4_ntrad	1	Quantity, non-traditional export aggregate
x4tot	1	Export volume index
x5tot	1	Aggregate real "other" demands
x6tot	1	Aggregate real inventories
GNE	1	Gross National Expenditure

Source: Horridge *et al.* (1993), adapted and appended by the writer.

Table 4.2 List of Coefficients and Database Parameters

Coefficient/ Parameter	Set	Description
$V1BAS_{csi}$	COM x SRC x IND	Basic value of a flow of intermediate inputs of commodity c from source s to user industry i
$V2BAS_{csi}$	COM x SRC x IND	Basic value of a flow of investment inputs of commodity c from source s to user industry i
$V3BAS_{cs}$	COM x SRC	Basic value of a flow of household of commodity c from source s.
$V4BAS_{c}$	COM	Basic value of a flow of export for commodity c
$V5BAS_{cs}$	COM x SRC	Basic value of a flow of government for commodity c from source s.
$V6BAS_{c}$	COM	Basic value of a flow of inventory for commodity c.
$p0DOM_{c}$	COM	Initial price setting for commodity c (arbitrary)
$V1MAR_{csim}$	COM x SRC x IND x MAR	Margin value of flow of intermediate inputs of commodity c from source s to user industry I and margin m
$V2MAR_{csm}$	COM x SRC x MAR	Margin value of flow of investment inputs of commodity c from source s for margin m
$V3MAR_{csim}$	COM x SRC x IND x MAR	Margin value of flow of household inputs of commodity c from source s for user industry I and margin m
$V4MAR_{cm}$	COM x MAR	Margin value of flow of export of commodity c for margin m
$V5MAR_{csm}$	COM x SRC x MAR	Margin value of flow of inventory inputs of commodity c from source s to user industry i and margin m
$V1TAX_{csi}$	COM x SRC x IND	Tax value of flow of intermediate inputs of commodity c from source s to user industry i
$V2TAX_{csi}$	COM x SRC x IND	Tax value of flow of investment inputs of commodity c from source s to user industry i
$V3TAX_{cs}$	COM x SRC	Tax value of flow of household input of commodity c from source s
$V4TAX_{c}$	COM	Tax value of flow of export of commodity c
$V5TAX_{cs}$	COM x SRC	Tax value of flow of inventory input of commodity c from source s
$V1CAP_{i}$	IND	Value of Capital rental in industry i
$V1LAB_{io}$	IND x OCC	Value of wage of industry I by occupation o
$V1LND_{i}$	IND	Value of land rental of industry i
$V1OCT_{i}$	IND	Value of other cost of industry i
$MAKE_{ci}$	COM x IND	Value of production of commodity c by industry i
$V0TAR_{c}$	COM	Value of tariff revenue of commodity c
$V0IMP_{c}$	COM	Basic-value of total import of commodity c
$V1PUR_{csi}$	COM x SRC x IND	Purchaser's value of a flow of intermediate inputs of commodity c from source s to user industry i

Table 4.2 (Continued)

Coefficient/ Parameter	Set	Description
$V2PUR_{csi}$	COM x SRC x IND	Purchaser's value of a flow of investment inputs of commodity c from source s to user industry i
$V3PUR_{cs}$	COM x SRC	Purchaser's value of a flow of household inputs of commodity c from source s
$V4PUR_{c}$	COM	Purchaser's value of a flow of export of commodity c
$V5PUR_{cs}$	COM x SRC	Purchaser's value of a flow of inventory inputs of commodity c from source s
$V1PUR_{ci\_s}$	COM x IND	Total purchaser's value of a flow of intermediate inputs of commodity c to user industry i
$V2PUR_{ci\_s}$	COM x IND	Total purchaser's value of a flow of investment inputs of commodity c to user industry i
$V3PUR_{c\_s}$	COM	Total purchaser's value of a flow of household inputs of commodity c
$S1_{csi}$	COM x SRC x IND	Share purchaser's value of a flow of intermediate inputs of commodity c to user industry i
$S2_{csi}$	COM x SRC x IND	Share purchaser's value of a flow of investment inputs of commodity c to user industry i
$S3_{cs}$	COM x SRC	Share purchaser's value of a flow of household inputs of commodity c to user industry i
$V1LAB_{i\_o}$	IND	Total value of labor cost in industry i
$V1PRIM_{i}$	IND	Total value of factor input to industry i
$V1TOT_{i}$	IND	Total value of cost in industry i
$V2TOT_{i}$	IND	Total value of capital created for each industry i
$V1LAB_{o\_i}$	OCC	Total value of wages for each occupation
$V0MAR_{c\_csi}$	COM	Total value of usage for margin purpose for each commodity c
$SALES_{c}$	COM	Total value of sales of domestic commodity c
$V0IMP_{c}$	COM	Total basic value of imports of commodity c
$V0CIF_{c}$	COM	Total ex-duty value of imports of commodity c
$V1TAX\_{csi}$	1	Aggregate revenue of indirect taxes on intermediate good
$V2TAX\_{csi}$	1	Aggregate revenue of indirect taxes on investment good
$V3TAX\_{cs}$	1	Aggregate revenue of indirect taxes on household good
$V4TAX\_{c}$	1	Aggregate revenue of indirect taxes on export good
$V5TAX\_{cs}$	1	Aggregate revenue of indirect taxes on inventory good
$V0TAR\_{c}$	1	Aggregate revenue of tariff
$V0TAX\_{csi}$	1	Aggregate revenue of indirect tax
$V1CAP\_{i}$	1	Aggregate factor cost of total payment to capital
$V1LAB\_{io}$	1	Aggregate factor cost of total payment to labor
$V1LND\_{i}$	1	Aggregate factor cost of total payment to land

Table 4.2 (Continued)

Coefficient/ Parameter	Set	Description
$V1LND_{\_e}$	1	Aggregate factor cost of total payment to land over estate crops and forestry
$V1LND_{\_r}$	1	Aggregate factor cost of total payment to land over food crops
$V1LND_{\_h}$	1	Aggregate factor cost of total payment to land over other industries
$V1OCT_{\_i}$	1	Aggregate factor cost of total payment to other cost
$V1PRIM_{\_i}$	1	Aggregate factor cost of total payment to primary factor
$V0GDPINC$	1	Nominal gdp from income side
$V0CIF_{\_c}$	1	Purchaser's value of total import cost, excluding tariff
$V0IMP_{\_c}$	1	Purchaser's value of total import cost, including tariff
$V2TOT_{\_i}$	1	Purchaser's value of total investment usage
$V3TOT$	1	Purchaser's value of total purchases by household
$V4TOT$	1	Purchaser's value of total export earning
$V5TOT$	1	Purchaser's value of total other demands
$V6TOT$	1	Purchaser's value of total inventories
$V0GDPEXP$	1	Nominal GDP from expenditure side
$V0GNE$	1	Nominal GNE
$\sigma 1LAB_i$	IND	Elasticity of substitution between skill types in each industry
$\sigma 1PRIM_i$	IND	Elasticity of substitution between primary factor in each industry i
$\sigma 1_c$	COM	Intermediate Armington elasticity in each industry i
$\sigma 1OUT_i$	IND	Elasticity of transformation in industry i
$\sigma 2_c$	COM	Investment Armington elasticity in each commodity c
$\sigma 3_c$	COM	Household Armington elasticity in each commodity c
$S1LAB_{io}$	IND x OCC	Value of share of occupation o in the total wage bill of industry i
$S3LUX_c$	COM	Marginal household budget share of commodity c
$S3_{c\_s}$	COM	Shares in total household expenditure of commodity c
EPS_c	COM	Household expenditure elasticity in each commodity c
$B3LUX_c$	COM	Supernumerary expenditure commodity c/total expenditure commodity c
$V4TRADEXP$	1	Total value of traditional export earning
$V4NTRADEXP$	1	Total value of non traditional export earning
EXP_ELAST_c	COM	Export demand elasticity by commodity c
EXP_ELAST_{-NT}	1	Non traditional export demand elasticity by commodity c
$TINY$	1	Very small number (0.0000000001)
$MAKE_{c\_i}$	COM	Value of total production of commodity c

Table 4.2 (Continued)

Coefficient/ Parameter	Set	Description
S_MAKE_{ci}	COM x IND	Share in total production of commodity c in industry i
$RISKFLAG$	1	Binary parameter to recognise risk (1) or not (0)
$WALMFLAG$	1	Binary parameter to apply Walmsley type of investment (1) or not (0)
$ORANIFLAG$	1	Binary parameter to apply ORANI type of investment (1) or not (0)
$RICAPRISK_i$	IND	Net rate of return including risk
$R1TCAPF_i$	IND	The future rate of return-temporary
$R1CAPF_i$	IND	The future rate of return
$S2INVEST_i$	IND	Share of investment in each industry
$V0CAP_i$	IND	Value of fixed capital stocks at the start of the period in each industry
$V0CAP\_i$	1	Aggregate value of fixed capital stocks at the start of the period
$V0CAPF_i$	IND	Value of fixed capital stocks at the future of the period in each industry
$X1GROW_i$	IND	The power of the net growth rate in industry i
$X1GROW\_i$	1	Aggregate of the power of the net growth rate
$GROSSRR_i$	IND	Gross rate of return, including risk
$R1CAPI_i$	IND	Net rate of return, risk free
$R1RISK_i$	IND	Risk premium
$R1FRISK_i$	IND	Future risk premium
$R1CAPRISK_i$	IND	Net rate of return with risk
$V0CAPF\_i$	1	Aggregate value of future capital
$R1CAPF\_i$	1	Aggregate future net rate of return
$R1RISK\_i$	1	Aggregate risk premium
$E1CAPF_i$	IND	Discrepancy in rates of return over time
$E1GROW_i$	IND	Discrepancy in growth rates over time
$E1STAT_i$	IND	Discrepancy in stationarity over time
$QCOEF_i$	IND	Ratio of gross to net rate of return
$BETA\_R_i$	IND	Investment parameter in each industry i
DEP_i	IND	Depreciation factors in each industry i
R_T_i	IND	Investment capital ratio in each industry i
ORD_y	YEAR	Ordinary number from 1 to T
T	YEAR	Number of years which is covered by simulation
Z_i	IND	Ratio of capital stock in year t and year 0
R_0_i	IND	Ratio of capital and investment in year 0
DEP_T_i	IND	Depreciation to the power of T
N_TERM_i	IND	Constant in industry i
M_TERM_i	IND	Constant in industry i

Table 4.2 (Continued)

Coefficient/ Parameter	Set	Description
K_TERM_i	IND	Del fudge coefficient in industry i
P_GLOBAL	1	Convert Rp values into "real" terms
BT	1	Real trade deficit
DEBT_RATIO	1	Debt/GDP ratio
DEBT	1	Real foreign debt
DEBT0	1	Original real foreign debt
R_WORLD	1	World interest rate
N_DEBT	1	Useful constant
M_DEBT	1	Useful constant
B0	1	Original real trade deficit
DEBT_RATIO_0	1	Original debt/gdp ratio
FRISCH	1	The Frisch parameter
ALPHA	1	Share of supernumerary in total expenditure

Source: Horridge *et al.* (1993), adapted and appended by the writer.

4.1.2 Flexibility in CGE Modelling

Before outlining the actual equations in the Indonesian model, it is useful to reflect on the issue of flexibility provided in a model and the way this is achieved by defining special variables and equations. CGE modellers have generally sought to develop models that are of greater applicability than to the immediate problem at hand and for which the model is first constructed. Thus a particular model, for example the ORANI model, has been designed to be used, without too much difficulty, in a variety of analyses of the Australian economy. Many of these applications might reasonably require "different" economic models.

There are various ways that a model can be designed "generically" to provide this flexibility. In particular, the model can be deliberately left incomplete in certain areas, that is more variables than equations can be included in the model. This then allows the user some freedom in completing the model. Ideally, the process of model completion would be simple.

The several techniques outlined here are widely used in CGE modelling. They are reported explicitly to facilitate explanation of some of the changes made to the

ORANI-F model in constructing the Indonesian Forecasting Model and to the GTAP model for the analyses in this study.

The simplest way for a user of a generic model to complete the model for a particular application is to define some variables as exogenous and taking particular values, thereby reducing the number of endogenous variable to match the number of equations. This is the standard notion of "closing" the model. The process of implementing different choices of closure in CGE modelling is straightforward.

Another way for the particular user to complete the model would be to add more equations, not introducing new variables, so reducing the number of variables to be specified exogenously. CGE developers, through their development of associated software packages, have made this task of appending more equations to the base model relatively simple, at least compared to the task of developing a completely new model. Nevertheless, the task of model modification is not trivial.

Many of the benefits of easily implemented model flexibility for those aspects of the model for which flexibility is likely to be most useful can be achieved by including in the model several alternative specifications of equations and allowing the user to select one (or none) of these simply by specification of appropriate exogenous variables and their values. For example, suppose there is a relationship (linear in percentage changes) which an economic analyst would sometimes want to impose but at other times omit. Suppose further that the relationship may take one of two forms. These might be:

$$w = A * x + B * y \qquad \text{(Version 1)}$$

$$w = A * x + C * z \qquad \text{(Version 2)}$$

where A, B and C are constants, and the other items are the percentage change variables. A simple way to allow for inclusion or removal of any version of a relationship is to define a slack variable. A slack variable is a variable that appears only in one equation. The extended model becomes, for example:

$$w = A * x + B * y + slackvar1 \qquad \text{(Version 1)}$$

$$w = A * x + C * z + slackvar2 \qquad \text{(Version 2)}$$

The coefficient on the slack variable is set at unity in the example, but can be any non-zero number. Since the slack variable appears only in the one equation, its value has no effect on the solution to the rest of the model. With the value of the slack variable free to fluctuate as an endogenous variable and to take whatever value is needed to satisfy the equation, the particular equation is effectively removed from the model. On the other hand, if the slack variable were made exogenous and given the value 0, the original equation becomes effective.

In the example, by setting one slack variable exogenously to 0 and making the other endogenous, one of the two equations becomes effective. By setting both slack variables to zero, neither is effective.

An alternative way to achieve the same result is to define a binary (0-1) slack "flag" parameter (SLACKFLAG) and include it multiplicatively in a single equation:

$$w = SLACKFLAG * (A * x + B * y) + (1 - SLACKFLAG) * (A * x + C * z)$$

When SLACKFLAG = 0, the second form of the equation is invoked; and when slackflag = 1, the first form applies. If the flexibility of removing this equation (effectively removing both original equations) is also needed, add another slack variable:

$$w = SLACKFLAG * (A * x + B * y) + (1-SLACKFLAG) * (A * x + C * z) + slackvar1$$

Either of these approaches can be used to gain flexibility. The ORANI-F model makes use of slack variables in this way, and the GTAP model uses both slack flags and slack variables. In the models developed in this study, principally in connection to their investment components, flexibility is built-in using these approaches.

4.1.3 Matching Model and Database

In studying the impacts of exogenous changes on the solution to a non-linear model, it is necessary to have an initial solution from which the impacts or movement in the solution is measured. Thus one must have a database of variable and parameter values such that the economic position described by that database satisfies the model's equations. Unfortunately, actual, real-world data may not satisfy the model's non-linear equations either because the model is an inadequate description of the real world as reflected in the database or because the database itself may have errors. Regardless of the cause of discrepancies between the database and the model, they must be removed before studying the impacts of exogenous changes. The model and the database must match in order to define the initial solution or equilibrium point.

Consistency can be achieved either by amending the database, that is effectively assuming the database to be wrong, or preferably, by extending the model, typically by introducing additional variables to a sufficient number of equations, to accommodate the discrepancies. These variables might be termed "artificial" variables in parallel with the use of similar variables in mathematical programming. They might be considered as capturing short run economic factors or "errors" in the data: given time, the real world would correct itself to comply with the original equations. Alternatively, they might be seen solely as a device to establish easily an initial solution, albeit "artificial", to an expanded model compatible with the database. Having established a solution to the expanded model, the artificial variables can be shocked to reduce their levels to zero. The updated solution is not only a solution to the expanded model but, since all artificial variables have been reduced to zero, but also a real solution to the model.

There are several ways to implement the removal of discrepancies, all of which, in theory at least, should work. Several are discussed here. For illustration purposes, suppose that the required equation in *levels* is itself linear (which includes the simple case $\mathbf{W} = \mathbf{X}$)

$$W = A * X + B * Y$$

but the information from the data base is such that

$$W - A * X - B * Y = DISCREP^0$$

where $DISCREP^0$ is the initial discrepancy. This is viewed here as a parameter. Then to match the model with the database, one could define a levels slack variable:

$$W - A * X - B * Y = DISCREP^0 * \mathbf{SLACKFLAG}$$

where **SLACKFLAG** has the initial value of 1 and is to be reduced to 0 to enforce the desired relationship. As the solution is adjusted, **SLACKFLAG** represents the fraction of the original discrepancy that remains.

Considering changes (using dvariable for a small change in a variable) to both sides of the equation,

$$dW - A\, dX - B\, dY = DISCREP^0 * \mathbf{dSLACKFLAG}$$

SLACKFLAG needs to be reduced by 100 per cent to match a real solution of the model with the database.

Expressing the left hand side changes in variables as percentage changes, the equation becomes

$$W * w - AX * x - BY * y = 100 * DISCREP^0 * \mathbf{dSLACKFLAG} \quad \text{(DMV1)}$$

This and several other equations in section 4.1.3 are numbered for convenience of discussion and referencing within the section. The letters DMV stand for "discrepancy model version".

Since to remove the discrepancy, the variable **SLACKFLAG** has to be reduced from 1 to 0, in the modified equation **dSLACKFLAG** has to be given a value -1.

The change in **SLACKFLAG** could also be expressed in percentage change terms. Then

$$W * w - AX * x - BY * y = DISCREP^0 * SLACKFLAG * slackflag$$

and substituting for $DISCREP^0$ * SLACKFLAG from the levels equation,

$$W * w - AX * x - BY * y = (W - A * X - B * Y) * slackflag$$

or

$$W * w - AX * x - BY * y = DISCREP * slackflag \qquad \text{(DMV2)}$$

where slackflag is interpreted as the change in the proportion of the *original* discrepancy expressed as a percentage of the discrepancy still remaining. Setting slackflag exogenously to -100 and solving for the other percentage change variables will define the levels variables that satisfy the levels equations.

The solution obtained from these two (equivalent) formulations will represent a real solution for the model in that **SLACKFLAG** will have a zero value by virtue of its forced 100 per cent reduction, and so the discrepancy will be eliminated. In the case of models in which the equations are linear in the levels variables, the discrepancy will be exactly zero. For non-linear equation models, however, these exogenous changes do not generally ensure that the discrepancy goes to zero. The linear difference equation, and so the percentage change equation, are only approximations to the levels equation. The linear approximation applies only for (infinitesimally) small changes in the level variables. The finite changes to variables determined by the linear model may imply levels of the variables, which do not satisfy the non-linear levels equation. By dividing the overall change needed in **SLACKFLAG**, namely its reduction from 1 to 0, into a succession of smaller steps, a more accurate solution, or one which more nearly has a zero discrepancy, can be attained. This applies for both the percentage change form (slackflag) and the change form (d**SLACKFLAG**). However, since any finite number of steps implies larger than infinitesimal changes, such solutions will retain some discrepancy.

Consider a two-step procedure. Suppose the first step changes **dSLACKFLAG** by 0.5, that is half the needed adjustment. After the first step, one has a new solution with a smaller discrepancy, close to half, but because of the approximation error, not necessarily exactly half. In the second step, retaining $DISCREP^0$ unchanged, one could reduce **dSLACKFLAG** by 0.5 again. Since the discrepancy at this point need not be exactly 0.5, this will may not eliminate that discrepancy. The final position after two steps will also be different from that from one large step (d**SLACKFLAG** = -1) since in the second step the coefficients on w, x and y would generally be different from those used in the one-step case. In fact, even if the coefficients in the particular equation where the discrepancy occurs remained the same, because coefficients in other equations may change through the two steps, the final solution may differ.

If using the percentage change version in two successive steps of equal size **dSLACKFLAG**, the coefficients on all the variables, including slackflag, alter for the second step. In the first step, slackflag would be set to -50. In the second step, slackflag would be set to -100 since, as a percentage variable, it would here be defined as dSLACKFLAG / **DISCREP**, where **DISCREP** has half its original value and **dSLACKFLAG** is also half the original discrepancy. The -100 for the second of the two steps is expected since this steps amounts to a one-step (100%) removal of the discrepancy remaining after one step.

Software such as GEMPACK for CGE modelling can do multiple steps automatically. Since, depending on the version of discrepancy model used, the coefficient on the discrepancy variable may or may not need updating from one step to the next (required in the percentage change model; not required in the change model) this information must be provided to the program. It is also necessary to indicate whether variables are percentage change variables or change variables since this determines the step lengths. The GEMPACK software allows the user to specify these characteristics of coefficients and variables.

The two formulations given above do not exhaust the modelling possibilities for discrepancies. Typically there are alternative ways of dealing with discrepancies between the model and the database. Taking the same example again, namely the requirement that

$$W = A * X + B * Y$$

one could equivalently write

$$(A * X + B * Y) / W = 1$$

Suppose the actual data situation is that the ratio differs from 1, namely

$$(A * X + B * Y) / W = 1 + DISCREP^0$$

Again introducing **SLACKFLAG** as a new variable taking the value 1 in the initial solution, the equation can be written as

$$(A * X + B * Y) / W = 1 + DISCREP^0 * \mathbf{SLACKFLAG}$$

where $DISCREP^0$ is the initial discrepancy of the ratio from 1, and is treated as a parameter. If **SLACKFLAG**, which is again interpreted as the proportion of the initial discrepancy which remains, is altered or shocked (by -100%) to become 0, the required relationship between **W**, **X** and **Y** will hold. Converting to changes and expressing left hand side variables as percentage changes,

$$A X / (A X + B Y) * x + b Y / (A X + BY) * y - w$$

$$= 100 W / (A X + BY) * DISCREP^0 * d\mathbf{SLACKFLAG} \quad \text{(DMV3)}$$

If the change d**SLACKFLAG** is also expressed in percentage terms,

$$A X / (A X + BY) * x + B Y / (A X + BY) * y - w$$

$$= W / (A X + bY) * DISCREP^0 * SLACKFLAG * slackflag \qquad (DMV3a)$$

But since

$$W / (A X + BY) = 1/ (1 + DISCREP^0 * SLACKFLAG)$$

then

$$A X / (A X + BY) * x + B Y / (A X + BY) * y - w$$

$$= DISCREP^0 * SLACKFLAG / (1 + DISCREP^0 * SLACKFLAG) * slackflag$$

But $DISCREP^0$ * SLACKFLAG is the discrepancy remaining in any solution. So

$$A X / (A X + BY) * x + B Y / (A X + bY) * y - w$$

$$= DISCREP / (1 + DISCREP) * slackflag \qquad (DMV4)$$

These latter two versions (DMV3 and DMV4) based on the discrepancy in the ratio clearly parallel the former two versions based on an additive discrepancy.

A somewhat simpler alternative to the above approaches is to define the ratio of the two sides of the required equation directly as a variable and shock it to the required value of 1. Thus

$$(A * \mathbf{X} + \mathbf{B} * \mathbf{Y}) / \mathbf{W} = \mathbf{RATIO}$$

Then

$$A X / (A X + BY) * x + B Y / (A X + BY) * y - w = ratio \qquad (DMV5)$$

If **RATIO** is initially (1 + $DISCREP^0$) and is to be altered to 1, then the required exogenous shock to apply to RATIO is 100 * $DISCREP^0$ / (1 + $DISCREP^0$). That is, one must set ratio to the negative of this expression.

The right hand side of this DMV5 equation, when shocked as suggested, is numerically identical to that of the DMV4 formulation with its -100% shock of **SLACKFLAG** from 1 to 0. So too are the left hand sides the same. Thus the latter two formulations should give the same solution; and they do when there is a single step. The formulations are numerically identical.

It would appear that the results should also be the same in the two approaches when using multiple steps. As an example, consider a two step procedure correcting a relative discrepancy of 0.1 (or 10%), reducing the **RATIO** from 1.1111 to 1.0. In GEMPACK, equal steps (changes in the levels exogenous variable) are applied in each step. For DMV4, the step for **SLACKFLAG** is -0.5; for DMV5 the step for **RATIO** is -0.055556. In the first step, slackflag will be -50 and ratio will be -5 for the two cases respectively. In both cases, the RHS will be -5.0; and both solutions after the first step will be the same. In the second step using DMV4, **SLACKFLAG** (see DMV3a) has been reduced to 0.5 and slackflag will be calculated as 100 to create the final change of -0.5 in **SLACKFLAG**. The coefficient on slackflag in DMV4 will no longer be 0.1. Ignoring approximation errors, the discrepancy will have become (0.1111-0.055556 = 0.055556, and the coefficient will be 0.056666/1.055556 = -0.0526. The RHS value is thus -5.26. In DMV5, the **RATIO** will have become (1.1111-0.055556) = 1.055556. The RHS will be calculated as ratio = -100 *.056666/1.055556 = -5.26, exactly the same as for DMV4. One might expect identical results for the two models.

However, when otherwise identical models are run with these two formulations, different results are achieved. The results also differ from the additive discrepancy approach for removing discrepancies. The explanation lies in the numerical approximations being employed. For DMV5, the second step shock of -5.26 is independent of any numerical approximation error in the first step since -5.26 is calculated based on the database prior to step 1. For DMV4, however, the coefficient in the second step will probably not be exactly -0.0526 because the coefficient will be calculated based on the discrepancy remaining after the first step; and this first step will have introduced some approximation error.

It is for this same reason of approximation errors that the results of procedures to remove discrepancies can give different results depending on which of the five models (DMV1 to DMV5) are used. In experiments with discrepancy removal in this study, surprisingly different results were obtained with the different models, though the differences become smaller as more steps are included in the procedures. Experience in this study, suggested that it is important to recalculate the discrepancy that exists after having completed a procedure to remove discrepancies. If the discrepancy is not sufficiently close to zero, the procedure for discrepancy removal can be repeated.

Recognising the difficulties associated with using linear approximations to update a solution to a set of non-linear equations from one solution to another, it follows that even when all discrepancies between a database and a model have been removed, the issue of discrepancies in further analysis is not overcome. New discrepancies can re-emerge as exogenous changes are made to the variables in the model. The extent of these is likely to be small relative to those discrepancies that existed in the initial database as a result of omitted short run economic factors, though sequentially applied large shocks, each building on earlier ones, or equivalently simultaneously applying numerous large shocks may produce significant discrepancies if step lengths are not very small. In the jargon of CGE modelling, the database can become unbalanced as noted, for example by Warr *et al.* (1998).

How should one proceed with policy analysis in the presence of initial model-database discrepancies? Suppose the model is run with the only shocks being those needed to achieve (as close as possible) consistency between the database and the model. Note here that it is possible (and more efficient) to remove multiple discrepancies simultaneously: there is, in theory at least, no need to remove them sequentially as Walmsley (1998) does. Once consistency is attained, the original database can be replaced with that implied by the consistent solution. Since there are no longer any major discrepancies between the database and the model, the discrepancy variables (eg. slackflag) might be discarded, either by deleting them from the model or by leaving them in but with their values set exogenously to zero change. Either way, the effects of further exogenous changes in policy settings etc. are identically measured using this new database; and the measures are properly the effects of the policy changes if the discrepancy does remain small. It would seem preferable to leave the discrepancy variables in the model rather than deleting them, so that the discrepancy in the solution can be readily calculated and corrected by reapplying the discrepancy removal procedures if warranted.

As an equivalent to working with the discrepancy-free database, one can continue to work with the original database, always retaining the exogenous setting of the discrepancy slackflag variables to -100%. The effects of policy changes are then measured by comparing the solution from a run which only removes discrepancies from the database against the solution from a run which includes both the policy changes and the removal of discrepancies. From a practical perspective, it is better to remove discrepancies and to then work with the discrepancy-free database. On the one hand, since CGE software usually produces reports of single runs, that is the changes in variables from their starting position before the run, rather than reporting differences between two runs, it is usually more efficient to create the consistent database and do the subsequent policy analyses, of which there may be many, with this database. Further, if the removal of large initial discrepancies demands using a relatively larger number of numerical computational steps than for estimating the effects of policy changes, it would be more efficient to remove the initial discrepancies once rather than repeating the process for each policy analysis.

This is the approach taken for example by Horridge *et al.* (1993) in their ORANI-F modelling of the Australian economy and by Walmsley (1998) in her GTAP modelling of the global economy. In both cases, the respective databases are altered to achieve consistency with specifications of long run equilibrium prior to doing the policy analyses. As briefly noted above, Walmsley (1998) in seeking to establish a database in which rates of return to investment are equated both across regions and across time periods within regions chose to remove the discrepancies in two stages, first achieving equality across time and then across regions. The same result could have been achieved by a single run simultaneously removing the discrepancies. Using stages however, does permit comparisons of the effects of imposing the individual restrictions. Furthermore, given the approximations that are involved, it may be better to correct discrepancies one by one. If nothing else, all else being equal this would involve more, and so smaller, steps in reducing the discrepancies. Experience in experimenting with Walmsley's model in the course of this study was that removing the discrepancies in the manner of Walmsley was more reliable than using simultaneous discrepancy formulations as outlined here. The precise reasons for this remain unclear.

As for the choice of which method DMV1 to DMV5 to use, ultimately all should be equivalent. DMV5 seems simplest, and was used by Walmsley (1998). Its disadvantage is that the needed shocks have to be calculated externally to the simulation of those shocks. The other four formulations all use standard shocks (eg -1 or -100) and these can be efficiently implemented with a single simulation run, with the coefficients being calculated as part of the run. Horridge *et al.* (1993) used a formulation of type DMV1 in enforcing a capital equation. On the other hand, using shocks such as -100% which take a levels variable to 0 and even <0 can be troublesome if the value of that variable is ever used as a divisor. With at least one of the common approximation methods (Gragg's method - see the GEMPACK User Documentation for Release 5.1, Volume 2, 1994), the shock to the levels variable is extended beyond the required shock. The numerical significance of the choice of linearization is also noted in the GEMPACK User Documentation (Volume 2, p.5.8). For an equation D=PQ, alternatively linearized as d= p + q or as Dd = PQ * p + PQ * q, surprisingly different results are obtained. Since D = PQ, the second linearization appears the same as the first. However, in a multi-step procedure, D, P and Q may all be updated independently according to their percentage changes from the linearization rather than from D = PQ, so that the product PQ may not equal D.

Examples of formulations of the type DMV1 and DMV4 are found in the Indonesian Forecasting model developed in this section and in the modified GTAP model of section 4.2. As well, examples of the use of slack variables as outlined in section 4.1.2 also occur. With this appreciation of the role that special variables might have and the potential to include alternative version of equations in the one model, the equations of the Indonesian Forecasting Model are now outlined.

4.1.4 The Equation System

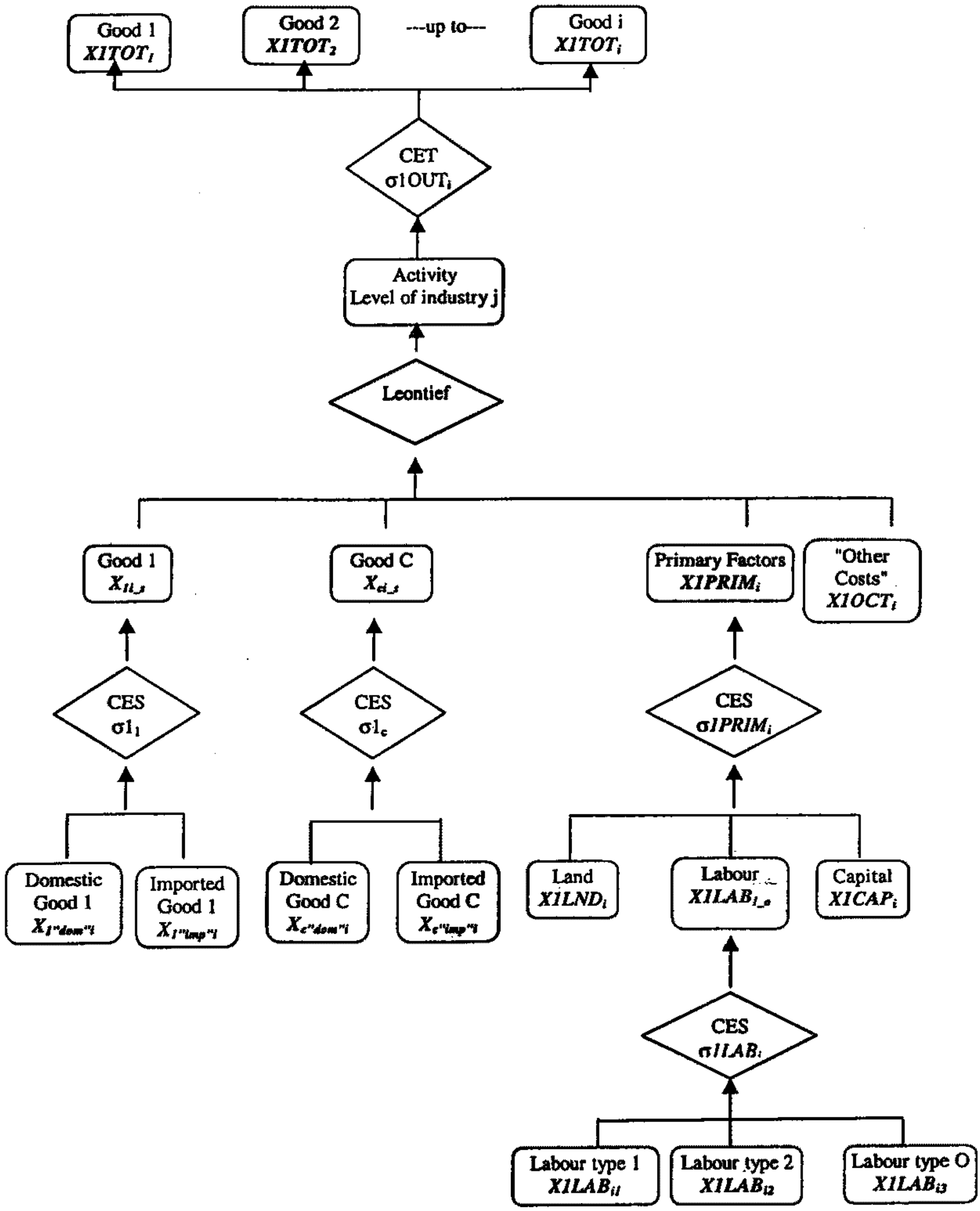
Following Horridge *et al.* (1993), the equation system is organized into 18 blocks. These are:

1. demands for labor
2. demands for primary factor
3. demands for intermediate inputs
4. demands for composite primary factor and intermediate input
5. commodity composite of industry output
6. demands for investment goods
7. household demands
8. export and other final demands
9. demands for margin
10. purchaser's prices
11. market clearing condition
12. indirect taxes
13. GDP from the income and expenditure sides
14. trade balance and other aggregates
15. rates of return, indexation
16. investment-capital accumulation equation
17. debt accumulation equations

Only a brief explanation is provided of the equations in each block, other than for blocks 15 and 16. More detail is provided for these two since these parts of the model differ from the standard ORANI-F model. The equations themselves, in percentage change form, are provided in Appendix 2.

The structure of production in a given industry is depicted in Figure 4.2. In the production process, each industry can produce several commodities. Industries use both intermediate and factor inputs. Each intermediate input can be source domestically or imported. Factor inputs for each industry are labor, capital and land. Key simplifying assumptions made in this production model include input-output separability and the multi-stage, hierarchal structure based always on constant elasticity of substitution (transformation) production (transformation) functions except for the combining of intermediate goods and aggregate primary factors, a stage which uses the Leontief or fixed proportions technology.

Figure 4.2 Structure of Production



This structure together with further assumptions about firm behavior and market structure determines the demands for labor, other primary factors and intermediate input and the supply of commodities by the industry. These market and behavioral assumptions are:

1. Producers and consumers are price takers in both input and output markets.
2. Producers seek to maximize profit by choosing input levels subject to the depicted production technology; and therefore choose the least cost combination of inputs for any given level of output.

The production function can be defined as

F(input,output) = 0

and can be written as

G(input)=**X1TOT**=H(outputs)

where **X1TOT** is an index or the level of industry activity. The assumption of input-output separability or separability in the transformation function means the production of a combination of products by an industry is not directly linked to the particular combination of inputs used, but only through the intermediary of the index of activity in that industry (Blackorby *et al.*, 1978). Thus given a level of industry activity, the decision as to what combination of products to produce is separate from, or independent of, the decision as to what combination of inputs to use. In particular, input prices have no effect on output combination other than through their output effect on the level of activity in the industry. Similarly, product prices have no effect on input combinations except through their effect on the level of activity in the industry. Thus demand functions and supply functions, conditional on activity level, contain only input prices or product prices, not both. This represents a substantial empirical simplification.

While the H(outputs) transformation function is assumed to have only a single stage, the G(inputs) function is hierarchically nested with up to three stages. This implies further separability and further simplifies the demand functions. In particular, the demand for inputs at any given level can be expressed as a function of the prices of inputs at that level and need not be expressed as functions of prices of inputs at lower levels in the hierarchy. For example, in Figure 4.2, the demand for labor for producing primary factors can be expressed as a function of the price of labor (and land and capital) without explicit mention of the prices of the individual types of labor. The latter prices do however, affect the price of labor and a separate equation can be written for this. Further, the nesting will mean that decisions, say, on the choice of combination of land and labor for producing primary factors will not depend directly on the prices and decisions of domestic and imported goods used to produce intermediate goods, but only indirectly through their effects on the production and price of intermediate goods. Again, the empirical task is greatly simplified.

The use of constant elasticity functions brings further empirical simplifications. Such functions have only three parameters: a scale parameter, a distribution parameter and the elasticity parameter. For example, the general CES production function has the form:

$$y = A\left[bx_1^{-g} + (1-b)x_2^{-g}\right]^{-v/g}$$

Beattie and Taylor (1985) described the properties of the CES function and its parameters: the scale parameter (v), the distribution parameter ($v+g$) and the elasticity parameter ($\sigma = 1 / (1+g)$). The homogeneity of the function depend on the degree of the scale parameter. The interdependency between sectors is influenced by the distribution parameter and there is a similarity of the substitution elasticity in each pair of input. In the model, these functions are assumed to be constant returns to scale, so there are only two parameters to be specified per function, a considerable reduction in the task of model implementation. Moreover, these functions contain implicit separability between the inputs (outputs) into the function so that the demands for inputs (or supply of outputs) depends only on the price of the particular input (output) and on an aggregate or average of all the input (output) prices (Beattie and Taylor, 1985; Blackorby *et al.*, 1978).

The advantages are obtained at a cost. A property of the constant elasticity function is that the elasticity between two inputs (or outputs) is not only constant as input (output) levels alter, but is the same for all pairs of inputs (outputs). Thus, for example, the substitutability, as measured by elasticity, between labor and capital is the same as that between land and labor; or the elasticity for the sugarcane industry in transforming or shifting from sugarcane to rice output is the same as for transforming rice into rubber. Clearly, such assumptions are likely to be commonly violated; and violations would be especially common on the output side where transformations can occur between the pairs of all the commodities. The empirical significance of using an erroneous elasticity depends on the distribution parameters. The latter determine the shares (between commodities) of an industry's income (or costs or expenditure on the input side); and when the share is relatively small, the elasticity value has little effect on the equilibrium position of the economy. Fortunately, in Indonesia's case, as explained in Chapter 5, the industries defined in the model essentially are single-commodity industries: all output shares except one are zero.

As indicated in Figure 4.2, at the highest level of the input function, the commodity composites, and a primary factor composite and an "other cost" are combined using a Leontief or fixed proportions production function. In this production function, there is no substitution among inputs. That is, there are fixed proportions in using the inputs (Debertin, 1986). With this technology, using more of an input beyond that to maintain the specified proportions of inputs adds nothing to output. In maximizing profits, the industry will not use an excess of any input, and will use the least amount to produce any required amount of the good. Prices at this level have no effect on how the industry produces its output other than to alter the level of output activity in the industry.

Block 1. Demands for labor

Equation 1.1 in appendix 2 is the percentage change in variable form of the occupational labor demand function in each industry. It is derived from an underlying production function (or aggregator function) for labor used in industry i:

$$X1LAB_{i\_o} = \text{CES}_{o \varepsilon OCC} (X1LAB_{io} \mid \sigma 1LAB_i \; ; S1LAB_{io} \;) \qquad (1.1)$$

In this equation, the terms before the "|" are variables entering the function and those after the "|" are parameters. Note that where equation numbers are used in this section, the number identifies the equation in model as presented in Appendix 2 to which the text equation corresponds.

The demand for labor of a particular occupational type is proportional to the overall labor demand in the industry and depends on the price of the particular type of labor relative to the" average" price of labor in that industry. This occupational labor demand function is derived from minimizing the total labor cost of labor subject to the CES aggregator function for labor. Both parameters of the CES aggregator function affect demand. The $S1LAB_{io}$ parameter does not appear explicitly in the demand equation, its effect being embodied in the weights used in calculating the weighted average labor price variable. This is evident in Equation 1.2 in which it does appear in its definitional form ($S1LAB_{io} = V1LAB_{io} \; / \; V1LAB_{i\_o}$). This equation reflects how the average price of labor faced by an industry is related to the individual occupational prices as a weighted index. The percentage change in the average wage paid by an industry is then a weighted (labor-cost-shares) average of percentage changes in each occupational wage.

Block 2. Demands for primary factors

The demand by industry for each factor depends on the overall factor demand in that industry, $X1PRIM_i$, and on individual factor prices in the industry relative to the average factor price in that industry. The demand equation of each factor follows from minimizing the total factor cost subject to the production function at this level, which is defined as:

$$XIPRIM_i = CES\left(\frac{XILAB_{i\_o}}{A1LAB_{i\_o}},\frac{XICAP_i}{A1CAP_i},\frac{XILND_i}{A1LND_i}\middle|\sigma 1PRIM;S1LAB_{i\_o};S1CAP_i;S1LND_i\right)$$

(2.1)

Changes in the price of the primary factor relative to an average factor price changes the demand for this factor. The producer will substitute towards the relatively cheaper factors. Percentage change versions of the demand functions for labor, capital and land for each industry are shown as Equations 2.1, 2.2 and 2.3 in Appendix 2.

These equations also contain technical change variables. Following the practice in the ORANI and ORANI_F models, allowance is made in the Indonesian model for input-augmenting technical change. That is, the various production functions are defined in terms of effective inputs

Effective Input = level of input / technical augmentation variable

The default value of the augmentation variable is one and any change in this variable would reflect technical change. These variables are treated as exogenous variables. In most cases they would be set to zero percentage change, but by being set to negative non-zero values can capture technical changes in particular factors. These augmentation variables have been incorporated in Indonesian Model in order to updated database and forecasting the impact of APEC trade liberalisation with macroeconomics and technology developments.

In all cases where they apply, the technical change variables enter the percentage change equations in conjunction with the quantity variable in the form, x...- a..., and they enter in conjunction with the corresponding price variable in the form p...+ a.... (Horridge *et al.*, 1993, p.98). Unless there is particular reason to do so, in describing the equation in the text in this chapter, no mention is made of these variables.

The final equation in the block for primary factor demands defines the price of the composite of primary factors. The percentage change version is shown as Equation 2.4 in the Appendix 2. The percentage change in the average price of primary factors in an industry is a weighted average of individual factor price

Block 3. Demands for intermediate inputs

Based on the Armington assumption (Armington, 1969), imports are imperfect substitution for domestic supplies. In acquiring a given amount of a commodity, an industry seeks to minimize the total cost of the imported and domestic good subject to the CES production function:

$$X1_{ci\_s} = \underset{s \in SRC}{CES}\left(\frac{X1_{csi}}{A1_{csi}} \middle| \sigma 1_c ; S1_{csi} \right) \qquad c \in COM, i \in IND \qquad (3.1)$$

The percentage change equations for input demand and the price of commodity composite appear as Equations 3.1 and 3.2 of Appendix 2. The input demand for domestic and imported sources of a given commodity depends on the quantity of the composite commodity and on the relative prices of the two sources. The price of the commodity composite is a cost-weighted divisia index of individual prices.

Block 4. The demand for intermediate inputs and the composite primary factor

At the highest level of the input side of the production process, the commodity composite, the primary-factor composite and 'other costs' factor are combined in a Leontief production function to determine the level of output activity for the industry (see Figure 4.2). This function is:

$$X1TOT_i = \frac{1}{A1TOT_i} MIN\left\{ \underset{c \in COM}{MIN}\left(\frac{X1_{ci\_s}}{A1_{ci\_s}} \right) \frac{X1PRIM_i}{A1PRIM_i}, \frac{X1OCT_i}{A1OCT_i} \right\} i \in IND \qquad (4.1)$$

The demand equations for the composite primary factor, for intermediate inputs, and for other "other costs" are, under profit maximizing behavior, directly proportional to the level of activity in the industry. In percentage change terms then, the change in demands must all equal the change in industry activity, except for the presence of any factor augmenting technical change.

The ratios in which the various inputs must be combined are parameters of the Leontief production function. These ratios, together with the prices of the inputs will determine the cost or expenditure shares in the industry. Vice versa, information on these shares and prices effectively define the production function. Since the industry under competition must operate with zero profits, revenue equals costs. Expressing this condition in percentage change terms results in Equation 4.4 in Appendix 2: the percentage change in output price must be a cost-share-weighted average of the percentage changes of individual input prices.

Block 5. The commodity composition of industry output

The commodity composition of industry output is determined as that maximizing the total revenue from all the commodities subject to the level of production activity in the industry and a CET transformation function:

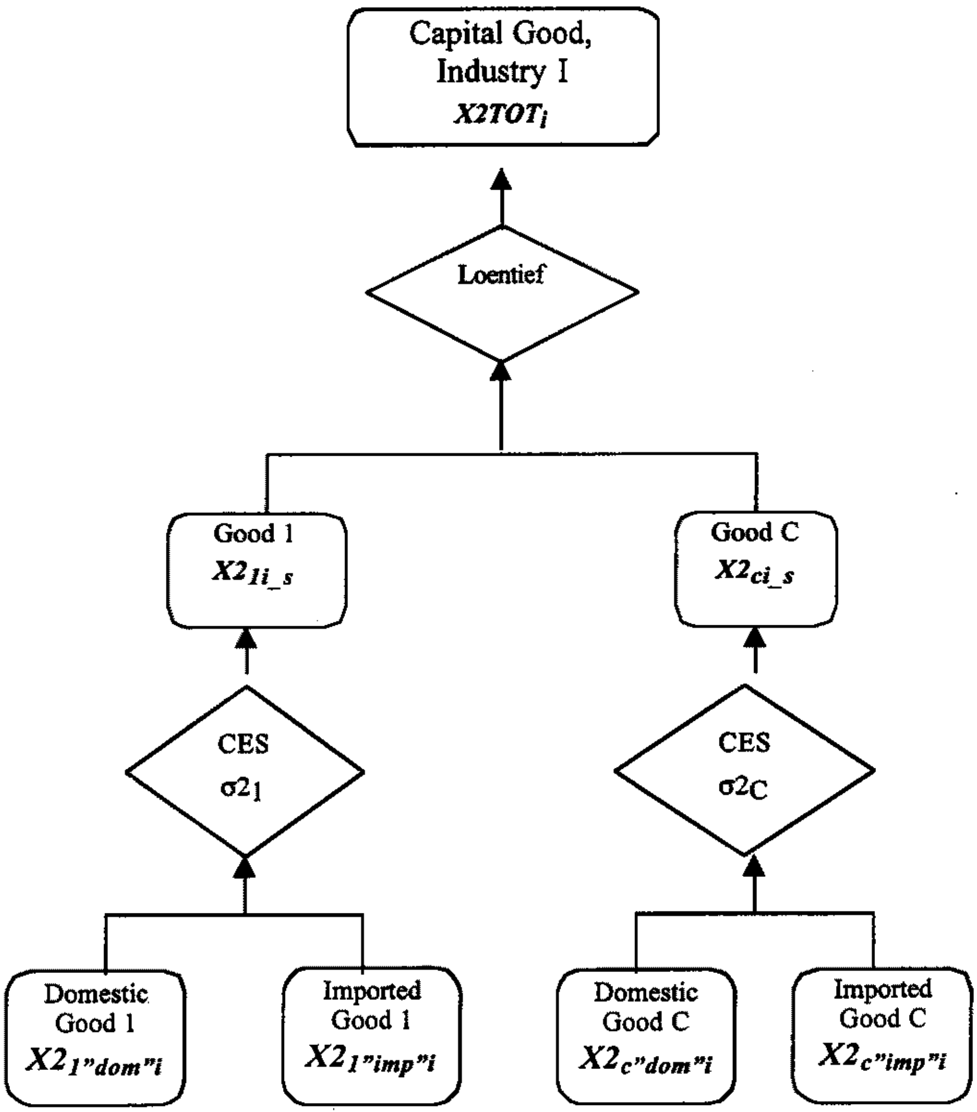
$$X1TOT_i = \underset{c\in COM}{CET}(Q1_{ci} | \sigma1OUT_i; S\_MAKE_{ci}) \tag{5.1}$$

In this case, the transformation will move in favor of a commodity if there is an increase in the price of that commodity, relative to the average. The commodity supply equation, conditional on industry activity level, is captured in percentage change form in Equation 5.1 of Appendix 2. The average price received by an industry for its various commodities is a revenue-share-weighted average of the individual prices. This must equal the price of the industry's activity or composite output under zero profits. Equation 5.2 in Appendix 2 expresses this linearly in percentage change terms.

Block 6. The demand for goods for producing capital goods or investment

The production process for new capital is depicted in Figure 4.3. Similar to the production of current-use goods, the production function for capital goods is assumed to be multi-staged with a CES function at the bottom level to combine different sources

Figure 4.3 Structure of Investment Demand



of goods and a Leontief production function at a higher level to combine composite intermediate goods. It is assumed that the capital good can be produced without using primary factors. At the lower stage, the total cost of imported and domestic good is minimized subject to CES production function and particular output level:

$$X2_{ci\_s} = \underset{s \in SRC}{CES}\left(\frac{X2_{csi}}{A2_{csi}} \middle| \sigma 2_c ; S2_{csi} \right) \qquad c \in COM, i \in IND \qquad (6.1)$$

At the top level, the total cost of commodity composites is minimized subject to the Leontief production function and the given level of capital good produced:

$$X2TOT_i = \frac{1}{A2TOT_i} \underset{c \in COM}{MIN} \left(\frac{X2_{ci\_s}}{A2_{ci\_s}} \right) \qquad i \in IND \qquad (6.2)$$

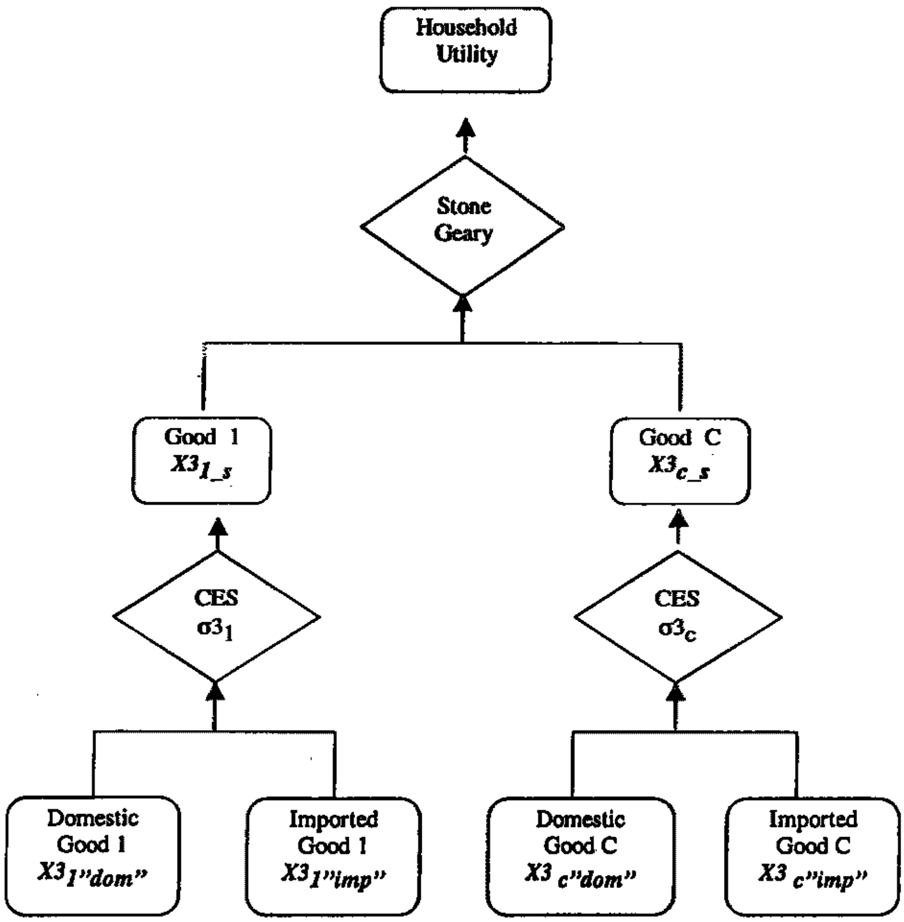
The equations in block 6 of Appendix 2 define the demands for source-specific inputs and for composites.

Block 7. Household demands

Following neoclassical theory, the household sector is assumed to take prices as given and to consume commodities to maximize a utility function subject to an aggregate expenditure constraint. Following ORANI-F, households act as a single consumer and maximize a single or aggregate utility function. As mention in section 3.1.1, the adequacy of the single-consumer assumption depends both on the aims of the analysis and on the impact of simulation on income distribution. The disaggregation of household groups is important if the research is to focus on welfare distribution and income structure. The simplification of the household aggregation can be acceptable because the focus of the study is on the impact of APEC trade liberalisation on the Indonesian economy and the agricultural sector. Also in keeping with the ORANI line of models, the consumers' utility function is nested with two layers as illustrated in Figure 4.4.

At the higher level, consumers choose between different types of commodities in accordance with the linear expenditure demand system (LES). At the second level consumers combine goods from different sources (domestic and imported) through a CES mechanism. The system of equations capturing the household consumption decisions are given in block 7 of Appendix 2.

Figure 4.4 Specification of Household Consumption



The demand and price index Equations 7.1 and 7.2 in Appendix2 parallel those that occur in production, namely those relating to the combining of differently sourced goods. The remaining equations relate to LES demand equations. This demand equation assumes that the expenditure on good i is a linear function of the n prices and income . This system, which is commonly used in applied demand analysis (eg., Clements *et al.*, 1994), is based on a Stone-Geary aggregate utility function:

$$TOTALUTILITY = P_c \; X3LUX_c{}^{S3LUX_c}$$

where $TOTALUTILITY$ is the utility of the household sector and $X3LUX_c$ is the aggregate "luxury" consumption of composite (i.e., CES-combined domestic and imported) good c. With this function, utility is obtained only from consuming goods additional to or above subsistence levels. These constitute "luxury" amounts of goods:

$$X3LUX_c = X3_{c\_s} - X3SUB_c \quad (7.5)$$

where $X3_{c\_s}$ is the aggregate consumption of good c and $X3SUB_c$ is the subsistence level consumption of good c in the economy and equal to

$$X3SUB_c = Q * A3SUB_c \quad (7.3)$$

where $A3SUB_c$ is the individual household subsistence level for the commodity. While potentially endogenous, it would normally be set exogenously, as would Q.

At a per household level, utility is given by

$$UTILITY = TOTALUTILITY \ / \ Q$$
$$= 1/Q * '_c X3LUX_c{}^{S3LUXc} \quad (7.6)$$

The demand function for luxury consumption of a good obtained by maximizing utility is such that luxury expenditure on the particular good is directly proportional to the luxury expenditure on all goods, that is the "luxury expenditure" elasticity for luxury consumption of each good is equal to one (see for example, Clements *et al.*, 1994). The constant share of "luxury expenditure" allocated to a good is equal to the relevant exponent parameter of the utility function

$$P3_{c\_s} * X3LUX_c = S3LUX_c * V3LUX\_c \quad (7.4)$$

where $V3LUX\_c$ is the total expenditure on luxury consumption over all goods.

The linear percentage changes forms of each of the above-labeled equations are given in the appendix. The correspondence is clear in all cases except perhaps Equation 7.5. Rearranging the relevant equation from above as

$$X3_{c\_s} = X3LUX_c + X3SUB_c$$

and converting to percentage changes yields

$$x3_c = \boldsymbol{X3LUX_c} \ / \ \boldsymbol{X3_{c\_s}} * x3lux_c + \boldsymbol{X3SUB_c} \ / \ \boldsymbol{X3_{c\_s}}\ x3sub_c \qquad (7.5)$$

This equation is clearly non-linear, but if the ratios of upper case quantity variables (or expenditures since the same composite good price occurs in numerator and denominator) were fixed at the initial ratios, the equation is linear. This first constant is designated $B3LUX_C$; the other is 1 - $B3LUX_C$.

The value of each $B3LUX_C$ can be determined from a database, but since the quantities are commodities but composites within the utility function framework rather than real, calculation of $B3LUX_C$ involves several steps. If $\boldsymbol{V3TOT\ \_c}$ represents the total consumption expenditure over all goods, the ratio $\boldsymbol{V3TOT\ \_c\ /\ V3LUX\ \_c}$ is called the FRISCH value and is treated here as a parameter calculated from the initial equilibrium. The inverse, the proportion of the household budget spent on luxury consumption is designated parameter ALPHA. As noted above, under the Stone-Geary utility function, the marginal budget shares are equal to the utility function parameters $S3LUX_C$. With $S3_{C\_S}$ being the (average) share of total expenditure on good c, then the expenditure elasticity for good c is

$$EPS_C = S3LUX_C \ / \ S3_{C\_S}$$

The required parameter $B3LUX_C$ is then calculated as

$$B3LUX_C = ALPHA * EPS_C$$

Equation 7.6 in Appendix 2 is included in the model purely as a convenient way of recording what happens to individual household utility under exogenous changes. It has no effect on the solution to the model since utility appears no where else in the model.

Equations 7.7 and 7.8 in Appendix 2 differ from other equations in that the only variables in these equations are variables which represent changes in "effectiveness" of actual goods providing "effective" consumption. Under the Stone-Geary utility function, budget shares and expenditure elasticities alter as prices and expenditure change. Equations 7.7 and 7.8 in Appendix 2 define the changes that would have to occur to the conversion of goods to "effective" goods if the expenditure elasticities are to remain unchanged and budget shares were to be altered exogenously.

Block 8 Export and other final demands

For modeling export demand, following ORANI-F, commodities are divided into two groups, traditional export commodities and non-traditional exports. The specification of export demand in the model differs for the two groups. Essentially, the model allows for the independent specification of an own-price dependent demand function for a traditional export commodity, but not for non-traditional exports. For the latter, exports are assumed to be in direct proportion to the aggregate of the group of non-traditional exports. A price dependent export demand function is specified for this aggregate. For this and for all the individually specified traditional export demand functions, the specified function is a power (constant elasticity of demand) function, demand being a function only of the foreign price. Unlike other areas of demand in the model, export demand exists only for domestically produced goods.

Given the different treatment of goods in the two groups, the decision as to which industries are treated as traditional exports is important in CGE analysis. Placing an industry in the non-traditional export sector means that its demand cannot respond fully to its own price since demand responds to an average price for the group. Its demand responsiveness can be hidden by virtue of a low average responsiveness of the whole group or because export prices of other commodities in the group do not alter as much as or in a similar way to the particular commodity. For example, all 10 (say) equal-value export commodities in the non-traditional export group may have the same elasticity of -20 (quite elastic, as expected for a country which, as a non-traditional exporter, is likely to be a minor part of the market supply) yet if its price falls by 1 percent while others for the group remain unchanged, the price for the group will have altered by only 0.1 per cent. Export demand for all goods in the group will change by only 2 per cent.

Arguably, the assumption is more important for studies of trade liberalisation than for differently focussed CGE studies. On the other hand, because the commodities placed in the non-traditional export group are those whose export levels are historically low, the errors following from incorrect representation of the demand functions for these goods would usually be expected to be small in absolute terms and in terms of aggregate effects on the economy; but they may be large in relative terms for the individual commodities and industries which produce these goods.

These problems can be avoided simply by placing all commodities into the traditional exports group and specifying individual export demand equations. This is the case in ORANI and other CGE models. If the model captures the domestic production opportunities and responses to incentives properly, this is likely to be the preferred approach. Specification of the appropriate demand functions may be difficult since, as non-traditional exports, there would be little data available. Equally however, as a non-traditional exporter of the good, the country would be a small country in this commodity market and essentially a price taker. Only if there is some doubt about the reliability of the domestic responses produced by the model, would there be reason to treat goods as non-traditional exports; and in this case, preferably the domestic aspects of the model should be improved rather than artificially curtailing export responsiveness.

Equation 8.1 in Appendix 2 defines, in percentage change terms, the downward sloping foreign demand schedules for traditional exports. Equation 8.3 in Appendix 2 does this for the aggregate of non-traditional exports. For the individual traditional export commodity, the actual demand function is:

$$X4_c = F4Q_c\ [P4_c/PHI/\ P4_c]^{EXP\_ELAST_c} \qquad (8.1)$$

where EXP_ELAST_c is the export elasticity of demand, $P4_c$ is the price (in Indonesian currency) and PHI is the exchange rate (Indonesian Rupiah per \$US). The $F4_c$ and

$P4_c$ variables act as shifters of the demand function. For the non-traditional export commodity, its level of exports is

$$X4_c = S4Q\_"NTRAD" * X4\_"NTRAD" \quad (8.2)$$

where $S4Q\_"NTRAD"$ is the ratio of exports of this commodity to the aggregate exports of non-traditional exports. The aggregate export of non-traditional exports is

$$X4\_"NTRAD" = F4Q\_"NTRAD" \, [P4\_"NTRAD"/PHI/P4_c]^{EXP\_ELAST\_NT} \quad (8.3)$$

Equations 8.4 and 8.5 in Appendix 2 define the share weighted average export prices for the two categories of commodities.

Block 8 also contains equations for the demand for goods by government. The demand for each source-differentiated commodity is assumed to be independent of price:

$$X5_{cs} = F5_{cs} * F5TOT \quad (8.4)$$

and

$$F5TOT = X3TOT * F5TOT2 \quad (8.5)$$

where the three F variables are demand shifters. In equation 8.5, shifter $F5TOT$ affects the demand for every source differentiated commodity whereas $F5_{cs}$ shifts only the one demand function. These two equations (actually many since (8.5) has multiple equations) simply serve to facilitate analysis with the model. For example, if the model is not intended to explain economically the level of government demand, then $X5_{cs}$ could be set exogenously. These two equations, and the shifters, could be dispensed with entirely; or equivalently, the two shifters $F5_{cs}$ and $F5TOT$ could be set exogenously to no change. On the other hand, it may be useful to analyse policies in an environment where government expenditure changes in direct proportion to consumer expenditure. This can be achieved by setting the two shifters $F5_{cs}$ and $F5TOT2$ exogenously to no change.

Block 9. The demand for goods as margins

While producers, consumers and other users of commodities use them in accordance with the production/consumption technology already outlined, the use of commodities often entails further "service" inputs. In effect, there are additional inputs which are not captured by the assumed CES/Leontief /LES production/demand processes. These inputs are the margin goods, for example transport and communication services. In the ORANI-based models, the margin goods are not additional to the general set of commodities but a subset of them. Such goods are potentially used directly in production as well as for margins.

The amounts of goods required as margins are assumed to be directly proportional to the commodity flows at the lowest levels of the production/consumption processes. For example, for current-use production, the demand for good m as a margin in facilitating the use by industry i of good c sourced from s is

$$X1MAR_{csim} = A1MAR_{csim} * X1_{csi} \quad (9.1)$$

where $A1MAR_{csim}$ is the proportionality constant.

The equations in block 9 of Appendix 2 describe the demand for margin to producers, capital creators, households, exports and "other uses" in percentage change form.

Block 10. Purchasers' prices for goods

The margin goods are not additional goods, but a subset of the full set of commodities. Thus a margin commodity can enter into the production of another good not only as an intermediate good but also as a margin. These margin inputs constitute costs for the users. Their cost is built into the price of the source- and use-differentiated commodities. The latter prices, so called "purchasers' prices", are equal to a "basic price" or market price for the source-differentiated commodity price plus the margin cost plus any net taxes on the use of the commodity. The first five equations in block 10 of Appendix 2 define the purchasers' prices for producers, investors, households, exports and government in percentage change terms. The parameter TINY in these equations represents a minor adjustment to the database information to ensure that it conforms with the model, in particular that there is some expenditure on each differentiated commodity in each use for purposes of calculating the shares of margins taxes and basic costs in that expenditure. Essentially, CES and CET functions, or more generally homothetic functions, rule out the possibility of zero flows, though flows may approach zero. Shares too can approach zero, and can be assumed to be zero for approximation purposes; but mathematically these shares are not defined if the database shows a zero aggregate expenditure on any source and use differentiated commodity (i.e. if $VkPUR_{csi} = 0$ for any k). TINY, which is a small value, e.g. 1.0E-12, ensures this.

Following ORANI-F, imports are treated as having a perfectly elastic supply function at an exogenous world price. The prices of imported goods in Indonesian currency are given by

$$POIMP_{csi} = PFOCIF_c * PHI * TOIMP_c \qquad (10.6)$$

namely the CIF price in US$ prices adjusted by the exchange rate (Indonesian currency per US$) and by the power of the tariff on the commodity (see sections 2.1 and 2.5). This equation imposes a zero profit condition on importers.

Block 11. The market clearing equations

Block 11 in Appendix 2 contains equations (11.1 to 11.3) which are the percentage change versions of the market clearing equations for domestic commodities. They equate the supplies (from Equation 11.1) with the sum of the various components of demand. The two sets of equations differ since one is for non-margin type goods and the other is for margin goods. The latter has extra components on the demand side.

This block also defines the aggregate level of import demand in percentage change terms (Equation 11.4), the aggregate demand for labor of each occupational type (Equation 11.5) and the aggregate and sub-aggregates of potentially different land types and prices (Equations 11.6 to 11.12 of Appendix 2). The land equations are explained here in more detail since the treatment of land in the Indonesian Forecasting Model is different from the ORANI-F model.

The model has some flexibility in regard to the assumptions about land mobility. In the model, three types of land are defined, namely land that is suitable for estate crops, land that is suitable for grain crops and land suitable for other industries. In the market clearing conditions, the supply and demand of land must be the same in aggregate, as well as for each type of land. The market clearing equation for aggregate land is the following:

$$x1\ln d_{\_i} = \frac{1}{V1LND_{\_i}} \sum_{i \in IND} V1LND_i \times x1\ln d_i \qquad (11.6)$$

where

$x1ln\ d_{\_i}$ = percentage change of aggregate land
$x1ln\ d_i$ = percentage change of land in industry i
$V1LND_{\_i}$ = total payment to land over industries
$V1LND_i$ = total payment to land in industry i

The market clearing equations for the three types of land are provided in Appendix 2 (equations 11.6 to 11.9). The market clearing equation for land suitable for estate crops serves as an example:

$$x1\ln d_{\_e} = \frac{1}{V1LND_{\_e}} \sum_{i \in ESTATE} V1LND_i \times x1\ln d_i \qquad (11.7)$$

where

$x1ln\,d_{\_e}$ = percentage change of aggregate land used in estate crops

$x1ln\,d_i$ = percentage change of land in industry i in the estate crops group

$V1LND_{\_e}$ = total payment to land used in estate crops

$V1LND_i$ = total payment to land in estate crops industry i

The price equation in each industry in the estate crops group can be defined in percentage change terms as:

$$p1\ln d_i = f1\ln d_{\_e} + f1\ln d_i + f1\ln d\_i \qquad (11.10)$$

where

$p1ln\,d_i$ = price of land in estate crops industry i

$f1ln\,d_{\_e}$ = aggregate estate crop's land rental shifter

$f1ln\,d_i$ = industry i's land price shifter (a slack variable for the price equation)

$f1ln\,d_{\_1}$ = overall land rental shifter

By varying the settings for the shifter variables, various land mobility assumptions can be modelled. For example, if land is to be mobile and transferable between the industries within the estate crops group, the price of land (and change in the price) in each industry in the group must be equal. Changes in prices ($p1ln\,d_i$) are the same when equal to the land price shifter for the estate crops group($f1ln\,d_{\_e}$). To ensure this, the other shifter variables in the equation ($f1ln\,d_i$ and $f1ln\,d_{\_1}$) must be set exogenously at zero. At the other extreme, if land is unique to each industry, prices across industries are not directly related. By allowing the slack variable ($f1ln\,d_i$) to be determined endogenously, the price equation for industry i is removed. More details of the alternative closures of the model to represent the various degrees of land mobility are provided in section 4.1.6.

Block 12. Indirect taxes

The model allows for sales taxes defined as ad valorem taxes on basic values. The sales-tax variables in the linearised model are percentage changes in the power (1+

rate of tax) of the taxes. The first six equations in block 12 of Appendix 1 follow ORANI-F, and allow differential tax rates for producers, investors, exporters, household and "other" users of commodities. The same sales taxes apply to both domestic and imported product. The structure allows for the model user to define either or both commodity-specific or user-specific taxes. For example, the power of the tax on use by producers is

$$T1_{csi} = F0TAX_{c\_s} * F1TAX\_{csi} \qquad (12.1)$$

where the first tax applies to a given commodity regardless of use, and the second to every commodity and every industry when using the commodity for current-use production.

The remaining six equations relate to the revenue generated by the sales taxes and tariffs. The tax revenue has the general form

Tax revenue = Tax rate * Value of product before tax
= (Power of tax - 1) * Value of product before tax

The derivations of the required equations, following Horridge *et al.* (1993), are exemplified by that for current-use production:

$$\begin{aligned} V1TAX\_{csi} &= S_{csi}\,(T1_{csi} - 1) * V1BAS\_{csi} \\ &= S_{csi}\,(T1_{csi} - 1) * (P0_{cs} * X1_{csi}) \qquad (12.7) \end{aligned}$$

Then

$$\begin{aligned} DV1TAX\_{csi} = {} & S_{csi}\,(T1_{csi} - 1) * (DP0_{cs} * X1_{csi}) \\ & + S_{csi}\,(T1_{csi} - 1) * (P0_{cs} * DX1_{csi}) \\ & + S_{csi}\,DT1_{csi} * (P0_{cs} * X1_{csi}) \end{aligned}$$

and

$$\begin{aligned} V1TAX\_{csi} * w1tax\_{csi} = {} & S_{csi}\,(T1_{csi} - 1) * (P0_{cs} * X1_{csi})\,p0_{cs} \\ & + S_{csi}\,(T1_{csi} - 1) * (P0_{cs} * X1_{csi})\,x1_{csi} \\ & + S_{csi}\,T1_{csi}\ t1_{csi} * (P0_{cs} * X1_{csi}) \\ = {} & S_{csi}\,(T1_{csi} - 1) * V1BAS_{csi}\ p0_{cs} \end{aligned}$$

$$+ S_{csi}\,(T1_{csi} - 1) * V1BAS_{csi}\;\; x1_{csi}$$

$$+ S_{csi}\, T1_{csi}\, t1_{csi} \;\; * V1BAS_{csi}$$

$$= S_{csi}\, V1TAX_{csi} * p0_{cs}$$

$$+ S_{csi}\, V1TAX_{csi} * x1_{csi}$$

$$+ S_{csi}\,(V1BAS_{csi} + V1TAX_{csi}) * t1_{csi}$$

Then, by treating all the values (taxes and basic values) as constants, the equation is the linear equation (12.7 in Appendix 2).

Equation 12.12 in Appendix 2 for tariff revenue is derived in a similar way from

$$V0TAR\_c = S_c\, X0IMP_c * PF0CIF_c * PHI * (T0IMP_c - 1) \qquad (10.6)$$

Block 13. GDP from the income and expenditure sides

An essential component of a CGE model is the link from the income earned by the owners of the factors of production to their expenditure. The GDP from both the expenditure and income sides must be equal (Equation 13.6 and Equation 13.27 in Appendix 2). The equations for the value added or income side (Equations 13.1 to 13.6 in Appendix 2) include the totals of the various factor payments, the value of other costs, and the total revenue from commodity taxes and the aggregate GDP. The expenditure side (Equations 13.7 to 13.27 in Appendix 2) records the aggregate payments made by the various groups of final demand users of factors, that is the aggregate of total investment, consumption, net export, the "other" demands and inventories, and aggregate expenditure, all in percentage change terms. The latter changes are decomposed into price and quantity changes to facilitate analysis of these components. The Equation 13.26 in Appendix 2 in turn being share weighted averages of the component prices. These in turn define changes in price indexes for consumers, investors, exporters, importers etc.

Block 13 also define GNE (gross national expenditure) change which is the change on national expenditure excluding export and import. It can be seen in equation 13.28 in Appendix 2.

The equations in the block 13 are exemplified by those for exports. The value of exports is

$$V4TOT = X4TOT * P4TOT \qquad (13.15)$$

with *X4TOT* and *P4TOT* being defined as a value-share-weighted indices

$$V4TOT * X4TOT = \prod_c X4_c^{V4PURc} \qquad (13.13)$$

$$V4TOT * P4TOT = \prod_c P4_c^{V4PURc} \qquad (13.14)$$

Block 14. The trade balance and other aggregates

The first six equations in this block relate to aspects of the trade balance. Equations 14.2 to 14.4 in Appendix 2 define the value of imports in terms of a quantity index and price index, the indices in turn being share-(basic)value-weighted averages of commodity import quantities and prices. These parallel the equations for CIF values (Equations 13.22-13.24 in Appendix 2).

Equation 14.5 in Appendix 2 defines the terms of trade. In the non-linear form, the term of trade is

$$P0TOFT = P4TOT \,/\, P0CIF\_c \qquad (14.5)$$

Equation 14.6 in Appendix 2 defines the real exchange rate (foreign to domestic prices). In the non-linear form, the equation is

$$P0REALDEV = P0CIF\_c \,/\, P0GDPEXP \qquad (14.6)$$

With balance of trade (in domestic currency) defined by

$$BTD = V4TOT - V0CIF\_c$$

and expressing this relative to gross domestic product **V0GDPEXP**

$$BTD/V0GDPEXP = V4TOT/V0GDPEXP - V0CIF\_c / V0GDPEXP \quad (14.1)$$

and then defining changes, expressing the value changes in percentage terms but leaving the balance of trade to GDP ratio in absolute terms in order to avoid the possibility of calculating a relative change a balance variable that might have an initial value of zero,

$$V0GDPEXP * D(BTD / GDP) = V4TOT * w4tot - V0CIF\_c * w0cif\_c + (V4TOT - V0CIF\_c) * w0gdpexp$$

Naming **D(BTD / GDP)** as **delB**, and treating all the values as constants,

$$V0GDPEXP * delB = V4TOT * w4tot - V0CIF\_c * w0cif\_c + (V4TOT - V0CIF\_c) * w0gdpexp$$

which is Equation 14.1 in Appendix 2.

The four equations (14.7 to 14.11 in Appendix 2) relate to various aggregates of primary factors across all industries, defining the percentage changes in the employment by industry and the aggregate employment of labor, indexes of aggregate use of capital and the average price (rent) of capital. These are all share-weighted indices.

Block 15. Rates of return on capital

Capital differs from other inputs in the model in that it is both producible and depletable. The price of constructing (for adding to or replacing existing capital) ($P2TOT_i$) is related to the price of capital in use ($P1CAP_i$) by virtue of investors' willingness to invest. This block defines the rate of return on capital, which links the supply and demand side prices of capital, and includes an equation specifying an equilibrium condition on rates of return to capital creation. However, unlike the blocks so far outlined, several alternative variants of the component for investment are included in the model using slack variables as explained in section 4.1.2. The alternatives differ by virtue of different assumptions about the driving force for investment and about how investors deal with risk premiums in choosing investment levels.

The model allows for risk premiums in the rates of returns, if wanted. That is, the model can be used either under an assumption of no risk (the conventional ORANI-F model) or under an assumption of recognition of the possible existence of risk premiums. The word "possible" is used here since, when risk premiums are included in the formulation, these premiums may nevertheless be zero.

The (net) rate of return ($R1CAPRSK_i$), which would include the risk premium, if any, is the gross rate of return less the depreciation rate ($DEPRAT_i$). The gross rate of return ($G1CAP_i$) is the use (or rental) price of capital relative to the cost of producing capital for the particular industry. Thus,

$$R1CAPRSK_i = G1CAP_i - DEPRAT_i$$

$$= (P1CAP_i \;/\; P2TOT_i) - DEPRAT_i$$

To allow for the possibility of risk, risk premiums are made explicit in the rental returns on capital earned by investors in a sector. The risk premium for sector i is initially defined relative to a riskless rate of return for the sector:

$$R1CAPRSK_i = R1CAP_i + R1RSK_i$$

where $R1CAP_i$ is the riskless net rate of return and $R1RSK_i$ is the risk premium for sector i. This formulation follows Walmsley's (1998) treatment of (regional) risk in the global GTAP model.

To allow for a formulation in which risk is not recognised, the risk premium variable is multiplied by a 0-1 flag parameter *RISKFLAG*. That is,

$$\boldsymbol{R1CAPRSK_i = R1CAP_i} + RISKFLAG * \boldsymbol{R1RSK_i}$$

When the user sets parameter *RISKFLAG* = 0, risk is absent from, or not recognised in, the model. The variable $\boldsymbol{R1CAPRSK_i}$ then does not include risk, despite its name: it is then identical to $\boldsymbol{R1CAP_i}$. When *RISKFLAG* =1, risk is allowed for in the model, though the level of the risk premium could still be zero. The equation can be expressed in percentage change terms as

$$R1CAPRSK_i * r1caprsk_i$$

$$= R1CAP_i * r1cap_i + RISKFLAG * R1RSK_i * r1rsk_i$$

Because the risk premiums may be zero, it is numerically better to avoid percentage changes for the premium variables and to work with absolute changes ($delr1rsk_i$):

$$R1CAPRSK_i * r1caprsk_i$$

$$= R1CAP_i * r1cap_i + 100 * RISKFLAG * delr1rsk_i \qquad (15.9)$$

Substituting for $\boldsymbol{R1CAPRSK_i}$ in the rate of return equation (the first equation of this block), that equation becomes

$$\boldsymbol{R1CAP_i} + RISKFLAG * \boldsymbol{R1RSK_i} = \boldsymbol{(P1CAP_i / P2TOT_i)} - DEPRAT_i$$

which in percentage change terms (except for $\boldsymbol{R1RSK_i}$) is

$$R1CAP_i * r1cap_i + 100 * RISKFLAG * delr1rsk_i$$

$$= (P1CAP_i / P2TOT_i) * (p1cap_i - p2tot_i)$$

Letting $\boldsymbol{QCOEF_i}$ be the ratio of the gross rate of return (including any risk) to net rate of return (excluding any risk),

$$QCOEF_i = (P1CAP_i / P2TOT_i) / R1CAP_i$$

then

$$r1cap_i + 100 * RISKFLAG / R1CAP_i * delr1rsk_i$$

$$= QCOEF_i * (p1cap_i - p2tot_i) \qquad (15.1)$$

which is the equation included in the linearized model.

Although risk is not recognised in the formulation when $RISKFLAG = 0$, the variable $\boldsymbol{R1RSK_i}$ still exists as a variable. With the then zero coefficient on this variable wherever it occurs in equations, the solution value of the variable $\boldsymbol{R1RSK_i}$, and changes in it ($delr1rsk_i$) in the linearized equations, will be undefined. The variable $delr1rsk_i$ needs to be set exogenously to zero (any other value could be used since the particular value will have no effect on the solution, but to avoid confusion in interpreting results, 0 is preferred) when $RISKFLAG = 0$. The variable $\boldsymbol{R1RSK_i}$, too, must be set since, although changes in it are no longer explicit in the equations, the value of $\boldsymbol{R1RSK_i}$ will affect the value of other coefficients in the equations. Logically, if risk does not exist, $\boldsymbol{R1RSK_i}$ should be set to zero.

The average risk premium across sectors is defined as the share weighted average of sector investments

$$R1RSK\_i = \sum_i R1RSK_i * S2INVEST_i$$

Working in actual changes rather than in percentage change terms because of the possibility of zero-valued risk premiums,

$$delr1rsk\_i = \sum_i S2INVEST_i * delr1rsk_i \qquad (15.2)$$

This equation is definitional only. In itself it does not restrict the risk premiums. Using knowledge of the average risk premium in the database, *delr1rsk_i* can be set exogenously to enforce a desired average risk premium.

In contrast to the model described here, the standard ORANI-F model does not include an explicit allowance for risk. When *RISKFLAG* is set to zero in the Indonesian Forecasting Model, Equation 15.1 corresponds to the ORANI-F rate of return equation. If there are apparent risk premiums in the database, the ORANI-F specification and the Indonesian Forecasting Model with *RISKFLAG* = 0 would be inconsistent with the database. A discrepancy slack variable as described in section 4.1.2 would be needed in each equation of type Equation 15.1 to achieve an initial model solution compatible with the database. These slacks could be altered appropriately to force the equivalent levels slacks to zero. However, slack variables for Equation 15.1 would look exactly like the risk premium variables. Thus by viewing the risk premiums as discrepancies and forcing them to zero, one obtains a database consistent with a riskless model solution.

When the formulation recognises risk (*RISKFLAG* = 1), discrepancies in the database in relation to Equation (15.1) would be indistinguishable from risk premiums (assuming the risk premium variables do not enter other restricting equations). These risk premiums could be forced to zero by exogenously setting $delr1rsk_i$ to -1. Having done so, one would have a discrepancy-free, risk-free solution to the model, that is the same as when *RISKFLAG* = 0. On the other hand, if the apparent discrepancies in the initial database were viewed as genuine risk premiums, they could be allowed to persist in equilibrium by exogenously setting $delr1rsk_i$ to 0. Finally, if there were estimates of the risk premiums from other sources, the apparent risk premiums in the database could be separated into actual premiums and discrepancies, and the $delr1rsk_i$ variables could be shocked to remove the discrepancies, leaving a database with risk premiums.

Equation 15.1 links the producer and user prices of capital within an industry definitionally. Equation 15.3, however, in its various alternative forms described below, is the key behavioural equation; and equation 15.4 is a key equilibrium condition. Equation 15.3 specifies what determines equilibrium current rates of return on investment in industries. Three alternative formulations are included in the Indonesian Forecasting Model: one based on the ORANI specification, one based on the ORANI-F specification and one based on Walmsley's (1998) specification. Slack variables are defined to allow removal of the unwanted versions from any particular simulation. In all three versions, it is assumed that riskless rates of return are the relevant ones in determining equilibrium.

ORANI specification of investment

In the case of the ORANI model, Dixon *et al.* (1982) develop capital creation equations by postulating that investors in an industry expect the future period equilibrium rate of return to creating capital in that industry to be proportional to the current period equilibrium rate of return with the proportionality constant being the ratio of the equilibrium level of capital that will exist in the future in the industry to the current period equilibrium level of capital in the industry:

$$R1CAP_i = (X1CAPF_i \;/\; X1CAP_i)^{BETA\_R_i} * R1CAPF_i \qquad \text{(ROR Eqn)}$$

where $R1CAPF_i$ is the future period expected rate of return applicable to the industry, $X1CAPF_i$ is the future period capital stocks in the sector and $BETA\_R_i$ is a positive coefficient. Future period (envisaged in the ORANI specification as the next or following period) equilibrium capital is definitionally related to current period equilibrium capital as that stock plus net investment.

$$X1CAPF_i = X1CAP_i * (1 - DEPRAT_i) + X2TOT_i$$

The ratio of next period capital to current period capital is the power of the net rate of growth in capital ($X1GROW_i$):

$$X1GROW_i = X1CAPF_i \;/\; X1CAP_i$$

$$= (X1CAP_i * (1- DEPRAT_i) + X2TOT_i) / X1CAP_i$$

$$= 1 + (X2TOT_i - (X1CAP_i * DEPRAT_i)) / X1CAP_i$$

$$= 1 + X2NET_i / X1CAP_i$$

where $X2NET_i$ is net investment in industry i. If capital stocks remain the same from the current to the next period, that is the sector is in a steady state, the current and expected future rates of return are equal.

Substituting $X1GROW_i$ for $X1CAPF_i / X1CAP_i$ and then linearizing the rate of return equation (ROR Eqn),

$$r1cap_i - r1capf_i = BETA\_R_i * x1grow_i + slackorwalm_i \qquad (15.3a\text{-Simple})$$

where

$$x1grow_i = x1capf_i - x1cap_i \qquad (15.5)$$

and where the slack variable $slackorwalm_i$ allows the equation to be removed if the ORANI investment model is not to be applied. Equation (15.3a-Simple) as such does not actually appear as the ORANI investment specification in the Indonesian Forecasting Model since it is further adapted to an equation which embraces the Walmsley investment model as well as the ORANI model (see the sub-section on Walmsley (1998) on p.10).

ORANI-F specification of investment

The ORANI-F investment condition is a simple one: for any given industry, the higher its capital stocks relative to aggregate capital stocks, the higher must be its net riskless rate of return to creating new (gross) capital relative to the average return to creating capital (across all industries). This model further assumes that relative rates of return are related to the relative levels of capital stocks for the industry according to a power function or constant elasticity relationship:

$$R1CAP_i \,/\, R1CAP\_i = F1RET_i \,(X1CAP_i \,/\, X1CAP\_i\,)^{BETA\_R_i}$$

where parameter $BETA\_R_i$ has a positive value and can vary between industries. Variable $F1RET_i$ captures the proportionality factor. In percentage change terms,

$$r1cap_i - r1cap\_i = BETA\_R_i * (x1cap_i - x1cap\_i) + f1ret_i \qquad (15.3b)$$

Treating $F1RET_i$ as a variable rather than a parameter allows the user either to fix the proportionality constant at its initial value (by setting $f1ret_i$ exogenously to 0) or to relax (remove) the ORANI-F specifications of the relative rate of return equation by letting $F1RET_i$ be endogenous.

Whereas the ORANI specification (15.3a-Simple) serves to link the current and future rates of return, the ORANI-F model (15.3b) in itself does not do this. It only concerns current rates of return. Further, the presence of the variable $F1RET_i$ means that the connection between current rates is not complete. This variable, which does not appear in any other equation in the model, essentially acts as a slack variable if made endogenous. Unless it is pre-set in the levels, it is free to adopt whatever value is needed to satisfy the levels version of (15.3b).

The ORANI-F relative rate of return condition lacks a fully coherent theoretical basis, being largely a pragmatic and empirical model. Nothing is contained in the Horridge *et al.* (1993) paper establishing a theoretical basis, though it is stated (seemingly wrongly) that the model follows ORANI. In the ORANI-F model, the higher the sector's share of the (current period) equilibrium level of capital, the lower its expected return relative to the average. Horridge *et al.* (1993) explain the model, saying that rates of return to creating capital are related to capital growth rates. However, the explanation is unclear as there is nothing in equation (15.3b) that specifically relates to capital growth, only to capital stocks. It is therefore difficult to see how it can be said that growth rates of capital determine rates of return in the ORANI-F model. Certainly the assumption that rates of return are related to growth rates is a common assumption in CGE models, including ORANI.

Horridge *et al.* (1993) further suggest that different equilibrium rates of return in their model may reflect risk premia, with industries experiencing relatively rapid growth being riskier. This too seems incorrect. Comparing rates of return across industries, rates can differ in the ORANI-F model because of the factors that lie behind the parameter $BETA\_R_i$ or the level of the variable $F1RET_i$. It is quite possible these include risks associated with the industry per se independent of growth in capital stocks.

The difficulties in interpretation of the ORANI-F investment model stem in part from the notion of changes in the existing capital in moving from one equilibrium to another as opposed to the changes in capital due to the creation of capital during a period as a result of investment.

The CGE model reflects equilibrium. Under imposed exogenous changes the economy has a different equilibrium. For example, an industry's equilibrium capital share may be higher in the new equilibrium and so too then, following equation (15.3b), would be the return on creating capital. The CGE model does not specify a higher rate of return because of an increase in capital stocks due to investment moving the economy from the previous equilibrium to the new one, but because the capital stocks are higher in the new equilibrium. For example, suppose that the economy had been in stationary equilibrium (net investment was zero) before some exogenous change which induces an expansion and requires additional capital stocks in some industry. Suppose further that after the changes, the economy again reaches stationary equilibrium. Both before and after, the growth rates of industries would be the same, namely zero. Yet under (15.3b) the rate of return would be higher. The higher rate of return is not associated with higher growth rates per se, but with the relative size of capital stocks.

Walmsley's investment model

Walmsley's (1998) formulation has much in common with the ORANI formulation. In Walmsley's multi-country case, differential rates of return are defined for various countries rather than industries as in the national ORANI model. This is adapted here to industries within the national economy. The major difference from ORANI is that Walmsley's model relates the ratio of current and expected future rates of return to *relative* growth rates of capital and not just growth rates as in the ORANI model. In the notation of the Indonesian Forecasting Model,

$$R1CAP_i \ / \ R1CAPF_i = ((X1CAPF_i \ / \ X1CAP_i) / X1GROW\_i)^{BETA\_R_i}$$

where $X1GROW\_i$ is a capital value share weighted average of the power of the individual industry growth rates:

$$X1GROW\_i = \sum_i (V0CAP_i / V0CAP\_i) * X1GROW_i$$

where, as noted in the outline of the ORANI formulation (p.195), $X1GROW_i$ is the power of the net growth rate in industry i, equal to $X1CAPF_i \ / \ X1CAP_i$. The equation for $X1GROW\_i$ is a definitional equation. The levels variables, $\mathbf{V0CAP_i}$ and $\mathbf{V0CAP\_i}$, here represent the value of fixed capital stocks at the start of the period in each industry and in aggregate.

In percentage change terms, the equations for the Walmsley formulation are:

$$r1cap_i - r1capf_i = BETA\_R_i * (x1grow_i - WALMFLAG * x1grow\_i) + slackorwalm_i \quad (15.3a)$$

$$x1grow_i = x1capf_i - x1cap_i \quad (15.5)$$

$$xlgrow\_i = \sum_i (VOCAPF_i / VOCAPF\_i) * (xlcap_i + plcap_i + xlgrow_i)$$

$$- \sum_i (VOCAP_i / VOCAP\_i) * (xlcap_i + plcap_i) + slackgrow\_i) \qquad (15.6)$$

where *WALMFLAG* is a binary parameter taking the value 0 except when the Walmsley investment model applies, in which case $WALMFLAG = 1$. The two new capital value variables, $VOCAPF_i$ and $VOCAPF\_i$, apply to the end of the period, and hence represent the next period's beginning capital stocks.

The Walmsley formulation is clearly similar to that in ORANI. Whereas in ORANI current and future rates of return in an industry are only equal if the capital stock remains the same over time, that is if there is zero net investment or equivalently the economy is in a steady state (assuming $BETA\_R_i$ differs from 0), in Walmsley's formulation, current and future rates of return to investment in an industry can be equal even if the industry is growing. Rates of return are equal provided the industry is growing at the same rate as the economy as a whole, that if is there is balanced growth. Rates could be equal under either a slow growing or rapidly growing economy. The Walmsley formulation thus offers a more general treatment of long-run equilibrium conditions than ORANI; or equivalently, the ORANI formulation is a special case of the Walmsley's formulation. Equation 15.3a thus serves for both formulations, the particular formulation being specified by the *WALMFLAG* parameter.

Nothing in the equations so far described defines equilibrium conditions on rates of return. For the multi-country case, Walmsley imposes two conditions for long run equilibrium: rates of return should be equal over time (equivalently countries should grow at the same rate); and rates of return should be equal across countries. The standard ORANI model includes a parallel condition applied across industries.

The ORANI investment model is completed by assuming that investment is allocated across industries to equate all equilibrium expected future rates of return to capital creation. In terms of the notation of the Indonesian Forecasting Model,

$$R1CAPF_i = R1CAPF\_i$$

Since this equilibrium condition may not hold in the database, a discrepancy variable ($E1CAPF_i$) and a "slack variable ($SLACKCAPF_i$) are introduced:

$$R1CAPF_i / R1CAPF\_i = 1 + E1CAPF_i * SLACKCAPF_i$$

which when linearized, with one addition, is

$$r1capf_i - r1capf\_i = E1CAPF_i/(1 + E1CAPF_i) * slackcapf_i + slackcapf2_i \tag{15.4}$$

where $slackcapf_i$ is set exogenously to -100 to remove the discrepancy. A second slack variable ($slackcapf2_i$) is included to remove the equation if it is not wanted by making that variable endogenous. Variable $slackcapf_i$ might appear able to accomplish the same task, but it cannot do so if the discrepancy, and hence the coefficient on $slackcapf_i$, is initially zero. It is not a normal slack variable.

Equation 15.4 applies not only for the ORANI specification but also in the Walmsley long-run investment equilibrium.

Walmsley's other long run equilibrium condition is that of equality of rates over time,

$$R1CAP_i = R1CAPF_i$$

For the Walmsley version of Equation 15.3a, this is equivalent to imposing balanced growth

$$X1GROW_i = X1GROW\_i$$

and Walmsley imposes equality of rates by imposing this condition on growth rates. In the standard long run equilibrium in the ORANI model, equality of rates across time is not usually imposed, though it could be. If equality of rates over time were imposed for ORANI, that is when WALMFLAG = 0 in Equation 15.3a, effectively the sectoral growth rates are held unchanged:

$$x1grow_i = 0$$

If the economy is in a steady state, imposing equality of rates of return would ensure it remains in a steady state.

While the equality of rates across time could be imposed directly, the Indonesian Forecasting Model follows Walmsley: the condition is imposed on the capital growth rates. The Indonesian Forecasting Model formulation also explicitly allows for discrepancies between the model and the data base

$$X1GROW_i / X1GROW\_i = 1 + E1GROW_i * SLACKGROW_i$$

which, when linearized, is

$$x1grow_i - x1grow\_i = E1GROW_i / (1 + E1GROW_i) * slackgrow_i + slackgrow2_i \quad (15.7)$$

where $slackgrow2_i$, when endogenous, allows for the equation to be effectively removed when this long-term equilibrium condition is not wanted and $slackgrow_i$ is set exogenously to -100 to remove the initial discrepancy in the database for this equation. $E1GROW_i$ is the discrepancy between the sector growth rate and the average. This equation imposes equality of rates of return for the Walmsley model, but not for the ORANI model.

To allow for the imposition of the stronger condition of maintenance of stationarity (once in such a state) in the Walmsley model, a further set of equations is included:

$$x1capf_i - x1cap_i = E1STAT_i / (1 + E1STAT_i) * slackstat_i + slackstat2_I \quad (15.8)$$

where the slack variable $slackstat_i$ has been included to relax stationarity as required and $slackstat_i$ is set exogenously to -100 to remove any database discrepancy $E1STAT_i$ for the equation. Slack variable $slackstat2_i$ acts to remove this stationarity condition if not wanted.

For the ORANI specification, Equation (15.8) not only ensures persistence of stationarity once attained but simultaneously imposes equality of the rates of return across time. Since the ORANI specification of long run equilibrium does not require equality of growth rates across sectors, Equation 15.7 would normally be removed for an ORANI specification by setting $slackgrow2_i$ as endogenous.

All three versions of the investment behaviour and equilibrium are defined in terms of risk-free rates of return. To this point, risk is present in the model only as a wedge (Equation 15.9) between current actual rates of return and the risk-free rates on which investment is based. Risk premiums could also exist in future rates of return:

$$R1CAPFRSK_i = R1CAPF_i + RISKFLAG * R1FRSK_i$$

or in linear form (using actual and not percentage changes for the risk premiums),

$$R1CAPFRSK_i * r1capfrsk_i$$

$$= R1CAPF_i * r1capf_i + 100 * RISKFLAG * delr1frsk_i \qquad (15.10)$$

which parallels Equation 15.9. Additionally, two further equations are included. One defines the average change in future risk premium, paralleling Equation 15.2 (which related to the current period):

$$delr1frsk\_i = \sum_i S2INVEST_i * delr1frsk_i \qquad (15.13)$$

The other relates changes in risk premiums in the current period to changes in future premiums:

$$delr1rsk_i = delr1frsk_i + slackrsk_i \qquad (15.14)$$

where $slackrsk_i$ is a slack variable.

These three new equations have introduced four new (groups of) variables: $r1capfrsk_i$, $delr1frsk_i$, $delr1frsk\_i$, and $slackrsk_i$. One group must be set exogenously. In all the analyses in this study, the changes in future premiums ($delr1frsk_i$) are set exogenously to zero (as are the changes to current period premiums). All analyses in this study also assume that the same risk premiums initially exist in both current and future rates, that is $R1RSK_i = R1FRSK_i$.

Several equations, in particular 15.3b and 15.4 include the average risk free rates of return, either for the current period or for the future period. These averages must be related to the rates of return in the individual industries. The linearized versions, Equations 15.11 and 15.12 of the model define these averages:

$$r1cap\_i = \sum_i (V0CAP_i / V0CAP\_i) * r1cap_i + slackautor\_i \qquad (15.11)$$

$$r1capf\_i = \sum_i (V0CAPF_i / V0CAPF\_i) * r1capf_i + slackautorf\_i$$

(15.12)

Slack variables are included to remove or enforce these definitions as required.

As noted earlier, the future (next period) capital stocks are definitionally related to current period stocks and investment:

$$X1CAPF_i = X1CAP_i * (1 - DEPRAT_i) + X2TOT_i$$

This relationship must be included in the model. In percentage change terms

$$X1CAPF_i * x1capf_i = x1cap_i * X1CAP_i * (1 - DEPRAT_i) + X2TOT_i * x2tot_i$$

or

$$x1capf_i = x1cap_i * (1-DEPRAT_i)* X1CAP_i / X1CAPF_i + X2TOT_i / X1CAPF_i * x2tot_i$$

$$= x1cap_i * (1-G_i) + G_i * x2tot_i \qquad (15.15)$$

where $G_i = X2TOT_i / X1CAPF_i$.

The ORANI line of models do not include an explicit supply function for current period capital. While these models, including ORANI-F, capture demand for capital ($X1CAP_i$), they deal with the supply of capital explicitly only for a future period. They do this via current period investment. The supply of current period capital is dealt with implicitly. If $X1CAP_i$ is endogenous, there is nothing in the model explicitly modelling supply, only the explicit demand and, in effect, capital is implicitly assumed to be available in the current period in unlimited quantities at a price that satisfies the rate of return on capital creation condition. Supply is thus implicitly perfectly elastic. On the other hand, if $X1CAP_i$ is made exogenous, then effectively supply is fixed at the chosen settings, which may, but need not, match an existing real world level of capital. In this, the treatment of capital is identical to that of land and labor.

Although models based on ORANI do not include an explicit link between current period capital supply and demand, they do include Equation 15.15 relating the current use (and by implicit assumption, supply) of capital ($X1CAP_i$) to the future levels of capital and capital creation or investment ($X2TOT_i$). The model equilibrium will ensure that current and future equilibrium stocks resulting from equilibrium investment are consistent with the assumed investment behaviour. However the equilibrium identified is generally, even if it results from a long run comparative statics analysis, only an ephemeral one. As soon as a non-zero equilibrium level of net investment has been incorporated into capital stocks, that is once the economy moves forward to the next period, the capital stock will be different from its previous level by the extent of net investment. With a different level of capital stocks, the economy will have a different equilibrium in this following period. Only if the level of gross investment perfectly matched the level of depreciation would there be a stationary equilibrium.

Equations 15.16 and 15.17 in Appendix 2 define the prices of labor and the "other costs" factor. The equation for labor is included in the ORANI-F model to capture (or not) institutional wage setting arrangements that previously applied in Australia, in particular the indexation of wages to movements in the consumer price index. The equation includes various shifter variables any one (set) of which, if made endogenous while others are exogenously set to zero change, free up wages from the CPI and force wages for particular groups of differentiated labor (eg. all occupations in an industry, or a particular occupation in all industries) to move similarly. These are similar in character to those described for land under block 11. The equation for the price of "other costs" is similar to that for labor but ensures either all such prices move similarly or that they move independently, depending on the treatment of the shifter (slack) variable.

In summary, block 15 describes the six alternative specifications for investment as included in the model. These comprise the factorial combinations of (a) an assumption about the existence or not of risk premiums in returns (2 possibilities); and (b) an assumption about the driving force for investment (3 possibilities). To implement a particular specification, particular choices of exogenous variables are required. These are summarised later in section 4.6 on the closure of the model. Each specification also gives rise to its own set of coefficients for the linearized equations and requires further specification of how the model is to be updated following exogenous changes. The particular formulae used in the model are listed in Table 4.5. The TABLO file which is related with the investment specification together with land specification can be seen in Appendix 4.

Block 16. Investment-capital accumulation equations

This block has only one equation. It represents one of the important differences between ORANI (and most CGE models) on the one hand and ORANI-F and, depending on the closure, the Indonesian Forecasting Model on the other. The standard CGE models have no equation directly relating investment to capital stocks. Only by virtue of imposing conditions on growth rates or through equilibrium conditions imposed on rates of return, do investment and capital stocks become indirectly related. The forecasting models differ from the standard models in that they include an equation directly linking pre-existing or time 0 capital stocks to capital stocks T periods hence or, equivalently, directly linking investment and capital stocks in period T:

$$X1CAP_i - X1CAP0_i = [\, (X1CAP0_i * (DEPRAT_i^T - 1) + X2TOT0_i * N] * delFudge + (X2TOT_i - X2TOT0_i) * M] * F\_ACCUM$$

or in percentage change terms,

$$x1cap_i * X1CAP_i = 100(X1CAP0_i * (DEPRAT_i^T - 1) + X2TOT0_i * N] * delFudge + X2TOT_i * x2tot_i * M + f\_accum_i \qquad (16.1)$$

where f_accum_i is a slack variable. Equation 16.1 in Appendix 2 differs only in that both sides of the text equation have been divided by $X1CAP_i$ and the parameters redefined accordingly.

The number "0" in a name indicates the variable and its value as it applied immediately before the current time period. The variables with standard names actually relate to period T rather than to the current period, that is period 1. The "T" is omitted for simplicity and because these variables are the same as those in all the other equations of the model. Thus in interpreting the variables in the Indonesian Forecasting Model, they always relate to a period T, where T is not made explicit except when Equation 16.1 is enforced. When it is enforced, the equation effectively adds one further restriction of the equilibrium levels of investment and capital. M and N are constants that emerge when summing investment coefficients over the T years:

$$M = \sum_{t=0}^{T-1} \frac{t}{T} D^{T-t-1} = \sum_{t=1}^{T} \frac{t-1}{T} D^{T-1}$$

$$N = \sum_{t=0}^{T-1} D^{T-t-1} = \sum_{t=1}^{T} D^{T-t}$$

The equation also includes a variable *delFudge*, unique to this equation. This is not part of the economics of the model per se but is a solution procedural device, which takes the constant term (attaching to *delFudge*) in or out of the equation. It is an example of the slack flag variables discussed in section 4.1.2. If the linear percentage change model was applicable over all sizes of changes, the need for this variable would not exist (other than perhaps to conform with limitations of particular computing software packages - for example, the GEMPACK package does not allow for constant terms, so one would need to define a variable such as *delFudge*, to be exogenously set to 1, to which the constant attached). One would simply solve the set of equations, with this particular equation including a constant term. Because the economic model is actually non-linear, it is necessary to approximate around points locally, moving in steps from an initial equilibrium to a new one under exogenous changes. Because the variables in the model now relate to a future (relative to the data base or current) time period on which no data exists, the economic equilibrium has to be moved from a current period equilibrium and solution to a future period one. When *delFudge* = 0, the constant term has no effect. The pre-exogenous change solution will directly correspond to the database. The constant term has to be added in to force the model to reflect future time period T equilibrium. This is achieved by exogenously setting *delFudge = 1*. Then the linear approximations will commence around the initial equilibrium corresponding to *delFudge* = 0, and step towards *delFudge = 1.*

The capital accumulation relationship of Equation 16.1 is based on an assumed pattern of accumulation over time, namely that investment grows in a linear fashion from period to period. The development of the relationship is given in Horridge *et al.*

(1993). The essence of this assumption regarding the investment pattern was explained in section 2.6. It is further discussed here.

It is instructive to consider the case T=1. Dropping the shifter variable for clarity, the percentage change equation then reduces to

$$xlcap_i * \mathbf{X1CAP_i} = [100(\mathbf{X1CAPi0} * (DEPRAT_i - 1) + \mathbf{X2TOT0_i}] * delFudge + \mathbf{X2TOT_i} * x2tot_i * \mathbf{M}$$

Further, $M=0$. So $xlcap_i$ is effectively set exogenously to the pre-existing capital stock at the start of the period. The model does not allow the capital stock in period 1 to be determined endogenously.

If T=2,

$$xlcap_i * \mathbf{X1CAP_i} = [100(\mathbf{X1CAP0_i} * (DEPRAT_i^2 - 1) + \mathbf{X2TOT0_i} * DEPRAT_i] * delFudge + \mathbf{X2TOT_i} * x2tot_i$$

This appears to show that (beginning) capital stocks in period 2 alter directly with the investment in that period. The relationship, however is not an economically direct one, but arises only because changes to $x2tot_i$ (period 2) means there is a change in period 1 ($x2tot1_i$) investment (because of the assumed linear investment growth) and it is the latter period's investment that alters the capital stocks in period 2.

It is important to recognise that the equilibrium position determined in this model is that for period T. That is capital stocks, along with all the other endogenous variables, are established for this period. The exogenous variables relate to this period too. Investment is also determined endogenously, now to be seen as a linear growth schedule over the T years. Any rate of return conditions also relates to year T, with the expectations about future rates of return referring to year T+1. That is, the equilibrium capital stocks and investment occurring in year T are those consistent with current rates and with an identical expected rate in period T+1. There is nothing in the model, however, to ensure that the rates of return to capital creation, other prices and quantities, etc. that would have resulted in each of the intervening years from year 0 to year T would be plausible values. One could track this easily with the model by running the model sequentially as a short run model (T=1) beginning in period one with existing capital stocks and setting investment exogenously to that required for the linear growth pattern, along with other assumed exogenous changes. The solution values obtained may be unrealistic. On the other hand, there is nothing in the model to ensure realistic values in the modelled period itself: the solution could be quite odd. The difference with regard to the intervening period is that the analyst is not made aware of the implications for those years, whereas for the solution year any lack of sense in the results is apparent.

When Equation 16.1 is enforced for some selected T, either $x1cap_i$ or $r1cap_i$ can be set exogenously as for the standard ORANI type model. The initial timing of the exogenous settings (other than investment) is not explicit, though they must apply to year T. Usually they would be imagined to apply from year 0, with the year T solution representing a long run response. The time of initiation is irrelevant in a formal sense so far as the model does not explicitly account for the actual sequential behaviour that occurs. It is relevant for interpretation, however.

Suppose at time zero the economy is in equilibrium. If this is a stationary equilibrium, and no exogenous changes subsequently occur, the economy will still be in equilibrium in year T. Any exogenous difference in year T from the base at that time will cause changes in endogenous variables in accordance with the model, though because investment is being implicitly assumed to change from year 1, conceptually some part, not necessarily all, of the exogenous change(s) needs to have occurred from year 1. It would seem reasonable to imagine, for most cases, a sustained change in an exogenous variable from time period 1.

The capital accumulation model is clearly open to criticism. At the extreme, it might be seen as the imposition of a fairly arbitrary relationship between *current* period capital stocks and investment. Certainly if the implicit pattern of investment cannot be justified this view of an arbitrary restriction may be the most appropriate interpretation.

Because of the close links to the production sectors of the economy, the restriction can have significant impacts on the equilibrium. Unless the restriction can be justified, it might often be better to discard it, or to replace it with one, which is defensible in other ways.

Block 17. Foreign debt accumulation

The Indonesian Forecasting Model, following ORANI-F, contains equations modeling the nation's accumulation of foreign debt. This is the second major difference from the ORANI comparative static model. The treatment of debt accumulation parallels that of capital accumulation. Over the period 0 to T, the annual trade deficit is implicitly assumed to change in a linear fashion from its initial to final period T level. Debt levels are linked to the accumulated balance of trade deficits, with interest being payable at a world interest rate on the accumulated debt. The debt, trade deficit and interest payments are denominated in base-period foreign currency units.

The balance of trade (in foreign currency, cf. usage in Equation 14.1) is defined by

$$BT = (V0CIF\_c - V4TOT) / P\_GLOBAL \qquad (17.1)$$

where **P_GLOBAL** is the exchange rate ('000 Rupiah / US$) between period T Indonesian currency (in which all domestic values are measured) and base period US dollars. In the linear approximation version of this equation, the change in ***BT*** is not expressed in percentage terms since ***BT*** itself may be zero and so create undefined numbers (see discussion of Equation 14.1).

Equation 17.2 relates accumulated debt to GDP, after converting both aggregates to the same currency:

$$DEBT\_RATIO = DEBT * P\_GLOBAL / V0GDPEXP \qquad (17.2)$$

Converting to changes,

$$delDebt\_Ratio = delDebt * DEBT\_RATIO / DEBT + DEBT\_RATIO / 100 * (p0cif\_c - w0gdpexp) \quad (17.2)$$

where both the change in the ratio and the change in debt are expressed in levels rather than percentages and the three upper-case items are treated as constants based initially on the pre-change accumulated foreign debt position.

Equation 17.3 adds nothing new in terms of the workings of the modeled economy. It simply serves to calculate the debt ratio corresponding to the new equilibrium so that it is reported for use in interpreting results. By definition, the resulting debt ratio is

$$levDebt\_Ratio = DEBT\_RATIO + delDebt\_Ratio$$

where the upper case item is the debt ratio before the change. Since the GEMPACK solution package that is used later in analysing the model does not allow for constant terms, a further variable delUnity is defined. If this is exogenously set to 1, the required relationship is captured:

$$levDebt\_Ratio = DEBT\_RATIO * delUnity + delDebt\_Ratio$$

Equation 17.4 for debt is the analogue of equation 16.1 for capital. However, the equation here is expressed in changes in levels rather than percentage changes. The constants in the equation are various sums of interest rates over the T years, paralleling the earlier constants *M_DEBT* and *N_DEBT*:

$$M = \sum_{t=1}^{T} \frac{t-1}{T} D^{T-t}$$

$$N = \sum_{t=1}^{T} D^{T-t}$$

The equation includes the *delFudge* variable, which appeared in the capital accumulation. It serves the same purpose in both cases.

This debt accumulation model is subject to many of the same criticisms that were made of the capital accumulation model. It essentially establishes a link between an accumulated debt and the current trade balance. The coefficients of this link vary with the chosen value of T, and they depend on an assumption of a linearly increasing set of trade balances, that is the year to year changes remain constant. There is, however, no good reason to expect that, following an exogenous change that trade deficits would progressively alter in this way. On the contrary one might expect that the trade balances would show declining year to year differences as the new equilibrium was approached. The model is subject to the criticism that the sequence of actual positions of the economy that would yield this pattern of trade balances and capital accumulation is not explicit in the model and could entail implausible values. Finally, the model could be seen as the imposition of a fairly arbitrary condition relating current level of debt to current balance of trade. Unless there is good reason to impose the particular relationship, the results may be unnecessarily restricted. It might be more plausible to either discard it or to impose an alternative, more easily defended condition.

On the other hand, the role of the debt accumulation equations in the model is minor if the various debt variables are all endogenous. The equations essentially add on to the rest of the model sequentially rather than being truly simultaneous. That is, the rest of the model essentially determines the balance of trade deficit (17.1); this determines the change in debt (17.4); and this in turn determines the debt ratio in (17.2) and (17.3). Thus the equations as a group merely operate to calculate consequence of the rest of the model. Setting any one of the balance of trade variables exogenously, however, would have implications for the rest of the model. One use of the model in this respect would be to explore settings of policy variables needed to achieve desired debt and balance of payments outcomes.

4.1.5 Calculating and Updating the Coefficients of the Linear Equations

Although the linearized equations of the model and the associated coefficients define the changes that occur to endogenous variables as exogenous changes occur, the model is not fully operational until the procedures for calculating the coefficients are specified. In many cases these coefficients are constants or parameters, eg. elasticities of substitution. In others they are cost/profit/value shares or other coefficients whose values depend on and change with the position at which the economy is being approximated. Their values are determined from derivatives of the relationships in the non-linear levels model. If an initial solution (an equilibrium point for the economy) to the system of non-linear equations is known, in principle it is a straightforward matter to calculate the values of coefficients. In reality, how this is to be done needs some care.

One potential problem is that an actual initial equilibrium point may not be known. For example, the typical database for CGE models involves an input-output accounting matrix of value flows. It does not reveal the individual prices and quantity flows, yet these latter variables are needed to fully describe an equilibrium. Fortunately, it is usually possible to specify many of the prices arbitrarily as having the value one, following which the associated quantities can be calculated from the value flows. Similarly, the database may contain no information on rates of return, risk premiums or even values of capital stocks. To find initial equilibrium values for these variables additional assumptions are required. There may be several possible assumptions that could be made, all of which may represent rather arbitrary numerical specifications. In the context of the Indonesian Forecasting Model, deficiencies in the database, along with alternative assumptions for establishing an initial equilibrium point, are discussed in Chapter 5.

A second issue, the one of immediate concern here, is that of how the new equilibrium position reached following an exogenous change is actually to be calculated. The obvious answer is that the new value of a variable is the old value adjusted by the calculated percentage change in the variable. However, with non-linear models, levels updated in this way do not necessarily satisfy the equations of the model. That is, the proposed new equilibrium may not be internally consistent, or unbalanced (see section 4.1.3 and Warr *et al.*, 1998) .

The problem arises because each calculated percentage change in an endogenous variable is only an approximation. The approximation works less well as the magnitude of the change increases. With multiple variables being independently approximated, it is not surprising that the independently calculated new equilibrium values do not fully satisfy the non-linear equations.

An alternative to updating each variable independently would be to update only a sufficient sub-set of the model's variables using the linearized equations and the calculated percentage changes and then to use these updated values to calculate the remaining ones directly from the non-linear equations. The new equilibrium solution would then be a fully consistent solution to the model. Typically there would be alternative sets of sufficient variables. A choice would need to be made between them.

Depending on how the updating is done, the calculated new equilibrium point can differ. This becomes even more important in a multi-step Johansen procedure, since a succession of updates are performed in reaching the final equilibrium. At each step, the non-constant coefficients in the linearized equations must be updated. The updated coefficients depend on the currently computed equilibrium point. If the latter point is in error, then so too can be the coefficients.

Not only will the final equilibrium after a given number of steps differ depending on how the levels variables and then the coefficients are updated but, if the extrapolation procedure as available in the GEMPACK model (see the GEMPACK User Documentation) is used to define the new equilibrium, the appropriateness of the extrapolation may be compromised by the updating method. The extrapolation procedure works when all variables are updated according to their individual percentage changes, but may not be so reliable when some of the variables and then coefficients are updated in a more internally consistent way.

To illustrate how different updating possibilities arise and how the results can differ, consider the following simple model involving two equations and three levels variables, one of which (X) will be altered exogenously:

$1 = \mathbf{X} + \mathbf{Y}$
$\mathbf{Z} = \mathbf{X} * \mathbf{Y}$

Once **X** is set, then **Y** and then **Z** are also determined. Here **Z** is a quadratic function of **X**, peaking with a value of 0.25 when **X** = 0.5.

Linearizing,

$X * x = - Y * y$
$z = x + y$

Consider an initial (valid) solution **X** = 0.1, Y = 0.9 and **Z** = 0.09. Suppose **X** is shocked to 0.5, ie. a 400% increase. Then, from the equations in the levels, **Y** must equal 0.5 too and **Z** has its peak value of 0.25. In the linearized model, however, x is set exogenously to 400%. The two equations are

$y = - 0.1 * 400 / 0.9$
$z = x + y$

and the solution is y = -44.444 and z = 355.555. The new "solution" defined by the updating formula,

New value of variable = Initial value * (1+percentage change/100)

is

$\mathbf{X} = 0.1 * (1 + 400/100) = 0.5$

$\mathbf{Y} = 0.9 * (1 - 44.444/100) = 0.5$

$\mathbf{Z} = 0.09 * (1 + 355.555/100) = 0.4099$

In contrast, if just **X** and **Y** are updated this way, and then **Z** calculated in accordance with the levels equations, **Z** = 0.25. The linearly updated solution is clearly not a feasible solution to the original model.

Suppose the overall exogenous change in **X** is done with two equal steps, changing **X** from 0.1 to 0.3 and then to 0.5. The two possible intermediate equilibrium positions, and the final positions, are reported in Table 4.3.

Table 4.3 Apparent, but Infeasible, Solutions to a Model under Different Updates

Variable	Method of updating variables					
	Each variable updated		**X** & **Y** updated, Z calculated		Exact solution	
	End step 1	End step 2	End step 1	End step 2	End step 1	End step 2
X	0.3	0.5	0.3	0.5	0.3	0.5
Y	0.7	0.5	0.7	0.5	0.7	0.5
Z	0.25	0.345	0.21	0.29	0.21	0.25

The example shows that the accuracy of the updated solution can be quite different depending on the method of updating. Here, updating only some variables and calculating solution values for others in a manner consistent with the levels equations works better. Progressively extending the number of steps (giving sequences of 0.41, 0.345, 0.3169, 0.3014, ... for the updated **Z** value when linearly updating all variables versus 0.41, 0.29, 0.2678, 0.26, ... when linearly updating only **X** and **Y**) confirms this result. Informal extrapolation of both these sequences approaches 0.25, the second clearly the converging more quickly. These results, however, have no necessary generality.

The formulae for updating the coefficients of the equations of the ORANI-F model are provided by Horridge *et al.* (1993), but not in a convenient condensed format. They are reproduced here in Tables 4.4 and 4.5, along with the additional formulae for updating the coefficients of the new equations introduced in blocks 15 and 16 of the Indonesian Forecasting Model. Table 4.4 contains default-update formulae for value flows. Each value flow is the product of a price and a quantity variable, and despite the appearance given by the unusual GEMPACK notation used in the table, is actually updated by adding the percentage changes in the two components and scaling the initial value accordingly. Thus

Updated value flow = Initial value flow * (1+ percentage change in price
+ percentage change in quantity)

Table 4.5 lists other coefficient update formulae which define the actual change in the corresponding data items.

For most of the equations in the model, the coefficients are calculated as for ORANI-F. However, the calculation of coefficients for the Indonesian Forecasting Model is made more complex by virtue of the alternative assumptions that can be made in relation to the available data, investment specifications and the specification regarding risk premiums. Figure 4.5 provides a schematic illustration of the main alternative sequential paths followed in calculating the coefficients of the investment related equations. In this figure, bold boxes with italicized text relate to items that would be prespecified for one or more of the formulations. Normal width, continuous lines indicate paths applying in all cases. Bold lines indicate paths applying when risk premiums are not recognized (*RISKFLAG* = 0), and broken lines are paths applying when allowance is made for risk premiums (*RISKFLAG* = 1).

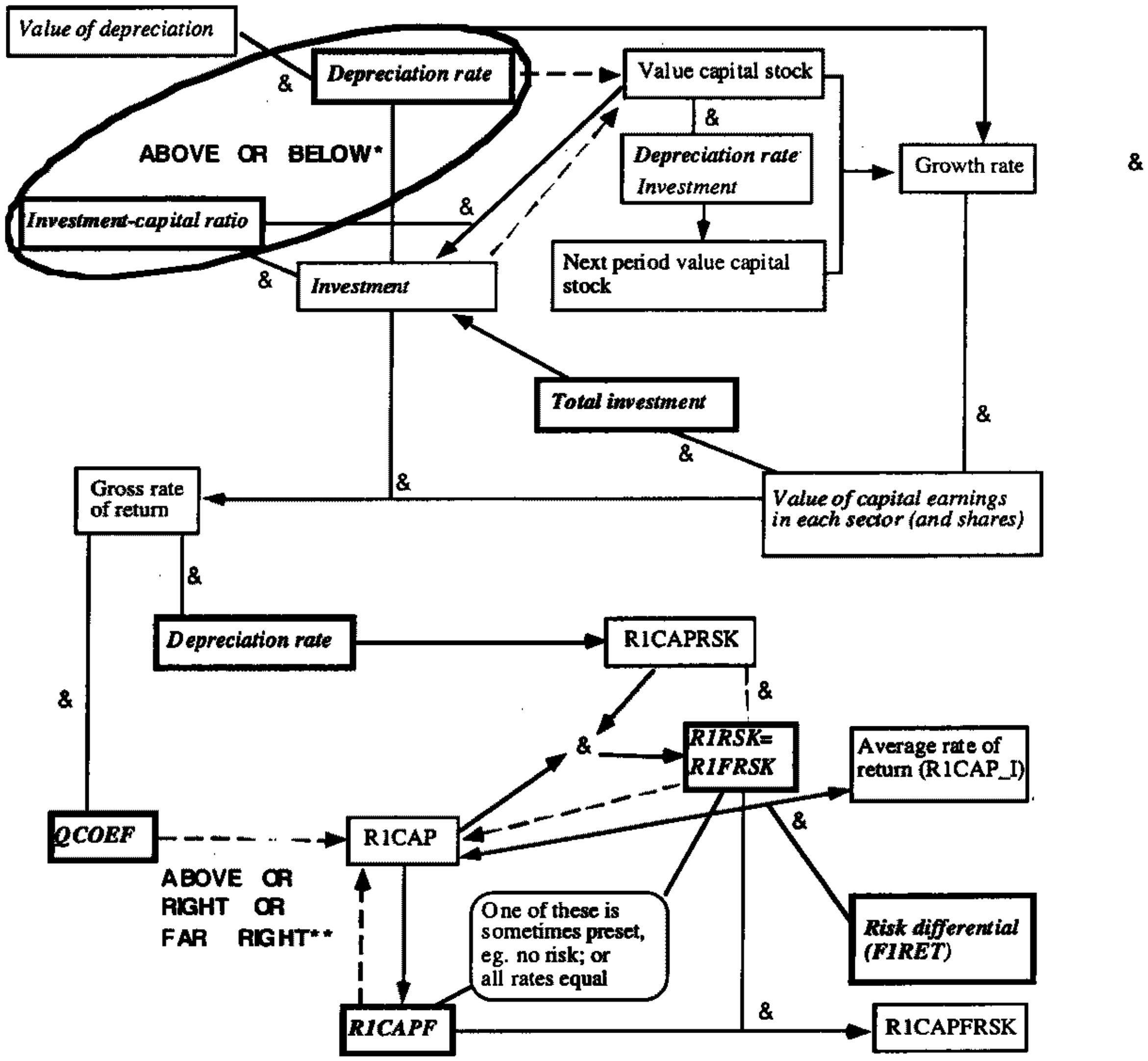
The importance of the calculation of the coefficients is not just that the calculated solution may not satisfy the equations of the model, but that the calculated solution could be spurious. Suppose a model has three linearized equations in six variables:

$$A\,x + B\,y + C\,z = q$$
$$D\,x + E\,y + F\,z = r$$
$$G\,x + H\,y + J\,z = s$$

If the three RHS variable are set exogenously, the model can be solved for the three LHS variables provided the equations are linearly independent. If, in fact, there is a linear dependence between the rows on the LHS, no unique solution exists for x, y and z. Suppose the third equation would be linearly dependent on the first two if the coefficients were calculated exactly but, because the coefficients in the equations are calculated based on an apparent but invalid solution to the underlying levels equations, the equations appear to be linearly independent. Then a solution may be calculated mathematically but it will essentially be arbitrary.

Figure 4.5 Main Alternative Pathways for Calculating the Coefficients in the Investment and Risk-related Components of the Indonesian Forecasting Model

Key: Bold/italics are items sometimes pre-specified. Broken lines are paths used only in some investment specifications. Solid lines are paths which generally apply.



Notes:
* In standard ORANI-F, the investment-capital ratio is prespecified. In Walmsley, the capital stock is known.
** QCOEF is prespecified in standard ORANI-F model; R1RSK is presepcified in Walmsley's no risk case (ie. RISKFLAG=0), and R1CAPF is prespeciifed in Walmsley's risk case (RISKFLAG=1).

Table 4.4 Formulae for Calculating the Default Update of Coefficients [1]

No	Formulae	Subscript range
1.	$V1BAS_{csi}=p0_{cs}*x1_{csi}$	$c\in COM$
		$s\in SRC$
		$i\in IND$
2.	$V2BAS_{csi}=p0_{cs}*x2_{csi}$	$c\in COM$
		$s\in SRC$
		$i\in IND$
3.	$V3BAS_{cs}=p0_{cs}*x3_{cs}$	$c\in COM$
		$s\in SRC$
4.	$V4BAS_{c}=p0_{c\text{"dom"}}*x4_{c}$	$c\in COM$
5.	$V5BAS_{csi}=p0_{cs}*x5_{cs}$	$c\in COM$
		$s\in SRC$
6.	$V1MAR_{csim}=p0_{m\text{"dom"}}*x1mar_{csim}$	$c\in COM$
		$s\in SRC$
		$i\in IND$
		$m\in MAR$
7.	$V2MAR_{csim}=p0_{m\text{"dom"}}*x2mar_{csim}$	$c\in COM$
		$s\in SRC$
		$i\in IND$
		$m\in MAR$
8.	$V3MAR_{csm}=p0_{m\text{"dom"}}*x3mar_{csm}$	$c\in COM$
		$s\in SRC$
		$m\in MAR$
9.	$V4MAR_{cm}=p0_{m\text{"dom"}}*x1mar_{cm}$	$c\in COM$
		$m\in MAR$
10.	$V5MAR_{csm}=p0_{m\text{"dom"}}*x1mar_{csm}$	$c\in COM$
		$s\in SRC$
		$m\in MAR$
11.	$V1CAP_{i}=p1cap_{i}*x1cap_{i}$	$i\in IND$
12.	$V1LABo_{io}=p1lab_{io}*x1lab_{io}$	$i\in IND$
		$o\in OCC$
13.	$V1LND_{i}=p1lnd_{i}*x1lnd_{i}$	$i\in IND$
14.	$V1OCT_{i}=p1oct_{i}*x1oct_{i}$	$i\in IND$
15.	$MAKE_{ci}=po_{c\text{"dom"}}*q1_{ci}$	$c\in COM$
		$i\in IND$
16.	$S3LUX_{c}=a3lux_{c}$	$c\in COM$
17.	$R1CAPF_{i}=r1capfi_{i}$	$i\in IND$

1. Notation follows GEMPACK (see GEMPACK User Documentation). The percentage change in the LHS variable is to be calculated as the sum of the percentage changes in the two variables separated by an * on the RHS.

Table 4.5 Formulae for Calculating the Updating of Ordinary Change in the Data Item[1]

No	Formulae	Subscript range
1.	$PODOM_C = p0_C\text{"dom"}$	$c \in COM$
2.	$V6BAS_C = V6BAS_C * p0_C\text{"dom"}/100)] + PODOM_C * delx6_C$	$c \in COM$
3.	$V1TAX_{csi} = V1TAX_{csi} * \frac{(x1_{csi} + p0_{cs})}{100} +$ $(V1BAS_{csi} + V1TAX_{csi}) * \frac{t1_{csi}}{100}$	$c \in COM$ $s \in SRC$ $i \in IND$
4.	$V2TAX_{csi} = V2TAX_{csi} * \frac{(x2_{csi} + p0_{cs})}{100} +$ $(V2BAS_{csi} + V2TAX_{csi}) * \frac{t2_{csi}}{100}$	$c \in COM$ $s \in SRC$ $i \in IND$
5.	$V3TAX_{cs} = V3TAX_{cs} * \frac{(x3_{cs} + p0_{cs})}{100} +$ $(V3BAS_{cs} + V3TAX_{cs}) * \frac{t3_{cs}}{100}$	$c \in COM$ $s \in SRC$
6.	$V4TAX_c = V4TAX_c * \frac{(x4_c + p0_{c\text{"dom"}})}{100} +$ $(V4BAS_c + V4TAX_c) * \frac{t4_c}{100}$	$c \in COM$
7.	$V5TAX_{cs} = V5TAX_{cs} * \frac{(x5_{cs} + p0_{cs})}{100} +$ $(V5BAS_{cs} + V5TAX_{cs}) * \frac{t5_{cs}}{100}$	$c \in COM$ $s \in SRC$
8.	$V0TAR_c = V0TAR_c * \frac{(x0imp_c + pf0cif_c + phi)}{100} +$ $V0IMP_c + \frac{t0imp_c}{100}$	$c \in COM$
9.	DEBT_RATIO=delDebt_Ratio	1
10.	$FRISCH = FRISCH * \frac{(w3lux - w3tot)}{100}$	1
11.	$R1TCAPF_i = -R1TCAPF_i + \frac{-1 + r1capfi_i}{100} \leftarrow R1CAPF_i$	$i \in IND$
12.	$R\_T_i = R\_T_i \leftrightarrow \frac{(x2tot_i - x1cap_i)}{100}$	$i \in IND$

[1] Notation is from GEMPACK (see GEMPACK User Documentation). The actual change in the LHS variable is to be calculated according to the algebraic formula on the RHS.

Redundancy can be encountered in the Indonesian Forecasting Model. With the inclusion of the discrepancy removal variable $slackgrow_i$ in Equation 15.7, once the discrepancy is removed, the coefficient on that variable is zero. If this equation is enforced via $slackgrow2_i$ being set exogenously to zero, Equation 15.7 is then essentially enforcing the growth rate in each sector to be the same and then, necessarily, equal to the average growth rate. However, Equation 15.6c defines the average growth rate as a weighted average of the individual rates. This equation is automatically satisfied once all the individual sector equations in Equation 15.7 are satisfied without discrepancy. Thus one of these is then redundant.

Despite this redundancy, experience with the model when all equations were included was that zero-discrepancy solutions were reached using GEMPACK. While linear dependency in equations will be detected when attempting to invert the coefficients matrix in the process of trying to solve equations, the redundancy in the model will not be detected if the dependency is hidden. When the coefficients are themselves sufficiently wrongly calculated in the linearization and updating processes, the dependency can be disguised.

In the present study, the problem of redundancy was initially evidenced by unreasonably large percentage changes in some endogenous variables in some simulations. The possibility that reasonable-looking but actually arbitrary solutions may go undetected. is a worry in modelling using linearization and updating methods. Standard CGE model specifications will be known not to have redundancy problems. However, more pragmatic additions and modifications to these standard models may produce models with redundant equations.

4.1.6 Closing the Model

To solve the linear equations, the number of endogenous variables must equal the number of equations. Because there are more variables than equations, some exogenous variable must be chosen and their changes specified. The choice is not entirely free since equality of numbers of variables and equations is only necessary, not sufficient for a solution. The equations must be linearly independent. Hence starting with an incomplete linear model and adding simple exogeneity restrictions does not ensure that the equations will have a unique solution. For CGE models, the kinds of variables that it is meaningful to set exogenously and that will provide a solution, is well understood. For an ORANI-F type model, the following variables will often be suitable choices (Horridge *et al.*, 1993): technical change variables, tax rate variables, shifter and slack variables, land endowments, the number of households, foreign prices, the average rate of return, inventory changes, the nominal exchange rate as a numeraire, household "luxury" expenditure, and the procedural or slack flag variables such as delFudge and delUnity. Table 4.6, reproduced from Horridge *et al.* (1993), lists a common specification of exogenous variables in the standard ORANI-F model.

Table 4.6 Numbers of Variables and Equations within Various Sets and each Variable Type in the ORANI-F Model

Variable Dimension	Amount of Variable	Amount of Equation	Amount of Exogenous Variable	Exogenous Variable[1]
MACRO	66	51	15	*delFudge delUnity f0tax_s employ_i f4_ntrad f5tot2 p3tot q r1cap_i delB f1tax_csi f2tax_csi f3tax_cs f5tax_cs*
COM	18	11	7	*t0imp a3_s f4p f4q pf0cif f4tax_trad delx6*
COM*IND	7	5	2	*a1_s a2_s*
CPM*MAR	2	1	1	*a4mar*
COM*SRC	9	7	2	*f5 a3*
COM*SRC*IND	8	6	2	*a1 a2*
COM*SRC*IND*MAR	4	2	2	*a1mar a2mar*
COM*SRC*MAR	4	2	2	*a3mar a5mar*
IND	27	15	12	*a1cap a1lab_o a1lnd a1oct a1prim a1tot f1lab_o f1oct f1ret f1_accum x1lnd a2tot*
IND*OCC	3	2	1	*f1lab*
OCC	2	1	1	*f1lab_i*
Total	150	103	47	

1. For simplicity, the industry and commodity subscripts on those variables that would usually be subscripted have been omitted. Aggregation subscripts are included, but not as subscripts.

Subject to the need to achieve linearly independent equations, the choice of exogenous variables and their values will depend on the research question. It is also important to recognise that the model, even when it can be solved for a particular set of endogenous variables for which the exogenous setting makes economic sense, should not be used to do so without care. The concerns can be illustrated by reference to the investment model.

The model for investment is economically incomplete. It entails more acceptable assumptions about investment allocation or comparative rates of return across sectors than about overall investment or about overall rates or return in the economy (see for example comments in Dixon *et al.* (1982), p. 118). Therefore, the model may produce nonsensical levels for the rates or return to investment and quantities of capital when both these are made endogenous. Hence, if capital is made endogenous, rates of return to capital creation should normally be made exogenous. Then the model will determine a set of capital stocks, depreciation levels and matching investments such that current rates of return equal their exogenously specified rates. Expected future rates of return will be equal to an endogenously determined amount. Vice versa, if the model is to be used to determine rates of return, capital stocks should normally be made exogenous even though they do not need to be.

It may seem odd that a model can be recommended for solution for a set of variables conditional on others; but not in reverse. The problem arise because solutions to the model can be more sensitive to model specification for some selections of endogenous variable than for others. The model should not be used for those endogenous variable selections whose solution values, on the basis either of experience with the model or knowledge of the model versus reality, are recognised as being sensitive to specification.

With the extra equations and even more variables included in the Indonesian Forecasting Model to provide for the additional detail on land types and the built-in flexibility for modelling investment than in the standard ORANI-F model, additional variables need to be specified as exogenous variables. Suggested additions are listed in

Table 4.7 for each of the three land mobility assumptions and for each of the three investment models. Combinations of these two assumptions will require both additional sets of variables to be specified as exogenous. For example, if the impact of trade liberalisation on the Indonesian economy is to be examined under an assumption of industry specific or fixed land and an ORANI-F type investment specification, then the variables in sets 3 and 5 would have to be added to the exogenous list.

Table 4.7 Changes to the Exogenous Variables Specifications Needed for Different Assumptions in the Indonesian Forecasting Model

No	Model Specification	Specification of flag variable	Exogenous variable to be switched to an endogenous variable	Exogenous variables to be added[1]
1	Only land in estate crops and food crops are mobile		x1lnd	x1lnd_e x1lnd_r f1lnd_i f1lnd(estate) f1lnd(crops) f1lnd_h x1lnd(othind)
2	Land is mobile in each industry		x1lnd	x1lnd_i f1lnd f1lnd_e f1lnd_r f1lnd_h
3	Land is fixed in each industry			f1lnd_i f1lnd_e f1lnd_r f1lnd_h
4	ORANI specification of investment	*RISKFLAG*=0 *WALMFLAG*=0	f1ret f_accum	delr1rsk r1capf r1cap_i slackgrow slackcapf slackstat slackgrow_i delr1frsk
5	ORANI-F specification of investment	*RISKFLAG*=0 *WALMFLAG*=0		delr1rsk r1capf r1cap_i slackgrow slackcapf slackstat slackgrow_i delr1frsk
6	Walmsley specification of investment	*RISKFLAG*=0 or *RISKFLAG*=1 *WALMFLAG*=1	f1ret f_accum	delr1rsk r1cap_i slackgrow slackgrow2 slackcapf slackcapf2 slackstat slackgrow_i slackorwalm r1capf_i delr1frsk

1. For simplicity, the industry and commodity subscripts on those variables that would usually be subscripted have been omitted. Aggregation indicators are included, but not as subscripts.

4.2 The GTAP Model

The GTAP model is fully described in Hertel and Tsigas (1997). It is similar to the national CGE model in that for each country (or "region" in the GTAP terminology) there are multistage production processes, a single aggregate household consuming unit, government and investment sectors, and production draws on primary factors of land, labor and capital. The major differences arise because of the formalization of the importing and exporting activities between countries, not just for commodities but also for global banking (savings and investment) services, and the associated demand for global transport services. GTAP also treats factors of production more flexibly than in the ORANI and ORANI-F national models. Other differences relate to the detail of the function specifications. For example, the GTAP model links government, savings and household consumption more formally than in an ORANI-F based national model by assuming a "super household" which aggregates these three forms of final consumption via a regional utility function. There is also some simplification of the production processes.

As in the national model, producers are assumed to minimize costs of any level of output subject to specified production functions. Constant elasticity of substitution technology is assumed in combining the three primary factors into a factor aggregate. Then the factor aggregate is combined with intermediate inputs in fixed proportions. While there is no substitution between intermediate inputs and primary factors or among the intermediate inputs, there is substitution between different sources of intermediate inputs, namely domestic and imports from each region. The capital stock is assumed to be mobile or reallocatable between sectors within a country but not between countries. Labor too is mobile between sectors in each country but not between countries. However, the degree of mobility can be specified by the model user, ranging from fully mobile to quite industry specific. Outputs from each sector can be used as intermediate inputs for industries and as consumption, investment and government uses in domestic and foreign countries.

Allocation of final income between these three uses via a regional "super household" has the advantage that the welfare implications for an individual country or region can be measured from the total income of this household. The total income consists of earnings from the factors of production and net tax revenues meanwhile the allocated income consists of savings, private household consumption and government expenditure. The Cobb-Douglas assumption of constant budget shares and the constant difference of elasticities (CDE) functional form used to allocate commodities in the government and the private household expenditure, respectively.

The regions are linked together by imports and exports of commodities. Similar commodities, which are produced by different countries, are assumed to be imperfect substitutes for one another.

Factors of production are classified as perfectly mobile or imperfectly mobile between sectors within a region. For imperfectly mobile factors, the degree of mobility can be differentially defined for each such factor in each region. This approach to mobility was followed and outlined in section 4.1.4 block 11 in developing the land equations of the Indonesian model. For capital, not only is there an issue of within-region mobility between sectors, but also inter-regional mobility. In GTAP, capital in one region is not reallocatable to other regions in the current period. In the long run, capital can move by virtue of investment. Savings in one region can be used to invest elsewhere. The standard GTAP specification for this follows the ORANI treatment of industry investment, and thus the same problems of possible inconsistency between investment and capital stocks arises. This problem is addressed in the modification of GTAP where capital is mobile developed by McDougall and Ianchovichina (1996) and used here.

The global model used later in this study and described in this section differs from the standard GTAP model. The model is formally equivalent to that of Walmsley (1998) who followed McDougall. and Ianchovichina (1996), and modified the GTAP investment behavioural assumption. She also introduced risk into this component of the model. These ideas are similar to, and in fact were the stimulus for, the "Walmsley" investment specification and the treatment of risk in the Indonesian Forecasting Model in section 4.1.4

The outline below, following Hertel and Tsigas' (1997) description of GTAP, begins (section 4.2.1) with the basic value accounting relationships in the model. These, together with the behavioural equations (section 4.2.2) for the various types of agents, constitute the GTAP model. The description is generally brief. Relatively more details are provided of the investment component in section 4.2.2.4 and of the risk modelling in section 4.2.2.5. While the model as described is formally equivalent to Walmsley's model, the specification of some of the investment and risk related variables and the notation differs. In section 4.2.3, closure details and issues relating to developing a steady state database consistent with the model are discussed.

4.2.1 Accounting Relationships

The relationships in the GTAP model are summarized here by a set of relationships between various value aggregates. Consider Table 4.8. The items appear in the central (or left) column. For many of the items there is a corresponding entry in the right hand column. The latter column shows how the particular central column item is defined in terms of price and quantity variables. In each of these flows it is important to recognize the price value as well as the presence of distortions, eg. taxes and subsidies. The convention followed in GTAP is that the implied tax rate is defined as the agent's (purchaser, producer, or factor owner) price relative to market prices for domestic taxes; and market price to world price for border taxes; or equivalently by the corresponding value ratios.

Contiguous items in the central column are often algebraically related; and these relationships (when converted to percentage change form) become the equations of the GTAP model. An item may be involved in several relationships. Relationships are read downwards, and are expressed either by algebraic symbols *all before* the items or *all after* the items. Symbols on the opposite side are ignored in reading a relationship. That is there can be separate relationships defined by each side. A relationship on a given side can begin with an item only if it does not have a + or - symbol attached on that side, and it continues to the next item only if there is an arithmetic symbol between the two items, with only one "=" symbol in the relationship. Relationships between items appear in linearized versions in the GTAP model.

Many of those relationships defined with "preceding" symbols involve taxes. For these, the quantity variable factors out, leaving a relationship between prices and the power of the tax. Relationships defined by "following" symbols frequently are such that price is constant to all items and can be factored out leaving a linearized version containing only quantity changes. Full descriptions of the notation, lists of variables, parameters, and the equations, etc. in the stabdrad GTAP model are available in Hertel (1997).

4.2.1.1 Distribution of Sales to Regional Markets

In contrast to the national model, in the GTAP model there is a one-to-one relationship between producing sectors and commodities. Each sector produces a single output. The distribution of sales to regional markets in the GTAP model is conveniently summarized in Table 4.8.

The flow of commodity is from the domestic market in region r to the world market and domestic market in region s. The flow begins with the *Value of Output at Agent's prices, VOA(i,r),* which shows the payments received by the firms in industry i of region r. To get the *Value of Output at Market prices, VOM(i,r),* producer tax, *PTAX(i,r),* must be added to (or subsidy deducted from) the agent's value.

Table 4.8 Distribution of Sales of Good i Produced in Region r to Regional Markets

		VOA (i,r)	*: PS(i,r) * QO(i,r)*
		+PTAX(i,r)	*: τ(i,r)*PM(i,r)*QO(i,r)*
Domestic Market 'r'		*=VOM(i,r)=*	*: PM(i,r)*QO(i,r)*
		VDM(i,r)+	*: PM(i,r)*QDS(i,r,s)*
		VST (i,r)+	*: PM(i,r)*QST(i,r,s)*
		VXMD(i,r,1)+	*: PM(i,r)*QXS(i,r,1)*
		...+	
		VXMD(i,r,s)	*: PM(i,r)*QXS(i,r,s)*
		+XTAXD(i,r,s)	*: τx(i,r) τxs(i,r,s)PM(i,r,s)*QXS(i,r,s)*
	*	*=VXWD(i,r,s)*	*: PFOB(i,r,s)*QXS(i,r,s)*
World Market	*	*+VTWR(i,r,s)*	
	*	*=VIWS(i,r,s)*	*:PCIF(i,r,s)*QXS(i,r,s)*
		+MTAX(i,r,s)	*: τm(i,s)*τms(i,r,s)*PMS(i,r,s)*QXS(i,r,s)*
		=VIMS(i,r,s)	*: PMS(i,r,s)*QXS(i,r,s)*
		+...	
		+VIMS(i,1,s)	
		=VIM(i,s)=	*: PIM(i,s)*QIM(i,s)*
Domestic Market 's'		*VIPM(i,s)+*	*: PIM(i,s)*QPM(i,s)*
		VIGM(i,s)+	*: PIM(i,s)*QGM(i,s)*
		Σ jεPROD VIFM(i,j,s)	*: PIM(i,s)*QFM(i,j,s)*
Where:		*VDM(i,r) =*	*: PM(i,r)*QDS(i,r,s)*
		VDPM(i,r)+	*: PM(i,r)*QPD(i,r)*
		VDGM(i,r)+	*: PM(i,r)*QGD(i,r)*
Σ jεPROD_COMM		*VDFM(i,j,r)*	*:PM(i,r)*QFD(i,j,r)*

Source: Hertel and Tsigas (1997), Table 2.1.

The *Value of Output at Market prices* is also the sum of the *Value of Domestic sales at Market prices, VDM(i,r)*, the *Value of Sales to the global Transport sector VST(i,r)*, and the *Value of eXports of i from r evaluated at domestic Market prices (in r), and destined for s, VXMD(i,r,s)*, for all regions.

Export tax by commodity and by region of destination is added to get the value of exports to fob values. The export taxes are denoted by *XTAD(i,r,s)* and can vary among commodities or regions so facilitating representation of bilateral trade details. After adding the tax value, the value of export in market price becomes the *Value of eXports at World Prices, VXWD(i,r,s)*. For the importing country, this becomes the cif-based value, *VIWS(i,r,s)*, after adding the international transport margin, *VTWR(i,r,s)* or the *Value of Transportation at World prices for commodity i, shipped from r to s.*

To get the *Value of Imports at Market prices by Sources, VIMS(i,r,s)*, within the importing country, *import taxes, MTAX(i,r,s)* are added to the cif-based value of the commodity. This import value is still based on imports differentiated (and priced) by alternative sources. These values are combined to form a single composite, *VIM(i,s), the Value of Imports of i into s at market prices* which is then distributed across sectors: households, *VIPM(i,s)*, government *VIGM(i,s)*, and industries *VIFM(i,s)*. All of the latter values are at "imported product" market prices in the importing country.

4.2.1.2 Sources of Household and Government Purchases

The key value relationships for the consuming household are shown in Table 4.9. The *Value of Private household purchases at Agents' prices, VPA(i,s)* for a good is the aggregate of all their expenditures on *domestically produced good, VDPA(i,s)*, and *composite imports of this good at agents' prices, VIPA(i,s)*. Then, the *Value of domestic purchases by the Private household at Market prices, VDPM(i,s)* is obtained after deducting *domestic commodity taxes, DPTAX(i,s)* from the *expenditure on domestic good, VDPA(i,s)*. Similarly to the expenditure on domestically produced goods, to get the *Value of Imports by the Private household at the Market prices, VIPM(i,s)*, the private household commodity taxes, *IPTAX(i,s)*, are deducted from the value of composite *imports at agents' prices, VIPA(i,s).* Value relationships for government purchases parallel those for the private household.

Table 4.9 Sources of Household and Government Purchases of Good i in Region s

Private Household		
	VPA(i,s)=	*:PP(i,s)*QP(i,s)*
	VDPA(i,s)+	*:PPD(i,s)*QPD(i,s)*
	VIPA (i,s)	*:PPM(i,s)*QPM(i,s)*
	- IPTAX(i,s)	$:\tau pm(i,s)$**PIM(i,s)*QPM(i,s)*
	= VIPM(i,s)	*:PIM(i,s)*QPM(i,s)*
Where:	*VDPA(i,s)*	*:PPD(i,s)*QPD(i,s)*
	-DPTAX(i,s)	$:\tau pm(i,s)$**PM(i,s)*QPD(i,s)*
	=VDPM(i,s)	*:PM(i,s)*QPD(i,s)*
Government Household		
	VGA(i,s)=	*:PG(i,s)*QG(i,s)*
	VDGA(i,s)+	*:PGD(i,s)*QGD(i,s)*
	VIGA (i,s)	*:PGM(i,s)*QGM(i,s)*
	- IGTAX(i,s)	$:\tau gm(i,s)$**PIM(i,s)*QGM(i,s)*
	= VIGM(i,s)	*:PIM(i,s)*QGM(i,s)*
Where:	*VDGA(i,s)*	*:PGD(i,s)*QGD(i,s)*
	-DGTAX(i,s)	$:\tau gd(i,s)$**PM(i,s)*QGD(i,s)*
	=VDGM(i,s)	*:PM(i,s)*QGD(i,s)*

Source: Hertel and Tsigas (1997), Table 2.2.

4.2.1.3 Sources of Firms' Purchases and Household Factor Income

Firm inputs consist of intermediate and primary factors. Flows of intermediate inputs can be described as the *Value of Firms' purchases of i, by sector j, in region s at Agents' prices, VFA(i,j,s)* including *the domestic components, VDFA(i,j,s) and imported components, VIFA(i,j,s).* Deducting domestic taxes *DFTAX(i,j,s)* from *VDFA(i,j,s)* gives the *Value of Domestic components at Market prices, VDFM(i,j,s).* Similarly, *VIFA(i,j,s)* is also reduced by imports taxes *IFTAX(i,j,s)* to get the market value of imported components, *VIFM(i,j,s).* These relationships are summarized in Table 4.10.

Table 4.10 Sources of Sector j's Purchases of Good i or Primary Factor i

Intermediate Input I:	*VFA(i,j,s)=*	*: PF(i,j,s)*QF(i,j,s)*
	VDFA(i,j,s)+	*:PFD(i,j,s)*QFD(i,j,s)*
	VIFA(i,j,s)	*:PFM(i,j,s)*QFM(i,j,s)*
	- IFTAX(i,j,s)	*: τfm(i,j,s)*PIM(i,s)*QFM(i,j,s)*
	=VIFM(i,j,s)	*: PIM(i,s)*QFM(i,j,s)*
Where:	*VDFA(i,j,s)*	*:PFD(i,j,s)*QFD(i,j,s)*
	- DFTAX(i,j,s)	*: τfd(i,j,s)*PM(i,s)*QFD(i,j,s)*
	= VDFM(i,j,s)	*:PM(i,s)*QFD(i,j,s)*
Primary Factor i:	*VFA(i,j,s)*	*:PFE(i,j,s)*QFE(i,j,s)*
	- ETAX(i,j,s)	*: τf(i,j,s)*PM(i,s)*QFE(i,j,s)*
	= VFM(i,j,s)	*:PM(i,s)*QFE(i,j,s)*
Zero Pure Profits Condition:		
	VOA(j,s) =	*:PS(j,s)*QO(j,s)*
	$\sum_{i \in TRAD}$ *VFA(i,j,s)+*	*:* $\sum$ *PF(i,j,s)*QF(i,j,s)*
	$\sum_{i \in ENDW}$ *VFA(i,j,s)*	*:* $\sum$ *PFE(i,j,s)*QFE(i,j,s)*

Source: Hertel and Tsigas (1997), Table 2.3

Table 4.10 also describes the flows of primary factors into production. The *Values of Firm's purchases at Market prices, VFM(i,j,s)* are calculated by deducting *taxes on factor endowments, ETAX(i,j,s)* from the *Value of Firms' purchases at Agents' prices, VFA(i,j,s).* The competitive market requirement of zero profits for a firm is that its aggregate expenditure equals its value of sales.

The factor income of the household consists of the value of factor services, which includes mobile and industry specific factors. By deducting taxes on household supply of *primary factor i in region s, HTAX(i,s)* from the *Value of factor product at Market prices, VOM(i,s),* the *Value of the mobile endowments at Agents' prices, VOA(i,s),* can be obtained. The relationships are shown in Table 4.11. A distinction is made between mobile and immobile factors in that the former will be priced in the market at one price irrespective of industry of use. Then the valuations of use by industry will be at industry independent prices. For immobile factors, individual prices are defined for each differentiated factor.

4.2.1.4 Disposition and Sources of Regional Income

Hertel and Tsigas (1997) assume that in the GTAP model there is a "super household" in each regional economy. The advantage of this assumption is that "the welfare of this household offers a useful proxy for regional welfare, thereby facilitating the analysis of interregional incidence of policy interventions".

As for GDP in a national model, expenditure on final demands ("super household" expenditure) must be balanced against the household's income. All income in a region is assumed to accrue to households in the region. The regional income comprises the factor payments less depreciation plus all the taxes collected by government. The two sides of expenditure are detailed in Table 4.12. The fiscal implications of all tax/subsidy programs, including binding quotas, are captured by comparison of the value of a given transaction at agents' prices vs. market (or market vs. world) prices.

Table 4.11 Sources of Household Factor Service Income for Factor i

Perfectly Mobile Factors (i ε ENDWM):

$VFM(i,j,1)$	$:PM(i,1)*QFE(i,j,1)$
+...	
$+VFM(i,j,s)$	$:PM(j,s)*QFE(i,j,s)$
$=VOM(i,s)$	$:PM(i,s)*QO(i,s)$
$-\ HTAX(i,s)$	$:\tau o(i,s)*PM(i,s)*QO(i,s)$
$=VOA(i,s)$	$:PS(i,s)*QO(i,s)$

Imperfectly Mobile Factors (i ε ENDWS):

$VFM(i,j,1)$	$:PMES(i,j,1)*QOES(i,j,1)$
+...	
$+VFM(i,j,s)$	$:PMES(i,j,s)*QOES(i,j,s)$
$=VOM(i,s)$	$:PM(i,s)*QO(i,s)$
$-\ HTAX(i,s)$	$:\tau o(i,s)*PM(i,s)*QO(i,s)$
$=VOA(i,s)$	$:PS(i,s)*QO(i,s)$

Source: Hertel and Tsigas (1997), Table 2.4

4.2.1.5 Global sectors

As previously noted, there are two global sectors in the GTAP model, namely the global transportation sector (see Table 4.13) and the global banking sector (see Table 4.14). The value of global transportation services for a particular commodity which is shipped along a particular route $VTWR(i,r,s)$, is the difference between fob and cif values (see Table 4.8). Table 4.13 shows the total demand for international transport services as the aggregate over all routes and commodities. The price of transport services is assumed to be the same for all routes and commodities.

Table 4.12 Disposition and Sources of Regional Income

EXPENDITURE(r) =	$\sum_{i \in TRAD}[VPA(i,r)+VGA(i,r)]+SAVE(r)$	
INCOME =	$\sum_{i \in ENDW} VOA(i,r) - VDEP(r)$	net factor income
	$+ \sum_{i \in NSAV} VOM(i,r) - VOA(i,r)$	household income tax
	$+ \sum_{j \in PROD} \sum_{i \in ENDW} VFA(i,j,r) - VFM(i,j,r)$	factor excise taxes
	$+ \sum_{i \in TRAD} VIPA(i,r) - VIPM(i,r)$	import consumption tax
	$+ \sum_{i \in TRAD} VDPA(i,r) - VDPM(i,r)$	domestic good consump.tax
	$+ \sum_{i \in TRAD} VIGA(i,r) - VIGM(i,r)$	import govt. use tax
	$+ \sum_{i \in TRAD} VDGA(i,r) - VDGM(i,r)$	dom. good govt. use tax
	$+ \sum_{j \in PROD} \sum_{i \in TRAD} VIFA(i,r) - VIFM(i,j,r)$	import prod. use tax
	$+ \sum_{j \in PROD} \sum_{i \in TRAD} VDFA(i,j,r) - VDFM(i,j,r)$	dom gd prd.use tax
	$+ \sum_{i \in TRAD} \sum_{s \in REG} VXWD(i,r,s) - VXMD(i,r,s)$	export tax
	$+ \sum_{i \in TRAD} \sum_{s \in REG} VIMS(i,s,r) - VIWS(i,s,r)$	import tax

Source: Hertel and Tsigas (1997), Table 2.4

Table 4.13 The Global Transport Sector

Value of services:

$\sum_i \sum_r \sum_s$	*VTWR(i,r,s)=*	*: PT*QS(i,r,s)*
	VT	*: PT*QT*
$=\sum_i \sum_r$	*VST(i,r)*	*: PM(i,r)*QST(i,r)*

Where:

VTWR(i,r,s)=	*: PT*QS(i,r,s)*
VIWS(i,r,s)-	*: PCIF(i,r,s)*QXS(i,r,s)*
VXWD(i,r,s)	*: PM(i,r,s)*QXS(i,r,s)*

Source: Hertel and Tsigas (1997), Table 2.6.

Table 4.14 Demand for Regional Investment Goods

$\sum_{r \varepsilon REG}$	*[REGINV(r)*	*: PCGDS(r)*QCGDS(r)*
	- VDEP(r)]	*: DEPR(r)*PCGDS(r)*KB(r)*
	=GLOBINV	*: PSAVE*GLOBALCGDS*
	$= \sum_{r \varepsilon REG}$ *SAVE(r)*	*: PSAVE*QSAVE(r)*

Capital Stocks in Region r:

VKB(r)	*: PCGDS(r)*KB(r)*
+ REGINV(r)	*: PCGDS(r)*QCGDS(r)*
- VDEP(r)	*:DEPR(r)*PCGDS(r)*KB(r)*
= VKE(r)	*: PCGDS(r)*KE(r)*

Source: Hertel and Tsigas (1997), Table 2.7.

The global banking sector acts as an intermediary between savings and investment. Net (of depreciation) regional investments form a composite investment good *(GLOBINV)*. All regional households face the same price for savings (PSAVE) and their aggregated savings must equal the global investment. Net regional investment adds to the opening stocks of capital, *VKB(r)*, to give end of period capital stocks, *VKE(r)*. The latter are not available for use in production during the current period, parallelling the treatment of capital stocks in the national model. Beginning (that is available for immediate use) capital stocks are allocated to sectors either according to a constant elasticity transformation function if treated as imperfectly mobile or as demanded at a uniform price to all sectors if treated as perfectly mobile.

4.2.1.6 Enforcing and Relaxing General Equilibrium Conditions

Supply and demand for every commodity, including the factors of production, must balance in general equilibrium. Equivalently, the value of the supply must equal the value of demand. For tradable commodities, value of output is related to value of sales (see the top of Table 4.8). The quantity of output in turn will relate to the use of inputs via a production function. The latter relationship is described below, again in value terms. To complete the general equilibrium, the supply of factors must equal the demand for factors; or again equivalently, the values must be equal. For perfectly mobile factors, the condition is given in Table 4.11. For less than perfectly mobile factors, the demands by industries must sum to the supply. The demands are specified by the transformation function. These must add to the supply. That is, $QO = \Sigma QFE$. But QFE are directly proportional to QO and add to 1 under the assumed production function and firm behaviour. With a given market price for the factor, $VOM = \Sigma VFE$(see Table 2.8 in Hertel and Tsigas (1997)).

While GTAP includes all the necessary equations for general equilibrium, as with most CGE models, shifter (or slack) variables are included in various equations to allow those equations to be easily removed from the model (see section 4.1.2). In GTAP, slack variables are included for the market clearing equation for tradable commodities and mobile factors, amongst others. For markets, the slack variable means that a price can be exogenously set with supply and demand in equilibrium allowed to differ, reflecting excess supply or demand, and facilitating partial equilibrium analysis.

4.2.2 Behavioural Equations

The GTAP model is completed by behavioural equations for producers, consumers and investors.

4.2.2.1 Firm Behaviour

Each sector's production technology is similar to that in the Indonesian Forecasting Model, with multiple nested stages based on Leontief and CES functions. The assumed technology differs in several respects. First, each sector produces only a single product. The Indonesian model allows for multi-output industries, though the database used in this study did not recognize any such industries. Since composite intermediate goods are combined with a primary factors composite in fixed proportions, output changes within a region can only occur if there are shifts of resources between sectors or if additional resources (factors or intermediate goods) become available to a region through altered levels of trade. Assumptions on factor mobility are therefore important (see section 4.2.2.3 below). Additionally, the GTAP model includes a new bottom layer of nesting for combining imports of a good from other regions into an aggregate of imports for the good. The treatment of imports follows the Armington approach. Hertel and Tsigas (1997) note that an imperfect competition/endogenous product differentiation approach would be better, but lack of the necessary data effectively precludes this approach in GTAP at this time. The price equations and the various derived demand equations at each level of the nest are given in Tables 2.10 and 2.11 of Hertel and Tsigas (1997) and parallel those of equation blocks 2, 3 and 4 for the Indonesian Forecasting Model.

4.2.2.2 Final Demand Behaviour

Whereas the Indonesian model treats private household demand independently of government final demand, in GTAP there is assumed to be, for each region, a single

Whereas the Indonesian model treats private household demand independently of government final demand, in GTAP there is assumed to be, for each region, a single "super household" which has an aggregate utility function over three forms of final demand: private household expenditures, government expenditure and savings, with population affecting the utility derived from private expenditure. Total regional income is allocated to the three forms of final demand household through maximizing a power (Cobb-Douglas) per capita utility function. The optimal government expenditure is then allocated between composite (combined import and domestic) goods according to another power function; then demand for each good is allocated between domestic and composite imports via a CES function; and finally the import demand is allocated between different sources via a CES function. The optimal expenditure by private households is allocated to composite goods according to a constant difference in elasticities (CDE) function; then the allocation to each good is split between domestic and differential imports as for firm and government expenditure. The detailed equations of final demand behaviour are available in Hertel and Tsigas (1996).

The GTAP model involves a large number of CES and other functions. Lack of data has led the GTAP developers to assume that many parameters are identical, either across alternative uses or across regions. Thus the elasticity of substitution between domestic and imported good is assumed to be the same whether the good is used in production or for final demand; and the same elasticity applies in all regions. Similarly the elasticity of substitution between differently source imports of a particular good is the same across all regions, but it does differ from one good to another. Although the elasticity parameters of these functions are usually the same, each function will usually have its own distribution parameter as reflected in the corresponding expenditure share coefficient determined from the database.

4.2.2.3 Imperfect Factor Mobility

As already noted, factors in GTAP are categorized as perfectly or imperfectly mobile between industries within regions. The latter are treated as aggregates which are converted or allocated to sectors by a CET function. An elasticity of transformation value near 0 implies the allocation of a factor is relatively unresponsive to "sector-factor" price relativity's and the allocation will remain near those implied by the distribution parameters of the CET function. The latter are reflected in the value of flows data base. As the elasticity approaches -∞, the factors approach perfect mobility.

Given the fact that each sector produces a single output, the classification of factors and the value assigned to the elasticity parameter can be expected to have significant effects on GTAP results for policy and other simulations. In the actual implementation of the GTAP model in the present study, only land is treated as imperfectly mobile (with an elasticity of –1.0000). With capital and labor fully mobile, and land relatively so, the model is arguably more suited to long run analysis than to short run analysis.

4.2.2.4 Investment Component

As for the Indonesian Forecasting Model, the GTAP model must include some mechanism for determining investment. As well, the issue of consistency of equilibrium investment with equilibrium capital stocks again arises. The standard GTAP model includes a relatively pragmatic treatment of investment. The treatment of investment in the GTAP model is non-standard and follows that of Walmsley (1998).

On the supply side, in capital formation it is assumed that composite intermediate inputs are combined in fixed proportions without primary factors. The composite intermediate inputs are formed, as for current production, by combining domestically sourced inputs and a composite of differently sourced imports via a CES function. This specification is identical to that in the Indonesian Forecasting Model, except for the additional bottom stage of combining the differently sourced imports.

In relation to the determination of investment, a multi-regional model potentially must deal with investment across regions and investment between sectors within each region. The latter question does not arise in GTAP because of the assumption that each factor is available as an aggregate for allocation either as a perfectly mobile or imperfectly mobile resource. Investment occurs for a region. Capital, as noted above, is treated as perfectly mobile. The capital stock available at the start of the period, new or old, is allocatable as required. On the other hand, the productive capacity of each region is not affected by current period investment, new capital only entering production in the next period. Nevertheless, current investment does influence current period production and trade through its effect on the final demand profile. The investment model in GTAP thus deals only with regional investment.

The notation used here in describing the investment component is not the standard GTAP notation. Though differing in important ways, much of it follows from Walmsley (1998).The equations which actually appear in the model are numbered below with a number corresponding to the order of the equations in the GEMPACK tablo file for implementing the model. The equations, as they appear in this file, are included in Appendix 5. Some of the other equations needed in the development and description below but not appearing in the model itself are also numbered below. These are numbered sequentially (I-1, I-2, etc.) as they occur in this section. It also needs to be noted that the notation of the model equations differs somewhat between the equations in the text and those in Appendix 5. This is because the notation for GEMPACK must use different alphabetic names, not just upper and lower case differences, whereas the convention of using upper case/lower case/**BOLD_UPPER** for parameters/percentage change variables/levels variables as established in section 4.1 has been followed here in the text. The translation of variables names is obvious in most cases.

End of period (regional) capital stocks (**KE(r)**) are by definition equal to initial (regional) stocks (**KB(r)**) plus net (regional) investment (**NETINV(r)**):

KE(r) = **KB(r)** + **NETINV(r)**

KE(r) = **KB(r)** * (1-DEPR(r)) + **REGINV(r)**

where DEPR(r) is the regional depreciation rate, **REGINV(r)** is gross regional investment and

$$\mathbf{NETINV(r) = REGINV(r) - VDEP(r)} \qquad \text{(I-1)}$$

where

$$\mathbf{VDEP(r) = KB(r)} * \mathrm{DEPR(r)}$$

is the value of depreciation in region r. The power of the capital growth rate in region r is defined as

$$\mathbf{KBGROW(r) = 1 + NETINV(r) / KB(r)}$$

$$\mathbf{= KE(r) / KB(r)}$$

This equation is included in the model in percentage change form as

$$\mathrm{ke(r) = kb(r) + kbgrow(r)} \qquad \text{(Eqn 2)}$$

The aggregate net investment, **GLOBINV**, is by definition,

$$\mathbf{GLOBINV} = \sum_r \mathbf{NETINV(r)} = \sum_r \mathbf{REGINV(r)} - \mathrm{VDEP(r)} \qquad \text{(I-2)}$$

Investment behaviour

As in the ORANI investment specification in the Indonesian Forecasting model (section 4.1.4, block 15), investors are assumed to focus on their expected net returns to capital creation in the next period (**ROREXP(r)**). This is directly related to current rate of net returns (**RORCUR(r)**). In the standard GTAP model it is also related to the relative capital stocks in the two periods:

$$\mathbf{ROREXP(r) = RORCUR(r)} * \mathbf{[KE(r) / KB(r)]}^{-\mathrm{RORFLEX(r)}}$$

However, as discussed in block 15 of section 4.1.4, Walmsley (1998) has generalised this investment behavioural equation by replacing relative capital stocks over time with the ratio of the power of the regional growth rates to the power of the average growth rate:

$$\mathbf{ROREXP(r) = RORCUR(r) * [(KE(r) / (KB(r)) / AVGROW)]^{-RORFLEX(r)}}$$

or equivalently

$$\mathbf{ROREXP(r) = RORCUR(r) * [KBGROW(r) / AVGROW]^{-RORFLEX(r)}}$$

which in percentage change terms is

$$rorexp(r) = rorcur(r) - RORFLEX(r) * (kbgrow(r) - avgrow) \qquad \text{(Eqn 1)}$$

where the power of the average growth rate is defined as a weighted average of the powers of capital growth rates in the regions:

$$\mathbf{AVGROW} = \sum_r \mathbf{(KB(r) / KB\_TOT) * KBGROW(r)}$$

where **KB_TOT** is the total capital stocks. Linearized, this becomes:

$$avgrow = \sum_r SHR\_VKE(r) * (kb(r) + pcgds(r) + kbgrow(r)) - kb\_tot + pkb + growavslack \qquad \text{(Eqn 8)}$$

where SHR_VKE(r) is the share region r has of end of period capital stocks, and growavslack is a slack variable. The model includes two definitional equations for defining the changes in global capital stocks and the price of global capital stocks:

$$kb\_tot = \sum_r \{KB(r) / \sum_r KB(r)\} * kb(r) \qquad \text{(Eqn 5)}$$

$$pkb = \sum_r \sum_r \{KB(r) / \sum_r KB(r)\} * pcgds(r) \qquad \text{(Eqn 6)}$$

In this investment specification, RORFLEX(r) is a regional parameter parallel to the negative of BETA_Ri in block 15, for example Equation 15.3. It specifies the *flexibility* of net rates of return to changes in beginning and/or ending capital stocks. Large absolute values mean that expected rates are altered by small changes in capital stocks; or that the needed adjustments to capital stocks to achieve a particular rates of return will be relatively small. Small values, on the other hand, would mean that relatively large changes in capital stocks would be needed to alter expected rates of return.

Allowing for risk in the model

The notion that expected rates of return might differ between regions and that the differences could be associated with differing levels of the riskiness of investment suggests a more formal treatment of risk may be useful. Walmsley (1998) introduces an additive and common risk premium (RISK(r)) into both current and expected rates of return to investment for each region. This can be expressed, using different notation from that used by Walmsley, as

RORCRISK(r) = **RORCUR(r)** + RISKFLAG * **RISK(r)**

and

RORERISK(r) = **ROREXP(r)** + RISKFLAG * **RISK(r)**

where the inclusion of RISK in the LHS variable names indicates they are risk-inclusive rates of return. The parameter RISKFLAG is a slack flag parameter, taking the value 1 when risk is allowed for tin the model and 0 otherwise. When equal to 0, risk essentially disappears from the model. In percentage change form

RORCRISK(r) * rorcrisk(r) = RORCUR(r) * rorcur(r) + RISKFLAG *RISK(r) * risk(r)

(Eqn 9)

and

RORERISK(r) * rorerisk(r) = ROREXP(r) * rorexp(r) + RISKFLAG *RISK(r) * risk(r)

(Eqn 10)

The investment component of the model is related to the current production activities in the model through the current net rate of return to capital. This is defined as for the ORANI specification: capital rental (**RENTAL(r)**) relative to price of creating capital goods (**PCGDS(r)**) less the depreciation rate;

RORCRISK(r) = RENTAL(r) / PCGDS(r) - DEPR(r)

or equivalently

RORCUR(r) + RISKFLAG* **RISK(r) = RENTAL(r) / PCGDS(r)** - DEPR(r)

or in percentage change terms

rorcur(r) + [RISKFLAG*RISK(r) / RORCUR(r)] * risk(r)

= GNRATIO(r) * (rental(r) -pcgds(r)) (Eqn 11)

where GNRATIO(r) is the ratio of risk-inclusive gross rate of return to net current rate of return:

GNRATIO(r) = [RORCUR(r) + RISKFLAG* **RISK(r)** + DEPR(r)] / **RORCUR(r)**

In this model, investment behaviour is driven by riskless rates. The one risk related difference from the standard GTAP model is that the current rate of return earned from current production is now viewed as a risk-affected rate. All other variables in the model, to the extent that they are indirectly influenced by the risk-affected current rates, are now also risk-affected.

Completing the investment model: equilibrium conditions

The final component of the investment model is the specification of investor equilibrium. To increase the flexibility of the model, the GTAP modellers have actually included two alternative specifications of investment equilibrium in the GTAP model. This was done by defining a slack flag parameter (RORDELTA) which takes the value 0 or 1 depending on which of the two specifications is to activated and then replacing the equations that would represent each of the individual specifications by equations formed as weighted sums of the individual equations, with the weights being the RORDELTA parameter and (1-RORDELTA).

In the first specification of equilibrium, investors are assumed to invest such that changes in their expected future rates of return are all equal. In percentage change terms,

$$\text{rorexp}(r) = \text{rorg} \qquad \text{(I-3)}$$

The corresponding model in the levels variables is not made explicit in the GTAP literature. Clearly, this restriction means that investors maintain a fixed ratio in the expected rates of return for the future across all regions. This can be written as:

$$\mathbf{ROREXP(r)} = (1 + \text{PREM}(r)) * \mathbf{RORG}$$

where **RORG** is a base global expected rate of return and PREM(r) is a constant premium applying in region r. Regional investments, rates of return and then the global rate adjust to maintain the same relativity of expected future rates.

Aggregate investment, from equation (I-2) is in percentage change terms is

$$globinv = \sum_r \{REGINV(r)/GLOBINV * qcgds(r) - VDEP(r)/GLOBINV * kb(r)\}$$
(I-4)

Equations (I-3) and (I-4) represent the first of the investment models: movements in the regional rates of return are restricted and the regional investments adjust accordingly. There are r+1 individual equations. The second and alternative model of investor equilibrium does not restrict movements in expected rates of return to be proportional but instead is based on the assumption that investors maintain the initial regional composition of the capital stock. That is, (net) regional investment is proportional to (net) global investment, the ratio being the same as the existing proportion the region has of the total capital stocks:

$$\mathbf{NETINV(r)} = CAPSHR(r) * \mathbf{GLOBINV}$$

where CAPSHR(r) is the initial share of global capital stock held in region r. In percentage change terms

$$netinv(i) = globinv \tag{I-5}$$

Equation (I-1) becomes in percentage change terms,

$$netinv(i) = [REGINV(r) / NETINV(r)] * qcgds(r) - [VDEP(r) / NETINV(r)] * kb(r)$$
I-6)

and by substituting netinv(i) out of the last two equations,

$$globinv = [REGINV(r) / NETINV(r)] * qcgds(r) - [VDEP(r) / NETINV(r)] * kb(r)$$
(I-7)

This second investment model is formally completed by defining a global expected rate of return as

$$\mathbf{RORG} = \prod_r \mathbf{ROREXP(r)}^{NETINV(r)/GLOBINV}$$

or in percentage change terms

$$\text{rorg} = \sum_r \{\text{NETINV(r)/GLOBINV* rorexp(r)} \qquad \text{(I-8)}$$

Equations (I-7) and (I-8) again contain r+1 individual equations in precisely the same variables as the first investment model. These two pairs of equations, (I-3 and I-4; and I-7 and I-8) constitute the alternative equilibrium conditions.

To build both formulations into the model, the two pairs of equations are weighted by the slack flag binary parameter RORDELTA which takes the value 1 for equations (I-3) and (I-4) and 0 for the other pair. Equation (I-3), weighted by RORDELTA is added to Equation (I-7) weighted by (1-RORDELTA). It does not matter which sides of the equations are added. The formulation here follows GTAP and Walmsley (1998), with the LHS of (I-3) being added to the RHS of (I-7); and the LHS of (I-4) being added to the LHS of (I-8). The resulting pair of equations, the first of which consists of r individual equations (one for each region) are

RORDELTA * rorexp(r) + [1-RORDELTA] *
{[REGINV(r) / NETINV(r)] * qcgds(r) - [VDEP(r) / NETINV(r)] * kb(r)}
= {RORDELTA * rorg + [1-RORDELTA] * globinv} +cgdslack(r) (Eqn 3)

and

RORDELTA * globinv + [1-RORDELTA] * rorg
= {RORDELTA * $\sum_r$ {REGINV(r)/GLOBINV* qcgds(r) - VDEP(r)/GLOBINV* kb(r)} + [1-RORDELTA] * $\sum_r$ {NETINV(r)/GLOBINV* rorexp(r) } (Eqn 4)

These equations appear in the modified GTAP model. A slack variable has been added to Equation (Eqn 3) to remove the requirement for either rates of return or investment amounts to change in proportion.

The inclusion of risk adds two new equations (Eqn 9 and Eqn 10) to the model and three variables (**RISK(r)**, **RORCRISK(r)**, and **RORERISK(r)**) (per region). Were it not for the occurrence of **RISK(r)** in the equation (Eqn 11) defining the current rate of return, the two new equations would add individually and sequentially to the rest of the model and they would have no impact on the solution to the rest of the model, even when RISKFLAG = 1. When RISKFLAG = 1, the solution to the three equations are interdependent. However, it is evident that these three equations in three new variables do simply add a set of three variables whose solution values will depend on the rest of the model, but whose values will not alter the solution of the rest of the model. In other words, if the effects of any exogenous changes are to be simulated while allowing risk premiums to alter along with the risk-affected rates, then the relativity of the rental and supply price of capital goods has no effect on the level or allocation of investment.

If any one of the three risk variables is set exogenously, then these three equations do affect the rest of the model through the **RISK(r)** variable. In particular, if risk(r) is set exogenously, for example to zero and so equilibria positions are compared under a condition of no change in the risk premiums, the equilibrium of the economy is affected. Treating risk(r) as exogenous or not is therefore potentially an important decision in long run analysis.

Setting risk(r) exogenously at 0 produces equations similar in appearance to those that apply when RISKFLAG=0. It might seem that the solutions would be the same. However, some of the *coefficients* attaching to the other variables in the risk associated equations would usually differ depending on whether RISKFLAG equals 0 or 1. Then the equilibria and changes in equilibria in response to exogenous changes do differ depending on whether risk premia are recognized or not in the model. The extent of the differences will be greater the larger the regional risk premiums. Evidence to this effect is available from Walmsley's results in which she compares the effects of exogenous changes to regional growth rates under the two alternative assumptions about risk premiums.

The preceding formulation of the Walmsley adaptation of the GTAP model for risk is simpler than in Walmsley (1998), but there is no real difference from her model. In introducing risk, Walmsley chose to define new variables for the risk free rates rather than letting the existing rate of return variables in the standard GTAP model be the risk-free rates and using the standard GTAP variables for the risk-affected rate variables. Consequently, in her description, a number of equations of the existing model had to be modified by replacing the original names of risk less rate variables with the new names of the risk-free variable . In the risk model described above, only one of the standard GTAP equations in the model needs alteration to allow for risk.

4.2.2.5 Supply of Global Transportation Services

The demand for international transport services has already been mentioned (section 4.2.1.5). On the supply side, services are assumed to be produced according to a Cobb-Douglas production function over services from each region.

4.2.2.6 Auxiliary Equations

The equations described to this point constitute the basic GTAP economic model. As for the Indonesian Forecasting Model, it is useful to append additional equations to calculate various economic aggregates, ratios or other measures associated with the economic equilibrium. These additional equations do not alter the equilibrium solution because they define one new or additional endogenous variable for each additional equation. They serve to assist the interpretation and analysis of the equilibrium and the changes to it.

The GTAP modellers have included many such definitional equations, including the volume of global exports, the volume of global imports, price indices, indices for regional exports and import, the volume of global trade, and regional equivalent variation as a measure of welfare. Of particular relevance to the present study is the percentage change in each region's terms of trade. This is calculated as the change in the ratio of the aggregate indices of prices received and prices paid. The details of these auxiliary equations are contained in Hertel and Tsigas (1996).

4.2.2.7 Coefficients

While the coefficients in the equations are obvious from the preceding descriptions, the process for updating these also needs to be specified. The tablo file in Appendix 5 gives the relevant formulae. Depending on whether risk is to be recognized or not in the model, the formula for calculating RORCUR(r) varies to make the updating consistent with the other rate of return variables. To allow efficient analysis under different assumptions, this formula for RORCUR(r) includes a risk-recognition flag, RISKRECOG, equal to 1 when risk in recognized. This flag operates independently of the RISKFLAG parameter which specifies whether risk premiums are allowed for in the model. In most analyses, however, the two parameters would take the same value.

4.2.3 Steady State Conditions

In the long run, capital is both mobile and accumulative. The standard GTAP model can mimic this case through making both regional capital stocks and investment endogenous. In relation to the choice between the two investment models, that in which investors seek to equate percentage changes in expected rates of return (RORDELTA = 1) is arguably the more appropriate. However, irrespective of which one is chosen, there is nothing in the GTAP model to ensure that capital stocks and investment are compatible from an equilibrium-over-time perspective, or that the expected rates of return are compatible with current rates from a similar equilibrium-over-time perspective.

One possible approach to long run equilibrium would be to add equations of the form

$$\text{RORCUR}(r) = \text{ROREXP}(r) \tag{I-9}$$

or in percentage changes,

$$\text{rorcur}(r) = \text{rorexp}(r)$$

Since these equations would be "closure equations" which an analyst would not always want to impose, they would be best included in the GTAP model with slack variables:

rorcur(r) = rorexp(r) + slackror(r)

This condition (the slack variable set to zero) was effectively imposed in the long run closure used by Huff *et al.* (1995) and Adams *et al.* (1997) in their studies of the Australian economy using the GTAP model. The closure is related to, though different from the standard long run closure used in ORANI studies. The latter, as noted in section 2.6 is that rates of return to capital creation are exogenously set to remain unchanged (see, for example, Dixon *et al.*, 1982). Walmsley (1998) notes that this may be reasonable for a small country national model. Prior to exogenous changes, domestic rates are expected to align with global rates of return. After an exogenous change is imposed and the economy has returned to long run equilibrium, domestic rates of return are expected to be restored to the same equilibrium rates since the policy changes and other exogenous changes studied would be unlikely to affect global rates of return. Thus an assumption of no-change in rates of return would reasonably capture the notion of the long run (provided that the initial position of the economy was truly a long run equilibrium). Walmsley argues that the no-change in rates view of equilibrium would not be appropriate in global analysis where the exogenous changes might alter global rates. This justifies the use of the specification of equilibrium in terms of proportional changes in current and expected rates and not in terms of no changes in rates.

Recalling that in the modified GTAP model future rates of return differ from current rates only because of differences in regional growth rates (Eqn 1), that is,

rorexp(r) = rorcur(r) - RORFLEX(r) * (kbgrow(r) - avgrow)

such closure equations for rates, with slackror(r) exogenously set to 0, would mean that in equilibrium, the changes in growth rates must be equal across regions.

Rather than impose this equilibrium condition through the rates across time, following Walmsley the condition has been imposed here through the growth rates, namely via:

kbgrow(r) = avgrow + growslack(r) (Eqn 7)

where growslack(r) is a slack variable.

Imposing Equation (Eqn 7) only ensures that the *changes* in growth rates are equal and that the *changes* in rates of return are equal. However, the notion of the long run solution being one in which the economy is in a steady state (not necessarily stationary) equilibrium requires something more. It requires that the levels themselves be equal.

Since the GTAP model operates in linearized percentage changes, a steady state cannot be imposed by constraints. On the other hand, if an economy is initially in a long run steady state, then enforcing condition (Eqn 7) would maintain it in a steady state. That is, equal percentage changes in both rates would maintain equality of the rates. Considered from another perspective, if the initial database does not have an essential characteristic of long run equilibrium, then it cannot be used as an initial equilibrium from which to measure comparative static long run changes.

Walmsley (1998) addresses the issue of a steady state database, both for equality of expected and current rates of return (Eqn 7) and for equality of rates across regions (Eqn 3 and Eqn 4).

4.2.4 A Steady State Database

In long run equilibrium, with rates of return equating across regions, if the growth rate of capital is the same as the rate of population growth and the rate of technological changes, the equilibrium is equivalent to a steady state condition

(Walmsley, 1998). She argues that the steady state condition is related to the capital mobility and balanced growth pertains.

However, the standard GTAP database is not consistent with these steady state conditions. Economic databases pertain to the economy at a point or a period of time. In the absence of immediate adjustment to long run equilibrium and given the on-going changes to exogenous factors, the data in general do not reflect long run equilibrium. That is, the position depicted by a database would not generally conform with the specified long run equilibrium model. Available data must be used and modified to establish a steady state database representing a long run equilibrium solution to the model from which changes to long run equilibrium can be measured.

To create a steady state database, the across region and across time conditions must be satisfied. Walmsley (1998) outlines how, the changes to rates of return and growth rates needed to adjust an initial database to the steady state can be calculated Using data on actual regional growth rates and rates of return it is a simple matter to calculate the percentage changes needed in these variables to equate them to any given value. Then, these necessary changes can be imposed as exogenous changes to the model, in which the equilibrium conditions are not imposed, to alter the rates so that they satisfy the equilibrium conditions. The updated database from such a process is a steady state database. The long run effects of other exogenous changes can then by studied by using the updated database as the initial equilibrium point and by imposing the equilibrium conditions in any simulations with the model.

Walmsley (1998) does this in two steps. First she calculates and imposes shocks on the non-equilibrium model to adjust the growth rates to be all be equal. She may then calculate and impose shocks to the regional rates of return to equalise them, with the equilibrium condition on growth rates applied. However, the need to do this second step only arises if the differences in regional rates of return in the initial database are viewed as discrepancies from equilibrium rather than as long-run risk premiums. In her "risk-adjusted steady state" case, the differences in regional rates are viewed as long run risk premiums and the second step to achieve a steady state database is not needed.

If risk premiums are to be forced to zero for the long run, the second adjustment is required.

4.2.5 Modified Model and Closure

Like the Indonesian Forecasting Model, the GTAP model is incomplete in that it contains more variables than equations. It has no single "solution", but instead alternative solutions values for a number of variables (equal to the number of equations in the model) conditional on the levels of others.

There are two primary GTAP closures (with variations) suggested in the work of Hertel and Tsigas (1997), Huff *et al.* (1995) and Adams *et al.* (1997): one for mimicking the economic short run and the other for the economic long run. The GTAP short run closure applies for a period during which the capital stock is fixed at existing levels in each region. Since in GTAP all factors are mobile between sectors, even if imperfectly so, the short sun is not as short as in the Indonesian Forecasting Model where factors, including capital may be fixed in each sector. Since capital is usually considered perfectly mobile in GTAP analyses, it would be appropriate for short run analyses to reclassify capital as a sluggish factor and to assign a sufficiently small elasticity of substitution to restrain reallocation. An alternative approach is possible, but best avoided: capital could be classified as perfectly mobile with the capital used in each sector being set exogenously to given levels. When capital is a perfectly mobile factor, the price of capital must be uniform across all sectors in equilibrium - there is only one rental price. If the factor cannot flow to achieve the uniform price, uniformity of the rental price of capital must be achieved instead by altered levels of production, product prices etc. Closures should be chosen to match causal economic logic and not just because they are mathematically possible.

A short run closure also requires some assumption about investment levels and where investment will occur. Either of the two investment models included in the standard GTAP model and in Walmsley's adaptation could be viewed as appropriate.

Both would represent short run situations in that they do not enforce any link between the current rates of return and the future rates of return.

In almost all the runs of the GTAP model reported in later chapters, long run closures are used. The impacts of trade liberalisations are assessed in relation to a steady state data base constructed following the procedures used by Walmsley. Steady state GTAP databases were computed under the alternative assumptions of the absence of long run regional risk premiums and the existence of such premiums. The implied premiums were found to be quite large for some countries, and in particular, Indonesia. Walmsley (1998) also found this. When risk premiums are forced to become zero and the data base forced to adjust to exhibit equality of expected future and current rates of return, the data base alters significantly, and particularly so for Indonesia. In the absence of strong reasons to believe that no risk premiums would exist in equilibrium, and given that the investment model remains pragmatic, the decision was made to assume in this study that risk premiums do exist in equilibrium and would continue to do so, unchanged, following trade liberalisation. That is, only a risk-affected, or "risk adjusted" steady state database is used.

As will be described in section 4.3, two GTAP simulations with the updated steady-state database are needed to derive the terms of trade changes that Indonesia will confront after trade liberalisation, namely runs with Indonesia treated either an isolated country or not. These closures follow the methods of Adams *et al.* (1997).

1. The long-run closure with Indonesia not isolated. The standard GTAP long run closure is used, except the ratios of current to expected rates of return are made exogenous and the capital quantity in each region is made endogenous. A shock reducing all tariffs to zero is applied.

2. The long-run closure with Indonesia isolated as a small country. In addition to the settings described for the first closure, the following changes, subject to some qualification noted below, are made to remove all feedback from the Indonesian economy to the other regions.

Changed from endogenous to exogenous:

- all bilateral trade flows into and out of Indonesia;
- the flow of the "savings good" from Indonesia into the global pool of saving;
- the flow of savings of real capital funds from the global pool into Indonesia.

Changed from exogenous to endogenous:

- all tax rates on bilateral trade flows into and out of Indonesia;
- the slack variable in the equation global rate of return to remove this equation from the model;
- the slack variable in equation regional income to remove this equation (The final equation of those listed for the modified GTAP model in Appendix 5)

There are some exceptions to the above "rules". Not all commodities are exported by or imported from Indonesia to every region. Neither do all commodities have an export tax or import tariff. For example, wheat exports from Indonesia and rice imports from Japan have no taxes or tariffs. Indeed the Indonesian export taxes on all commodities except manufacturing are all zero. In these cases, no swapping between the endogenous and exogenous variable specification of the standard GTAP long run closure is made.

4.3 Linking the Single Country and Multi-Country Models

In the case of multilateral trade policy changes in a number of countries, with interest focussed on the effects on a particular country, linking the multi-country GTAP model with a national model for that country potentially provides a useful approach to studying trade liberalisation (see discussion in section 2.5). The impact of trade liberalisation on the country is likely to be assessed more realistically than using a national model alone with no formal reference to global modeling of the effects of the liberalisation.

To analyse the impact of trade liberalisation by a group of countries, all relevant policy interventions (whether export tax, export subsidy, import tax or import subsidy) in each country can be removed in the multi-country multi-commodity model. The simulation with the global model reveals the changes in the global trade and market equilibrium. The country of particular interest, the one to be further studied with a national model, can be treated as a small country or a large country as appropriate. Indonesia, as argued later, is a small country.

The small country case is the simpler since its exports, imports and cross border capital flows by definition have no effect on the global market. The country can then be isolated in the global model (using what Adams *et al.* (1997) have called an "isolation closure") by making the real level of its imports, exports, saving and capital goods into and out of the country exogenous and fixed (that is, zero change) in the global model. That is, in the face of changes elsewhere, the country retains its original domestic and international trading activities. If the country is indeed small for all commodities, these exogenous settings have little effect on the global model results. The global model determines the demand price and supply price changes for the particular country's exports and imports. For there to be no response by the economic agents in the particular country, there must be tariff changes in the country to offset the world price changes. These too are determined endogenously in the global model.

The trade liberalisation applied in the global model entails all participating countries, other than the particular country, reducing their tariffs. The result of the global simulation is essentially a hypothetical new global equilibrium in which world prices have changed and in which tariffs have been reduced in participating countries and hypothetically altered in the particular country. The price changes can then be treated as exogenous in the national country model.

In the national model, the domestic producers and consumers adjust to the exogenous export and import price changes. *Ceteris paribus*, the export supply volume increases (decreases) if the export price increases (decreases) and the import demand volume decreases (increases) if the import price increases (decreases). Simulations of the national model in response to the globally determined price changes show how the country's economy is affected. If the country is also to join in trade liberalisation by reducing its trade barriers, then exogenous shocks to its trade barriers should be included along with the world price change shocks. This global-national linkage approach to modeling trade liberalisation has been used before, notably by Huff *et al.* (1995) and Adams *et al.* (1997, 1998).

4.3.1 Tariff and Subsidy Rates and Their Economic Effects

In the GTAP model, trade policy settings of tax and subsidy rates in each country are defined as the ratio of domestic market prices to the world prices. An import tax will increase the market price above the world price and causes the power of the ad valorem tax to be greater than one, where the power of a tax is the value of the good at the tax-affected domestic price relative to the world price. For a subsidy, the opposite will occur.

As an example, consider an export tax. This will lower domestic price relative to the world price. Using the standard notion of the GTAP literature, the power of the export tax is defined as:

$$TXS(i,r,s) = VXMD(i,r,s)/VXWD(i,r,s)$$

where :

$TXS(i,r,s)$ = the power of the tax

$VXMD\ (i,r,s)$ = the value of exports at the exporter's domestic market price, by destination

$VXWD(i,r,s)$ = the value of exports of commodity i from region r to region s, valued at the world prices, by destination

The existence of an export tax is evidenced by a TXS value, which is less than one. Similarly, an export subsidy is indicated by a TXS value greater than one. The export tax revenue ($XTAX(i,r,s)$) is calculated by:

$$XTAX\ (i,r,s) = VXWD(i,r,s) - VXMD\ (i,r,s)$$

Tax revenue is positive if the country implements exports tax and negative if it implements an export subsidy.

Intervention by exporters and importers is described in Figures 4.6 to 4.9, taken from Brockmeier (1996). Figures 4.6 and 4.7 describe graphically the intervention by a country exporting commodity i from region r to region s. The first figure shows the domestic price of commodity i to be less than the world price after implementing the export tax. Figure 4.7 shows the higher domestic price under an export subsidy.

Policy intervention by an importer is illustrated in Figure 4.8 for an import tax and Figure 4.9 for an import subsidy. If the government of country s implements an import tax and/or import quota, the cif price of commodity i supplied from region r will be less than the importer's domestic price of that commodity supplied from region r.

Using standard GTAP notation, the power of the import tariff is defined as:

$$TMS(i,r,s) = VIMS\ (i,r,s)/VIWS(i,r,s)$$

where :

$TMS(i,r,s)$ = the power of the import tax

$VIMS\ (i,r,s)$ = imports of commodity i from region r to region s, valued at importer's domestic price

$VIWS(i,r,s)$ = imports of commodity i from region r to region s, valued at CIF price

Figure 4.6 Export Tax in Region r on Sales to Region s

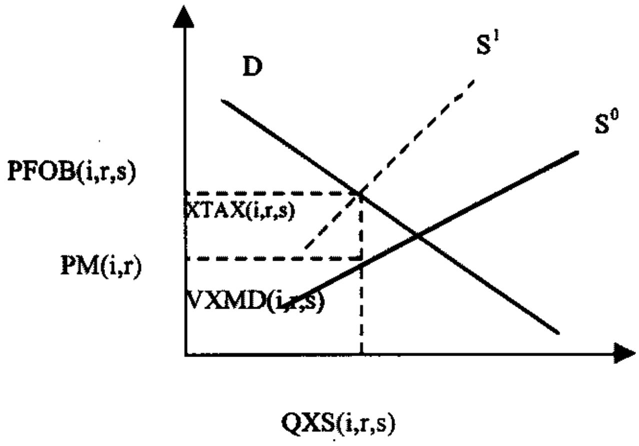
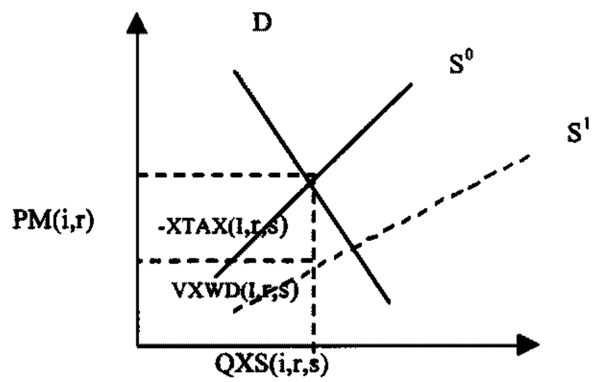


Figure 4.7 Export Subsidy in Region r on Sales to Region s



PM	Domestic price commodity i in region s from origin r
PFOB	FOB price of commodity i supplied from region r to region s (PFOB(i,r,s))
QXS	Export of commodity i from region r to region s
VXMD	Export of commodity i from region r to region s, valued at exporter's domestic price (VXMD (i,r,s) = VXWD (i,r,s) - XTAX (i,r,s))
VXWD	Export of commodity i from region r to region s, valued at FOB price VXWD (i,r,s) = VXMD (i,r,s) + XTAX (i,r,s)
XTAX	Tax revenue expenditure (negative for subsidy)
D	Demand for imports of commodity i supplied from region r by region s
S^0	Pretax net supply of commodity i supplied from region r by region s
S^1	Taxed net supply of commodity i supplied from region r by region s
	Net supply of commodity from region r

$$(QXS(i,r,s) = QO(i,r) - \Sigma_{k,\ k<>s}\ QXS(i,r,k) - VST(i,r))$$

Figure 4.8 Import Tax in Region s on Purchases from Region r

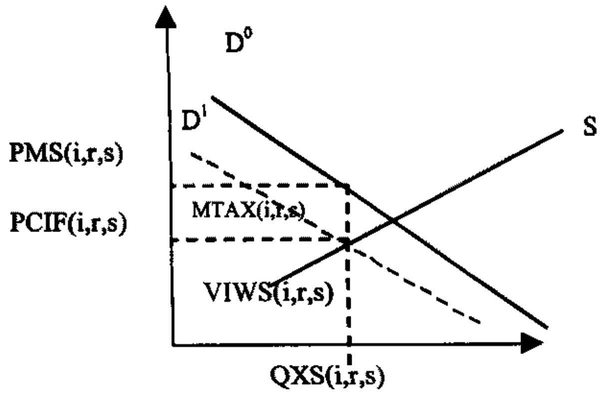
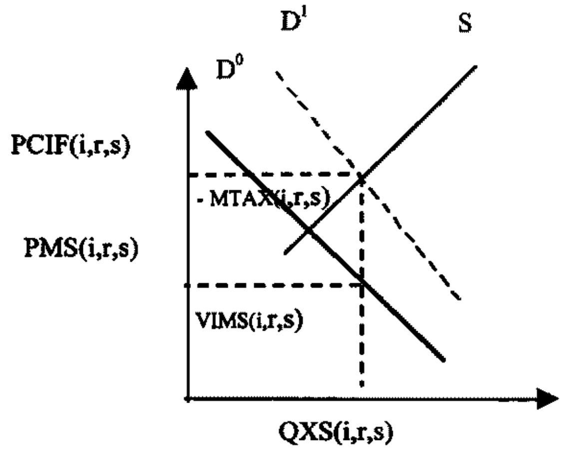


Figure 4.9 Import Subsidy in Region r on Sales to Region s



PMS	Importer's domestic price commodity i in supplied from origin r to region s
PCIF	CIF price of commodity i supplied from region r to region s
QXS	Export of commodity i from region r to region s
VIMS	Imports of commodity i from region r to region s, valued at importer's domestic price (VIMS (i,r,s) = VIWS (i,r,s) + MTAX (i,r,s))
VIWS	Imports of commodity i from region r to region s, valued at CIF price (VIWS (i,r,s) = VIMS (i,r,s) - MTAX (i,r,s))
MTAX	Tax revenue expenditure (negative for a subsidy)
D^0	Pretax demand for differentiated imports of commodity i from region r in region s
D^1	Taxed demand for differentiated imports of commodity I from region r in region s
S	Net supply of commodity i supplied from region r in region s
QXS(i,r,s)	Net supply of commodity i from region r $(QXS(i,r,s) = QO(i,r) - \Sigma_{k,\ k<>s} QXS(i,r,k) - VST(i,r))$

The existence of an import tax is evidenced by a *TMS* value, which is more than one. Similarly, an import subsidy is indicated by a *TMS* value less than one. The import tax revenue (*MTAX(i,r,s)*) is calculated by :

$$MTAX\ (i,r,s) = VIMS(i,r,s) - VIWS\ (i,r,s)$$

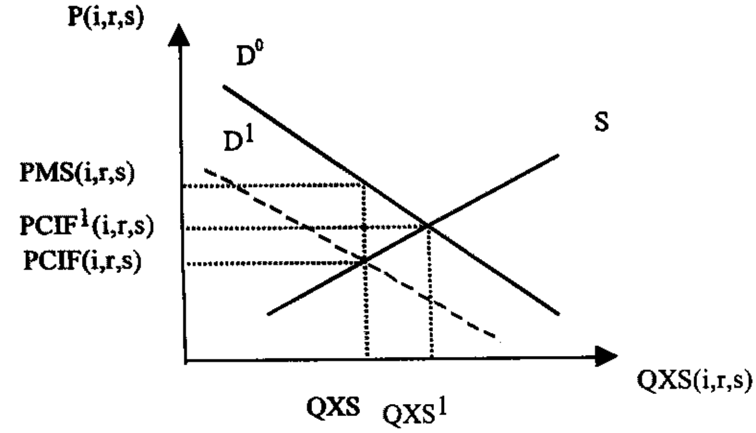
Tax revenue is positive if the country implements import tax and negative if it implements an import subsidy.

Trade liberalisation is implemented by altering the export and import barriers among those countries participating in the agreement. Under full APEC trade liberalisation, for example, all APEC countries remove all their barriers. On the import side, the removal of import tariffs and non tariff barriers is done in the GTAP model by altering the power of the tariff (*TMS*) on each commodity to become unity. The required exogenous percentage change in *TMS* is that which eliminates the wedge between the value of import in importer's domestic price (*VIMS*) and in world price (*VIWS*). Then *PMS(i,r,s) = PCIF(i,r,s)* and *VIMS(i,r,s)=VIWS(i,r,s)*. The necessary shock is calculated as follows:

$$tms(i,r,s)=[(1-TMS(i,r,s))/TMS(i,r,s)]*100$$

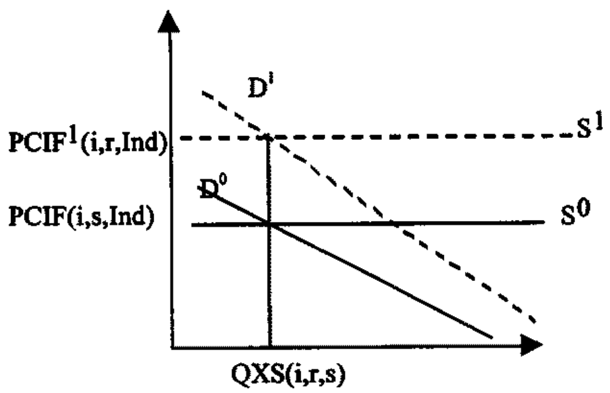
Figure 4.10 shows that reducing the import barriers in one country will increase the net supply of commodity i from region r to region s, from QXS(i,r,s) to QXS^1(i,r,s). The import price also increases from PCIF(i,r,s) to $PCIF^1$ (i,r,s). In the GTAP simulations of APEC trade liberalisation in the present study, all participating APEC countries, excluding Indonesia, reduce their tariff barriers. Therefore the world price will increase as will imports. Figure 4.10 is representative of the import demand and supply schedule in each APEC countries (except Indonesia) in the GTAP model for this study.

Figure 4.10 Reducing Import tariff in Region s on Purchases from Region r



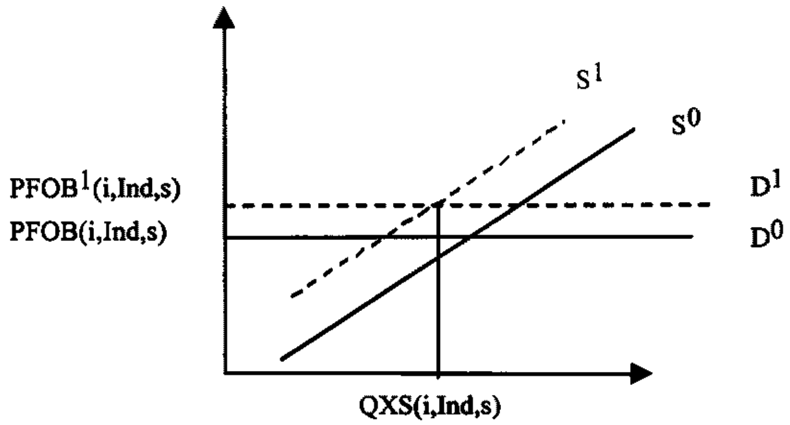
In the GTAP simulation, Indonesia is treated as a small country, isolated from the global market. Essentially, the export, import, saving and investment for Indonesia are treated as fixed. The change in these variables is set exogenously to zero. The import supply and demand schedule for Indonesia in the GTAP simulations are illustrated in Figure 4.11. With no market power, the import supply is perfectly elastic (Houck, 1986): the supply schedule from other countries to Indonesia is horizontal. The change in the import price as a result of reductions of import tariffs in other countries increases the quantity being traded internationally and shifts Indonesia's import supply schedule. However, imports into Indonesia are required to remain unchanged in the GTAP simulations. This requires the import demand schedule be shifted upwards (from D^0 to D^1) and is achieved by reducing Indonesian import barriers.

Figure 4.11 Import Demand and Import Supply Schedule from other countries to Indonesia in GTAP model



The export demand and supply schedule of Indonesia to other countries in the GTAP simulations is illustrated in Figure 4.12. As a small country, Indonesia cannot influence the export demand for its products expressed by other countries. The export demand schedule is horizontal. An increase in import demand in other countries and in import prices because of trade liberalisation can be represented as an upwards shift in the Indonesian export demand function (from D^0 to D^1). With exports from Indonesia held fixed in the GTAP simulations, Indonesian export taxes have to be changed to shift the export supply function upwards too (from S^0 to S^1).

Figure 4.12 Export Demand and Export Supply Schedule from Indonesia to other countries in GTAP model



The description to this point has related to the GTAP model. Export demand and supply schedules and import demand and supply schedules must also be present in the Indonesian Forecasting Model. These are illustrated in Figures 4.13 and 4.14.

The export price change derived from the GTAP model is used as an exogenous shock to the export demand function in the Indonesian model. The export demand function is described mathematically in equation block 8 in section 4.1.2. The shock, introduced through the shift variable 'f4p(c)', acts to shift the export demand schedule (upwards if the price change is positive).

4.3.2 Specifying Tariff Rate Changes for the Indonesian Forecasting Model

In relation to imports in the Indonesian model, the supply schedule is perfectly elastic. The changes in import prices derived from the GTAP simulation are applied as

Figure 4.13 The Export Demand and Export Supply Schedule in Indonesian Model

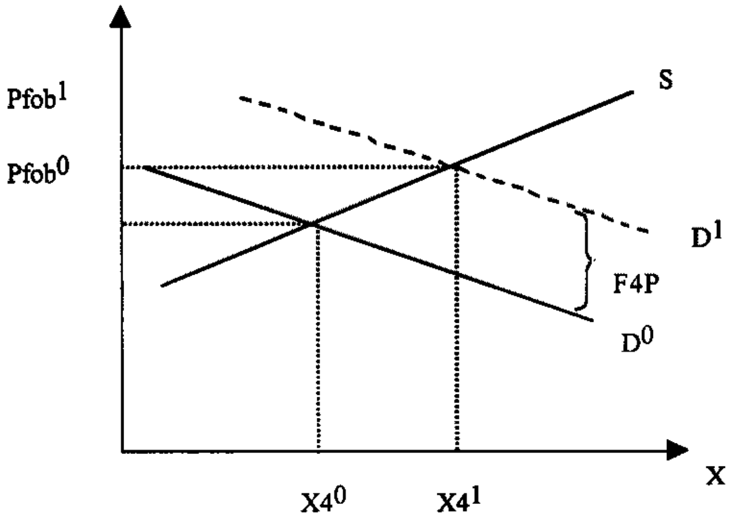
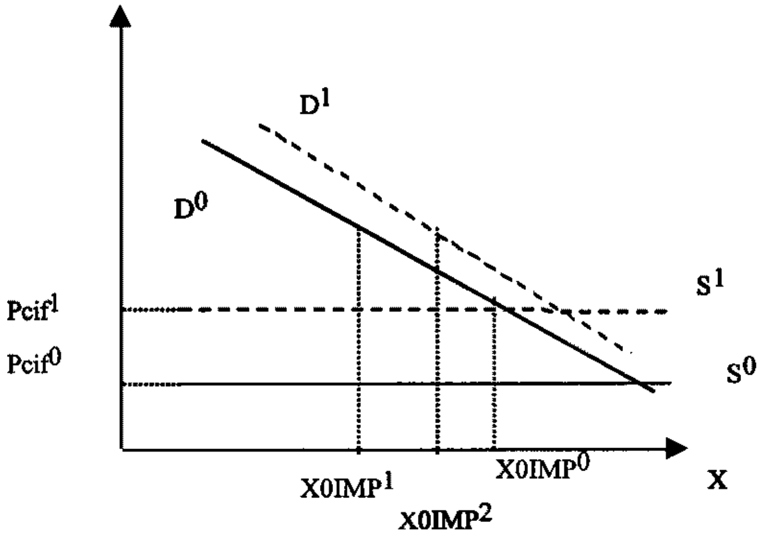


Figure 4.14 The Import Demand and Import Supply Schedule in Indonesian Model



exogenous shocks in the Indonesian model. If there is an increase in import price (from Pcif0 to Pcif1), the import demand from Indonesia declines (from $X0IMP^0$ to $X0IMP^1$). However, if Indonesia reduces its tariffs, the import demand function will shift upwards so that at a given world price more will be demanded. Import demand will increase (from $X0IMP^1$ to $X0IMP^2$). The overall impact of the changes in world prices and in Indonesia's tariffs on her import demand can be positive or negative depending on those changes.

When the changes to Indonesia's trade barriers and trading prices applied exogenously in the Indonesian model are the same as the changes determined endogenously in the GTAP simulation, the changes in Indonesia's trading activities would be zero if the national model were 100% consistent with the GTAP model. For various reasons, simulations with the Indonesian model do not show zero change.

First, the national model and the global model are, because of their different aggregations, not 100% compatible. For example, the Indonesian model does not distinguish between Indonesia's individual trading partners. Then in the Indonesian model, the exogenously applied cif price change for a given product has to be an the average of the GTAP price changes for this product from different countries of origin.

Second, in the GTAP model, at least for the APEC trade liberalisation under study here, participating countries only eliminate import barriers, not their export subsidies, whereas the endogenous determinations for Indonesia include change sin both import barriers and export subsidies. That is, to isolate Indonesia in the GTAP model, both her import and exports barriers are adjusted. However, in the simulations with the Indonesian model, in accordance with the APEC trade liberalisation agreement, only import barriers are changed. Export taxes are not changed. The changes in trading activities in the national simulation would then not be expected to be zero.

In the case of previous Australian studies of trade liberalisation (Huff *et al.*, 1995 and Adams *et al.*, 1997) and in a study of China (Adams *et al.*, 1998), the import tariff changes that are applied as exogenous shocks in the national models appear (the descriptions of the process used in these papers are not entirely clear or complete) to be the changes determined from the GTAP simulation. Thus if the GTAP results show Indonesia's tariffs for a product increasing by various amounts for the different sources of this product, a weighted average increase can be calculated using the same weights as used to calculate average price change for the product.

Tariff rate changes calculated in this way are those needed to isolate Indonesia from the effects of trade liberalisation elsewhere. They are not necessarily the changes in tariffs that Indonesia must make as a participant in trade liberalisation. For example, suppose that Indonesia had no tariffs, though other countries did. When other countries liberalise, world prices generally rise. Indonesia would have to use import subsidies to isolate itself from the effects of liberalisation. To impose exogenous increases in subsidies in the Indonesian national would not correspond to trade liberalisation.

In the present study, in addition to calculating the tariff shocks as described above, two alternative specifications of the Indonesian tariff shocks are considered. First, Indonesia's import tariffs as existing prior to trade liberalisation are calculated from the Post-NAFTA GTAP database. The tariff variables in the Indonesian Forecasting Model are then shocked sufficiently to reduce these calculated tariffs to zero. Second, since in reality Indonesia would be eliminating its tariffs along with the other countries, the levels of trade barriers are calculated from the GTAP database after updating for APEC trade liberalisation by the other participating countries. Trade liberalisation changes world prices and so too the effective levels of protection Indonesia has in place as a country isolated from these price changes. It is the latter level of effective trade barriers that have to be eliminated if Indonesia is to remove its import barriers. Simulations and implications from these different approaches are reported in section 7.6.

4.3.3 Summary of Model Closures

The linkage between the global and national model approach is effected through modifying the (standard) closures of both the multi-country and the single-country models (Adams *et al.*, 1997). The following variables are required to be set as exogenous variables in GTAP in the isolation closure (they are endogenous in the standard GTAP closure).

- all bilateral trade flows into and out of the national economy;
- the flow from the national savings into the global savings; and
- the flow from the global savings of real capital funds into the national economy.

The following variables (exogenous in the GTAP standard closure) are endogenous:

- all tax rates on bilateral trade flows into and out of national economy;
- the slack variable in the global model equation for determination of global investment; and
- the slack variable in the global model equation for regional income determination.

This approach to linkage removes all feedback from the particular national economy to other regions. The approach is only appropriate in the case of a small country. In effect it is assumed that any changes in the country's exports or import demand will not have any significant effect on the global equilibrium. If this is accepted, it is then appropriate to calculate that global equilibrium treating the existing (or close to existing) import and export quantities for the country as exogenous in the global model. In turn, in the national model, representing a small economy, the global prices can be taken as given to determine what changes will occur in the national economy. Supply and demand will change, and so too export and imports. The latter would no longer be fully consistent with the quantities, which were initially assumed exogenous in the global model; but any difference would be unimportant since, as a small country, changes in its exports or imports would not affect the global equilibrium.

4.3.4 Checking the Small Country Assumption

It is important to establish that the particular country studied is small, for if it is not, the calculation of world prices after trade liberalisation would have to allow for the country's economic response to the changing economic environment by including tariff rate reductions by that country in the global modeling. The approach used by Adams *et al.* (1997) to indicate that Australia is a small country was to show that there is no significant difference in the terms of trade and GDP results generated for Australia by the GTAP model when (1) Australia was treated as a small and isolated country and when (2) Australia was included in the GTAP model identically to the other regions.

The approach of Adams *et al.* (1997) to checking the validity of the small country assumption involves a comparison for the effect of exogenizing the country on equilibrium. As well, it is useful to examine the particular country results to ensure that the changes in imports and exports are not excessive in terms of world trade in the various commodities. In addition to the empirical evidence acquired from running the models, one can also refer to the GTAP data base. The country should hold only a small share of total world trade's position in most commodities (ideally all) and not be in a position to dominate any trade. For most countries, this will be a reasonable assumption, unless they are studied as a regional aggregate. Some countries do have significant positions in markets and possess some market power, e.g. the United States of America, Japan and Europe Union (Trewin, 1997) or market power in a few products. In the case of a large country, the national model results (that is, changes in supply and demand) in response to imposed exogenous price shock from the global model would be substantial enough to affect the global model equilibrium. The feed-back effects would need to be taken into account, perhaps by sequentially running the global and national models, readjusting the exogenous settings until the results converge.

4.3.5 Other Problems Encountered in Linking Models

The question as to whether the small country assumption is appropriate is not the only problem in linking the global and national models. A potential problem arises because of the likely differences between the two models in the definitions of traded commodities. There will usually be differences, with the global model frequently working with more aggregated commodities than used in the more detailed national model. Indeed, part of the justification for using the national model in studying trade is to provide more detail than available in the global model. While the detail could be in sectors or industries rather than commodities, computable general equilibrium models are typically developed with single-commodity industries, so that less detailed global models do have differently defined commodities from those in the national models. To link the two models, commodity equivalencies have to be defined for the models.

Defining equivalencies is not necessarily difficult. For example, each disaggregated commodity of the national model may be uniquely associated with a more aggregated (or at least not less aggregated) commodity in the global model. This would generally be the case since the databases in global models are built up from the same information used in national models. The real difficulty is that the price changes that are generated in the global model for imposing as exogenous changes in the national model, will be generated for an aggregated commodity but have to be applied to disaggregated commodities. While it is easy to apply the calculated price change for the aggregate commodity to all its disaggregated components in the national model, this may be an unwarranted assumption. In reality, the price changes that occur following trade liberalisation (or other exogenous shocks) for narrowly defined goods are potentially different. In relation to estate crops, for example, there is no reason to expect that the price of rubber will change in the same direction and by the same amount as the price of sugar following trade liberalisation. Yet if the global model provides an estimate only for an aggregate commodity called "non-grain crops", there would be only one calculated price change to apply to the various non-grain crops, including estate crops. Once the national model is subjected to unreliable estimates of the effect of trade liberalisation on the global price changes for disaggregated commodities, the results from the national model necessarily have also to be regarded as suspect as estimates of the detailed effects of trade liberalisation.

This difficulty is not a problem of linkage per se. It would apply even if one were to build into a single global model a more detailed component for the particular country of interest. Only if the global model fully recognises commodities at the most disaggregated level of interest would the problem be avoided. However, the disaggregation becomes more difficult in the global model because multiple data sources must be used and some compromise must be involved to obtain the sectoral detail for many different countries (Hertel, 1999). Adams *et al.* (1997) does not address the issue; and neither have other general equilibrium trade modelers whose research objectives evidently have been satisfied by the level of detail available in the global model although Gehlhar and Frandsen (1998) point out that different outcomes (for example welfare) will occur with different aggregations. If greater detail is needed, one either lives with the caveats or turns to partial equilibrium models with their limitations.

CHAPTER 5

CONSTRUCTION OF THE DATABASE FOR THE INDONESIAN GENERAL EQUILIBRIUM MODEL

National Input-Output Tables (I-O Table) usually provide the main source of data for CGE models. The 1990 Indonesian I-O Table is the basic source of information for the database, but this is complemented by information from an Indonesian Social Accounting Matrix (SAM) and some other sources. There are several steps in producing a database that meets the requirements of a general equilibrium model. The construction of the database begins with modeling decisions concerning the aggregation of data, such as the number of commodities, industries, households and sources of commodities to include explicitly in the model; and numbers and types of labor and factors of production to include. In order to match the aggregation used in the model with the available I-O Table and SAM, mapping tables are required. Once these are defined, it is relatively easy to compute the value aggregates for the existing economy. These define many of the parameters of the equations of the model. Other data required for the general equilibrium model include various elasticity parameters and other indexing parameters. This chapter explains how the Indonesian database for 1990 is constructed, how to update it to later time periods (viz. 1997), and how to check the balance of the database.

5.1 The 1990 Indonesian Input-Output Accounts

I-O Tables for Indonesia are produced periodically by the Central Bureau of Statistics. The present research uses the 1990 Input-Output Tables, the latest published tables. The same I-O Tables served as the database of the Lewis model previously used by Ratnawaty (1996) to analyse import tariff and export tax policy and agricultural sector and income distribution in Indonesia. Warr (1998) too built a database that relied on this I-O Table, updated to 1993, along with a Social Accounting Matrix for 1993, for "WAYANG", his comparative static general equilibrium model of the Indonesian economy.

The previous Indonesian general equilibrium models have been comparative static models except for the Dee model's (1991). The Indonesian Forecasting Model developed for the present study is designed to have the capability to solve a comparative static model like ORANI (Dixon *et al.*, 1982), a forecasting model like the ORANI-F (Horridge, *et al.*, 1993) and a risk inclusion model like Walmsley's model (Walmsley, 1998). The forecasting model provides the capability to update the database in the medium run. In particular, by running the model, it is possible to capture post-1990 developments of the Indonesian macroeconomy, and to create an updated database. The 1990 Input-Output Table is updated to 1997 in this way.

The Input-Output Tables account for all of the Indonesian market economy activities, in particular the transactions of goods and services among economic sectors. The tables show the linkages among those sectors. The Input-Output Tables have two sub-groups of tables: the basic tables and the analytical tables (Central Bureau of Statistics, 1994). The basic tables consist of transaction tables at purchaser prices, transaction tables at producer prices and domestic transaction tables at producer prices. The analytical tables are derived from the basic tables and include input coefficient tables, the inverse matrix at producer's prices, and the domestic inverse matrix at producer prices. The present research uses the basic tables of transaction tables on producer prices. Accordingly, the trade margins and transport costs are not included in the transaction values and are defined in the separate equation. The Central Bureau of Statistics publishes tables for three different levels of aggregation of commodities and industries, namely 161, 66 and 19 sectors. The first of these, from which the others can be derived, is used as the basic information source here.

5.1.1 The Input-Output Structure

The structural detail of the Input-Output database for the Indonesian model follows that for ORANI-F (Horridge, *et al.*, 1993). Figure 5.1 shows the database consists of the absorption matrix, the joint product matrix and the import duty matrix. The columns of the absorption matrix represent six groups of agents in the economy: the domestic producers and investors in each of i industries; one single representative household; the aggregate of foreign purchaser export; the government sector which corresponds to the "other" demand category and, finally, changes in inventories. As mentioned in section 4.1.1, all quantities in the matrix flow are valued in billions Rupiah.

Figure 5.1. Input-Output Data Base in the Indonesian Forecasting Model

		Absorption Matrix					
		1	2	3	4	5	6
		Producers	Investors	Household	Export	Other	Change in Inventories
	Size	← I →	← I →	← 1 →	← 1 →	← 1 →	← 1 →
Basic Flows	↑ CxS ↓	V1BAS	V2BAS	V3BAS	V4BAS	V5BAS	V6BAS
Margins	↑ CxSxM ↓	V1MAR	V2MAR	V3MAR	V4MAR	V5MAR	n/a
Taxes	↑ CxS ↓	V1TAX	V2TAX	V3TAX	V4TAX	V5TAX	n/a
Labor	↑ O ↓	V1LAB					
Capital	↑ 1 ↓	V1CAP					
Land	↑ 1 ↓	V1LND					
Other Costs	↑ 1 ↓	V1OCT					

C=Number of commodities
I =Number of industries

S=Source of commodities
O=Number of occupation type
M=Number of commodities as margins

	Joint Production Matrix
Size	← I →
↑ C ↓	MAKE

	Import Duty
Size	← I →
↑ C ↓	V0TAR

Source: Horridge, *et al.* (1993)

The rows show the sources of purchases made by the agents of each column. The rows include basic flows, margins, taxes, labor, capital, land and other costs. The basic flows in the first and second column shows the flow of domestic and import commodities which are used by industries as an input or capital formation. For example, VIBAS (the first column and first row of the absorption matrix) is the value of the basic demand quantity of commodity c, from source s, by industry i for current production. The basic flow in the third column shows the commodities, which are consumed by household. The basic flows in the fourth, fifth and sixth column indicate the value of commodities to export, consumed by the government and adding or reducing the inventory, respectively.

The margins flows of the second row are the margins cost of commodities which are used by producers, investors, household, the government and the margins cost of exporting commodities. The tax matrices in the third row show the taxes on commodities, as consumed by producers, investors, household and the government, and finally export taxes. The rows of labor, capital, land and other costs record the primary factor usage for each industry in the first column, indicating the return to these input factors as used by each sector.

The final two matrices are the joint production matrix and the import duty matrix. The joint production matrix shows the commodity composition of the output of each industry. This study assumes that one industry can produce one commodity. The import duty matrix records the import duty paid on each commodity imported by each industry.

5.1.2 Sector aggregation

The present research deals explicitly with 35 industries and 35 commodities aggregated from the 161 sectors of the 1990 Input-Output Table. Because the study is primarily interested in the agricultural sector, most of the industries and commodities are agricultural production and agricultural processing sectors. The concordance of the

35 sectors in the model and the 161 sectors of the Indonesian Input-Output Table 1990 is in Table 5.1.

5.2 The Social Accounting Matrix

The Central Bureau of Statistics also periodically publishes a Social Accounting Matrix (SAM) for Indonesia. A SAM provides information on the Indonesian macro socio-economic performance, including not only I-O Tables information but also information on the distribution of income across the factors of production, household income, and the pattern of household expenditure (Central Bureau of Statistics, 1996). Compared to a standard I-O Table, the SAM therefore not only identifies the structure of production but also has the advantage of describing distribution, employment, and capital accumulation (Jemio and Jansen, 1993). In the SAM, the columns identify the revenue from each production factor, institution, production sector, other sectors while the rows identify the expenditure side of these sector classifications. A simplification of SAM can be seen in Table 5.2.

The Indonesian Social Accounting Matrix is published at two levels of sectoral aggregation, namely 37x37 and 106x106 versions. The latest is for 1993. While it might conceivably serve as the primary source of data for the study, unfortunately the production sector aggregations in the SAM are different from the aggregations in the published I-O Tables and from the detailed agricultural sector structure required for the study. Accordingly, the SAM is used only to supplement data from the 1990 I-O Table. In order to combine the data from the Social Accounting Matrix with the I-O Table, a mapping between the sectors in the two is needed. The mapping is provided in Table 5.3.

Table 5.1. Sector Aggregation from Indonesian 161 Sector Input-Output Table

No	Sector Aggregation in 1990 I-O Table	No	Sector Aggregation in this study
1.	Paddy	1.	Paddy
2.	Maize	2.	Maize
10.	Cereals & Other Food Crops	3.	CerOthGrain
3.	Cassava	4.	RootCrop
4.	Other root crops	4.	RootCrop
5.	Groundnut	5.	Beans
6.	Soybeans	5.	Beans
7.	Other beans	5.	Beans
8.	Vegetables	6.	VegFruit
9.	Fruit	6.	VegFruit
11.	Rubber	7.	Rubber
12.	Sugarcane	8.	Sugarcane
13.	Coconut	9.	Coconut
14.	Oil palm	10.	OilPalm
15.	Fibre crops	13.	OthEstate
16.	Tobacco	13.	OthEstate
17.	Coffee	11.	Coffee
18.	Tea	12.	Tea
19.	Clove	13.	OthEstate
20.	Other estate crops	13.	OthEstate
21.	Other agriculture	14.	OthAgr
22.	Livestock & livestock products	15.	Livestock
24.	Poultry & its products	15.	Livestock
25.	Other livestock raising	15.	Livestock
28.	Hunting products	15.	Livestock
26.	Wood	16.	Forestry
27.	Other forest products	16.	Forestry
29.	Sea fish & other sea products	17.	Fishery
30.	Inland water fish & its product	17.	Fishery
31.	Drying & salting of fish	17.	Fishery
32.	Coal	18.	CoalOthMin
33.	Crude oil	19.	OilGas
34.	Natural gas & geothermal	19.	OilGas
95.	Liquefied of natural gas	19.	OilGas
35.	Tin ore	18.	CoalOthMin
36.	Nickel ore	18.	CoalOthMin
37.	Bauxite ore	18.	CoalOthMin
38.	Copper ore	18.	CoalOthMin
39.	Gold & silver ore	18.	CoalOthMin
40.	Other mining	18.	CoalOthMin
41.	Chemical & fertilising mineral	18.	CoalOthMin
42.	Crude salt	18.	CoalOthMin
43.	Quarrying, all kinds	18.	CoalOthMin
50.	Rice milling & husking	24.	Rice

Table 5.1 (Continued)

No	Sector Aggregation in 1990 I-O Table	No	Sector Aggregation in this study
44.	Meat & entrails of slaughtered	20.	LivProc
45.	Processed & preserved meat	20.	LivProc
23.	Fresh milk	20.	LivProc
46.	Dairy products	20.	LivProc
47.	Canning & preserving of fruits & beverages	21.	FoodProc
48.	Processed & preserved fish	22.	FishProc
49.	Copra, Animal oil & vegetable oil	23.	EstateProc
51	Wheat Flour	21.	FoodProc
52.	Flour except wheat flour, milled cereals & peeled root	21.	Foodproc
53.	Bakery product & the like	21.	FoodProc
54.	Noodle, macaroni & the like	21.	FoodProc
55.	*Sugar*	*23.*	*EstateProc*
56.	*Peeled grain, chocolate & sugar confectionery*	*23.*	*EstateProc*
57.	Milled & peeled coffee	23.	EstateProc
58.	Processed tea	23.	EstateProc
59.	Soybean products	21.	FoodProc
60.	Other foods	25.	OthFoodProc
61.	Animal feeds	25.	OthFoodProc
62.	Alcoholic beverages	26.	BevTob
63.	Non-alcoholic beverages	26.	BevTob
64.	Tobacco products	26.	BevTob
65.	Cigarettes	26.	BevTob
66.	Yarn & cleaning kapok	27.	TxtLthr
67.	Textile	27.	TxtLthr
68.	Made up textile goods except wearing apparel	27.	TxtLthr
69.	Knitting mills	27.	TxtLthr
71.	Manufacture of carpet, rope, twine & other textile	27.	TxtLthr
70.	Manufacture of wearing apparel	27.	TxtLthr
72.	Leather tanneries & leather finishing	27.	TxtLthr
73.	Manufacture of footwear & leather products	27.	TxtLthr
74.	Sawmill & preserved wood	28.	WoodPrd
75.	Manufacture of plywood & the like	28.	WoodProd
76.	Wooden building components	28.	WoodProd
77.	Manufacture of furniture & fixtures mainly made of wood, bamboo & rattan	28.	WoodProd
78.	Manufacture of other products mainly made of wood,bamboo & rattan	28.	WoodProd
79.	Manufacture of non-plastic plait	28.	WoodProd
80.	Manufacture of pulp	33.	OthManufac
81.	Paper & cardboard	33.	OthManufac
82.	Paper & cardboard products	33.	OthManufac
83.	Printing & publishing	33.	OthManufac
94.	Petroleum refineries products	18.	CoalOthMin
84.	Basic chemical except fertiliser	29.	Chemical
85.	Fertiliser	30.	Fertiliser

Table 5.1 (Continued)

No	Sector Aggregation in 1990 I-O Table	No	Sector Aggregation in this study
86.	Pesticides	31.	Pesticide
87.	Synthetic resins, plastic, & fibre	29.	Chemical
88.	Paints, varnishes & lacquers	29.	Chemical
89.	Drugs & medicine	29.	Chemical
90.	Native medicine	29.	Chemical
91.	Soap & cleaning preparation	29.	Chemical
92.	Cosmetics	29.	Chemical
93.	Other chemical products	29.	Chemical
96.	Smoked & crumb rubber	29.	Chemical
97.	Tire	29.	Chemical
98.	Other rubber products	29.	Chemical
99.	Plastic products	29.	Chemical
100	Ceramic & earthenware	32.	MinMet
101	Glass products	32.	MinMet
102	Clay & ceramic structural products	32.	MinMet
103.	Cement	32.	MinMet
104.	Other non-ferrous products	32.	MinMet
105.	Basic iron & steel	32.	MinMet
106.	Basic iron & steel products	32.	MinMet
107.	Non-ferrous basic metal	32.	MinMet
108.	Non-ferrous basic metals products	32.	MinMet
109.	Kitchen wares, hand tools & agricultural tools	32.	MinMet
110.	Furniture & fixture primarily made of metals	32.	MinMet
111.	Structural metal products	32.	MinMet
112.	Other metal products	32.	MinMet
113.	Prime movers engine	33.	OthManufac
114.	Machinery & apparatus	33.	OthManufac
121.	Ship & its repair	33.	OthMnaufac
122.	Train & its repair	33.	OthManufac
123.	Motor vehicle except motor cycle	33.	OthManufac
124.	Motor cycle	33.	OthManufac
125.	Other transport equipment	33.	OthManufac
126.	Aircraft & repair	33.	OthManufac
115.	Electric generator & electrical motor	33.	OthManufac
116.	Electrical machinery & apparatus	33.	OthManufac
117.	Communication equipment & apparatus	33.	OthManufac
118.	Household electronics appliances	33.	OthMnaufac
119.	Other electrical appliances	33.	OthManufac
120.	Battery	33.	OthManufac
127.	Measuring, Photographic & optical equipment	33.	OthManufac
128.	Jewellery	33.	OthManufac
129.	Musical industries	33.	OthManufac
130.	Sporting & athletic goods	33.	OthManufac
131.	Other manufacturing industries	33.	OthManufac
132.	Electricity & gas	35.	Service
133.	Water supply	35.	Service

Table 5.1 (Continued)

No	Sector Aggregation in 1990 I-O Table	No	Sector Aggregation in this study
134.	Residential & non residential building	35.	Service
135.	Construction on agriculture	35.	Service
136.	Public work on road, bridge & harbour	35.	Service
137.	Construction & installation on electricity, gas, water supply and communication	35.	Service
138.	Other construction	35.	Service
139.	Trade	34.	TradTrans
140.	Restaurant	34.	TradTrans
141.	Hotel	34.	TradTrans
142.	Railway transport	34.	TradTrans
143.	Road transport	34.	TradTrans
144.	Sea transport	34.	TradTrans
145.	River & lake transport	34.	TradTrans
146.	Air transport	34.	TradTrans
147.	Services allied to transport	35.	Service
148.	Communication services	35.	Service
149.	Banking & other financial intermediaries	35.	Service
150.	Insurance	35.	Service
152.	Business services	35.	Service
154.	Educational services	35.	Service
155.	Health services	35.	Service
156.	Other community services	35.	Service
157.	Motion picture & its distribution	35.	Service
158.	Amusement, recreational & cultural services	35.	Service
159.	Repair shops N.E.C	35.	Service
160.	Personal & household services	35.	Service
153.	General government	35.	Service
154.	Educational services	35.	Service
155.	Health services	35.	Service
156.	Other community services	35.	Service
161.	Other goods & services N.E.C	35.	Service
151.	Real estate & dormitory	35.	Service

Table 5.2 A Simplified Social Accounting Matrix

			EXPENDITURE					
			1	2	3	4		5
			Factors	Institutions Including Household	Production Activities	Other Account		Total
						Combined Capital	Rest of the World	
RECEIPTS	1	Factor			Factorial Income Distribution			Income of Factors
	2	Institution Including Household	Income Distribution to Household and Other Institutions	Transfers, Taxes, and Subsidies			Receipts of Institutions from Rest of World	Income of Institutions
	3	Production Activities		Institutional Demand for Goods and Services	Inter-industry demand	Capital Formation	Exports	Gross Demand
	4	Combined Capital		Institutional Savings				Aggregate Savings
		Rest of World		Institutional Imports of Goods and Services	Production Activity Imports of Goods	Import of Investment Goods		Total Payment to Outside
	5	Total	Outlay of Factors	Expenditures of Institutions	Gross Output	Aggregate Investment	Total Receipt from Outside	

Source: Thorbecke (1985)

Table 5.3 Sectoral Mapping of Input-Output Table and Social Accounting Matrix

Sector Aggregation	35 Input-Output Sectors	22 Social Accounting Matrix Production Sectors
Paddy	1	1
Maize	2	1
CerOthGrain	3	1
RootCrop	4	1
Beans	5	1
VegFruit	6	1
Rubber	7	2
Sugarcane	8	2
Coconut	9	2
OilPalm	10	2
Coffee	11	2
Tea	12	2
OthEstate	13	2
OthAgr	14	2
Livestock	15	3
Forestry	16	4
Fishery	17	5
CoalOthMin	18	6,7,12,11
OilGas	19	6,7
LivProc	20	3,8
FoodProc	21	8
FishProc	22	5
EstateProc	23	8
Rice	24	8
OthFoodProc	25	8
BevTob	26	8
TxtLthr	27	9
WoodPrd	28	10
Chemical	29	12
Fertiliser	30	12
Pesticide	31	12
MinMet	32	11,12
OthManufac	33	11
TradTrans	34	14,15,16,17,18
Service	35	13,10,14,18,19,20,21,22

Ideally, the Social Accounting Matrix and Input-Output Table should rate to the same year. However, the published SAM closest in time to 1990 is for 1993. It is used to specify the occupational composition of labour, labour being divided into farmer, operator, administrator and professional. This SAM is also used to specify the share of returns between capital and land. These parameters are discussed later. The errors introduced in using SAM and I-O from different years is likely to be relatively unimportant since the shares are not expected to have changed much over the 3 years.

5.3 Construction of Tax Matrices

The data needed for a CGE model includes the tax revenue, by commodities, sources and users. Unfortunately, there is no publication detailing tax data for Indonesia. Some data is published by the Central Bureau of Statistics and by Bank Indonesia in its Report. However, the tax data relate only to the overall amount in each year.

The tax system in Indonesia includes income tax, value added tax on the sale of luxury goods, import duties, excise duties, export tax, other tax, and taxes on land and building (Bank Indonesia, 1998). The tax composition of the government revenue can be seen in Table 5.4.

Table 5.4 Domestic Government Revenue 1990/1991 and 1996/1997 (billion Rupiah)

Type of domestic revenue	1990/1991	% Share	1996/1997	% Share
Domestic revenues	**39 546**	**100**	**78 202**	**100**
Oil and gas receipt	**17 712**	**44.79**	**14 120**	**18.06**
Oil	14 578	36.86	10 315	13.19
Gas	3 134	7.92	3 805	4.87
Non-oil receipt	**21 834**	**55.21**	**64 082**	**81.94**
Income tax	6 755	14.08	23 708	30.32
Value-added tax on goods and services and sales tax on luxury goods	7 643	19.33	21 788	27.86
Import duties	2 486	6.27	3 450	4.41
Excise duties	1 917	4.85	4 033	5.16
Export duties	44	0.11	160	0.20
Land and building tax	811	2.05	160	0.20
Others	243	0.61	2 277	2.91
Non-tax and oil receipt	2 115	5.35	8 096	10.35

Source: Bank Indonesia (1994) and (1998)

Taxes are an increasingly important source of revenue for the Indonesian government. As oil and gas prices have fallen, oil and gas revenue as a proportion of government revenue has decreased from 44.76 per cent in 1990/1991 to 18.06 per cent in 1996/1997. Of the non-oil and gas revenue, income tax and value-added tax on good and services constitute a major portion, with their shares increasing significantly from

14.08 and 19.33 per cent in 1990/1991 to 30.32 and 27.86 per cent respectively in 1996/1997.

Commodity-based taxation values are needed for the database. These have to be derived from the industry-based taxation figures in the Input-Output Tables. The allocation of the indirect taxes being levied on industries to the commodities is here based on the information on commodity composition of industry output in the make matrix. It is assumed that one industry only produces one commodity, therefore the industry-based taxes is the same as the commodity based taxes.

The indirect tax payments and commodity demands by users are calculated from the estimation of the tax matrices and the basic values of purchases by each user. The assumption is the rates of the indirect taxes applied on commodities purchased by all the users are the same. Therefore, a domestic indirect tax rate on commodity c can be calculated as:

$$DomTaxR_c = \frac{DomTax_c}{Sales_c} \qquad c \in COM \qquad (5.1)$$

where:

$DomTax_c$ = the collection of indirect tax by commodity

$Sales_c$ = the total purchase of commodity c by all of the users.

Total purchase is determined by summing the purchase of commodities across all users in the absorption matrix.

The domestic indirect tax collection from each user by commodity can be estimated from:

$$TaxRev_{cis}^{k} = VBAS_{cis}^{k} * DomTaxR_c \qquad c \in COM, i \in IND, k \in USER, s = DOM \qquad (5.2)$$

where:

$VBAS^k_{cis}$ = the basic values of domestic commodity c (valued at producer prices) by user k as shown in the I-O table.

For imported commodities, the general import sales tax on commodity c can be calculated as:

$$Im\,pTaxR_c = \frac{Im\,pTax_c}{Vimp_c} \tag{5.3}$$

where:

$Im\,pTax_c$ = the Import sales tax by commodity

$Vimp_c$ = the total basic-value import of good c by all of the users.

The import tax revenue from each user by commodity can be estimated from:

$$Im\,pTax\,Rev^k_{cis} = VBAS^k_{cis} * Im\,pTaxR_c \qquad c \in COM, i \in IND, k \in USER, s = IMP \tag{5.4}$$

5.4 Disaggregation of Labour

The Indonesian Model allows for and requires information on the labour expenditure by each industry on each of four occupations, namely farmers, operators, administrators and professionals. The wage cost account in the Indonesian Input-Output Tables is based on industries but contains no occupational break-up. Data is available on the occupational composition of labour in the Social Accounting Matrix. The 1993 wage costs of each occupation in each of the 35 sectors for the Indonesian Model is obtained from the SAM by applying the mapping between sectors of the Social Accounting Matrix and the 35-sector I-O Table (Table 5.3). The implied occupational shares are then used to allocate the 1990 wage payments for each industry. The resulting occupational wages are reported in Table 5.5.

Table 5.5 1990 Wage Payments in each Industry, by Occupations (billion Rupiah)

No	Sector Aggregation	Farmer	Operator	administration	Professional
1	Paddy	2246.67	3.29	0.87	0.34
2	Maize	213.44	0.31	0.08	0.03
3	CerOthGrain	7.55	0.01	0.00	0.00
4	RootCrop	243.39	0.36	0.09	0.04
5	Beans	243.72	0.36	0.09	0.04
6	VegFruit	1039.63	1.52	0.40	0.16
7	Rubber	364.37	26.55	3.40	0.46
8	Sugarcane	282.76	20.60	2.64	0.36
9	Coconut	181.60	13.23	1.70	0.23
10	OilPalm	171.23	12.47	1.60	0.22
11	Coffee	111.65	8.13	1.04	0.14
12	Tea	63.74	4.64	0.60	0.08
13	OthEstate	298.08	21.72	2.78	0.38
14	OthAgr	178.94	13.04	1.67	0.23
15	Livestock	685.42	3.00	0.86	0.23
16	Forestry	382.38	60.63	51.96	9.03
17	Fishery	498.19	3.06	1.84	1.83
18	CoalOthMin	0.00	1741.22	470.98	246.39
19	OilGas	0.00	467.18	126.37	66.11
20	LivProc	0.00	344.47	21.45	8.26
21	FoodProc	0.00	481.97	30.01	11.56
22	FishProc	166.62	1.02	0.61	0.61
23	EstateProc	0.00	752.20	46.84	18.04
24	Rice	0.00	513.70	31.99	12.32
25	OthFoodProc	0.00	130.01	8.10	3.12
26	BevTob	0.00	372.09	23.17	8.92
27	TxtLthr	0.00	1328.56	68.39	38.58
28	WoodPrd	0.00	993.11	93.84	35.29
29	Chemical	0.00	721.40	387.25	74.92
30	Fertiliser	0.00	135.99	73.00	14.12
31	Pesticide	0.00	17.60	9.45	1.83
32	MinMet	0.00	638.88	238.99	54.30
33	OthManufac	0.00	1674.74	408.28	117.03
34	TradTrans	0.00	2744.71	5748.98	211.68
35	Service	0.00	11080.16	13408.09	3062.20

5.5 Returns to Land and Capital

The Indonesian Model requires information on the returns to land and capital individually. The I-O Table only provides the combined returns to these two factors by industry, which are derived from the sum of the gross operating surplus (sector 202 in I-O Table) and the depreciation allowances (sector 203 in I-O Table). Several methods have been done to split the total of gross operating surplus and depreciation to be returns to land and capital. In the "INDOGEM" model (Trewin *et al*, 1993), it is assumed that 80 percent of these total is allocated to return to land and 20 percent to return to capital for the agricultural sector. For forestry and mining, the composition between return to land and return to capital become 85 and 15; and 75 and 25, respectively. For the Philippines model, Buetre (1996) uses Clarete and Cruz's (1992) estimation of the share of land in total value added in agricultural industries. In the INDORANI database (Impact Project) it is assumed that for the land based industries, the share of return to land is one third of the total gross operating surplus and depreciation. Another assumption of splitting the value of return to land and capital is to use the proportion, which is derived from the SAM data. The method is used by Warr (1998) to calculate the share in the "WAYANG" database. However, it is not clear in his paper how to calculate the proportion of these returns.

From previous research, it is clear that for the agricultural based commodities, the portion of return to land is bigger than those to capital. However, the precisely share of these portion is still unclear. Information on the share of returns to land and capital are available from the Indonesian Social Accounting Matrix. In this matrix, the factors of production other than labour consist of land, houses, other capital in rural areas, and other capital in urban areas, private capital, public capital and foreign capital. The land share can be calculated as the cost of land over the total factor cost of production other than the labour cost. In other words, the share of capital is one minus the share of land. The land and capital shares thus calculated relate to the industry aggregation of the Indonesian Social Accounting Matrix. The industry's mapping between the SAM and the I-O Table is applied to find the 1993 land and capital share in each of the 35 industries in the Input-Output Table. If one industry in SAM consists of several industries in I-O Table, it is assumed that the latter industries have the same share as the SAM industry.

The 1993 land and capital shares derived from the Social Accounting Matrix are assumed to apply in 1990 and are used to allocate the 1990 combined returns to the two factors. The calculated capital and land payments for 1990 are reported in Table 5.6.

Table 5.6 1990 Returns to Land and Capital (billion Rupiah)

No	Sector Aggregation	Land	Capital	Total
1	Paddy	10023.48	42.89	10066.37
2	Maize	1131.46	4.84	1136.30
3	CerOthGrain	57.49	0.25	57.74
4	RootCrop	2250.41	9.63	2260.04
5	Beans	1887.72	8.08	1895.80
6	VegFruit	6091.07	26.06	6117.13
7	Rubber	233.16	31.79	264.95
8	Sugarcane	324.66	44.26	368.92
9	Coconut	779.58	106.28	885.86
10	OilPalm	514.48	70.14	584.62
11	Coffee	309.54	42.20	351.74
12	Tea	81.78	11.15	92.93
13	OthEstate	858.86	117.09	975.95
14	OthAgr	372.01	50.72	422.73
15	Livestock	2728.62	95.04	2823.66
16	Forestry	1285.86	1136.20	2422.06
17	Fishery	1933.28	296.30	2229.58
18	CoalOthMin	0.00	5506.81	5506.81
19	OilGas	0.00	23969.36	23969.36
20	LivProc	0.00	621.32	621.32
21	FoodProc	0.00	892.88	892.88
22	FishProc	786.64	120.56	907.20
23	EstateProc	0.00	2010.15	2010.15
24	Rice	0.00	860.86	860.86
25	OthFoodProc	0.00	482.59	482.59
26	BevTob	0.00	1402.14	1402.14
27	TxtLthr	0.00	3003.62	3003.62
28	WoodPrd	0.00	2796.95	2796.95
29	Chemical	0.00	1580.62	1580.62
30	Fertiliser	0.00	1378.62	1378.62
31	Pesticide	0.00	146.60	146.60
32	MinMet	0.00	2795.51	2795.51
33	OthManufac	0.00	3745.85	3745.85
34	TradTrans	0.00	30736.37	30736.37
35	Service	0.00	25664.21	25664.21

5.6 Investment in Each Industry

The allocation of investment by industry is used in the Indonesian Forecasting Model, because the model predicts the long run impact of trade liberalisation. This investment value is calculated because the value can influence the next period of capital stock, the capital growth and the output of industry. Other general equilibrium model for Indonesian economy which focus on short run closure such as "WAYANG" (Warr,

1998) assumes that the investment in each industry has no effect in the level of capital stock and industry's output even though the total investment of all industry has a macroeconomic implication. In the "WAYANG" database, the investment in each industry is assumed the same as the proportion to the level of economy-wide aggregate investment. However, it is not clear in the construction of the "WAYANG" database how to get the proportion of the investment in each industry.

The Indonesian Forecasting Model is a long run equilibrium model incorporating equilibrium conditions on investment and capital stock. Therefore, investment and capital data are needed in defining the existing equilibrium. Unfortunately, investment data for each industry is not available in the 1990 I-O Table of the Indonesian economy. While sector 303 of the I-O Table contains the data for the value of investment goods of type i, the table does not provide information on the investment made *by* particular industries. The sum of the sector 303 values does, however, represent the total investment by all industries. This sum needs to be allocated across industries.

There are at least two alternatives for calculating industry investment from the total investment. The first alternative, which is used in the INDORANI database (Impact Project, 1998) is to assume that the share of investment by each industry is the same as the share of return to capital earned by each industry. Therefore, the investment share in each industry can be defined as :

$$INVSHR_i = V1CAP_i/V1CAP\_i \qquad (5.5)$$

Where:

$INVSHR_i$ = Investment share in each industry

$V1CAP_i$ = Value of capital return in each industry

$V1CAP\_i$ = Total value of capital return

It is not clear why the investment shares should necessarily parallel the earnings shares, since differences in depreciation rates, capital-investment ratios, risk levels and equilibrium growth rates across industries would impact on the shares.

The second alternative for calculating the investment value for each industry is to define the investment share from other available investment data. Some data is available from Capital Investment Coordinating Board in the Report for the Financial Year 1992/93 (Bank Indonesia, 1993). This data set consists of the approved domestic investment projects and approved foreign investment projects by sector. Domestic investment is defined as investment implemented by an Indonesian enterprise whereas foreign investment is direct investment of foreign capital in building enterprises in Indonesia. A domestic enterprise can be a fully private company, cooperative or state-owned enterprise. Foreign investment can be through a joint venture between foreign and Indonesian partners or a 100 per cent foreign share holding (Investment Indonesian online, http://www.bkpm.go.id/, 20 October 1999). The data is only for investments which are *approved* by the government. Therefore it does not necessarily describe the real value of investment. Table 5.7 indicates that the available data on approved domestic and foreign investment in each industry is limited. The industries for which data is available are not the same as those defined for the Indonesian Model and accordingly this data set is insufficient in itself for determining investment in each industry.

One way to use this data set is to use it to define industry investment shares. This needs a sectoral mapping between the industries in the model (35 industries) and the industries in the data set. When one industry in the investment data set consists of more than one industry of the model's aggregation, the investment share for a modeled industry can be calculated as (by assumption) the share of the returns to capital of each of the industries in the group times the share that group (the industry in the investment data) has of total investment. Table 5.8 shows the resulting industry investment share calculated in this way.

Table 5.7 Approved Domestic and Foreign Direct Investment Project by Sector in 1990

Sector	Domestic (billions of Rupiah)	Foreign (millions of US$)	Foreign (billions of Rupiah)	Total Investment (billions of Rupiah)*)	Investment share (%)
Agriculture, forestry, fishery	9403.9	191.6	353.08	9756.98	12.84
Agriculture	8113.1	169.7	312.72	8425.82	11.09
Forestry	593	2.4	4.42	597.42	0.79
Fishery	697.8	19.5	35.93	733.73	0.97
Mining	147.1	115.5	212.84	359.94	0.47
Manufacturing	40863.5	5646.9	10406.11	51269.61	67.46
Food	1137.7	98.9	182.25	1319.95	1.74
Textile	12612	1094.2	2016.39	14628.39	19.25
Wood	2178.5	217.6	400.99	2579.49	3.39
Paper	5983.2	730.2	1345.61	7328.81	9.64
Chemical and Pharmaceutical	12667.8	1998	3681.91	16349.71	21.51
Non-metal mineral	3795.1	124.8	229.98	4025.08	5.30
Basic metal	982.4	824.5	1519.39	2501.79	3.29
Metal products	1323.3	460.1	847.87	2171.17	2.86
Others	183.5	98.6	181.70	365.20	0.48
Construction	86.5	76.8	141.53	228.03	0.30
Hotel	4661.7	874.4	1611.34	6273.04	8.25
Transportation	2083.3	803	1479.77	3563.07	4.69
Real estate and office	2101.3	901.7	1661.65	3762.95	4.95
Other services	531.1	140.2	258.36	789.46	1.04
Total	59878.4	8750.1	16124.68	76003.08	100.00

*) calculated from : million US$ x 1 842.8/1000 where 1 842.8 is the average period exchange rate of Rupiah in US$ from IMF, 1997

Source: Bank Indonesia, 1993; IMF, 1997

Table 5.8 The Sectoral Mapping and Investment Share for each Industry

No	Industry aggregation in the research	Industry aggregation in the investment data	V1CAP (value of capital rental)	V1cap/v1cap_i (Share of capital rental in each industry)	Share of investment in each industry*)
1	Paddy	Agriculture	42.695	0.04	0.71
2	Maize	Agriculture	4.646	0.00	0.08
3	CerOthGrain	Agriculture	0.05	0.00	0.00
4	RootCrop	Agriculture	9.238	0.01	0.15
5	Beans	Agriculture	7.49	0.01	0.12
6	VegFruit	Agriculture	25.672	0.02	0.43
7	Rubber	Agriculture	31.707	0.03	0.53
8	Sugarcane	Agriculture	44.18	0.04	0.73
9	Coconut	Agriculture	106.2	0.10	1.77
10	OilPalm	Agriculture	70.058	0.06	1.17
11	Coffee	Agriculture	42.12	0.04	0.70
12	Tea	Agriculture	11.069	0.01	0.18
13	OthEstate	Agriculture	116.768	0.11	1.94
14	OthAgr	Agriculture	50.636	0.05	0.84
15	Livestock	Agriculture	103.869	0.09	1.73
16	Forestry	Forestry	1136.74	1.03	0.79
17	Fishery	Fishery	296.165	0.27	0.97
18	CoalOthMin	Mining	5515.612	5.01	0.09
19	OilGas	Mining	23971.758	21.78	0.39
20	LivProc	Food	552.075	0.50	0.15
21	FoodProc	Food	897.678	0.82	0.24
22	FishProc	Food	316.565	0.29	0.08
23	EstateProc	Food	2014.154	1.83	0.54
24	Rice	Food	861.662	0.78	0.23
25	OthFoodProc	Food	484.194	0.44	0.13
26	BevTob	Food	1405.344	1.28	0.37
27	TxtLthr	Textile	3010.023	2.74	19.25
28	WoodPrd	Wood	2801.747	2.55	3.39
29	Chemical	Chemical and Pharmaceutical	1590.216	1.45	21.51
30	Fertiliser	Others, paper	1379.422	1.25	2.64
31	Pesticide	Others, paper	147.404	0.13	0.28
32	MinMet	Non-metal mineral, Basic metal, metal product	2805.913	2.55	11.44
33	OthManufac	Others, paper	3764.249	3.42	7.20
34	TradTrans	Construction, Hotel, Transportation	30742.771	27.94	13.50
35	Service	Other services, real estate and office	25681.811	23.34	5.99
	Total		110041.901	100	100

*) for example, the agriculture group industry is mapping with 15 industries in the research aggregation. The investment share of paddy can be calculated as :

$$INVSHR_{paddy} = \frac{V1CAP_{paddy} \big/ V1CAP\_i}{\sum_{i=agriculture} V1CAP_i} \times INVSHAR_{agriculture}$$

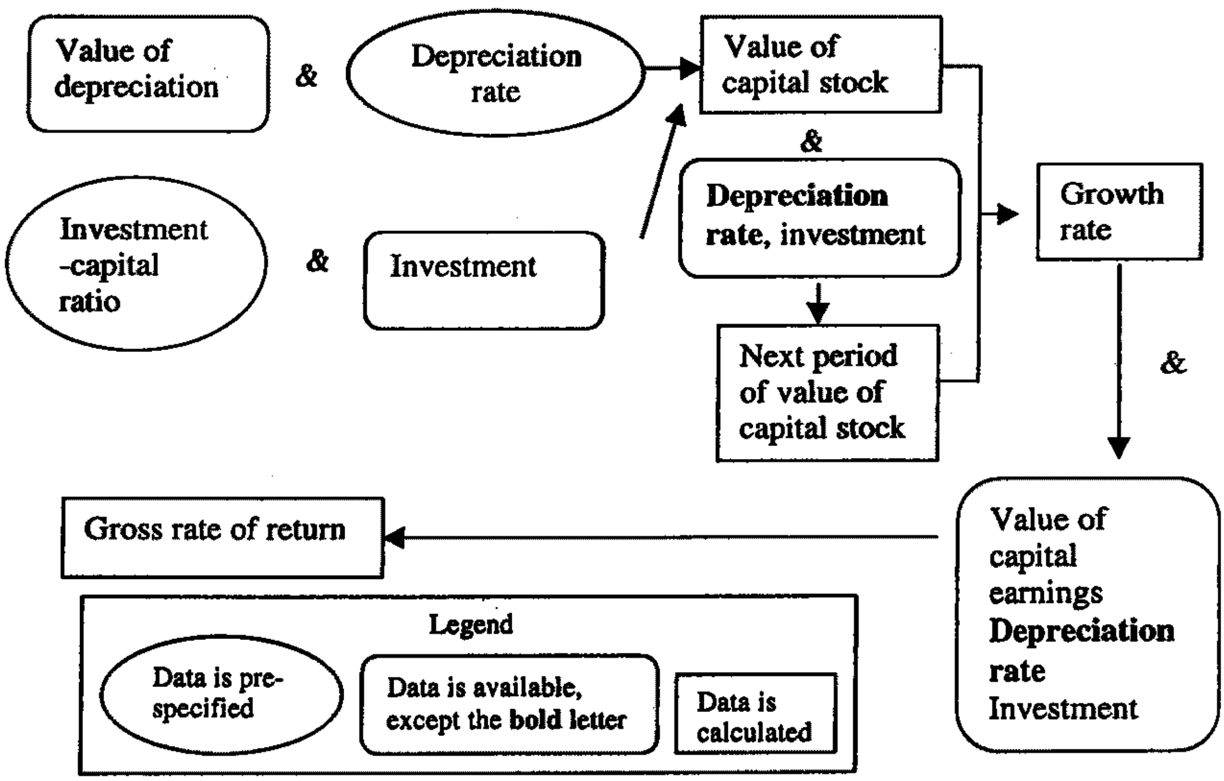
After calculating the investment share of each industry, the actual investment in each industry can be calculated by multiplying the investment share by the total investment in the economy as given in the I-O Tables.

5.7 Capital Stock in Each Industry

Beginning capital stock data for each industry are also needed in defining the equilibrium of the economy. This information is used in the model to predict the growth rate, gross rate of return and the next period's capital stock for each industry. Once again, no beginning capital stock data for each industry is available in the I-O Table.

There are at least three alternatives for generating beginning capital stocks from other data items. These are illustrated in Figure 5.2.

Figure 5.2 Calculating the Value of Capital Stock



The first row of the Figure 5.2 shows that value of capital stock can be calculated from a known depreciation rate and the value of depreciation in each industry. Beginning capital stock would then be calculated as :

$$VOCAP_i = VDEP_i/(1\text{-}DEP_i) \quad (5.6)$$

Where

$VOCAP_i$ = Value of beginning capital stock

$VDEP_i$ = Value of depreciation

$1\text{-}DEP_i$ = Depreciation rate

The second row of the Figure 5.2 shows how to calculate the beginning of capital stock value from a known investment capital ratio and investment data. Beginning capital stock value would then be:

$$VOCAP_i = V2TOT_i/R\_T_i \quad (5.7)$$

Where:

$VOCAP_i$ = Value of beginning capital stock

$V2TOT_i$ = Value of investment in each industry

R_T_i = Investment capital ratio in each industry

An additional alternative for calculating the beginning capital stock value is by calculating an average of the first and the second formula.

As mentioned in section 5.6, there are two alternatives to calculate the investment value of each industry. With three alternative of calculating the beginning of capital stock value in each investment alternative, the calculation of the beginning of capital stock value in each industry has six alternatives. In theory, if the data was available and fully consistent, it would not matter which was used - all would be equivalent. As good data are not always available, a choice has to be made between alternatives and suitable values on subjective and empirical grounds, including how sensible are the results of the simulation. The choice is made and explained later in section 7.5.

5.8 Elasticities and Other Parameters

The general equilibrium model requires that elasticity parameters and various behavioural parameters be specified. The elasticity parameters used in the model are the Armington elasticities, the substitution elasticities for labour, the substitution elasticities for primary factors, the export elasticities and the demand expenditure elasticities. Other parameters are related with investment. Ideally, these parameters of the Indonesian model would be estimated econometrically using time series data. Relatively little effort has been devoted to this substantial task for Indonesia, in part due to the lack of availability of good time series data. No attempt was made in this study to econometrically estimate the parameters. As with previous Indonesian CGE studies, and many CGE studies more generally, the present study relies on parameters first estimated for other countries but judged to be reasonable guides to the parameters for the study country (i.e., Indonesia). Parameters are also drawn from the GTAP database because, as mentioned in Chapter 4, the study links the Indonesian model to results from the GTAP model.

5.8.1 Armington Elasticities

Armington's theory of demand for imports is that commodities are differentiated by place of origin as well as by kind in international trade (Babula, 1987). Therefore, domestically produced and imported goods are imperfect substitutes. The degree of substitution is captured by the so-called Armington elasticity that appears in and must be specified for the commodity demand functions for different users, namely investors, households and government. In the GTAP model, the same Armington elasticity value applies for all agents in all regions for a given commodity (Dimaranan *et al.*, 1997). The substitution elasticity between imported and domestically sourced products in the GTAP database are available in Jomini *et al.* (1991). The values are mostly around 2, except for wearing apparel and leather, which have a substitution elasticity of 4.4. The value of the Armington elasticity for intermediates, consumption and investment are also centered on 2 in the ORANI model of the Australian economy (Dixon *et al.*, 1982). The same value is also applied in the Papua New Guinea model (Thompson *et al.*,

1990) and in Trewin and Erwidodo's (1995) Indonesian model. For the Philippines model, Buetre (1996) uses Kapuscinski and Warr's (1992) estimates, which differs from 2 and between commodities. For example, this elasticity is estimated to be 3.7 for rice and corn and around 1.0 for non-agricultural commodities. In the present study, the Armington elasticity in each commodity follows the GTAP model. The values are reported in Table 5.9.

Table 5.9 Elasticity Parameters Used in the Model

Industry	Armington Elasticity	Elasticity of labor substitution	Elasticity of substitution for primary factors	Export elasticity of demand	Expenditure elasticity
Paddy	2.2	0.5	0.56	-10.0	0.49
Maize	2.2	0.5	0.56	-10.0	0.10
CerOthGrain	2.2	0.5	0.56	-10.0	0.98
RootCrop	2.2	0.5	0.56	-10.0	0.71
Beans	2.2	0.5	0.56	-10.0	0.71
VegFruit	2.2	0.5	0.56	-10.0	0.71
Rubber	2.2	0.5	0.56	-10.0	0.71
Sugarcane	2.2	0.5	0.56	-10.0	0.71
Coconut	2.2	0.5	0.56	-10.0	0.71
OilPalm	2.2	0.5	0.56	-10.0	0.71
Coffee	2.2	0.5	0.56	-10.0	0.71
Tea	2.2	0.5	0.56	-10.0	0.71
OthEstate	2.2	0.5	0.56	-10.0	0.71
OthAgr	2.2	0.5	0.56	-10.0	0.71
Livestock	2.2	0.5	0.56	-10.0	0.85
Forestry	2.8	0.5	0.56	-10.0	1.57
Fishery	2.8	0.5	0.56	-10.0	1.57
CoalOthMin	2.8	0.5	1.12	-10.0	1.57
OilGas	2.8	0.5	1.12	-10.0	1.57
LivProc	2.8	0.5	1.12	-10.0	1.05
FoodProc	2.2	0.5	1.12	-10.0	0.71
FishProc	2.2	0.5	1.12	-10.0	0.71
EstateProc	2.2	0.5	1.12	-10.0	0.71
Rice	2.2	0.5	1.12	-10.0	0.10
OthFoodProc	2.2	0.5	1.12	-10.0	0.71
BevTob	3.1	0.5	1.12	-10.0	1.00
TxtLthr	2.2	0.5	1.26	-10.0	0.95
WoodPrd	2.8	0.5	1.26	-10.0	1.57
Chemical	1.9	0.5	1.26	-10.0	1.57
Fertiliser	1.9	0.5	1.26	-10.0	1.15
Pesticide	1.9	0.5	1.26	-10.0	1.15
MinMet	2.8	0.5	1.26	-10.0	1.59
OthManufac	2.8	0.5	1.26	-10.0	1.15
TradTrans	1.9	0.5	1.68	-10.0	1.53
Service	1.9	0.5	1.26	-10.0	1.15

5.8.2 Elasticities of Substitution

In the CES production function, the primary factors substitute for each other with a constant elasticity of substitution, the same for all pairs of factors. The elasticity value determines the responsiveness of the input in each sector because of the change to the cost price. A commonly used value for this elasticity is 0.5. This value is used, for example, in the ORANI, ORANI-F and ORANI-G (Dixon *et al.*, 1982; Horridge *et al.*, 1993; Horridge *et al.*, 1997) models of the Australian economy. The same value is also used for a Philippines model (Buetre, 1996). Vincent *et al.* (1990) also uses the 0.5 value in their Papua New Guinea model, except for agricultural sector (around 0.65) and fisheries (1.65). Since the present study involves linking the Indonesian model to the GTAP model, the specification of the elasticities follows the GTAP database (Dimaranan *et al.*, 1997). The elasticity of substitution values are reported in Table 5.9.

The Indonesian model also allows for constant elasticity substitution between four types of occupations (farmers, operators, administrators and professional workers). No research has been done to estimate the substitution elasticity between those occupations for Indonesia. The value applied here for the elasticity is 0.5, which follows the Australian (Horridge *et al.*, 1993) and the Philippines model (Buetre, 1996). This value applies to all industries.

5.8.3 Export Elasticity of Demand

Indonesia is assumed to be a small country in the world market. With this assumption, the export demand elasticities are expected to be high, with the world market absorbing Indonesia's exports without any impact on world prices. In the Papua New Guinea study, it is also assumed that the country export volume is not large enough to affect the world market price of the commodity. In this study, it is assumed that the value of export elasticity of demand is 10.0, a value sufficiently large to effectively remove any power to influence world prices (Table 5.9).

5.8.4 Expenditure Elasticities and Marginal Budget Shares

The expenditure elasticities are required in order to calculate the marginal household budget share. The Papua New Guinea study (Vincent *et al.*, 1990) used the value of the Indonesian study of Deaton and Case (1988) on expenditure elasticity. Those values are 0.88 (food), 1.18 (tobacco), 1.51 (housing), 0.69 (fuel), household goods (1.57), and transport (2.51). However, the elasticity data are excessively aggregated compared to the commodity aggregation in this research. To make it consistent with the GTAP model, this research use the value of the GTAP database after it is scaled (Table 5.9).

The expenditure elasticities are then scaled in order to make the share weight or an Engel aggregation equal to one, to satisfy the restriction of utility maximization (Dixon *et al.*, 1992). This scaling was not described in building the Indonesian general equilibrium database in the INDOGEM model (Trewin *et al.*, 1993) and in the WAYANG model (Warr, 1998). The calculation of this requirement follows Thompson *et al.*, (1990) and Buetre (1996). The first step is to calculate the budget share of each commodity.

$$S3_{c\_s} = \frac{X3_{c\_s}}{\sum_{c=COM} X3_{c\_s}} \qquad (5.8)$$

where:

$S3_{c\_s}$ = budged share of each commodity

$X3_{c\_s}$ = Value of purchases each commodity from all sources

The Engel aggregation then is calculated as follow:

$$T = \sum_{c} (S3_{c\_s} \times \varepsilon_c) \qquad (5.9)$$

where:

T = Engel aggregation

ε_c = Expenditure elasticities of commodity c

If the first scaling of the Engel aggregation is not equal to one, then the second scaling is required to make the Engel aggregation equal to one. It uses the equation below:

$$\varepsilon_c^* = \frac{\varepsilon_c}{T} \qquad (5.10)$$

The next step is to scale again the Engel aggregation again with adjusted expenditure elasticity (ε_c^*) to get the sum of the Engel aggregation equal to one. Finally, the marginal household budget share ($S3LUX_c$) can be calculated as :

$$S3LUX_c = S3_{c\_s} \times \varepsilon_c^* \qquad (5.11)$$

5.8.5 The Debt and World Interest Rate

The external debt of Indonesia in 1990 was 85 891 billions Rupiah and the GDP was 195 597.2 billion Rupiah (International Financial Statistics, 1996). Therefore, the Debt/GDP ratio in 1990 was 0.43912. The world power of interest rate is 1.04 which follows the rate which is used in ORANIF (Horridge, 1993).

5.8.6 The Investment Parameter

The investment parameter (BETA_R$_j$) specifies the relationship between the rate of return on capital and capital in each industry (see Block 15 section 4.1.2). There is no data available on the investment parameter. The investment parameter value of 5 is taken from the ORANIF model of the Australian economy (Horridge, *et al.*, 1993). Beside that, while running the model for updating the database, the real investment change is close to the actual ones (section 7.1) if this investment parameter is used.

5.8.7 The Depreciation Rate, Factor and Depreciation Values

The basic assumption is that the depreciation rate is 10 per cent, following the ORANI-F model (Horridge *et al.* 1993). The depreciation factor (namely 1 minus the depreciation rate) is then 0.9. The same rate is also applied for the Philippine case in Buetre (1996).

The depreciation rate is used at several points in the model. One possible use is in calculating the value of beginning capital stock for each industry (see section 5.7, equation 5.6) for which it would be used along with depreciation values.

Depreciation values for each industry can be obtained from the I-O Table (sector 203). Unfortunately, when these depreciation values are compared to the investment values, for some industries such as coconuts and other agriculture, the value of depreciation is found to be relatively very small. Investment then dominates depreciation and even the implied beginning capital stocks. Then, next period's capital stock, being the sum of beginning capital stock and investment net of depreciation, is found to be very high compared to the beginning capital stock. The growth rate of capital can then take on unrealistically large values (e.g. 6400% for the coconut industry).

There appears then to be some inconsistency between the various data items and the depreciation rate assumptions. Which ones are suspect is not entirely clear. While depreciation rates might be less than 10 per cent and might differ between industries, perhaps being much smaller for those industries with small depreciation values, the small depreciation values seem odd in themselves. In the study, following experimentation with alternatives for specifying sufficient data items, it was decided that the depreciation rates should be maintained at 10 per cent for all industries. The published depreciation values data were discarded. Beginning capital stocks were calculated using the alternative assumption of a given capital-investment ratio (see below) and known investment figures as already discussed.

5.8.8 Investment Capital ratio

The investment capital ratio in the ORANI-F model (Horridge *et al*) is set at 0.7, while in the Philippines model (Buetre, 1996) it is assumed to be 0.13. This ratio is assumed to be 0.152 in this present study. The ratio is chosen after applying several numbers in a number of simulations for updating the database. Using the number 0.152 as an investment parameter, the percentage changes of the real GDP and investment are almost the same as the actual changes (see Table 7.10). For the trade liberalisation simulations, this number is used as an investment capital ratio.

5.8.9 The Ratio of Gross to Net Rate of Return

The gross to net rate of return ratio relates gross rate of return (including risk) to net rate of return (excluding risk). Depending on the particular modeling assumption, the ratio can take an assumed value or can be calculated from other information in the database. The gross to net of return ratio is calculated in this research with the following formula:

$$QCOEF_i = GROSSRR_i/R1CAP_i \quad (5.12)$$

$$GROSSRR_i = V1CAP_i/V2TOT_i*(X1GROWI_i-DEP_i) \quad (5.13)$$

where:

$QCOEF_i$ = Ratio of gross to net rate of return in industry i

$GROSSRR_i$ = Gross rate of return including risk in industry i

$V1CAP_i$ = Capital rental in industry i

$V2TOT_i$ = total capital created for each industry

$X1GROWI_i$ = Capital growth in industry i

DEP_i = Depreciation factors in industry i

5.9 Data for Updating the Indonesian Database from 1990 to 1997

The final demand from National Account that is published yearly is one source of the study to update the database. In order to predict the database closely to the actual condition, the consistency of the final demand in the I-O Table and National Account is necessary.

5.9.1 Consistency of the Input-Output Table and Macroeconomic Changes Over 1990-7

The consistency of the I-O Table can be seen by comparing the composition of the final demand from the I-O accounts and from the Indonesian Statistical Yearbook. Even though the source of data for building the I-O Table is the same as those for accounting the National Account of Indonesia (Central Bureau of Statistics, 1994), Table 5.10 shows that there is a difference between the GDP measurement from the National Account and the I-O Table 1990. The GDP from the Input-Output Table is 13 947 million Rupiah bigger than the GDP from National Account. The differences between both accounts also occur in each type of expenditure, with the biggest difference of both accounts is in the private consumption expenditure. However, the share of each type of expenditure to the GDP in the National Account is slightly different from those in the Input-Output Table, which is less than 5 per cent. With this limitation, in this research, it is assumed that the final demand from National Account in 1997 would be consistent with final demand in the updated data for 1997.

Table 5.10 The Comparison of Final Demand Components from the Input-Output Table and the National Account, 1990 in Million Rupiah (Current Price)

Type of Expenditure Accounts	National Output	% Share	Input-Output	% Share	Difference Of Share
Private Consumption Expenditure	106 312.3	54.0	124 184.2	58.9	4.9
Government Consumption	17 572.7	8.9	18 649.1	8.9	0.0
Capital Formation	58 403.0	29.7	59 758.0	28.3	1.4
Change in Stock	11 222.2	5.7	5 031.9	2.4	3.3
Export	54 086.0	27.5	53 288.7	25.27	2.23
Import	-50 677.0	-25.8	-50 045.7	- 23.73	2.07
Gross Domestic Product	196 919.2	100	210 866.2	100.0	

Source: Central Bureau of Statistics (1993); Central Bureau of Statistics (1994)

Because APEC trade liberalisation will be introduced under conditions prevailing in the late 1990s and the early 2000s, the 1990 database is not the most appropriate one. While no later suitable I-O Table has been published, a 1997 database can be created by updating the 1990 database on the basis of subsequent developments in the economy. These updates are achieved by using the actual (i.e. the historical) data changes in the macroeconomic and sectoral variables as an exogenous closure of the Indonesian Model to generate consistent values for the remaining variables of the model. The macroeconomic variables which are set exogenously are employment, population, and the expenditure side of GDP including private and government consumption expenditure. The relevant macroeconomic data from the Indonesian National Accounts are reported in Table 5.11.

Table 5.11 Macroeconomic Data for 1990 and 1997 Used to Obtain a 1997 Database, at 1993 Current Price (Billion Rupiah)

Variable	1990	1997	Percentage Change
Personal Consumption Expenditure	157136.478	273917	74.11
Government Consumption	26248.8991	31700.8	20.77
Capital Formation	73355.6427	139724.8	82.72
Exports	58205.0453	121157.9	108.76
Imports	60284.3351	139796.1	138.92
Gross Domestic Product	271968.12	434095.5	59.46
Gross National Product	263621.403	418632.6	59.16
Employment [1)]	75850	84757.39	14.26
Population[2)]	179381	202818.6	11.41
CPI	112.48	211.62	88.14
Import Price Index	191	261	36.65
Export Price Index	195	238	22.05
Nominal Exchange rate in SDR (the unit of account for the Fund)	2704.5	6274	131.98
Nominal Exchange Rate in Rupiah per US$ (average of period)	1842.8	2909.4	57.88
Nominal Exchange Rate in Rupiah per US$ (end of period)	1901	4650	144.61

1) Employment (1997) = (Employment (1996) * 1.122 %) + Employment (1996)
The employment growth is assumed as the average of employment growth between 1990-1996

Source : Bank Indonesia (1998), International Monetary Fund (1998)

5.9.2 Other Exogenous Changes in the Economy over 1990-1997

The economic growth of the nation occurs not only because of changes in macroeconomic variables, but also because of changes in sectoral variables. Sectoral variables treated as varying exogenously include the primary factor technological change and the world export prices.

In the sectoral variables, the source of output growth consists of the growth rate of total factor productivity (TFP), the capital stock and effective labor supply (Sarel, 1997). The TFP growth can be calculated as a difference between the growth rate of output and a share-weighted index of output growth (Sarel, 1997; Timmer, 1999). The TFP growth is the residual output growth that is not accounted by the increases of labor and capital. There are number of studies that have calculated the TFP growth in Indonesia. Reviews of TFP calculations by different authors can be found in Sarel (1997) and Craft (1998). Craft (1998) finds that there is a difference between the projected TFP growth, which is 2.1 per cent, and actual TFP growth, which is 0.8 per cent, in Indonesia during the period of 1960 and 1984. The TFP calculation for more recent years is provided by Sarel (1997). He calculates the annual average TFP for Indonesia during 1991 to 1996 as 2.20, which is 43 per cent of total output growth.

Timmer (1999) has reviewed the TFP calculation for Indonesia's manufacturing sector. He found that during the period 1975-1995, the manufacturing output grew because of 60 per cent growth in capital input, an 18 per cent growth in labor input and a 22 per cent TFP growth. The average annual TFP growth rates over the period 1986 to 1995 by industry, as calculated by Timmer (1999), are reported in Table 5.12.

Table 5.12 Average Annual TFP Growth in Manufacturing by Industry, 1975 1995 (per cent) and the Total TFP Growth 1990-1997

No	Industry types	1975-1981	1982-1985	1986-1990	1991-1995	1975-1995	1990-1997*)
31	Food, beverage and tobacco	3.7	3.8	5.6	5.7	4.7	43.5
32	Textiles, garment and leather	0.8	3.5	12.4	3.6	4.9	40.2
33	Wood products	12.0	-2.4	7.9	-1.8	4.7	8.3
34	Paper, printing and publishing	-1.8	2.5	7.5	3.2	2.6	28.7
35	Chemical, rubber and plastic	-4.9	-2.1	1.7	-0.3	-1.6	-3
36	Non-metallic minerals	-1.7	-8.3	7.1	-0.5	-0.5	3.6
37	Basic metals	3.6	13.6	8.9	-3.6	5.1	1.1
38	Metal products and machinery	5.6	-7.8	9.9	6.9	4.3	53
39	Other manufacturing	2.4	8.9	5.6	-2.3	3.3	0.7

*) The total productivity growth during 1990-1997 is calculated as the sum of average annual TFP growth during 1990-1997. The TFP growth in 1996 and 1997, not available in Timmer (1999), is assumed to be the same as the average annual TFP growth during 1975-1995.

Source: Timmer (1999)

In this research, the primary factor technology change in each industry (*alprim$_i$*) is assumed to reflect the TFP growth. The TFP growth for each manufacturing sector is taken from Timmer (1999) calculation. However, there is no estimation of TFP growth in detail sector for other sectors of Indonesian economy. Because the TFP growth is 43 per cent of the total output growth (Sarel, 1997), the TFP growth for each sector is simply assumed to be 43 per cent of the GDP growth in each sector. Table 5.13 shows the GDP growth in each sector from 1990 to 1997 as provided by the Central Bureau of Statistics and in Bank Indonesia publications. Based on Table 5.12 and 5.13, the TFP growth of each sector as used in the study are as reported in Table 5.14.

Table 5.13 Annual Growth of Gross Domestic Sector by Sector in 1990 – 1997 (percentage change) and Total Factor Productivity growth over 1990- 1997

	1990	1991	1992	1993	1994	1995	1996	1997	1990-1997	TFP*) (1990-1997)
Agricultural, livestock, forestry and fishery	2	1.6	6.7	1.7	0.6	4.2	3.2	0.4	20.4	8.772
Food crops	0.5	-0.5	7.7	-0.7	-2.1	4.6	2.4	-1.9	10	4.3
Estate crops	7.17	5.96	5.3	6.3	5.3	4.7	4.2	3.3	32.23	18.16
Livestock	3.06	5.14	6.7	4.7	4	4.2	6.1	3.7	37.6	16.17
Forestry	3	0	-2.2	1.3	0.4	0	1.3	1.2	5	2.15
Fishery	5	5.2	5.8	5.3	4.7	5.6	4.6	4.3	40.5	17.415
Mining and quarrying	5	9.3	-1.9	3.4	5.6	6.7	5.8	2.3	36.2	15.566
Oil and natural gas	4.2	9.3	0.13	0.1	2.6	0	1.5	-1	16.03	7.24
Other mining	14.6	18.1	24.1	20.8	13.9	35.5	16.4	7	150.4	64.672
Quarrying						12.9	12.7	9.2	34.8	14.964
Manufacturing Industry	12.2	9.8	9.7	11.4	12.5	10.8	11.2	8.5	86.1	37.023
Refinery oil	10.1	3.1	5.8	0.1	1.5	-2.8	16.7	-5.8	28.7	12.341
LNG	9.6	8.4	5.2	1.9	11	-7	4.2	4.6	37.9	16.297
Non oil and gas	13	10.6	11	13.2	13.5	13	11.7	9.8	95.8	41.194
Electricity, gas and water supply	17.9	16.1	10.1	11.1	12.7	15.5	13.2	11.8	108.4	46.612
Construction	13.5	11.3	10.8	14.5	14.9	12.9	12.8	9.2	99.9	42.957
Trade, hotel and restaurant	7.1	5.4	7.3	9.8	7.3	7.8	8.2	7.3	60.2	25.886
Transportation and Communication	9.6	7.9	10	7.5	7.8	9.4	7.8	9.2	69.2	29.756
Finance & other services	14.1	12.7	10.3	10.2	11.2	11.2	8.8	6.8	85.3	36.679
Other Services	5	5.3	4.3	3.5	2.8	3.3	3.4	3.1	30.7	13.201
Gross Domestic Product	7.2	7	6.5	7.3	7.5	8.2	8	6	57.7	24.811

*) Total TFP growth in each sector = 43%of GDP growth in each sector

Source: Bank Indonesia (1994), Bank Indonesia (1998)

The world export and import price change is derived from the change of the relevant commodity price index in the world market. Data is available on and was taken from Bank Indonesia's World Wide Web home page. The changes in these price variables are reported in Table 5.14.

Table 5.14 Total TFP Growth and World Price change between 1990 and 1997 (per cent)

No	Sector	TFP	f4p	Pf0cif
1	Paddy	4.3	0	0
2	Maize	18.16	0	0
3	CerOthGrain	4.3	0	0
4	RootCrop	4.3	0	0
5	Beans	4.3	0	0
6	VegFruit	18.16	0	0
7	Rubber	18.16	6.8	0
8	Sugarcane	4.3	0	0
9	Coconut	18.16	0	0
10	OilPalm	43.5	88.3	0
11	Coffee	18.16	107.5	0
12	Tea	18.16	13.4	0
13	OthEstate	18.16	0	-1.4
14	OthAgr	4.3	0	0
15	Livestock	16.17	0	0
16	Forestry	2.15	0	0
17	Fishery	17.4	0	0
18	CoalOthMin	47.13	-14.5	0
19	OilGas	7.24	0	0
20	LivProc	43.5	0	0
21	FoodProc	43.5	0	0
22	FishProc	43.5	0	0
23	EstateProc	43.5	0	0
24	Rice	43.5	-19.8	-19.8
25	OthFoodProc	43.5	0	0
26	BevTob	43.5	0	0
27	TxtLthr	40.2	0	0
28	WoodPrd	8.3	36.7	0
29	Chemical	-3	0	0
30	Fertiliser	37	0	0
31	Pesticide	37	0	0
32	MinMet	14.9	0	0
33	OthManufac	37	0	0
34	TradTrans	27.3	0	0
35	Service	24.9	0	0

Source: Calculated from Bank Indonesia (1994), Bank Indonesia (1998), Sarel (1997) and Timmer (1999) for TFP, Bank Indonesia (1999), Home page: http://www.bi.go.id/ind/datastatistik, 27 May 1999.

5.10 The Computing Procedure Used to Create the Database

While the original source of data for the database is the 1990 Indonesian I-O Table, in reality the basic data was actually obtained by modifying an existing Indonesian CGE database, namely the database for the INDORANI model. This unpublished Indonesian database is also based on the 1990 I-O Table and was kindly provided to the author by members of the Impact Project, Monash University. This database has the same structure as the Australian ORANI-G database. As the ORANI-G and INDORANI models are static CGE models, the INDORANI database needs to be modified and extended for the Indonesian Model. There are some modifications on the TABLO input file to meet the demand of flexibility of the model, especially in the investment specifications (ORANI, ORANI-F, and Walmsley type of investment). The original TABLO input file for INDORANI is CONVINDO.TAB and it is modified to CONVINF.TAB in the research.

The DAGG and GEMPACK computing packages includes programs for constructing and modifying a CGE database. The raw data consists of the I-O Table and the SAM. The USE90S.HAR is the first header array file of the raw data. The land and investment share coefficients have been added in the header array file (USE90S.HAR) by using the MODHAR (Modify header array) program. The steps to compute a comparative static database of Indonesian model are shown in Figure 5.3.

The first step is to run the TABLO program to read CONVINF.TAB and USE90S.HAR to produce INDOF161.HAR and SUPP90.HAR. The second step is to aggregate the database to the required aggregation (see Figure 5.4). The aggregation starts from the files INDOF161.har and SUPP90.HAR. The DAGSUPP.HAR file is produced by the MODHAR program, which combines the SUPP90.HAR, the MODSUPP.INP and the DAGMAP.TXT (mapping 161 sectors and 35 sectors). The DAGSUPP.HAR is then used by the DAGG program that executes aggregation instructions from input files for commodity aggregation (DGCOM35.INP), industry aggregation (DGIND35.INP) and margin aggregation (DGMAR.INP). The INDO35.HAR file is produced by the DAGG program.

Figure 5.3 Database Construction

From raw data subdirectory

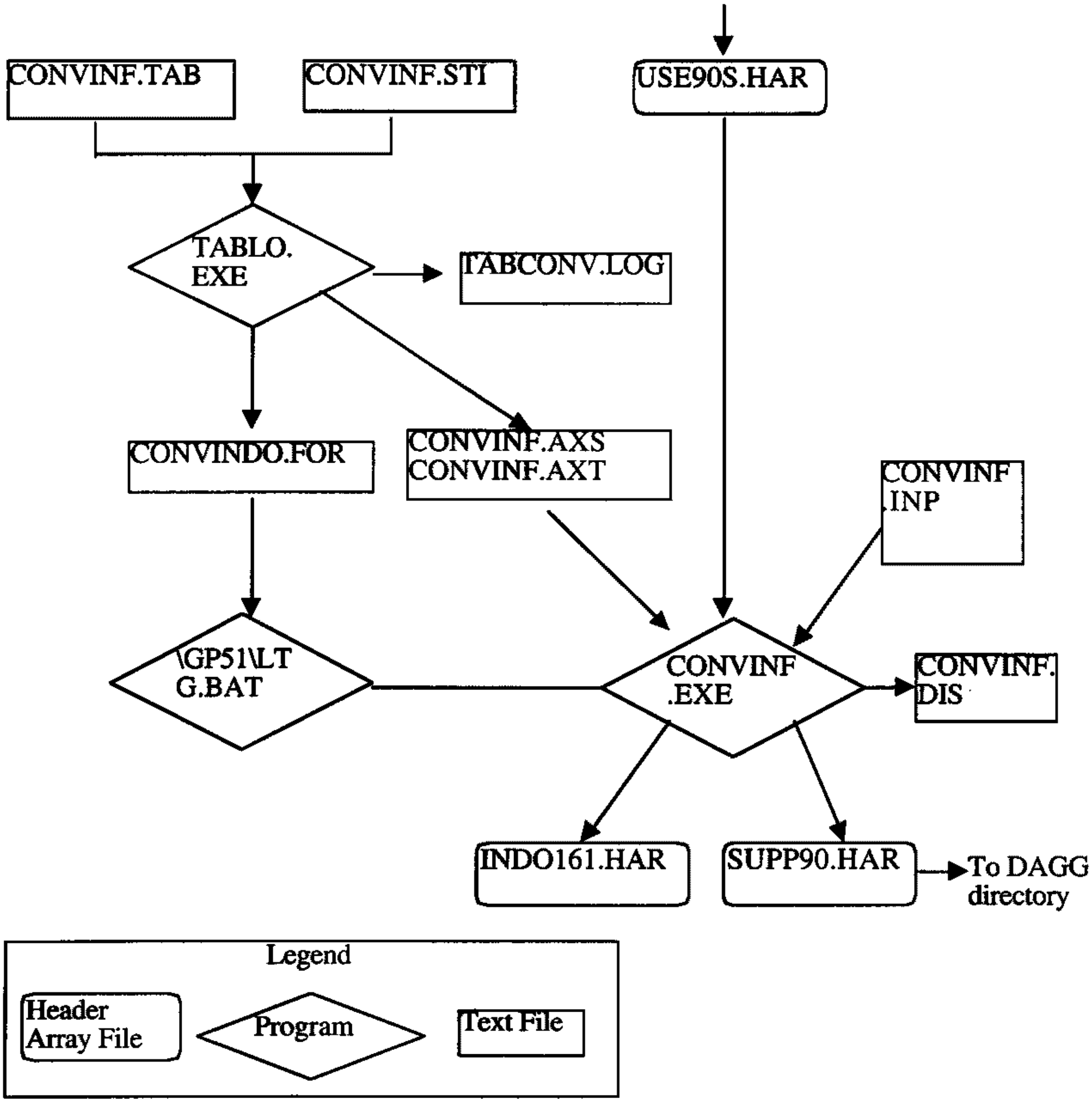
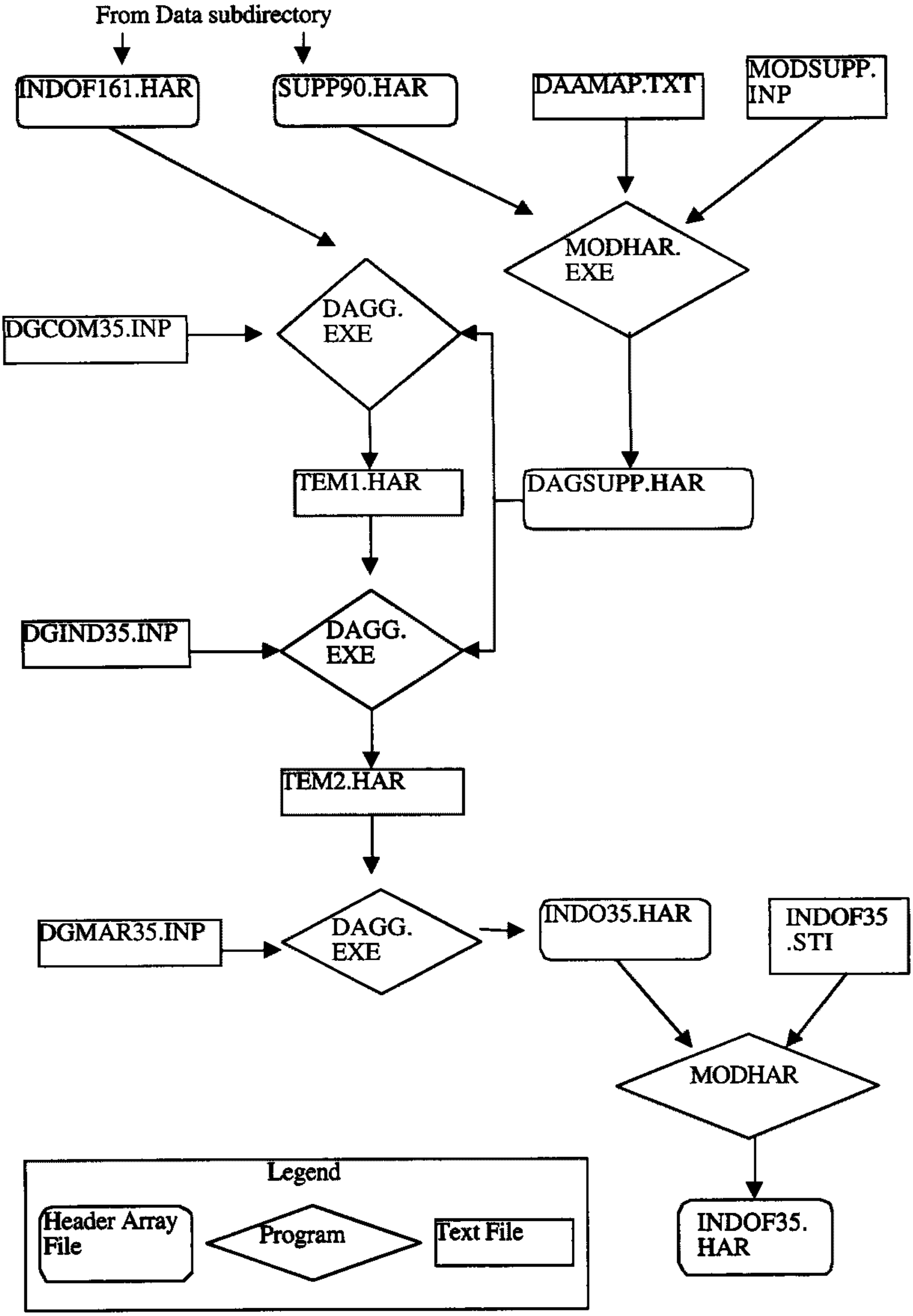


Figure 5.4 Aggregating the Database



The additional third step is to modify INDO35.HAR to a file suitable for the Indonesian Model and have a flexibility to capture the two investment data specifications (see section 5.6) and capital stock data (see section 5.7), namely INDOF35.HAR. The input file INDOF35.STI contains the data that has to be added to the standard CGE database file, information such as the depreciation factors, the investment capital ratio and modified data such as the capital land share and labor by occupation. The MODHAR program is run to execute the commands in the INDOF35.HAR file to modify the INDO35.HAR file.

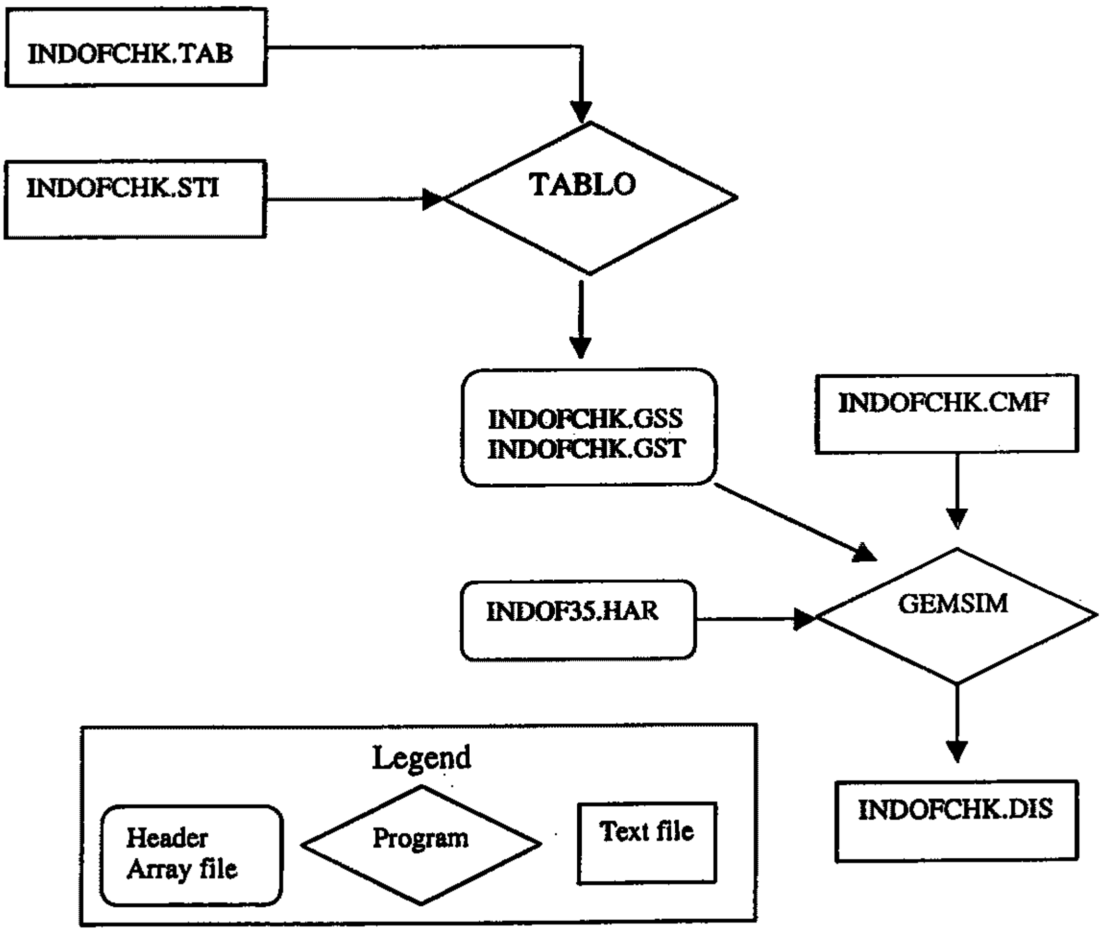
5.11 Checking the Balance of Database

The output from a general equilibrium model represents thesimulated movement of an economy from one equilibrium position to another . Warr (1998) clarifies that it is necessary for the database to reflect equilibrium if the results of simulations are to represent changes from an initial equilibrium. The database must be internally consistent with the equilibrium condition as well as internally consistent in the sense of the value-flows adding-up or balancing. Whether the balance condition is satisfied by the database can be checked through the equalisation of the total value of inputs and the total sales for each industry (Dixon *at al.*, 1991). In the aggregate economy, the GDP expenditure must be equal with the GDP income. This section reports on the check for balancing in the original 1990 database and the updated 1997 database. The procedure for checking the database is illustrated in Figure 5.5.

In practice, the procedure using GEMPACK to check balance is to create a TABLO input file which contains the set of commodities, sources, industries and margin commodities; the coefficients and the formulae for calculating the coefficients of the equations; and all variables including the industry specific cost and sales, the income and expenditure side of the GDP. The TABLO program executes the commands in an input file (INDOFCHK.STI) to produce intermediate files INDOFCHK.GSS and INDOFCHK.GST. These in turn are read by the GEMSIM program along with the command file (INDOFCHK.CMF) to produce the file INDOFCHK.DIS that displays the calculated coefficients needed to check the balance of the database. The same procedure is applied to check the balance of the 1992 and the 1997 updated database, since an updated database obtained from an initially balanced database need not be balanced if the updating formulae are not fully consistent (see section 4.1.5)

The database is balanced if, first, the aggregate GDP expenditure is equal to the aggregate GDP income and second, the total cost is equal to the total sales (that is, there is zero profit) for each industry (Warr, 1998). Tables 5.15 and 5.16 show that the total sales and total cost in each industry are the same in each industry for the 1990 database. The 1990 database is also balanced in the aggregate economy as shown in Table 5.17. A check of the balance of the updated 1997 database reveals that it too is balanced. The test of balance for the 1997 database is not reported here. The database itself is provided in the Appendix 3.

Figure 5.5 Checking the Database



Tables 5.15 Sales of Domestic Commodities to Different Users in the 1990 Database (Billion Rupiah)

No.	Sector Aggregation	Intermediate	Investment	Household	Export	Government	Inventory	Margin	Total Sales
1	Paddy	13955.3	0.0	0.0	0.0	0.0	19.9	0.0	13975.1
2	Maize	552.2	0.0	997.7	28.3	0.0	1.5	0.0	1579.7
3	CerOthGrain	19.3	0.0	0.2	52.3	0.0	2.4	0.0	74.2
4	RootCrop	292.4	0.0	2327.6	19.4	0.0	3.0	0.0	2642.4
5	Beans	874.7	0.0	1547.7	9.2	0.0	77.3	0.0	2508.9
6	VegFruit	605.0	0.0	7110.7	14.7	0.0	0.0	0.0	7730.4
7	Rubber	853.9	0.0	0.0	60.5	0.0	8.5	0.0	922.8
8	Sugarcane	898.6	0.0	1.2	0.1	0.0	10.8	0.0	910.7
9	Coconut	423.1	0.0	710.6	3.0	0.0	53.9	0.0	1190.6
10	OilPalm	741.6	0.0	0.0	311.5	0.0	2.0	0.0	1055.1
11	Coffee	385.7	0.0	185.6	97.4	0.0	45.5	0.0	714.2
12	Tea	106.1	0.0	16.5	62.2	0.0	-0.6	0.0	184.2
13	OthEstate	1130.2	0.0	123.1	350.6	0.0	12.7	0.0	1616.6
14	OthAgr	228.9	0.0	367.4	39.7	20.8	30.4	0.0	687.3
15	Livestock	3392.9	0.6	1829.9	42.8	0.0	38.9	0.0	5305.1
16	Forestry	3034.5	0.0	341.2	49.5	0.0	15.8	0.0	3441.1
17	Fishery	1355.2	0.0	1771.3	192.3	0.0	45.7	0.0	3364.5
18	CoalOthMin	11651.0	0.0	1433.4	3588.7	49.4	405.5	0.0	17128.0
19	OilGas	8613.0	0.0	0.0	18567.5	0.0	3041.6	0.0	30222.1
20	LivProc	1225.9	0.0	3032.3	37.4	0.0	25.1	0.0	4320.7
21	FoodProc	888.9	0.0	3217.3	218.9	0.0	-54.0	0.0	4271.0
22	FishProc	113.5	0.0	1718.6	1056.7	0.0	-70.0	0.0	2818.8
23	EstateProc	1558.8	0.0	3173.1	1428.6	0.0	27.6	0.0	6188.1
24	Rice	1210.1	0.0	14306.6	3.7	0.0	34.5	0.0	15554.9
25	OthFoodProc	1112.6	0.0	607.9	74.1	0.0	39.7	0.0	1834.2
26	BevTob	1038.2	0.0	4114.2	118.3	0.0	-78.4	0.0	5192.2

Table 5.15 (Continued)

No.	Sector Aggregation	Intermediate	Investment	Household	Export	Government	Inventory	Margin	Total Sales
27	TxtLthr	4982.5	4.3	3940.8	5170.3	50.0	-163.6	0.0	13984.4
28	WoodPrd	3462.2	194.1	329.6	5133.2	2.9	-261.4	0.0	8860.6
29	Chemical	5216.5	0.0	2751.8	2538.1	71.3	-420.3	0.0	10157.4
30	Fertiliser	1560.2	0.0	49.5	324.2	33.5	-62.9	0.0	1904.5
31	Pesticide	309.0	0.0	30.2	42.7	0.4	-19.0	0.0	363.3
32	MinMet	8767.7	458.8	236.5	1754.0	40.4	-375.0	0.0	10882.5
33	OthManufac	8823.0	3766.1	4245.1	1270.2	503.7	-712.3	0.0	17895.7
34	TradTrans	6361.0	1067.4	19218.7	2557.9	1048.1	0.0	30070.7	60323.8
35	Service	21056.1	36452.4	22799.8	2514.8	15305.4	31.4	0.0	98159.9

Source: Calculated from Database (INDOF35.HAR)

Table 5.16 Cost Structure in Domestic Industries of the 1990 Database

No.	Sector Aggregation	Intermediate input at purchaser's price	Factor input cost	Other cost	Total Cost
1	Paddy	1656.6	12317.5	1.0	13975.1
2	Maize	228.6	1350.2	1.0	1579.7
3	CerOthGrain	7.9	65.3	1.0	74.2
4	RootCrop	136.5	2503.9	2.0	2642.4
5	Beans	365.9	2140.0	3.0	2508.9
6	VegFruit	569.6	7158.8	2.0	7730.4
7	Rubber	262.1	659.7	1.0	922.8
8	Sugarcane	234.4	675.3	1.0	910.7
9	Coconut	107.0	1082.6	1.0	1190.6
10	OilPalm	283.9	770.1	1.0	1055.1
11	Coffee	240.5	472.7	1.0	714.2
12	Tea	21.3	162.0	1.0	184.2
13	OthEstate	313.7	1298.9	4.0	1616.6
14	OthAgr	69.7	616.6	1.0	687.3
15	Livestock	1788.0	3513.2	4.0	5305.1
16	Forestry	513.0	2926.1	2.0	3441.1
17	Fishery	628.0	2734.5	2.0	3364.5
18	CoalOthMin	9151.6	7965.4	11.0	17128.0
19	OilGas	5590.1	24629.0	3.0	30222.1
20	LivProc	3321.2	995.5	4.0	4320.7
21	FoodProc	2848.6	1416.4	6.0	4271.0
22	FishProc	1740.7	1076.1	2.0	2818.8
23	EstateProc	3355.9	2827.2	5.0	6188.1
24	Rice	14135.0	1418.9	1.0	15554.9
25	OthFoodProc	1208.4	623.8	2.0	1834.2
26	BevTob	3381.9	1806.3	4.0	5192.2
27	TxtLthr	9537.3	4439.1	8.0	13984.4
28	WoodPrd	4935.4	3919.2	6.0	8860.6
29	Chemical	7381.2	2764.2	12.0	10157.4
30	Fertiliser	1452.1	1601.7	-1149.4	1904.5
31	Pesticide	186.9	175.5	1.0	363.3
32	MinMet	7141.8	3727.7	13.0	10882.5
33	OthManufac	11926.8	5945.9	23.0	17895.7
34	TradTrans	20874.1	39441.7	8.0	60323.8
35	Service	44923.3	53214.7	22.0	98160.0

Source: Calculated from Database (INDOF35.HAR)

Table 5.17 Gross Domestic Product from Income and Expenditure Sides of the 1990 Database (Billion Rupiah)

Income Side		Expenditure side	
Total primary factor payment	198435.8	Total purchases by household	124184.0
Total other cost	-989.4	Total investment usage	59758.1
Aggregate Indirect tax revenue	13419.8	Total value of other demand	18649.1
		Total value of inventories	1755.9
		Total export earning	53288.8
		Total import cost, excluding tariff	-46769.7
GDP-Income side	210866.2	GDP-Expenditure side	210866.2

Source: Calculated from Database (INDOF35.HAR)

5.12 Homogeneity Tests

It is usual to do several other tests on the CGE model. In particular, tests of nominal and real homogeneity are often made to check the computational error of the model result. The purpose in doing the nominal homogeneity test is to make sure that there is no money illusion in the model. If not, the system will be homogenous of degree zero in the price variables (Buetre, 1996; Warr and Aziz, 1997). To implement this test, all exogenous variables are fixed (zero percentage change) and only the nominal variable such as exchange rate and factor price is shock by 10 per cent. In this case, consumer price index variable is shocked, which is increased by 10 per cent. If homogenous of degree 0, all the real variables will remain unchanged while the entire set of nominal variables will increase by the same percentage as the price numeraire (consumer price index). The model simulations which is used the 1990 and updated 1997 database both pass this test.

The real homogeneity test is a test for whether constant returns to scale apply in the production structure of the model as implied by the assumed production functions (Buetre, 1996). The test is done by uniformly shocking all the real exogenous variables. If real homogeneity is satisfied, all the real endogenous variables will change by the same percentage and there will be no change in the nominal endogenous variables. The model simulations used in both databases pass this test.

CHAPTER 6

CONSTRUCTION OF THE GTAP DATABASE

The present study uses version three of the GTAP database, published in 1997. The database consists of matrices of bilateral trade flows, transport payments, and protection payments, which define the inter-connection among countries or regions, along with. input-output (I-O) matrices defining the flows within each country or region. This GTAP database identifies thirty regions and thirty-seven traded commodities. The detailed construction of the database is available in Chapter 3 of *The Global Trade Analysis, Modelling and Applications* (Hertel, 1997) and in *Global Trade, Assistance, and Protection: The GTAP 3 Data base* (McDougall, 1997).

Version 4 of the GTAP database became available in 1998. Although there would be advantages in using the later version in GTAP analyses, for example there are additional sectors available and more primary factor splits, it has not been used in this study. In part, this is because the detail of the additional sectors included in version 4 would add very little to the present study which ideally wants disaggregation of the agricultural sector, and in particular the estate crops. This is not available in either version. A more significant factor in the decision to use version 3 relates to the 1998 publication date, a time by which most of the GTAP simulations done for the study had already been completed.

The focus of this chapter is on explaining the sectoral aggregation and the construction of a database that is consistent with both the prior implementation of NAFTA and a risk adjusted, steady state growth equilibrium. Few details are provided on the regular GTAP database since details, as already noted, are available elsewhere.

6.1 Commodity and Country Aggregation

For the present study, the commodities and countries in the GTAP database have been aggregated into 20 traded commodities and 8 regions. Eleven of the twenty data aggregations consist of agricultural commodities and agricultural processing. The details of the aggregation of the traded commodities and the link with the aggregation used in the Indonesian model are given in Table 6.1

For the study, eight regions are created from the thirty regions of the GTAP database. Given the focus on the impact of APEC trade liberalisation, the aggregation is specified to be relatively more detailed for the APEC countries. Indonesia is treated as a separate region. Some APEC countries, such as Australia and New Zealand, are treated as one region. The details of the country aggregation are given in Table 6.2.

In order to have the aggregation that is suitable for the research, the aggregating mapping file was prepared. Then, by running the aggregation program, DATA-AGG, the header array file for data, parameters and settings are produced.

6.2 The Risk-Adjusted, Steady-State GTAP Database

Given the interest in the long-run effects of trade liberalisation, the initial database must reflect a risk-adjusted steady-state equilibrium. The standard GTAP database describes the world economy as it was in 1992, and not an economy in long-run equilibrium. Furthermore, the objective of the study involves studying APEC trade liberalisation given that the NAFTA agreement is already in place. Version 3 of the GTAP database does not incorporate the NAFTA agreement, so the GTAP database needs further modification for this agreement.

Table 6.1 The Sectoral Mapping between the GTAP Database, the Indonesian I-O Table, and the Corresponding Aggregations used in the Study

No	GTAP Sectors used in the Study	No.	GTAP Database Sectors	No	Indonesian I-O Table Sectors	No	Indonesian Sectors used in the Study
1.	PDR	1.	PDR, paddy rice	1.	Paddy	1.	Paddy
2.	WHT	2.	WHT, wheat	10.	Cereals & Other Food Crops	3.	CerOthGrain
3.	GRO	3.	GRO, grain except wheat & rice	2.	Maize	2.	Maize
4.	NGC	4.	NGC, non grain crops	10.	Cereals & Other Food Crops	3.	CerOthGrain
				3.	Cassava	4.	RootCrop
				4.	Other root crops	4.	RootCrop
				5.	Groundnut	5.	Beans
				6.	Soybeans	5.	Beans
				7.	Other beans	5.	Beans
				8.	Vegetables	6.	VegFruit
				9.	Fruit	6.	VegFruit
				11.	Rubber	7.	Rubber
				12.	Sugarcane	8.	Sugarcane
				13.	Coconut	9.	Coconut
				14.	Oil palm	10.	OilPalm
				15.	Fibre crops	13.	OthEstate
				16.	Tobacco	13.	OthEstate
				17.	Coffee	11.	Coffee
				18.	Tea	12.	Tea
				19.	Clove	13.	OthEstate
				20.	Other estate crops	13.	OthEstate
				21.	Other agriculture	14.	OthAgr
5.	LVS	5.	WOL, wool	22.	Livestock & livestock products	15.	Livestock

Table 6.1 (Continued)

No	GTAP Sectors used in the Study	No.	GTAP Database Sectors	No	Indonesian I-O Table Sectors	No	Indonesian Sectors used in the Study
5.	LVS	6.	OLP, other livestock products	22.	Livestock & livestock products	15.	Livestock
				24.	Poultry & its products	15.	Livestock
				25.	Other livestock raising	15.	Livestock
				28.	Hunting products	15.	Livestock
6.	FOR	7.	FOR, forestry	26.	Wood	16.	Forestry
				27.	Other forest products	16.	Forestry
7.	FSH	8.	FSH, fisheries	29.	Sea fish & other sea products	17.	Fishery
				30.	Inland water fish & its product	17.	Fishery
				31.	Drying & salting of fish	17.	Fishery
9.	COL&OMN	9.	COL, coal	32.	Coal	18.	CoalOthMin
8.	OIL&GAS	10.	OIL, oil	33.	Crude oil	19.	OilGas
8.	OIL&GAS	11.	GAS, gas	34.	Natural gas & geothermal	19.	OilGas
				95.	Liquefied of natural gas	19.	OilGas
9.	COL&OMN	12.	OMN, others minerals	35.	Tin ore	18.	CoalOthMin
				36.	Nickel ore	18.	CoalOthMin
				37.	Bauxite ore	18.	CoalOthMin
				38.	Copper ore	18.	CoalOthMin
				39.	Gold & silver ore	18.	CoalOthMin
				40.	Other mining	18.	CoalOthMin
				41.	Chemical & fertilising mineral	18.	CoalOthMin
				42.	Crude salt	18.	CoalOthMin
				43.	Quarrying, all kinds	18.	CoalOthMin
10.	PCR	13.	PCR, processed rice	50.	Rice milling & husking	24.	Rice
11.	LVSPROC	14.	MET, meat products	44.	Meat & entrails of slaughtered	20.	LivProc
				45.	Processed & preserved meat	20.	LivProc

Table 6.1 (Continued)

No	GTAP Sectors used in the Study	No.	GTAP Database Sectors	No	Indonesian I-O Table Sectors	No	Indonesian Sectors used in the Study
11.	LVSPROC	15.	MIL, milk products	23.	Fresh milk	20.	LivProc
				46.	Dairy products	20.	LivProc
12.	OFP	16.	OFP, others food products	47.	Canning & preserving of fruits & beverages	21.	FoodProc
				48.	Processed & preserved fish	22.	FishProc
				49.	Copra, Animal oil & vegetable oil	23.	EstateProc
				51	Wheat Flour	21.	FoodProc
				52.	Flour except wheat flour, milled cereals & peeled root	21.	Foodproc
				53.	Bakery product & the like	21.	FoodProc
				54.	Noodle, macaroni & the like	21.	FoodProc
				55.	Sugar	23.	EstateProc
				56.	Peeled grain, chocolate & sugar confectionery	23.	EstateProc
				57.	Milled & peeled coffee	23.	EstateProc
				58.	Processed tea	23.	EstateProc
				59.	Soybean products	21.	FoodProc
				60.	Other foods	25.	OthFoodProc
				61.	Animal feeds	25.	OthFoodProc
13.	B_T	17.	B_T, beverages & tobacco	62.	Alcoholic beverages	26.	BevTob
				63.	Non-alcoholic beverages	26.	BevTob
				64.	Tobacco products	26.	BevTob
				65.	Cigarettes	26.	BevTob

Table 6.1 (Continued)

No	GTAP Sectors used in the Study	No.	GTAP Database Sectors	No	Indonesian I-O Table Sectors	No	Indonesian Sectors used in the Study
14.	TEX&LEATH	18.	TEX, textiles	66.	Yarn & cleaning kapok	27.	TxtLthr
				67.	Textile	27.	TxtLthr
				68.	Made up textile goods except wearing apparel	27.	TxtLthr
				69.	Knitting mills	27.	TxtLthr
				71.	Manufacture of carpet, rope, twine & other textile	27.	TxtLthr
14.	TEX&LEATH	19.	WAP, wearing apparel	70.	Manufacture of wearing apparel	27.	TxtLthr
14.	TEX&LEATH	20.	LEA, leather, fur & their products	72.	Leather tanneries & leather finishing	27.	TxtLthr
				73.	Manufacture of footwear & leather products	27.	TxtLthr
15.	LUM	21.	LUM, lumber & wood products	74.	Sawmill & preserved wood	28.	WoodPrd
				75.	Manufacture of plywood & the like	28.	WoodProd
				76.	Wooden building components	28.	WoodProd
				77.	Manufacture of furniture & fixtures mainly made of wood, bamboo & rattan	28.	WoodProd
				78.	Manufacture of other products mainly made of wood, bamboo & rattan	28.	WoodProd
				79.	Manufacture of non-plastic plait	28.	WoodProd
18.	OMF	22.	PPP, pulp, paper & printing	80.	Manufacture of pulp	33.	OthManufac
				81.	Paper & cardboard	33.	OthManufac

Table 6.1 (Continued)

No	GTAP Sectors used in the Study	No.	GTAP Database Sectors	No	Indonesian I-O Table Sectors	No	Indonesian Sectors used in the Study
				82.	Paper & cardboard products	33.	OthManufac
				83.	Printing & publishing	33.	OthManufac
17.	MIN	23.	P_C, petroleum & coal products	94.	Petroleum refineries products	18.	CoalOthMin
16.	CRP	24.	CRP, chemicals, rubber & plastic products	84.	Basic chemical except fertiliser	29.	Chemical
				85.	Fertiliser	30.	Fertiliser
				86.	Pesticides	31.	Pesticide
				87.	Synthetic resins, plastic, & fibre	29.	Chemical
				88.	Paints, varnishes & lacquers	29.	Chemical
				89.	Drugs & medicine	29.	Chemical
				90.	Native medicine	29.	Chemical
				91.	Soap & cleaning preparation	29.	Chemical
				92.	Cosmetics	29.	Chemical
				93.	Other chemical products	29.	Chemical
				96.	Smoked & crumb rubber	29.	Chemical
				97.	Tire	29.	Chemical
				98.	Other rubber products	29.	Chemical
				99.	Plastic products	29.	Chemical
17.	MIN	25.	NMM, nonmetallic minerals products	100	Ceramic & earthenware	32	MinMet
				101	Glass products	32	MinMet
				102	Clay & ceramic structural products	32	MinMet
				103.	Cement	32	MinMet
				104.	Other non-ferrous products	32	MinMet

Table 6.1 (Continued)

No	GTAP Sectors used in the Study	No.	GTAP Database Sectors	No	Indonesian I-O Table Sectors	No	Indonesian Sectors used in the Study
17.	MIN	26.	I_S, primary ferrous metals (iron & steel)	105.	Basic iron & steel	32	MinMet
				106.	Basic iron & steel products	32	MinMet
17.	MIN	27.	NFM, primary ferrous metals	107.	Non-ferrous basic metal	32	MinMet
				108.	Non-ferrous basic metals products	32	MinMet
17.	MIN	28.	FMP, fabricated metal products	109.	Kitchen wares, hand tools & agricultural tools	32	MinMet
				110.	Furniture & fixture primarily made of metals	32	MinMet
				111.	Structural metal products	32	MinMet
				112.	Other metal products	32	MinMet
18.	OMF	29.	TRN, transport industries	113.	Prime movers engine	33.	OthManufac
				114.	Machinery & apparatus	33.	OthManufac
				121.	Ship & its repair	33.	OthMnaufac
				122.	Train & its repair	33.	OthManufac
				123.	Motor vehicle except motor cycle	33.	OthManufac
				124.	Motor cycle	33.	OthManufac
				125.	Other transport equipment	33.	OthManufac
				126.	Aircraft & repair	33	OthManufac
18.	OMF	30.	OME, other machinery & equipment	115.	Electric generator & electrical motor	33.	OthManufac
				116.	Electrical machinery & apparatus	33.	OthManufac
				117.	Communication equipment & apparatus	33.	OthManufac
				118.	Household electronics appliances	33.	OthMnaufac

Table 6.1 (Continued)

No	GTAP Sectors used in the Study	No.	GTAP Database Sectors	No	Indonesian I-O Table Sectors	No	Indonesian Sectors used in the Study
				119.	Other electrical appliances	33.	OthManufac
18.	OMF	31.	OMF, other manufacturing	120.	Battery	33.	OthManufac
				127.	Measuring, Photographic & optical equipment	33.	OthManufac
				128.	Jewellery	33.	OthManufac
				129.	Musicals industries	33.	OthManufac
				130.	Sporting & athletics goods	33.	OthManufac
				131.	Other manufacturing industries	33.	OthManufac
20.	SVC	32.	EGW, electricity gas & water	132.	Electricity & gas	35.	Service
				133.	Water supply	35.	Service
20.	SVC	33.	CNS, construction	134.	Residential & non residential building	35.	Service
				135.	Construction on agriculture	35.	Service
				136.	Public work on road, bridge & harbour	35.	Service
				137.	Construction & installation on electricity, gas, water supply and communication	35.	Service
				138.	Other construction	35.	Service
19.	T_T	34.	T_T, trade & transport	139.	Trade	34.	TradTrans
				140.	Restaurant	34.	TradTrans
				141.	Hotel	34.	TradTrans
				142.	Railway transport	34.	TradTrans
				143.	Road transport	34.	TradTrans
				144.	Sea transport	34.	TradTrans
				145.	River & lake transport	34.	TradTrans
				146.	Air transport	34.	TradTrans

Table 6.1 (Continued)

No	GTAP Sectors used in the Study	No.	GTAP Database Sectors	No	Indonesian I-O Table Sectors	No	Indonesian Sectors used in the Study
20.	SVC	35.	OSP, other services (private)	147.	Services allied to transport	35.	Service
				148.	Communication services	35.	Service
				149.	Banking & other financial intermediaries	35.	Service
				150.	Insurance	35.	Service
				152.	Business services	35.	Service
				154.	Educational services	35.	Service
				155.	Health services	35.	Service
				156.	Other community services	35.	Service
				157.	Motion picture & its distribution	35.	Service
				158.	Amusement, Recreational & cultural services	35.	Service
				159.	Repair shops N.E.C	35.	Service
				160.	Personal & household services	35.	Service
20.	SVC	36.	OSG, other services (government)	153.	General government	35.	Service
				154.	Educational services	35.	Service
				155.	Health services	35.	Service
				156.	Other community services	35.	Service
				161.	Other goods & services N.E.C	35.	Service
20.	SVC	37.	DWE, ownership of dwellings	151.	Real estate & dormitory	35.	Service

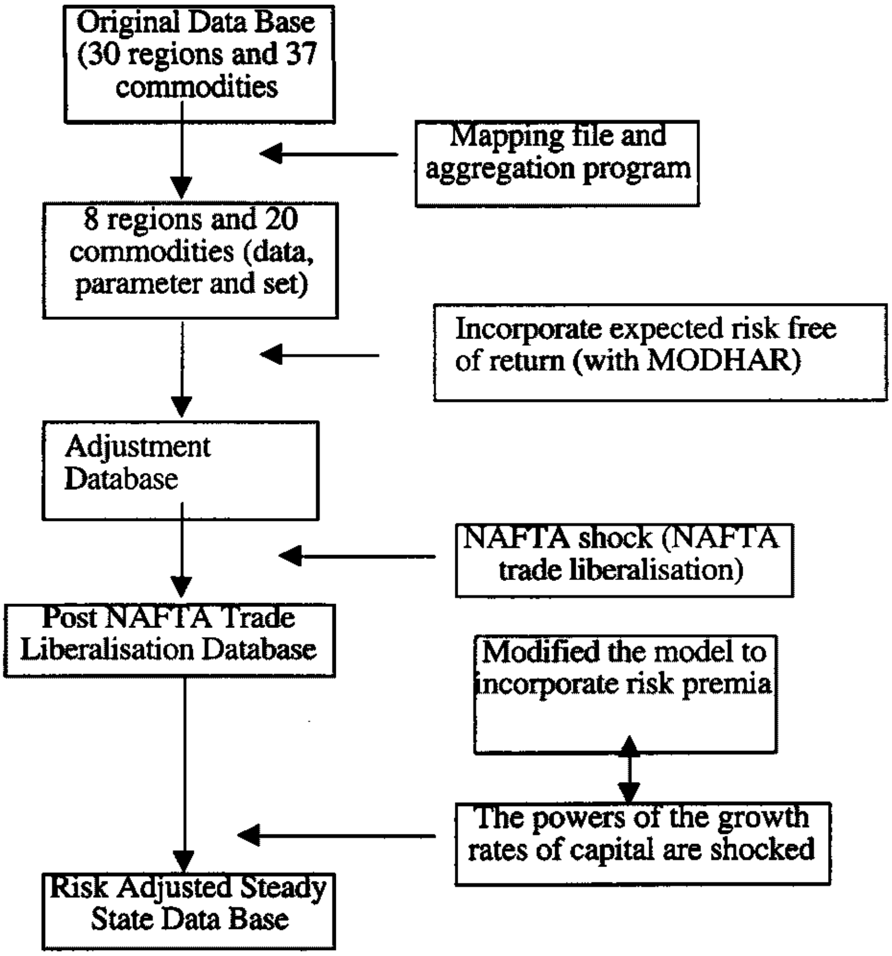
Table 6.2 Regional Aggregation for the GTAP Model

No	Countries forming a Region	Short Name
1	Australia, New Zealand	ANZ
2	Japan	JPN
3	Indonesia	INA
4	North America	NAM
5	Malaysia, Singapore, Philippines, Thailand	ASEAN4
6	Korea, China, Hongkong, Taiwan	OAPEC
7	Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, United Kingdom	EU12
8	Rest of the world	ROW

The NAFTA agreement, which eliminates tariffs in the agricultural, resource and manufacturing sectors among North America countries (the USA, Canada and Mexico), is allowed for by first running the GTAP model with exogenous shocks that remove those tariffs. The changes in the endogenous variables are used to update the initial equilibrium of the world economy to a Post-NAFTA position. Procedurally, this is done using the Shock Tablo facility of the GTAP package. This Tablo file is modified in the region and commodity setting, which is suitable with the research aggregation and produce the power of the tariffs shock to make the zero tariffs. The tariff shocks then is applied in order to get the post NAFTA trade liberalisation database. The latter is used in order to exclude the influence of the NAFTA agreement on the APEC trade liberalisation.

In order to obtain the risk adjusted steady state database, the GTAP model is modified to incorporate the long run steady state model with a risk adjusted and a non risk adjusted database. The expected risk free of return is incorporated in the database using the MODHAR program. This procedure follows Wamsley (1998) with the adjustment in commodities and regional setting. Again, using the Shock Tablo file facility in the GTAP package, the powers of the growth rates of capital required as shocks to the GTAP model in order to equate the growth rates of capital across regions, are produced. The risk adjusted steady state database is then obtained by a further run of the GTAP model, with the changes in endogenous variables being used to update the position of the economy.

Figure 6.1 The Modified Database



CHAPTER 7

RESULTS AND ANALYSIS

The impacts of APEC trade liberalisation on the Indonesian economy, particularly on its agricultural sector, are analysed in this chapter. Because of the dramatic change in the Indonesian exchange rate from mid 1997 and the possibility that this may affect the results of the general equilibrium analysis, the Indonesian database is first updated to 1997 using the historical data as outlined in section 5.9. In order to validly link the multi country GTAP model to the Indonesia model in a top down approach, it needs to be established that Indonesia can be treated as a small, price-taking, country. This is done in section 7.2 using market share data and GTAP simulations with Indonesia treated as isolated or not in APEC trade liberalisation. The results of the GTAP model under APEC trade liberalisation are presented in section 7.3. The impacts of trade liberalisation on the sectors of the Indonesian economy are calculated using exogenous shocks derived from the GTAP model with the long run steady state closure and the risk adjusted steady-state database. These results are presented and discussed in section 7.5.

7.1 The Updated 1997 Indonesian Database

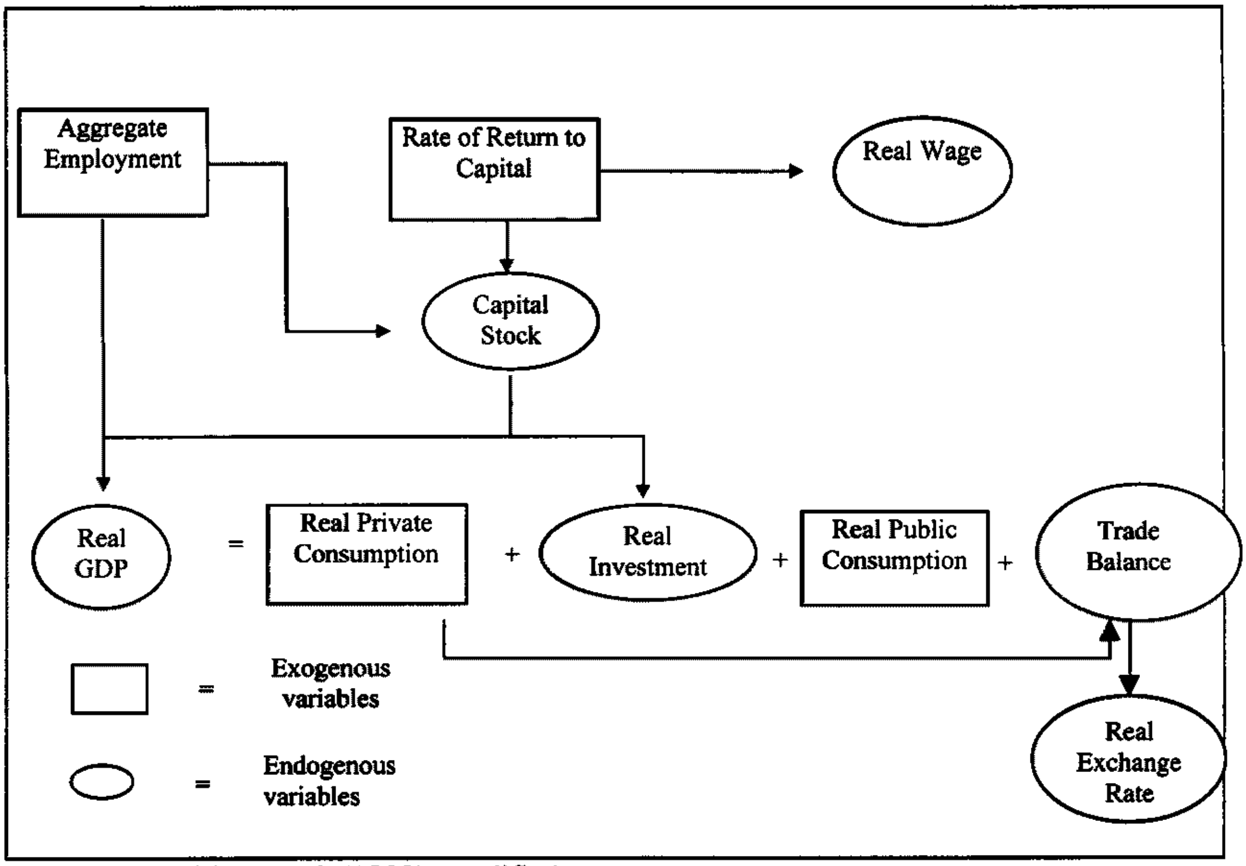
In CGE modeling, the notions of short run and long run have no particular real time connotations: they simply define time periods sufficient for the economy to have re-established alternative notions of equilibrium. Since the implementation of the APEC agreement is to be completed by 2010 for developed countries and 2020 for developing countries, there is less value in considering now the short term impacts that might arise in the future than the long run effects. The long run closure defines better the ultimate results of exogenous trade changes and is used in this study in obtaining the estimates of trade liberalisation effects. However, by the time that the changes are made, the factor endowments of the Indonesian economy will have changed, altering the macroeconomic and the sectoral economics of the nation.

Although there is some debate as to whether the changes to the database over a period of a decade or less would have significant effects on the analysis of other exogenous changes, an updated database was computed in the course of the present study. This is subsequently used (section 7.5) in assessing the impacts of trade liberalisation on Indonesia. The updating is achieved using the actual (i.e. the historical) data on the key macroeconomic variables as an exogenous closure of the Indonesian general equilibrium model.

The historical macroeconomic data consist of the aggregate demand and aggregate supply of the economy. Private and government consumption, capital formation, export and imports constitute the expenditure side of the economy. The supply side consists of employment and population. The historical simulation is depicted in Figure 7.1.

This macroeconomic closure follows the ORANI-F macroeconomic closure used by Horridge *et al.* (1993). One small modification concerns the exogenous variables on the expenditure side, namely real government consumption and real private consumption expenditure. In the present model, an exogenous change of real private consumption will influence the real balance of trade through the change on GDP expenditure; and the trade balance determines the real exchange rate. Real investment is set endogenously being determined by capital growth. In the ORANI-F macroeconomic closure, real public consumption and the trade balance are exogenous variables but not real private consumption. The trade balance still influences the real exchange rate. These small changes to the macroeconomic closure in the Indonesian model are applied to make as many as possible of the percentage changes of macroeconomic variables the same as the actual data (by giving the same amount of exogenous shock). On the income side, the rate of return on capital is set as an exogenous variable, which is determined by the world capital market. In this case, the Indonesian economy is treated as a small country facing an elastic supply of capital from the world capital market. The wage rate is determined endogenously in the simulation allowing the employment growth to influence the capital stock and real GDP.

Figure 7.1 Macroeconomic Closure for Historical Simulation



Source: Horridge, *et al.* (1993), modified

The updating of the database is done by using the Indonesian model with the ORANI-F investment specification, the fixed land specification (section 4.2.3), a fixed investment capital ratio, and some macroeconomic variable shocks to the model. The ORANI-F investment specification is chosen because the updated database is the by-product of a forecasting simulation (Horridge *et al.,* 1993). The fixed land specification is chosen because, for the period of next 7 years (1990-1997), it is assumed that land mobility is quite limited among the estate crops and food crops sector and also among manufacturing industries. The choice of a fixed investment capital ratio is somewhat arbitrary. Investment and capital stock data in each industry are not available. As mentioned in sections 5.6 and 5.7, the lack of these data for the Indonesian economy warrants examining of several alternatives for specifying investment and capital in each industry. After using several alternative ways of arriving at investment figures, the fixed capital ratio assumption was chosen because it seemed to provide a more acceptable solution and all further analyses incorporated this assumption. As mentioned in section 7.5, the alternative of using the value of depreciation and depreciation rate to calculate the beginning capital stock, some variables have unrealistically large capital growth rates. The macroeconomic variables that are shocked in the historical simulation in details of the percentage changes are explained in section 5.9.

The results from running the model, in particular the two endogenous macroeconomic variable values (the real investment and real GDP) were compared to the real macroeconomic changes in order to examine the consistency of prediction. Other macroeconomic variables which are the exogenous variables in the model, are shocked consistently with the actual data. The comparative data for the 1997 forecasting simulations are provided in Table 7.1. The table shows that the percentage change of real GDP (that is, from the actual 1990 real GDP to that in 1997) is almost the same in the historical data as in the simulation. The percentage change of real investment from the period of 1990 to 1997 is also almost the same in the historical data as the simulation.

The simulated data changes for the two key macroeconomic variables are quite similar to the real historical changes, suggesting the simulation is providing an acceptable update to the macroeconomic database while other macroeconomic variables are treated as the exogenous variables with the actual data shocks. The result is very sensitive with respect to the investment capital ratio assumption. Using sensitivity analysis, the closest result for both variables with the actual ones happen using 0.152 as an investment capital ratio.

Table 7.1 Actual and Simulated Changes in Key Macroeconomic Variables from 1990 to 1997 (Percentage change from the 1990 base case)

Variable	1990 – 1997	
	Historical Data	Simulation Result
Real GDP	59.46	59.41
Real investment	82.72	82.55

To be acceptable, the updated database also needs to be consistent with any published data of the economic structure in 1997 (Adams *et al.*, 1994). In this case, instead of comparing the macroeconomic changes of the updated database with the actual data changes, it is also important to compare the changes in sectoral data. In relation to Indonesian sectoral data, there are four sources of information: the Bank of Indonesia, FAO publications, FAO World Wide Web Home Page and CBS.

Data on commodity outputs are reported in Table 7.2 as percentage changes from 1990 to 1997. The table shows that there are differences between the percentage change of the output for each commodity after updating the 1990 database to 1997 database and the percentage change of each commodity according to these various data sources. There are also substantial differences between the four sources. For example, the percentage change of rubber production ranges from 29.73, 4.15, 29.73 and –1.74, whereas the updating in the present study suggests a change of 24.49 per cent.

Table 7.2 Forecast and Actual Percentage Change of Output in 1990-1997

Commodity	Output (1990-1997)				
	Forecast	Bank Indonesia	FAO Web page	FAO Publication	CBS
Paddy	19.47		9.02	24.02	9.20
Maize	25.47	36.35	38.29	38.48	30.07
Root Crop	22.52	-5.44	-90.48	4.31	-4.79
Beans	13.62	10.95	-8.74	-2.49	-8.04
Rubber	24.50	29.73	4.15	29.73	-1.74
Sugarcane	41.01	3.54	-0.77	2.23	-0.31
Coconut	41.85	21.31	21.37	-0.85	
Oil Palm	77.56	132.45	140.32	120.80	42.18
Coffee	43.29	17.68	16.62	-27.36	-9.80
Tea	15.45	4.52	-3.26	3.85	-8.29

Source: Bank Indonesia (1994) and (1998), FAO (1992) and (1997), FAO Home Page (http://www.fao.org/) 12 April 1999, CBS (1996) and (1998).

Differences in sectoral data from the various sources are seen not only in the output volumes but also in the data on import and export volumes. The reason for the differences in the data from the various sources is not fully clear. It is clear that these data themselves involve some estimation and the differences may occur because of different forecasting methods. Another possibility is that there may be minor differences in the specification/classification of commodities.

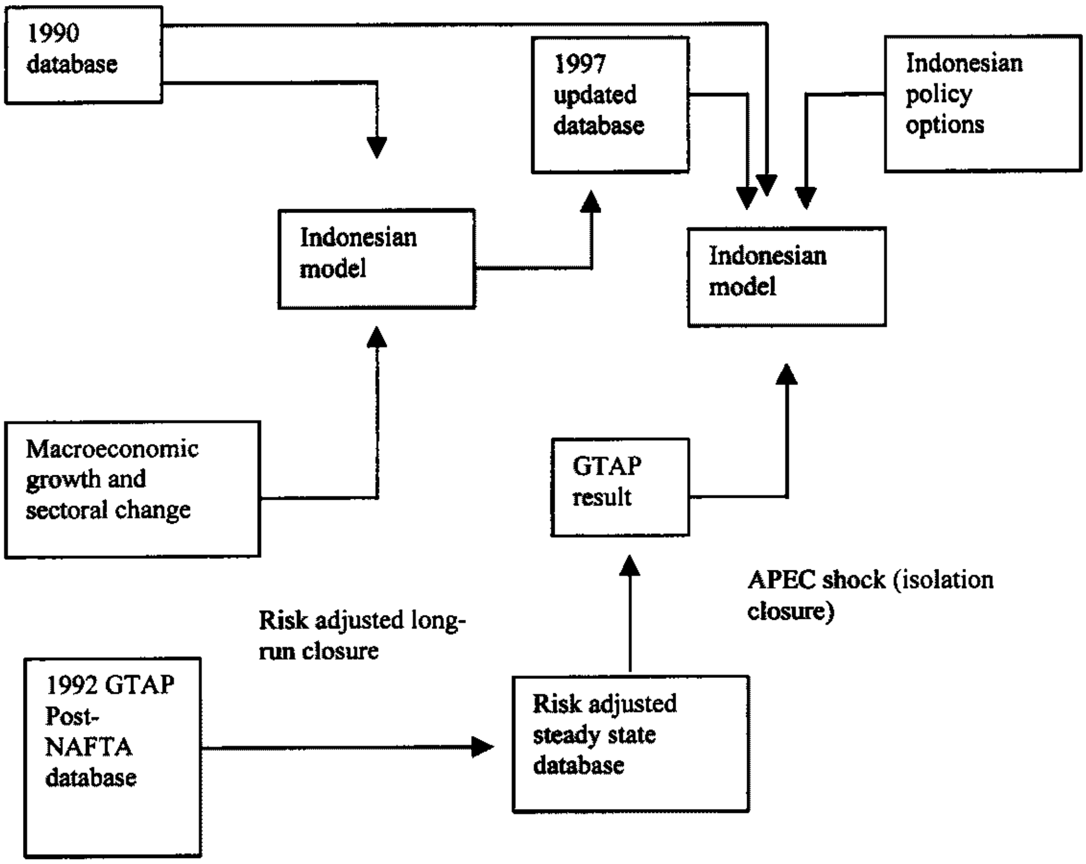
Because of the uncertainty about the causes of differences and of the precise way the data have been developed, it is difficult to decide which data source to accept as the most reliable and against which to compare the updated data from the present study. Nevertheless, it is clear that for some sectors, including many of the estate crops, the updated database has output values different from any of the four published sources, while for others, the simulated data fall within the range of published figures.

It is therefore possible that there are discrepancies between the data in the updated database and the actual real world situation in 1997. In the case of an updated database for the Philippines, obtained in a similar way to that used here, Buetre (1994) also found differences between the simulated changes and observed sectoral changes for some variables. In his simulation, he imposed equal percentage change in technology in each sector; and also equal change in consumer taste and "import twist". He argued that the differences occur because the actual consumer taste changes, technology changes, and import twist are not identical across commodities and industries. To reduce the problem, Buetre puts the actual sectoral changes which were known to him at the time of his study together with the actual macroeconomic changes as shocked exogenous variables. In the present study, the prediction data for primary factor productivity and the actual data for world export and import price in each sector and the macroeconomic variable changes have already been included as shocked exogenous variables. The detailed explanations of those shocks are provided in section 5.7.

Despite the potential errors in the sectoral details of the updated database, given the good results for the macroeconomic variables (Table 7.1) and recognizing that very high accuracy in the database may not be essential in studying exogenous changes, it is hereafter assumed that the updated database for 1997 is acceptable.

As previously explained, the analysis of the impacts of trade liberalisation on the sectors of the Indonesian economy involves two steps. Having updated the database, the second step is to use the updated database of 1997 and impose price shocks (import prices, export prices and tariffs) as suggested by GTAP simulations of APEC and APEC developed countries trade liberalisation. The structure of the analysis using the Indonesian model is illustrated in Figure 7.2. Further discussion is provided in the next section.

Figure 7.2 The Structure of the Analysis



7.2 Is Indonesia a "small" country?

The appropriateness of the small country assumption can be examined in the first instance by looking at actual shares of Indonesian exports and imports in world production and more particularly trade for individual products. From Table 7.3 it can be seen that the Indonesian import shares of the product aggregates to be used in the analysis were all less (usually much less) than 3 per cent of total world import value of the particular aggregate. Similarly, the export share of Indonesia in each commodity was less (usually much less) than 10 per cent. The biggest export share was in lumber and wood product (LUM) which was 9.58 per cent, followed by oil and gas at 4.83 per cent and non-grain crops (NGC) with 3.2 per cent. On these data, Indonesia is a minor player in all sectors, has a weak bargaining position and is a price taker in the world market, suggesting Indonesia can be taken as a small country.

Table 7.3 Indonesian share of world import value and share of world export value for product aggregates in 1992

Sector	Total Import to Indonesia (US$ million)	Total World Import (US$ million)	Import share of Indonesia (%)	Total Export from Indonesia (US$ million)	Total World Export (US$ million)	Export share of Indonesia (%)
PDR	2.82	489.97	0.58	0.05	471.17	0.01
WHT	378.32	13820.11	2.74	0.00	12861.25	0.00
GRO	6.13	11702.08	0.05	20.53	10786.65	0.19
NGC	989.43	75724.72	1.31	2388.17	66128.00	3.61
LVS	57.44	18632.26	0.31	95.47	16958.39	0.56
FOR	20.71	11311.57	0.18	48.97	8885.04	0.55
FSH	17.35	30937.31	0.06	1300.87	26742.46	4.86
C_M	435.84	86577.54	0.50	1799.55	78442.31	2.29
O_G	1067.52	220160.33	0.48	9946.57	205998.72	4.83
PCR	152.35	3886.91	3.92	9.07	3681.18	0.25
LVP	153.38	34552.73	0.44	64.09	31323.95	0.20
OFP	587.20	81030.43	0.72	1446.57	74618.16	1.94
B_T	81.61	31543.78	0.26	194.98	29912.47	0.65
T_L	1931.96	264926.72	0.73	8214.26	240155.00	3.42
LUM	79.16	66631.20	0.12	5515.51	57570.81	9.58
OMF	13516.51	1329515.00	1.02	2817.69	1261252.25	0.22
MIN	4166.31	297815.22	1.40	1920.19	276497.50	0.69
CRP	3882.11	303006.47	1.28	2206.07	288503.31	0.76
T_T	2352.60	325453.72	0.72	1543.06	325453.72	0.47
SVC	3178.83	315633.91	1.01	941.70	315633.91	0.30

Source: Calculated from GTAP database version 3.

In making the small country assumption, issues of country-specific product differentiation, imperfect substitution, spatial market power and the possibility that Indonesia may have more power in particular component products of the broad aggregates used are not considered. The individual estate crops do provide examples where Indonesian trade shares are greater but they are not more than 20 per cent of world exports. For example, in 1995, Indonesian palm oil exports were the second largest (16.46 per cent) after Malaysia (67.27 per cent) (FAO, 1995). One also needs to recognise the possibility that Indonesia apparent smallness may be reflection of the variious trade barriers that are to be relaxed under trade liberalisation. The later result in section 7.5 confirms that although Indonesia expands its trading activities under liberalisation, so do other countries and Indonesia remains a small player.

An alternative approach, less satisfactory in that it is not based directly on actual market behaviour and therefore not a real test of smallness. Furthermore, the effort to focus on whether the small country assumption to be made in linking the models is internally consistent with the GTAP model, is to explore the sensitivity of GTAP solutions under different treatments of Indonesia. In this case, the simulations use the post-NAFTA database and non-risk adjusted steady state of GTAP model (section 4.2.5). In Table 7.4, key results for the short and long run closures of the GTAP model, in particular the percentage changes in the terms of trade (TOT) and GDP of other APEC countries in response to the removal of tariffs are reported. It is evident that little is affected by whether Indonesia is isolated or not in either the short or the long run. However, the impact on Indonesia itself is quite significant regarding whether Indonesia is isolated or not under trade liberalisation. The positive percentage change of real GDP if Indonesia is not isolated is bigger than if Indonesia is isolated both in the short run and long run closure. It shows that it is better for Indonesia to open their market to the world market.

Table 7.4 Percentage Change in the TOT and Real GDP of APEC Countries with Indonesia Alternatively Isolated and Not Isolated in the Short Run and Long Run Closures

	Terms of Trade (TOT)				Real GDP			
Countries	Short Run		Long Run		Short Run		Long Run	
	Not Isolated	Isolated	Not Isolated	Isolated	Not Isolated	Isolated	Not Isolated	Isolated
ANZ	3.16	3.02	2.3	2.13	0.29	0.27	1.65	1.59
JPN	6.73	6.72	6.46	6.42	0.58	0.57	0.64	0.64
INA	-0.27	0.81	-0.7	1.27	0.47	0.03	4.62	0.01
NAM	-2.04	-2.06	-2.04	-2.09	0.04	0.03	-0.29	-0.28
ASEAN4	-0.96	-0.99	-3.09	-3.12	0.82	0.55	19.58	19.5
OAPEC	0.03	-0.07	-0.87	-0.98	2.06	2.06	7.64	7.57
EU	-2.49	-2.45	-1.74	-1.71	-0.07	-0.07	-1.47	-1.45
ROW	-1.05	-1.05	-0.59	-0.57	-0.13	-0.13	-1.67	-1.64

7.3 APEC Trade Liberalisation: GTAP Model Results for APEC Countries

The impact of APEC trade liberalisation on APEC members and other countries is simulated using the GTAP model. Results are obtained first using the Post-NAFTA GTAP database and, second, using the risk-adjusted steady state version of the Post-NAFTA database. Both short and long run closures are studied for the Post-NAFTA database. Risk-adjusted steady state long run closure is studied for the risk adjusted steady state version of Post-NAFTA database. Subsequently, the results from the risk adjusted long run closure of the GTAP model which is applied to the risk adjusted steady state database are used to specify exogenous shocks for the Indonesian general equilibrium model in order to analyse the impacts of APEC trade liberalisation on the Indonesian economy.

The simulation of APEC trade liberalisation involves eliminating all tariff barriers in all APEC countries. In the GTAP database version 3, the distortion between the world price and domestic price is due to the tariff barrier and non-tariff barrier whereby the non-tariff barrier have been converted to nominal tariff rate equivalent (McDougall and Hertel, 1997). The average tariffs applied in APEC and non-APEC countries prior to trade liberalisation are reported in Table 7.5. The rates can be calculated from the average power of the import tariffs (*TMS*) (see section 4.3).

Table 7.5 Average Tariff Rates (%) by Region and Commodity from the Post-NAFTA Database (Updated from GTAP database version 3, 1992)

	ANZ	JPN	INA	NAM	ASEAN4	OAPEC	EU	ROW
PDR	8.33	493.33	9.25	4.22	31.11	0.00	82.00	7.57
WHT	0.24	307.99	0.00	9.69	257.81	86.74	57.00	9.24
GRO	0.00	335.98	6.36	7.88	297.98	300.74	74.00	8.16
NGC	2.88	42.00	54.69	37.74	33.52	33.33	50.00	32.08
LVS	0.00	0.76	5.39	1.43	57.67	40.35	1.12	16.30
FOR	0.00	0.00	14.68	0.70	9.77	3.83	0.01	5.00
FSH	0.07	4.97	29.20	1.48	25.06	15.83	6.58	11.86
C_M	0.50	0.00	3.58	0.56	6.96	1.31	0.17	9.44
O_G	0.15	2.91	0.02	0.37	3.96	4.94	0.03	5.86
PCR	0.76	36.45	0.00	8.94	57.19	-5.80	57.00	9.37
LVP	8.21	299.29	15.79	24.17	102.31	43.79	73.84	37.35
OFP	3.52	13.75	12.28	5.83	21.99	15.38	9.36	19.05
B_T	7.50	11.67	23.78	5.44	34.84	47.56	22.86	41.64
T_L	30.77	11.47	27.01	13.21	20.74	30.64	10.59	24.02
LUM	9.80	3.01	34.46	1.49	13.41	13.06	2.12	11.48
OMF	12.72	1.41	15.97	7.66	13.35	16.68	6.72	14.48
MIN	9.92	2.70	10.46	3.85	11.27	10.91	2.87	14.73
CRP	8.13	4.01	6.35	7.17	14.86	13.93	12.32	12.98
T_T	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SVC	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.01

Source: Calculated from Post-NAFTA GTAP database

As can be seen in Table 7.5, most APEC countries, especially in East Asia, have applied relatively, and in some cases absolutely, high effective tariff rates on agricultural products as well as agricultural processing. For example, in 1992 Japan levied tariffs at rates of 493 per cent for rice, 307 per cent for wheat and 336 per cent for grain crops. Malaysia, Singapore, the Philippines and Thailand (ASEAN4) applied tariffs for wheat and grain crops at rates in excess of 250 per cent. Non-tariff barriers have played a very important role, particularly for agricultural products and are responsible for the high tariff rates of these products (McDougall and Hertel, 1997). In contrast, Australia and New Zealand (ANZ) applied almost zero tariff rates for wheat and grain crops, livestock, fishery and forestry sector. These two countries applied higher tariffs (31 per cent) on textile and leather, at rates comparable with most other APEC countries.

The high tariff rate in agricultural product in some countries needs to be considered for further observation to updated the tariff measurement. Hertel (GTAP mailing list communication, 1999), has explained that high tariffs on agricultural products were due to non-tariffs being applied when world prices for farm products in the pre-Uruguay Round in the late 1980's were low (the source of GTAP database version 3). In version 4 of the GTAP database, the effective rates of tariff protection are lower. The high prices of the world price of farm product in version 4 of the GTAP database reduces the measured average tariff rate.

Either database can be used to estimate the effects of the simultaneous elimination of tariffs, though the estimates will be different. In all the analysis reported here, the version 3 database is used. In the APEC agreement case, the impact of these policies are reported in Table 7.6. Both the short and long run impacts are reported from the Post-NAFTA database using the non-risk-adjusted method.

Table 7.6 Short-run and Long-run Model Results of APEC Trade Liberalisation with the Post-NAFTA GTAP Database in Percentage Change

Region	Short-run		Long-run	
	Real GDP	Current rate of return	Real GDP	Value of the beginning period of capital
ANZ	0.29	5.1	1.65	3.75
JPN	0.58	2.07	0.64	0.14
INA	0.47	4.35	4.62	7.13
NAM	0.04	1.24	-0.29	-0.89
ASEAN4	0.82	14.37	19.58	29.27
OAPEC	2.06	10.37	7.64	13.43
EU	-0.07	-0.49	-1.47	-3.32
ROW	-0.13	-0.31	-1.67	-3.34
rorg (global rate of return)	1.57		1.94	
Avgrow (average capital growth)	0.05		0.00	
kb_tot (total beginning-of-period capital stock)	0.00		-0.98	
Globalcgds (global supply of new capital goods)	0.33		0.84	

Source: Calculated from the Post-NAFTA GTAP database

Under both closures, the real GDP of all APEC countries is estimated to increase following APEC trade liberalisation, with one exception, namely North America in the long run closure. The elimination of the high tariffs applied in APEC countries will bring about an increase of real GDP. The removal of capital import protection increases the downward pressure on real capital rental rates and increases the rate of return on capital. Moreover, in the long run, because the capital stock is then allowed to change and increase, the improvement of GDP is generally greater than in the short run for all APEC countries, except for North America. A decrease of the value of the beginning period of capital in North America is associated with a negative percentage change of the real GDP. In APEC countries except North America, the positive percentage change of real GDP in the long run is bigger than those in the short run, which is also related to a high-expected global rate of return in the long run (1.94 per cent) compared to 1.57 per cent in the short run.

In contrast to the APEC countries, the non-APEC countries (EU and ROW), which do not eliminate their protection in these simulations, will lose in the short run and will be even worse off in the long run. As can be seen in Table 7.5, the European Union applies high tariffs for agricultural products before liberalisation, for example the tariff for paddy is 82 percent and for non-grain crops is 74 percent. Even though for other commodities the tariffs applied are not as high (below 40 per cent), the tariffs still influence the imported price input. The higher cost of imported capital inputs for their industries compared to APEC countries because tariffs are not removed in the European Union and Rest of the World, means there is a loss of competitiveness of their industries and decreases the real income of these sectors.

Table 7.6 also shows that global capital (Kb_tot) is estimated to fall by 0.98 per cent in the long run as a result of trade liberalisation. On the other hand, global net investment (globalcgds) rises by 0.84 per cent in the long run. As explained in section 4.2.5, the long run closure imposes equality of the percentage change of current and expected rates of return and forces the percentage change in capital growth zero. This requirement will also mean that the percentage change of capital stock in each region will be the same as the percentage change of gross investment. However, the result shows that the percentage change of global capital, which is the sum of the weighted average of capital stock, is not the same as the percentage change of global net investment, which is the sum of the weighted average of investment in each region. Therefore it can be concluded that the initial database is not consistent with the long run condition.

The initial database is also not consistent with the steady state assumption (see section 4.2). In Table 7.7 the capital growth data are not the same in all countries and not all equal to the average capital growth. The latter is assumed to be the steady state growth rate of capital in this research. Moreover, the expected rate of return is also not the same in all countries and not all equal to the average expected rate of return. Therefore the initial database needs to be adjusted to fulfill the requirement of the long run steady state condition.

To properly analyse the long run impacts of trade liberalisation, the benchmark database needs to be first converted to a steady state database. Walmsley (1998), as well as this research, has found that the calculated changes in capital stock and real GDP working from a steady state database tend to be bigger than those simulated from the standard benchmark database. As explained is section 4.2 and 6.2, the steady state database can be risk adjusted or non risk adjusted. Preliminary trial simulations were done to create both the risk-adjusted and the non-risk adjusted steady state databases. The changes in the real GDP and capital in moving to the steady state databases can be seen in Table 7.8.

Table 7.7 Capital Growth (KBGROWTH(r)), Average Growth (AVGROWTH), Expected Rate of Return (ROREXP(r)) and Average Expected Rate of Return (AVROREXP) Data in Per Cent

Region	KBGROWTH (r) and AVGROWTH	ROREXP(r) and AVROREXP
ANZ	1.015	0.072
JPN	1.053	0.058
INA	1.094	0.127
NAM	1.019	0.099
ASEAN4	1.088	0.084
OAPEC	1.091	0.062
EU	1.027	0.098
ROW	1.024	0.010
AVGROWTH	1.032	
AVROREXP		0.090

Source: Calculated from the Post-NAFTA GTAP database

Table 7.8 Changes in Real GDP and Capital Stock Due to Building Risk-adjusted and Non-Risk-Adjusted Steady State Databases (Per cent)

Country	Risk-adjusted Steady State Database		Non-risk-adjusted Steady State Database	
	Real GDP	Capital Stock	Real GDP	Capital Stock
ANZ	-3.27	-9.9	-17.4	-41.1
JPN	5.99	14.9	-10.5	-25.1
INA	26.32	48.4	257	689
NAM	-2.16	-6.7	-1.7	-5.5
ASEAN4	28.94	50.4	65.8	123
OAPEC	20.71	55.4	7.28	18.2
EU	-1.46	-3.7	1.99	4.4
ROW	-2.38	-5.7	0.78	0.89

Based on the preliminary simulations, the risk-adjusted steady state database as described earlier in sections 4.2 and 6.2 is used subsequently since this allows the expected rates of return to differ between region in recognition of differences in regional risk premium. The risk-adjusted steady state database assumption is considered more realistic representation than forcing the same expected rate of return on all countries (non risk-adjusted steady state database assumption). Table 7.8 shows that in converting the Post-NAFTA database to a non-risk-adjusted steady state database, large changes in capital are observed for some countries. For example, the capital stock increases by 689 percent in Indonesia and 123 percent in other ASEAN countries from the benchmark database. Walmsley (1998) also found high percentage changes of capital stock (more than 150 percent) in Indonesia, Thailand-Philippines and Taiwan. Such high percentage changes are unrealistic as are the implied capital stocks in the non risk-adjusted steady state. To avoid assessing trade liberalisation from a nonsensical starting point for the economy, the study here uses the risk-adjusted steady state database to obtain the long run estimates. In this regard, this study follows Walmsley (1998).

Table 7.9 reports the long run economic growth, economic income, economic expenditure, and trade effects of the APEC trade liberalisation using the risk-adjusted steady state database. Eliminating tariffs in all APEC countries reduces the economic performance of non-APEC countries, while in all APEC countries, real GDP increases. This result is the same as that found in other research, for example, the studies by Murtough *et al.* (1994), and Hertel *et al.* (1995) and Walmsley (1998). GDP value, as opposed to real GDP, also increases in all APEC countries except for North America.

The behaviour of GDP real and GDP value can be analysed from either the income side or expenditure side. The income side consists of earnings from capital, labor and land. In most Asian countries, the capital rental (rate of return) decreases, with the biggest percentage change occurring in ASEAN4 (Malaysia, Singapore, Thailand and the Philippines). The reduction in capital costs associated with trade liberalisation is due primarily to the reduction of tariffs on the duty-paid prices of imported inputs to investment and the reduction of average cif-prices of imported capital goods relative to the GDP deflator (Adams *et al.*, 1998).

Table 7.9 The Long Run Effect of APEC Trade Liberalisation on Macroeconomic Variables of Regions other than Indonesia with Risk-adjusted Method on Risk-adjusted Steady State Database

	Capital rental	Labor wage	Land rental	Real GDP	GDP value	Terms of Trade	Private household expenditure	Export volume	Export value	Import volume	Import value
ANZ	-0.8	5.6	53.0	3.1	4.4	1.6	4.0	16.2	20.2	17.6	18.2
JPN	7.1	10.3	-14.0	2.2	9.3	7.8	8.8	8.7	16.8	30.7	29.3
NAM	-3.7	-1.7	29.8	1.1	-2.3	-3	-2.0	14.7	11.8	9.1	9.3
ASEAN4	-4.6	22.8	16.9	26.0	17.4	-4.1	15.0	41.7	36.4	42.6	43.1
OAPEC	-0.4	13.5	1.8	10.4	8.7	-1.6	7.2	35.1	33.4	44.1	45.3
EU	-1.3	-1.2	-2.5	0.1	-1.1	-0.8	-1.0	-1.3	-2.4	-1.4	-1.9
ROW	-1.1	-1.0	-2.9	-0.1	-1.1	-0.4	-1.0	-0.4	-1.4	-0.5	-1.2

The relationship between capital rental and wage rates can be seen in the structure of GTAP framework (Hertel and Tsigas, 1997). In the two input case, the elasticity of substitution between the inputs is defined as the percentage change in the ratio of the input demands, given a change in the inverse of their price ratio. In percentage change terms, the one can write:

$$(q_1 - q_2) = \sigma_{12}(p_2 - p_1) \qquad (7.1)$$

where:

$q_{1,2}$ = percentage change of input quantity 1 or 2

$p_{1,2}$ = percentage change of input price 1 or 2

σ_{12} =elasticity of substitution between input 1 and 2

If input 1 is labor and input 2 is capital and the quantity of labor is exogenously set to zero change in the long run closure, change in capital rental and labor wage will be accommodated by a change in capital.

Based on equation 7.1, a decrease in capital rental will encourage investment and finally the real GDP. Because there is a large decrease of capital rental in ASEAN4 countries, the countries will experience a large increase in real GDP. Another income side item is labor wages, which increases significantly in all APEC countries except North America following trade liberalisation. The large size of the increase in wages reflects the low labor wage levels in some APEC countries before trade liberalisation, especially in South East Asia compared to developed countries. In APEC developing countries, especially with large populations, the ratio of factor payments of capital and labor is relatively high (more than one).

The land rental in all APEC countries, except Japan, also increases. Depending on the share of land income in GDP, this item contributes to a positive percentage change in the real GDP for APEC countries.

Because agricultural production and processing are subject to relatively higher import tariffs than the rates of producer and export subsidies and are also higher than the tariff rates in non-agricultural sectors, trade liberalisation tends to affect the agricultural sector relatively more. For example, Japan applied a high tariff on agricultural imports and it experiences a positive percentage change in its terms of trade because of a fall in the aggregate import price after the elimination of import tariffs. Agricultural exporting countries such as Australia and New Zealand also experience improved terms of trade.

Agricultural production in Australia and other APEC countries has often received assistance from government leading to increased supplies and to decreased world agricultural prices (Murtough, *et al*, 1995). The results here show that removing the assistance leads to higher prices in the world market. This has a positive impact for Australian and New Zealand as exporting agricultural products. The trade liberalisation leads to a deterioration in the terms of trade for ASEAN4 countries because most of exports from these contries are to the EU and ROW (Table 1.3), countries which have not reduced their tariffs in the simulation. The non-APEC countries, which do not reduce their tariffs here, serve to limit the increase in the average export price.

When viewed from the expenditure side, the changes in GDP relate to changes of private household expenditure and net exports. Private household expenditure increases in all APEC countries except North America to bring about an increase of the GDP expenditure in all APEC countries. Trade liberalisation increases the export value and volume as well as imports in all APEC countries. In all countries except North America, the increase in export volume is less than the increase in import volume. Data indicates that other countries which are not signatories of the APEC agreement (the Rest of the World and Europe Union), will suffer a decrease in both export and import value and volume because of APEC trade liberalisation and a decrease in their trade balances.

Thus far, the impact of APEC trade liberalisation on APEC and non-APEC countries has been considered only in terms of macroeconomic variables and not in terms of the sectoral implications for any country. The impact on Indonesia is analysed in more detail both macroeconomically and for individual sectors, especially the agricultural and agricultural processing sectors in the next section using the changes to world import prices, world export prices and Indonesian tariffs because of APEC trade liberalisation.

7.4 GTAP-simulated Changes in Prices for Indonesian Imports and Exports and Effective Tariffs

Table 7.10 reports the GTAP results for Indonesian trading prices based on the long run closure and the risk adjusted steady state database, and tariffs changes which are based on different assumption. Two simulations are reported: one for full APEC trade liberalisation (left hand section of Table 7.10), and one for trade liberalisation just by the developed APEC countries (in the middle of section of Table 7.10). In both APEC trade liberalisation simulations, Indonesia is treated as an isolated country, that is, its import and export quantities are held fixed, while the prices it faces vary endogenously as do the tariff rates needed to maintain these imports and exports. The last two columns of Table 7.10 do not relate to the GTAP results themselves but relate to the tariff rates applying in Indonesia, first based on the Post-NAFTA database before trade liberalisation; and second, on the updated database after all APEC countries (except Indonesia) have reduced their tariffs (see section 4.3.2). The reported figures are the percentage changes needed to the powers of the Indonesian tariffs implicit in these databases to fully remove Indonesian tariffs. The impacts of full APEC trade liberalisation are discussed first.

Table 7.10 Indonesian Import and Export Weighted-Average Price Changes and Tariff Changes Simulated Using the Risk Adjusted Steady State Database (Percentage Change)

Commodities	APEC[1]			APEC Developed countries[2]			tms-ave (original)[4]	tms-ave[5]
	pcif-ave	pfob-ave	tms-ave	pcif-ave	pfob-ave	tms-ave		
PDR	10.49	25.18	-9.35	1.61	1.19	0.00	-8.25	2.36
WHT	3.94	0.00[3]	-4.65	-0.36	0.00[3]	-4.74	0.00	5.83
GRO	-0.62	15.72	-0.01	3.05	1.74	0.00	-5.98	-5.78
NGC	3.06	15.84	-3.71	0.61	10.25	-9.96	-35.36	-32.69
LVS	4.21	-3.22	-4.41	1.49	2.94	-0.37	-5.09	-0.44
FOR	-2.05	7.49	1.65	-2.53	1.17	0.00	-12.69	-14.06
FSH	2.40	7.16	-2.94	1.67	2.75	-0.34	-22.65	-20.24
C_M	-0.38	2.56	-0.48	-0.11	0.65	0.00	-3.47	-2.93
O_G	-1.44	2.00	0.58	-0.14	1.40	0.00	0.00	-0.58
PCR	8.31	-0.43	-8.05	2.2	-0.07	0.00	0.00	9.43
LVP	1.79	4.69	-2.49	0.24	3.06	-6.50	-13.62	-11.18
OFP	-6.11	-1.38	6.00	0.5	-0.01	-0.68	-10.76	-15.45
B_T	-1.94	6.45	1.25	0.08	3.15	-4.89	-19.14	-20.10
T_L	-3.58	-1.30	1.72	1.72	2.90	-1.72	-21.56	-22.71
LUM	2.45	8.11	-2.92	1.97	4.56	-5.02	-25.47	-22.98
OMF	2.10	1.66	-2.64	2.24	1.83	-1.99	-13.61	-10.93
MIN	0.69	4.12	-1.24	1.68	1.96	-1.27	-9.36	-8.08
CRP	-0.08	3.55	-1.24	0.99	2.59	-1.67	-6.09	-4.70
T_T	-0.66	0.86	-0.27	-0.4	0.80	0.00	0.00	0.37
SVC	-0.44	0.06	-0.51	-0.19	0.02	0.00	0.00	0.61

[1] APEC tariffs are removed in all APEC countries excluding Indonesia

[2] APEC tariffs are removed in all APEC developed countries

[3] The zero value is because Indonesia is not an exporting country for wheat.

[4] Percentage changes needed to the powers of the Indonesian tariffs to removed those tariffs, calculated from the Post-NAFTA database

[5] Percentage changes needed to the powers of the Indonesian tariffs to removed those tariffs, calculated from GTAP database after removing tariff and non tariff barriers of all APEC countries except Indonesia.

As anticipated, there is a positive impact on Indonesian export commodity prices. The fob prices of almost all commodities have increased and this is especially so for the agricultural commodities. This is not surprising, given that most countries applied high tariff and non-tariff barriers for agricultural products (see Table 7.6). Moreover, of the agricultural commodities, the paddy rice and non-grain crops experience the highest percentage increases in fob prices, 25.18 and 15.84 per cent, respectively. The result is encouraging for Indonesia as an agricultural exporting country, especially for non-grain crops which provide the main agricultural export commodities (see section 1.1).

On the import side, the direction of price change is less uniform. The cif prices for several commodities decrease, for example other food products (OFP) and textile and leather (L_T), by -6.11 and -3.58 per cent respectively. Imports of some commodities, namely those which have a positive change, become more expensive. In the agricultural sector, rice (PDR), wheat (WHT), non-grain crops (NGC), livestock (LVS) and fish (FSH) all experience an increase in import prices. These rises in cif prices reflect the fact that Indonesia has applied trade barriers on these imported agricultural commodity in order to protect and encourage domestic production in meeting domestic demand. Especially for rice, as a staple food with price-inelastic demand, an increase in the cif price will increase the import value given the exogenously fixed import quantity.

The changes in the Indonesian tariff rates (powers are averaged across supplying countries using market shares) under full APEC trade liberalisation consistent with no change in Indonesian exports and imports volume are determined endogenously in the GTAP simulation. The changes vary among commodities. The largest tariff change is for paddy (a 9.35 per cent decrease) because many countries applied high tariff rates before trade liberalisation causing relatively low world trade rice prices. With a rise in prices, tariffs must be decreased to maintain the imports status quo.

The next three columns of Table 7.10 show the percentage changes in import prices, export prices and tariffs for Indonesia to remain isolated when only the developed countries in the APEC region liberalise their trade. For most of the commodities, the percentage changes from base levels are less than those from full APEC trade liberalisation. For example, the fob prices of some Indonesian main exports such as non grain crops, oil and gas and forestry all increase less than if all APEC developing countries also join the APEC trade liberalisation. This reflects the fact that besides trading with developed countries, Indonesia also trades with other

APEC developing countries (see Table 1.5 and 1.6 for share of imports and exports value to and from Indonesia).

In the next section, the tariff changes calculated in these GTAP simulations are imposed as shocks in the Indonesian Forecasting Model. However, two alternatives for specifying the shocks to the Indonesian tariffs are also used there (see section 4.3.2). The first alternative is to calculate implied Indonesian tariffs directly from the Post-NAFTA database and to shock the power of the tariffs to reduce these to zero. The second alternative is to calculate the implied tariffs for Indonesia from the database updated after reducing the tariff and non-tariff barriers of all APEC countries except Indonesia; and to shock the powers of the tariffs to reduce these rates to zero. The final two columns of Table 7.10 report the calculated required shocks. A positive percentage change of the power of a tariff means that Indonesia must reduce the import subsidy on that commodity, whereas a negative change means a tariff must be reduced.

The required changes in the powers of the tariffs under these two approaches are larger than those based on the endogenous changes of both scenarios of APEC trade liberalisation. The two new sets of changes are not too dissimilar except for wheat, paddy rice and processed rice, all of which have a positive sign in the last column of Table 7.10 but negative signs in the second last column. The differences in the two sets of changes are in fact related to the tariff rate changes determined in the GTAP runs. Under the Post-NAFTA database, Indonesia has import barriers on most commodities, and no subsidies. For Indonesia to remain isolated under trade liberalisation, it generally must reduce its tariff barriers, as indicated by the changes calculated in the GTAP runs. Most of these changes are small, so the final two columns are generally similar. Only when there is a large change in Indonesia's tariffs from GTAP will the last two columns differ much. For the three commodities mentioned, the reductions exceed the initial barriers, meaning that subsidies are needed to maintain Indonesia's isolation. These implied subsidies must be removed in liberalising trade. These commodities have been monopolised by the government through the BULOG (Food Logistics Agency). BULOG controlled the price, imports, exports, and domestic marketing of major crops such as rice, sugar, soybeans, wheat and flour. The objective of BULOG's monopoly on those markets was to stabilise the domestic price on the world price trend (see section 2.8.2). So when world prices for these commodities alter with the removal of their trade distortions, the prices can easily rise above the Indonesian domestic prices.

Which of these sets of shocks to the Indonesian tariffs is most relevant? If the aim is to identify how the Indonesian economy will be affected as she and other countries remove their import protection, the final column of Table 7.10 is the relevant one. The shocks here remove the implied tariffs that would apply were Indonesia to be importing and exporting after APEC trade liberalisation exactly what it was before liberalisation. The shocks in the second last column change tariffs as they existed prior to trade liberalisation. These will not exactly remove tariffs as they exist after liberalisation. In general the tariff changes in this set will be excessive, since Indonesia's implied tariff barriers generally fall as world prices rise under liberalisation. This set of changes will mean, in effect, that Indonesia introduces subsidies on imports. It would be anticipated that the benefits of trade liberalisation for Indonesia would be less under this set of distortionary tariff shocks. Finally, shocks equal to the tariff rate changes generated by the GTAP runs do not constitute removal of Indonesia's tariffs but alterations in tariffs to compensate for the altered world prices.

In section 7.5.2, the results from both scenarios of APEC trade liberalisation are used as exogenous shocks, along with tariff rate changes, in the Indonesian Forecasting Model to simulate the impact of trade liberalisation on Indonesia in more detail.

7.5 The Long Run Impacts of APEC Trade Liberalisation

As discussed in sections 4.1.2, 4.1.5, 5.6 and 5.7, the Indonesian general equilibrium model has been developed to allow some flexibility in its precise specification. The database in Indonesian Model is not uniquely defined since there are some alternatives for arriving at some items of important "missing" data. Decisions have first to be made in relation to these details in order to develop the estimates of the effects of trade liberalisation.

7.5.1 Sensitivity of Results to Data and Model Specification

In relation to model specification, the model includes three investment specifications (the ORANI, ORANI-F and Walmsley investment specifications) and three types of land mobility (land immobile among industries, land mobile among food crops and estate crops, and land mobile among all industries). In the construction of an Indonesian database for 1990, for which there is no immediately available full set of information on capital stock and investment in each industry, there are three alternatives for calculating the capital stock and two alternatives for calculating the investment data. The beginning of capital stock can be calculated from predetermined depreciation rates and the value of depreciation in each industry, predetermined investment capital ratios, and an average of these two. The investment data can be calculated by assuming the share of investment in each industry is either the same as the share of return to capital in each industry, or the same as the share of investment data of the Capital Investment Coordinating Board. An explanation of each of these approaches is provided in sections 5.6 and 5.7.

Given the flexibility in the model and the various possible assumptions in making the database, there are numerous simulations that can be done to estimate the impacts of trade liberalisation. The appropriate choice of assumptions and formulation is not well guided by theory, so a number of model runs to predict the impacts of liberalisation was completed initially. The results were then examined for the presence of economically unrealistic results before settling on a preferred set of assumptions under which the main results on trade liberalisation were derived. While the questions of data specification and model specification should perhaps be considered simultaneously and using a formal experimental design to allow for the possibility that there are interactions between the two, in practice, the two aspects were essentially considered independently and in a relatively informal analysis in this study. The most economically sensible results were obtained from using an exogenously set capital-investment ratio and known aggregate investment to calculate the aggregate value of beginning capital stock, and using the known proportions of the capital stock as the investment shares to calculate the investment in each industry.

The results obtained using the other two approaches to data specification led to economically non-sensible figures. For example, if the known value of depreciation was used together with assumed depreciation rates to calculate the beginning capital stocks, the expansion in some commodities was unbelievable. That is, the capital growth for coconuts was calculated as 64 times or 6400%. It is clearly unrealistic, and excessive compared to other commodities. The alternative method of calculating sectoral investment levels by taking the share of investment from the domestic investment approval data reported by the Indonesian Investment Coordinating Board (Table 5.7) also gave rise to economically unrealistic results. For example, the capital growth rates for coconuts, other agriculture and chemicals were calculated as 16, 34 and 4 times, respectively. As discussed in section 5.6, the investment data reported by the Investment Coordinating Board only consists of the investment that has been approved by government and relates only to large companies. For much of agriculture, and probably other sectors, this investment data and the shares calculated are likely to be unreliable as estimates of shares of actual investment. Moreover, in making the data consistent with the steady state condition, there is a large percentage decrease in real GDP (379 percent). Even though the macroeconomic results of the impact of APEC trade liberalisation when using this steady state database are economically sensible, for example the real GDP change is 5.18 per cent, the result is suspect because it is based on a dubious database.

In relation to land mobility between sectors, the choice of specification can be made more positively. In generating the estimates of the impacts of trade liberalisation, land is assumed to be mobile among estate crops and food crops, with no mobility between other sectors. This choice, from amongst the three alternatives regarding land mobility, is based on the notion that the land used in these sectors is agronomically suitable to the range of estate crops and secondary food crops. The time period associated with the long run effects of trade liberalisation, starting in 2010 and 2020 for developed and developing countries respectively, is sufficient to allow the economic replacement of these crops and the reallocation of land use within this form of agriculture. Preliminary simulations show that the results of using the assumption of land mobility among estate crops and food crops, and fixed land in each other industry are smaller impacts compared to assuming land mobility among all industries, as would be expected.

Having settled on the assumption of land mobility within estate and food crops and the specification of a set capital-investment ratio, the question of the specification of the investment component of the model needs to be addressed. The decision as to which model to use is dependent in part on the availability of Indonesian data, especially the investment and capital stock data in each industry, but also on what is most economically reasonable. As mentioned in section 4.1.4, the Walmsley investment specification differs from the ORANI investment specification in that there is a given relationship between the ratio of current and expected future rates of return and the relative growth rates of capital; whereas in the latter specification, the relationship is between the ratio of current and expected rate of return and the ratio of the level of expected and current capital. The Walmsley investment specification then gives a more general treatment of the long-run equilibrium condition because it allows the current and future rates of return in an industry to be equal even though the industry is growing. On the other hand, the ORANI-F investment specification assumes that the relative current rates of return in industries are related to the relative levels of capital stocks via a constant elasticity relationship.

The impacts of APEC trade liberalisation, assuming land is fully mobile among the estate crops and food crops, simulated under two specifications of the investment component, are reported in Table 7.11.

Table 7.11 Simulated Indonesian Macroeconomic Changes Following APEC Trade Liberalisation Using the 1990 Database (Percentage Change from Base)

Macroeconomic Variable	ORANI-F Investment Specification	Walmsley Investment Specification
Real GDP (x0gdpexp)	1.32	1.78
GDP price deflator (p0gdpexp)	-0.04	-0.22
Average capital rental (p1cap_i)	-1.33	-1.87
Wage rate (w1lab_io)	0.6	0.75
Land rental (w1lnd_i)	5.84	6.38
Capital stock (x1cap_i)	2.38	3.28
Aggregate employment (employ_i)	0	0
Aggregate land (x1lnd_i)	0	0
Land shifter in all estate crops industry (f1lnd_e)	18.67	20.47
Land shifter in all food crops industry (f1lnd_r)	3.18	3.41
Consumer price index p3tot	0	0
Investment price deflator (p2tot_i)	-1.35	-1.87
Real private consumption (x3tot)	1.79	2.11
Real investment (x2tot_i)	2.29	3.28
Real public consumption (x5tot)	0	0
Real inventories (x6tot)	0	0
Import price index (p0cif_c)	-2.4	-3.12
Duty-paid import price index (p0imp_c)	-3.74	-4.45
Export price index (p4tot)	-0.49	-1.07
Import volume (x0imp_c)	4.29	4.79
Export volume (x4tot)	2.25	2.64
Real devaluation (p0realdev)	-2.36	-2.91
Term of trade (p0toft)	1.96	2.12

As revealed in Table 7.11, the impact of APEC trade liberalisation on the macroeconomy using the Walmsley investment specification is slightly different from that using the ORANI-F investment specification. Not only does the Walmsley investment specification allow industries to be growing in long run equilibrium, it also allows for risk to be recognized in the model, namely when the coefficient RISKFLAG=1 in the model closure (see section 4.1.6) Meanwhile in the closure for the ORANI-F investment specification, RISKFLAG=0, that is, risk is not recognized in the capital rate of return equation.

As discussed above, in the absence of actual data on investment and the beginning capital stocks for each industry in Indonesia, it is assumed that the investment capital ratio among industries is the same and the investment share of each industry is the same as its share of capital stock. These assumptions mean that the future and current rates of return within industries and the rates of capital growth across industries are already equal and the database is already in the balanced growth condition. Therefore, the results under the Walmsley and the ORANI-F investment specifications are likely to be similar. As discuss in section 4.1.4, the percentage change of economic variables in the Walmsley investment specification tends to be bigger than in the ORANI-F investment specification because of the more flexibility of the model to capture the long run equilibrium condition. The Walmsley investment specification can capture the industry growing even though the current and future rate of return is equal.

The Walmsley investment specification is arguably a better choice than either the ORANI or the ORANI-F investment specifications because it is more general and complete in covering the long run equilibrium. However, because of the limitations in the database, especially in the data for beginning capital stocks and investment in each industry, the inherent flexibility of the Walmsley type of investment cannot be exploited. This research therefore uses the assumption of a fixed investment capital ratio and the ORANI-F specification to analyse the impact of trade liberalisation. The assumptions regarding investment and capital also mean that the risk premiums are the same for all industries. Again, the full capability of the Walmsley type of investment model to capture the differences of risk premiums among industries could not be used.

The results described to this point have all related to the 1990 database. Because of the growth and developments that has occurred in Indonesia population and macroeconomy, the analysis was repeated using a 1997 database as updated from the 1990 database. While the results for 1997 are potentially interesting in their own right and potentially more relevant than those based on the 1990 database for analysing trade liberalisation to be implemented into the future, of equal interest is the comparison between the results from each of the two databases. However, as noted earlier and by a number of other authors, the results are not expected to be overly sensitive to the database. To the extent that the results confirm this general expectation, great confidence may be placed in the results from the more reliable, even if outdated, 1990 database. The macroeconomic results are reported in Table 7.12 along with the results from use of the 1990 database as previously listed in Table 7.11 for ease comparison.

Table 7.12 Simulated Indonesian Macroeconomic Changes Following APEC Trade Liberalisation Based on 1990 and 1997 Databases (Percentage Change from Base)[1]

Macroeconomic Variable	1990 base case	1997 base case
Real GDP (x0gdpexp)	1.32	1.04
GDP price deflator (p0gdpexp)	-0.04	-0.14
Average capital rental (p1cap_i)	-1.33	-1.7
Wage rate (w1lab_io)	0.6	0.01
Land rental (w1lnd_i)	5.84	4.44
Capital stock (x1cap_i)	2.38	2.08
Aggregate employment (employ_i)	0	0
Aggregate land (x1lnd_i)	0	0
Land shifter in all estate crops industry (f1lnd_e)	18.67	13.38
Land shifter in all food crops industry (f1lnd_r)	3.18	1.89
Consumer price index p3tot	0	0
Investment price deflator (p2tot_i)	-1.35	-1.76
Real private consumption (x3tot)	1.79	1.48
Real investment (x2tot_i)	2.29	1.81
Real public consumption (x5tot)	0	0
Real inventories (x6tot)	0	0
Import price index (p0cif_c)	-2.4	-2.82
Duty-paid import price index (p0imp_c)	-3.74	-4.2
Export price index (p4tot)	-0.49	-0.82
Import volume (x0imp_c)	4.29	3.98
Export volume (x4tot)	2.25	2.04
Real devaluation (p0realdev)	-2.36	-2.68
Term of trade (p0toft)	1.96	2

[1] Estimates made assuming the ORANI-F investment specification.

Compared to the 1990 situation, the impact of trade liberalisation on macroeconomic variables under 1997 conditions is generally less positive or more negative. For example, when economic conditions in Indonesia are consistent with actual conditions as prevailing in 1990, the model predicts that full APEC trade liberalisation would increase real GDP by 1.32 per cent. Following the dramatic devaluation of the Rupiah from mid 1997, APEC trade liberalisation is estimated to increase the real GDP of Indonesia by only 1.04 per cent. It is clear that the real GDP of the Indonesian economy still increases as a result of APEC trade liberalisation, despite following the financial crisis in 1997.

The impacts of trade liberalisation on Indonesia are altered by the financial crisis. On the income side of GDP, the percentage change of average capital rental from the 1997 post-crisis base is more negative than that from 1990 pre-crisis base because of greater appreciation Rupiah against the US$ from 1997 base than from the 1990 base. The cheaper average rental for capital is also partly due to the greater reduction in the duty-paid import index more than the cif import price index. The decrease in capital cost brings about an increase in the wage rate in both cases and it tends to increase the capital labor ratio.

On the expenditure side, an increase in capital growth following trade liberalisation leads to an increase in investment as well as private consumption in both the pre-and post-financial crisis cases. Trade liberalisation also improves the terms of trade. It leads to an appreciation of the Rupiah against the US$ to ensure the trade balance in the economy. This appreciation and the elimination of trade barriers tend to reduce import prices and increase the import volume. However, for a given domestic currency price, the export price of exports will increase and make these products less competitive than before trade liberalisation. Therefore, the percentage change in export volume increases less than for import volume. With the assumption of zero change in real public consumption and real inventories, the negative net exports can cause the real GDP increase to be smaller than the increase of investment when using either the 1990 and 1997 databases.

While there are differences, the results from the two simulations suggest that there are no big differences between the impacts of APEC trade liberalisation under the two bases. It is the nature of comparative static model that the effects of the same exogenous shocks are not overly sensitive to the underlying economic database. Accordingly, further analysis here is based only one database. The 1990 base case is chosen as it is a more reliable database for that time than the forecast 1997 database is for that time. To the extent that the database does alter results, the analysis is less relevant to the actual implementation of APEC trade liberalisation than ideally.

7.5.2 Trade Liberalisation Impacts on Macroeconomic Variables

There are two stages to APEC trade liberalisation. In the first stage, APEC developed countries liberalise their trade by 2010. In the second stage, all APEC countries will liberalise their trade by 2020. Japan, North America, Australia and New Zealand are defined as developed countries. Three scenarios relating to the first stage have been simulated here. These scenarios (scenarios 4, 5 and 6), and the others relating to the second stage, are listed in Table 7.13 and described below.

Table 7.13 Different APEC Trade Liberalisation Scenarios

Scenario	Countries	Specification of the terms of trade shocks	Specification of the tariff shocks
1	All APEC countries	The GTAP risk-adjusted steady-state model, with the risk-adjusted steady-state database and Indonesia is assumed to be a small country	GTAP isloation closure
2	All APEC countries		Remove tariffs in GTAP Post NAFTA database
3	All APEC countries		Updated database after all APEC countries except Indonesia have reduced their tariffs
4	APEC developed countries		GTAP isloation closure
5	APEC developed countries		Remove tariffs in GTAP Post NAFTA database
6	APEC developed countries		No tariff shocks

In scenario 4, Indonesia reduces its tariffs based on the results from the isolation closure of the GTAP model (section 4.3.2). In scenario 5, Indonesia reduces its tariffs based on removing her original tariffs as implied by the GTAP Post-NAFTA database (see Table 7.10) and in scenario 6 Indonesia does not reduce its tariffs.

For the second stage, a further three scenarios are simulated. The first one is for Indonesia reducing her tariffs based on the results from the isolation closure of the GTAP model (scenario 1). The second one (scenario 2) is based on removing

Indonesia's original tariffs as implied by the GTAP Post-NAFTA database. The third one is based on removing Indonesia's tariffs as calculated from the updated database after all APEC countries (except Indonesia) have removed their tariffs. Besides these Indonesian tariff changes, the terms-of-trade shocks (average cif and fob price) associated with trade liberalisation are also simulated in all scenarios. These shocks are those generated from the GTAP risk-adjusted steady-state model, with the risk-adjusted steady-state database and with Indonesia assumed to be a small country (see section 4.3). All of the world price and tariffs shock can be seen in Table 7.10 in section 7.4.

Scenarios 1 and 4 have been studied because, in the GTAP model, Indonesia is assumed to be a small country (see section 4.3 and 7.3). In this case, tariff reductions are calculated from the GTAP simulation as the reaction to the reduction of other APEC countries' tariffs in order to maintain the same level of imports as in the GTAP simulation. Scenarios 2 and 5 have been done in order to estimate the impact of full APEC trade liberalisation and APEC developed country trade liberalisation were Indonesia to elect to reduce its original tariffs as in the Post-NAFTA database in response to the changing terms of trade. These tariff rate changes are not the most relevant since, once other countries have liberalised, the implied barriers in Indonesia will have changed. More relevant is that of Scenario 3. In this scenario, world prices have changed because of APEC trade liberalisation and so then do the effective levels of protection in Indonesia if she remains isolated from these price changes. The change in the power of the tariff is that needed for Indonesia to remove her import barriers. Finally, scenario 6 analyses the impact of APEC developed countries trade liberalisation if Indonesia were to decide not to reduce its tariffs. Scenarios 2 and 6 represent the extremes of the Indonesian tariff changes under study, scenario 2 involving an excessive or over-reduction in tariffs while scenario 6 entails no change in tariffs. Results for these two scenarios are likely to be least like those from the other scenarios.

The macroeconomic changes associated with all scenarios of APEC trade liberalisation using the 1990 base case (with ORANI-F type of investment and mobility of land) are reported in Table 7.14.

Table 7.14 Simulated Indonesian Macroeconomic Changes under Different APEC Trade Liberalisation Scenarios Using the 1990 Database (Percentage Change from Base)[1]

Macroeconomic Variables	All APEC Countries			APEC developed countries		
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Real GDP (x0gdpexp)	1.32	2.84	3.65	0.44	3.24	-0.51
GDP price deflator (p0gdpexp)	-0.04	-5.06	-0.99	-0.01	-0.4	-0.19
Average capital rental (p1cap_i)	-1.33	3.11	-3.42	-0.18	-0.69	0.28
Wage rate (w1lab_io)	0.6	8.48	1.49	0.72	4.47	-0.2
Land rental (w1lnd_i)	5.84	-3.44	14.15	1.47	4.69	0.36
Capital stock (x1cap_i)	2.38	5.26	6.79	0.8	6.04	-0.9
Aggregate employment (employ_i)	0	0	0	0	0	0
Aggregate land (x1lnd_i)	0	0	0	0	0	0
Land shifter in all estate crops industry (f1lnd_e)	18.67	23.29	19.21	11.6	14.36	10.58
Land shifter in all food crops industry (f1lnd_r)	3.18	-21.69	2.62	-2.97	-9.02	-1.75
Consumer price index (p3tot)	0	0	0	0	0	0
Investment price deflator (p2tot_i)	-1.35	3.05	-3.45	-0.19	-0.72	0.27
Real private consumption (x3tot)	1.79	-4.29	6.34	0.36	1.56	-0.15
Real investment (x2tot_i)	2.29	19	0.00025	0.94	7.07	-1.06
Real public consumption (x5tot)	0	0	0	0	0	0
Real inventories (x6tot)	0	0	0	0	0	0
Import price index (p0cif_c)	-2.4	2.73	-3.66	-0.09	0.72	-0.22
Duty-paid import price index (p0imp_c)	-3.74	-5.06	-9.88	-1.55	-7.03	-0.19

[1] Scenario 1: Terms-of-trade and tariffs shocks to Indonesian model are calculated from the GTAP model

Scenario 2: Terms-of-trade shocks to Indonesian model are calculated from the GTAP model and tariffs shock are calculated from the GTAP Post-NAFTA database

Scenario 3: Terms-of-trade shocks to Indonesian model are calculated from the GTAP model and tariffs shock are calculated from the updated database after all APEC countries except Indonesia have reduced their tariffs

Scenario 4: Terms-of-trade and tariffs shocks to Indonesian model are calculated from the GTAP model.

Scenario 5:Terms-of-trade shocks to Indonesian model are calculated from the GTAP model and tariffs shock are calculated from the GTAP Post-NAFTA database

Scenario 6:Terms-of-trade shocks to Indonesian model are calculated from the GTAP model. There are no tariffs shock to Indonesian model

Table 7.14 (Continued) [1]

Macroeconomic Variables	All APEC Countries			APEC developed countries		
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Export price index (p4tot)	-0.49	3.2	-2.53	0.1	-0.26	0.24
Import volume (x0imp_c)	4.29	14.67	11.52	2.3	11.71	0.17
Export volume (x4tot)	2.25	12.61	9.95	1.9	11.84	-0.3
Real devaluation (p0realdev)	-2.36	1.12	-2.7	-0.07	1.12	-0.4
Term of trade (p0toft)	1.96	0.47	1.17	0.19	-0.97	0.46

[1] Scenario 1: Terms-of-trade and tariffs shocks to Indonesian model are calculated from the GTAP model

Scenario 2: Terms-of-trade shocks to Indonesian model are calculated from the GTAP model and tariffs shock are calculated from the GTAP Post-NAFTA database

Scenario 3: Terms-of-trade shocks to Indonesian model are calculated from the GTAP model and tariffs shock are calculated from the updated database after all APEC countries except Indonesia have reduced their tariffs

Scenario 4: Terms-of-trade and tariffs shocks to Indonesian model are calculated from the GTAP model.

Scenario 5:Terms-of-trade shocks to Indonesian model are calculated from the GTAP model and tariffs shock are calculated from the GTAP Post-NAFTA database

Scenario 6:Terms-of-trade shocks to Indonesian model are calculated from the GTAP model. There are no tariffs shock to Indonesian model

The analysis of the impact of trade liberalisation under these scenarios starts in this section with the macroeconomic variable impacts. This is followed by analysis of the impacts on the output, import and export volume variables for different industries, especially the agricultural and agricultural processing industries. The analysis is focussed on scenario 1 for APEC trade liberalisation and scenario 4 for APEC developed countries trade liberalisation, scenarios consistent with the small country assumption made in the GTAP model, and these results are compared to those for other scenarios for some variables.

Table 7.14 shows that the impact on Indonesia of trade liberalisation by APEC developed countries is to increase real GDP by 0.44 percent if Indonesia also alters its tariffs in accordance with the GTAP results (scenario 4). The increase is even greater (scenario 5) if Indonesia fully removes its tariffs based on Post-NAFTA database. The latter tariff changes are greater than those associated with the GTAP run. It can be seen in Table 7.10 that for non grain crop, the average tariff should be reduced by 35 per cent from the latter case compared to 9.9 per cent and 3.7 per cent from the GTAP isolation closure of APEC developed countries and APEC trade liberalisation, respectively. However, when Indonesia does not participate in tariff reductions (scenario 6), real GDP decreases by 0.51 per cent. From the perspective of overall economic growth, it is better for Indonesia to also reduce its tariffs when APEC developed countries liberalise their trade.

The positive gains achievable by Indonesia from trade liberalisation are greater if all APEC countries liberalise their trade (scenarios 1, 2 and 3) than if only the developed countries do so. This is to be expected. Again, the gains are greater when Indonesia eliminates tariff barriers (scenario 2 and 3) rather than applying the small changes derived from the GTAP simulation. Furthermore, the positive percentage change in scenario 3 is bigger than in scenario 2. As can be seen in Table 7.10, in scenario 3, the tariffs shocks required to removed intervention after trade liberalisation are not only reductions in tariffs or other barriers, but also reductions in subsidies for some commodities. Scenario 1 and, to a lesser extent, scenario 2 fail to completely remove Indonesia's actual import distortions. Indonesia gains more if she eliminates (as in scenario 3) the implied barriers after APEC trade liberalisation than if she under adjusts (scenario 1) or over-adjusts barriers and introduces import subsidies (scenario 2).

7.5.2.1 Trade Liberalisation Impacts on the Income Side

The income side of GDP consists of earnings from capital, labor and land. Generally, trade liberalisation will encourage reductions to capital cost because of the reductions in tariff barriers on imported capital goods. Because the change to the rate of return on capital is zero in the long run closure, reducing the average capital rental implies reducing the capital cost and this brings about an increase in total capital stock because the employment is assumed to be fixed. The percentage change of the average capital rental is –1.33 per cent under full APEC trade liberalisation scenario 1 and –3.42 in scenario 3. The impact of APEC developed countries trade liberalisation on capital rental is only -0.18 per cent for scenario 4 and –0.69 per cent in scenario 5. This suggests that under full APEC trade liberalisation, the capital cost will reduce more and capital stock will increase more than if Indonesia joins in trade liberalisation with only APEC developed countries.

A decrease of the average capital rental is generally accompanied by an increase of the wage rate. The relationship between the capital rental and the wage rate is described in section 7.3. Under the perfect competition assumption, the ratio of factor payment (which implies the ratio of marginal products) is the same as the negative ratio of the demand of both inputs. Because the supply of employment is assumed to be fixed, a decrease in the average capital cost and an increase in wage cost tends to increase the capital stock. Therefore, industry tends to become more capital-intensive.

In other simulations (scenarios 2 and 6), the change in average capital rental is positive. However, the increase of the average rental of capital is less than the increase in the wage rate and it still encourages the demand for capital in scenario 2. An increase in the average capital rental is compensated with a decrease on the wage rate in the scenario 6 and encourages a decrease of capital demand. Without reducing the tariffs while developed countries liberalise their trade (scenario 6), the capital labor ratio in industries tends to decrease and industries tend to become more labor intensive.

Any increase in the capital stock must be financed. It can be financed not only from domestic savings but also from foreigners. Additional capital for Indonesia from foreign countries is possible via direct foreign investment. However, the Indonesian model does not differentiate between owners of capital. It is important to recognize, then, that an increase in GDP then does not necessarily imply let alone accurately measure an increase in domestic welfare. If the increase of foreign ownership of capital were large enough, an increase in GDP could be associated with a fall in domestic welfare.

7.5.2.2 Trade Liberalisation Impacts on the Expenditure Side

From the expenditure side, GDP consists of private and public consumption, investment and net export. Public consumption is assumed never to change in any of the simulations. Capital growth and investment are directly related through the assumed capital-accumulation relationship. Therefore, an increase in capital growth leads to an increase in investment. The simulations indicate that investment in Indonesia will be greater when other countries liberalise their trade. The increase is significantly greater if Indonesia also eliminates its tariffs.

An increase of investment in the simulations is accompanied with an increase of private consumption in scenarios 1, 3, 4 and 5. The consumption changes are generally not as big as for investment. On the other hand, in both the more extreme tariff rate change scenarios (2 and 6), private consumption decreases. In scenario 2, the shift to subsidising imports leads to a large increase in imports and investment (19 per cent compared to, for example, 2.29 per cent in scenario 1) which can only be accommodated with a fall in private consumption. In scenario 6, with no tariff reductions to offset the domestic price for importing commodity changes, the investment decreases. So does real GDP.

In all scenarios, the percentage change in real GDP following trade liberalisation is smaller than the percentage change in investment. Increases in private consumption are also smaller than the increases in investment. Based on the scenarios of full APEC trade liberalisation (scenarios 1 and 2), it is evident that if the government objective was to increase private consumption instead of investment expenditure, decreasing the tariff rates in line with the GTAP computed changes (scenario 1) would be better than over-reducing them in as in (scenario 2). As can be seen in Table 7.10, there are large differences in the shocks to the tariffs for some commodities under these two scenarios. For example, non grain crops, forestry and textile and leather have tariff shocks of –3.71 per cent, 1.65 per cent and 1.72 per cent in scenario 1 but –35.36 per cent, -12.69 per cent and –21.56 per cent, respectively in scenario 2. As can be seen in Table 5.15, the major share of the production of these commodities is sold as intermediate goods rather than to households. The large negative tariff shocks for these commodities in scenario 2 results in increases in the import value of these commodities, which is used in industry and not for household consumption. Real private consumption in scenario 2 declines.

In all simulations except scenario 5, trade liberalisation improves the terms of trade. The Rupiah appreciates against the US$ in scenarios 1,3, 4 and 6 to enforce the trade balance, which in all the simulations is exogenously set not to change. This appreciation tends to reduce import prices and to increase import volumes. In scenarios 2 and 5, Indonesian tariff elimination generates a real depreciation and an increase in the import price index. However, the duty paid import price index decreases by 5.06 and 7.07 per cent in these two scenarios respectively, larger decreases than in the other scenarios because of their bigger tariff shocks. The import volume increases more when Indonesia eliminates tariffs than if it alters tariffs on the basis of the GTAP simulation results.

On the export side, given unchanged domestic prices, the appreciation of the Rupiah against the US$ will increase the export price and make the export products less competitive with other countries than before trade liberalisation. The world price for Indonesian products will be relatively higher than before. This is apparent under trade liberalisation by the APEC developed countries, eg. with scenario 4 and 6. With no reduction in Indonesia's tariffs (scenario 6), a small increase in the export price index is associated with a decrease in export volume. However, with Indonesia reducing its tariffs (scenario 4), the export price index increases by 0.1 percent and export volume still increases only by 1.9 per cent (less than the import volume). Under full APEC trade liberalisation scenario 1, the export price index decreases and the export volume increases more than the impact of APEC developed countries trade liberalisation in scenario 4. Elimination of the trade barriers in all APEC countries reduces the import price index of the importing countries more than the increase of the export price associated with appreciation of Rupiah (in US$) from Indonesia. A small change in export price index is also affected by the type of trade liberalisation in this simulation, which only reducing the tariff and non tariff barrier without changing the export tax/subsidy.

Trade liberalisation under all simulations except for scenario 5, increase import volume more than export volume (negative percentage change of net export). This trade performance and the change in private consumption induces the real GDP to change less investment in all simulations, except scenario 3. Even in scenario 5, the increase in real GDP is smaller than in investment because of the decrease in consumption.

When the same Indonesian tariff change scenario is applied with the different versions of trade liberalisation (for example scenarios 1 and scenario 4), the impacts of trade liberalisation are generally in the same direction, with the impact of APEC trade liberalisation being more positive or less negative than the impacts of trade liberalisation by only the APEC developed countries. On the other hand, for a given version of trade liberalisation, the different scenarios for Indonesia's response generate quite different impacts. Some variables, for example average capital rental and land rental in scenarios 1 and 2 have different signs. Therefore, when Indonesia has the freedom to choose its tariff responses to trade liberalisation by other countries, the decisions are important.

The appropriate Indonesian tariff response to altered world import and export prices depends on the objectives of the Indonesian government. In the full APEC trade liberalisation simulation, GDP increases more in scenario 3 than in scenario 2 and 1. In scenario 3, the average rental of capital decreases. With the fixed aggregate employment and land there is an increase in capital intensity. Investment increases slightly in scenario 3 together with a large increase in real private consumption. In scenario 2, the average rental of capital increases less than the increase of wage rates causing investment to be capital intensive. Investment increases in scenario 2, however real private consumption decreases. In scenario 1, a decrease in average rental on capital encourages an increase in investment (bigger than in scenario 3 but less than in scenario 2) which tends to be more capital intensive. Real private consumption increases. Even though the increase in export and import volumes in scenario 1 are not as big as in scenario 2 and 3, the net export is almost the same as in scenario 3. These results imply that the Indonesian government could choose to implement the tariff rate changes of scenarios 1 and 3 if it seeks development focussed on increased investment and on increasing private consumption. The in private consumption is substantially larger in scenario 3.

This conclusion, however, is based only on broad economic performance measures. Appropriate choices are likely to depend on more detailed sectoral considerations. These are considered in the next section.

7.5.3 Impacts of Trade Liberalisation on the Sectoral Variables

The impacts of trade liberalisation on domestic output, export volume and import volume for each of the 35 sectors are reported in Tables 7.15 and 7.16 for the two cases of full APEC trade liberalisation (scenario 1) and liberalisation by the developed countries only (scenario 4), respectively. To see the potential benefits of freeing up trade, the following analysis is focused mainly on the first case. The second case is interesting in that, with the first, it provides a measure of the benefits of making trade liberalisation more extensive, and in that it gives some idea of what the impacts may be in the interim before full APEC trade liberalisation is implemented. Where the impacts of narrower trade liberalisation are significantly different from these, the differences are discussed.

Within the agricultural sector, almost all estate crops expand their outputs. Of these, tea expands the most (10.48 per cent). As mentioned in section 7.6.2, trade liberalisation tends to decrease the capital cost and increase the fob price, which encourages investment and the production of these traditional export commodities. The relatively large increase in tea production occurs because a decrease of capital cost is more effective in tea production. In the cost of production of tea, the cost of primary input factors (land, labor and capital) is high, almost eight times, the cost of intermediate inputs (see Table 5.15 section 5.9). The input factors cost share for tea is the highest of all the estate crops. For coffee, for example, primary inputs cost less than two times the intermediate inputs for coffee while for oil palm and rubber, it is less than three. A decrease in capital cost can therefore generate an increase of investment in tea plantations, which are dominated by estates (see Appendix 1.1 and Appendix 1.2).

Table 7.15 The Impact of APEC Trade Liberalisation on Industry's Output, Exports and Imports using the 1990 Database (Percentage Change from Base)

No	Sector	Output	Export Volume	Import Volume
1	Paddy	0.21	-4.21	0
2	Maize	-0.11	-4.21	13.58
3	CerOthGrain	-3.45	-4.21	0.69
4	RootCrop	0.84	-4.21	15.04
5	Beans	-0.33	-4.21	10.15
6	VegFruit	0.48	-4.21	20.34
7	Rubber	6.38	112.8	23.75
8	Sugarcane	-5.46	-4.21	0
9	Coconut	-1.64	-4.21	36.75
10	OilPalm	7.24	37.55	22.97
11	Coffee	1.71	22.69	0
12	Tea	10.48	42.58	19.75
13	OthEstate	5.6	27.45	32.77
14	OthAgr	-0.15	-4.21	7.58
15	*Livestock*	*0.85*	*-4.21*	*14.2*
16	Forestry	4.25	-4.21	35.52
17	Fishery	0.43	-4.21	14.48
18	CoalOthMin	1.7	3.4	4.74
19	OilGas	2.51	4.07	9.85
20	LivProc	0.79	-4.21	14.67
21	FoodProc	0.51	-4.21	5.88
22	FishProc	-2.55	-9.65	0.55
23	EstateProc	-6.04	-27.57	5.64
24	Rice	0.21	-4.21	10.57
25	OthFoodProc	0.09	-4.21	4.7
26	BevTob	1.98	23.36	17.07
27	TxtLthr	-3.08	-6.83	0.58
28	WoodPrd	6.34	9.53	24.65
29	Chemical	-1.28	-4.21	2.05
30	Fertiliser	3.24	17.06	5.61
31	Pesticide	2.9	15.79	2.91
32	MinMet	2.87	22.14	5.6
33	OthManufac	0.63	6.54	3.09
34	TradTrans	1.59	-4.21	6.79
35	Service	1.29	-4.21	6.92

Table 7.16 The Impact of APEC Developed Countries Trade Liberalisation on Industry's Output, Exports and Imports using the 1990 Database (Percentage Change from Base)

No	Sector	Output	Export Volume	Import Volume
1	Paddy	0.04	-2.49	0
2	Maize	-0.08	-2.49	-7.17
3	CerOthGrain	-2.16	-2.49	0.39
4	RootCrop	0.5	-2.49	19.94
5	Beans	-1.17	-2.49	14.39
6	VegFruit	-0.02	-2.49	26.67
7	Rubber	3.79	71.14	34.61
8	Sugarcane	-3.14	-2.49	0
9	Coconut	-1.31	-2.49	45.76
10	OilPalm	6.1	28.17	38.56
11	Coffee	2.1	20.29	0
12	Tea	7.85	32.08	34.15
13	OthEstate	3.65	23.81	41.08
14	OthAgr	-0.55	-2.49	22.26
15	Livestock	-0.01	-2.49	0.98
16	Forestry	1.62	-2.49	25.39
17	Fishery	-0.05	-2.49	0.16
18	CoalOthMin	0.74	2.7	2.85
19	OilGas	0.49	0.65	1.99
20	LivProc	-0.35	-2.49	19.09
21	FoodProc	0.28	-2.49	0.31
22	FishProc	-0.87	-3	0.73
23	EstateProc	-3.44	-13.97	3.39
24	Rice	0.04	-2.49	0.12
25	OthFoodProc	-0.18	-2.49	1.21
26	BevTob	0.24	8.12	20.75
27	TxtLthr	3.23	7.39	5.32
28	WoodPrd	2.79	4.41	20.88
29	Chemical	-1.04	-2.49	1.85
30	Fertiliser	1.49	8.25	3.6
31	Pesticide	1.58	8.99	2.11
32	MinMet	0.81	6.86	1.79
33	OthManufac	0.35	8.29	1.37
34	TradTrans	0.43	-2.49	2.97
35	Service	0.35	-2.49	3.05

Investment in tea is more attractive than in other estate crops in terms of its first harvest and economic life. Tea needs only 3-4 years to be ready for harvest, compared to 8 years for coconuts, and 4-5 years for oil palm, coffee, cocoa and cloves. The economic life of a tea plantation is as much as 60 years, which is longer than other estate crops such as rubber (30 years); coconut (50 years); and coffee and cocoa (40 years) (Spillane, 1992). It is not clear from the data whether this contributes to tea's high primary factor cost component. These advantages are sensible reasons for estate crop growers to investment in tea production. How much, if at all, the advantage of early harvest and long economic life contributes to the increase in tea production following trade liberalisation is unclear. Because of tea's early harvest and long life, the capital value of tea plantations relative to their current earnings is relatively high. However, the model does not properly capture capital in the form of productive trees or biological assets. Research into better representation of capital in perennial estate crops as in Dee's forestry model (Dee, 1991) would seem desirable.

The results from Table 7.15 indicate that tea experiences a large increase in exports (43 per cent) and somewhat less in imports (20 per cent). Based on the 1990 Input-Output Table, the greater portion of the total sales of tea is for the intermediate input industry usage (56 per cent), namely tea processing, followed by export sales (34 per cent). Only a small portion of total sales of tea is consumed by households directly (10 per cent). The efficiency of the tea processing industry largely determines whether the tea is destined for export or for local processing. If improvements could easily be made in the efficiency of local tea processing, Indonesia could gain more added value from its tea industry.

Rubber, oil palm and coffee also experience increases in output and exports. Amongst the estate crops, in fact amongst all sectors, rubber experiences the largest percentage increase in exports (113 per cent). However, the increase is not a big amount in terms of value because the export sales share of rubber is only 7 per cent, namely 60.5 billion Rupiah compared to 922.8 billion Rupiah of total sales of rubber (see Table 5.14). Most of the rubber production (93 per cent of total sales) is used as an intermediate input for other industries. Therefore, its relatively small increase in production (6 per cent) can be complemented by a large increase in imports (24 per cent) to fulfil the intermediate demand of rubber.

APEC trade liberalisation also has positive impacts on the oil palm sector, with moderate increases in output (7 per cent), exports (38 per cent) and imports (23 per cent). In the world market for palm oil, Indonesia is the second largest producer after Malaysia. In 1996, the palm oil world production was 10.4 million tons, of which Indonesian had a 27 per cent share, compared to Malaysia's 51 per cent share (Seng, 1997). Under trade liberalisation, given the availability of suitable land, and the suitability of its climate, Indonesia's planted area and production of oil palm are expected to expand. Similar but smaller expansions also occur for coffee: a 2 percentage increase in output and a 23 percentage rise in exports.

The positive impacts of APEC trade liberalisation on the output of most estate crops does not translate into an expansion of the estate crops processing sector. In most cases, direct exports of estate crops expands, and the domestic estate crops processing sector experiences a reduction in output (6 per cent) and an even bigger fall in export volume of the processed product (28 per cent). The oil palm tree produces both palm oil and palm kernel oil, each of which has different physical and chemical characteristics. Coconut produces coconut oil which has similar characteristics to the palm kernel oil (Basiron and Thiagarajan, 1998). One of the estate-processing products produced from palm oil and coconut oil is cooking oil, which is classified as one of the nine essential commodities for Indonesian consumers. Government policy has attempted to ensure that the supplies of cooking oil are both adequate in quantity and supplied at an affordable price for domestic consumers (Tomich, 1995) by applying an export tax on crude palm oil (CPO) and related products (as a main intermediate input of cooking oil). However, the consumer benefits from the tax are not economically significant because cooking oil is of limited importance in the household budget (Larson, 1996). The government has the option either of continuing with the export tax on oil palm in order to meet the domestic demand or to reduce this export tax to increase exports of oil palm. The results suggest that when the export tax of palm oil is retained (as in the simulation), the estate crops processing sector (principally cooking oil processing) cannot thrive under trade liberalisation and vice versa for the palm oil production sector. The results show that without changes in technology, Indonesia's comparative advantage lies more in palm oil production than in processing.

Wood products are estimated to experience a boost in output (6 per cent) as a result of APEC trade liberalisation. Wood products were affected by Indonesian policy in the early 1980s (between 1980 and January 1985) which imposed an export ban on logs to support the domestic wood products industry. The ban was replaced by export taxes in 1992 (Fane, 1999). The export volume of this sector is also increase from the 1990 base (10 per cent), which is more than the output percentage change. The total share of exports in total sales by the wood products industry is 58 per cent, so in absolute terms, output expands by more than exports. More production is therefore consumed locally as an intermediate input (39 per cent of total sales). Additionally, there is an increase in import demand (25 per cent). Although this percentage is large, the actual volume is small. Based on the I-O Table, the import share for usage as an intermediate input is only 0.5 percent and for household consumption only 4.5 per cent. Also, these results suggest that domestic consumption will increase.

The wood products industry is closely related to the forestry industry, the latter being the main source of intermediate input to wood products. The impact of APEC trade liberalisation on output in the forestry sector is 4 per cent, less than the 6 per cent increase for the wood products industry. There are several factors that have affected forest production, including forest fires in the dry season, large scale forest clearing for the expanding estate crops and transmigration settlement, expansion of mining, and the construction of roads and bridge (Sunderlin, 1999). Even though there is a fund for replanting forest trees, most of the funds have not been used for this purpose and only 10 per cent of the funds have been used for re-forestation and land rehabilitation (Sunderlin, 1999). Although the model does not capture these factors or changes in them directly, these factors will put further pressure on the forestry sector in the face of APEC trade liberalisation, especially given the economic pressure on land available for estate crops and expansion in some of those crops.

Because of the close ties between the two industries (88 per cent of the output of forestry is an intermediate input to wood products), to service the expanded needs of the wood products sector, less forestry output is exported. Forestry exports decrease by 4 per cent. The forestry sector is classed as a non-traditional export in the model. The exports change only in direct proportion to the aggregate of the group of non-traditional exports. Forestry exports cannot fully respond to the forestry products price since its demand responds to an average price for the group (see section 4.1.2 block 8). Because the export share of forestry industry sales is only small (1 per cent), a decrease in exports alone cannot fulfil the increased domestic demand. Therefore imports increase by 35 per cent.

The fishing industry experiences a small percentage increase in output (0.43 per cent) as a result of APEC trade liberalisation. However, at the same time, the sector experiences a decrease in export volume (4 per cent). Based on the 1990 I-O Table, the share of exports in the sales of fish production is only 6 per cent, which is much lower than the household share of fish sales (53 per cent). As for forestry, the fishing sector is categorised as a non-traditional export in the model and its performance is essentially dependent on domestic household demand. The small increase in output of the fishing industry and corresponding decrease in exports following trade liberalisation will therefore have a small impact in terms of changes in domestic consumption.

Unlike the benefits of APEC trade liberalisation experienced by the estate crops, forestry and fishery industries, and most food crops industries suffer reductions, or at best experience very small increases, in output and export volume. Of the food crops, cereal and other non-grain crops show the biggest relative impact (-3.45 per cent).

The larger share of sales for most of the food crops goes to domestic households. Based on the 1990 database, the share of sales to the household for maize is 63 per cent, for root crops are 88 per cent, for beans are 62 per cent, and for vegetable and fruit 92 per cent. Any decrease in output would therefore affect the sufficiency of household consumption if the decrease in output were not accompanied by either a decrease in exports or an increase in imports. All food crops are categorised as non-traditional export commodities and do experience a reduction in exports, though these are small quantities in absolute terms. For some commodities such as maize, cereal and other grain crops, and beans, reductions in output are followed by increases in import volumes to meet the domestic demand.

The reductions in the output of food crops are relatively small. Nevertheless, if food crops are to maintain their historical position in the face of trade liberalisation, some government assistance may be needed. But to provide support would go against the comparative advantage signalled in the results. Furthermore, these crops are already supported. The Indonesian government has long pursued a policy of rice self-sufficiency through price and purchasing policies and through productivity improvement strategies such as fertiliser subsidies related to land use patterns. Self-sufficiency was achieved in 1984. The government has also attempted to improve the productivity of food crops other than rice. During the period 1990 to 1997, land productivity for rice increased from 4.30 to 4.43 ton per hectare. For maize the increase was from 2.13 to 2.61 ton per hectare and for soybean, average productivity increased from 1.11 to 1.21 ton per hectare (CBS, 1993 and 1997). The new government (Reformation Cabinet after Suharto stepped down in 1998) has continued to attempt to increase the land productivity of food crops (mainly for rice, soybean and maize) in order to achieve self-sufficiency in these commodities by 2003 (Bahri and Suryana, 1999). In the absence of these interventions, the competitive advantage of food crops would be less and the decline in them greater than indicated in the results. Given that the cost of support to achieve these objectives will increase under trade liberalisation, the Indonesian government could usefully re-examine their objectives and policies.

The livestock industry suffers a reduction in its export volume. On the other hand, import volume increases to meet the domestic demand. Meat consumption in Indonesia in the 1990s, while increasing, has been lower than in other countries. For example, meat consumption in Malaysia in 1991 was 33.8 kg per capita compared to 5.8 kg per capita in Indonesia in the same year. The Indonesian government has set a target of 7.6 kg per capita per year by 1998-1999 (Trewin, 1996). Given that meat consumption is still low, potential exists for a significant increase in domestic demand. The percentage change of imports could in reality be much larger than that estimated here if consumer tastes and preferences were to alter sufficiently and this target were to be achieved or exceeded.

Other sectors to be adversely affected by the APEC trade liberalisation are the agricultural processing sectors. The negative impact on estate crops processing was discussed earlier. Fish processing also suffers the same effect. More generally, all agricultural processing industries experience a reduction in export volume and an increase in import volume. Assuming there is no technical change in the economy, these results consistently suggest that Indonesia has a comparative advantage in exporting raw products rather than processing these products. The most significant increases in imports are for rice and livestock processing industries in order to meet the domestic demand. Since rice is a major staple food, the government has historically intervened in the rice market through the National Logistic Agency (BULOG) to stabilise the market price and monopolise the import market. The effectiveness of the Agency in maintaining stable prices, thereby encouraging the farmer and rice processor to increase rice production and improve productivity to effectively face trade liberalisation, is still being questioned and is in need of future research.

These results suggest tha t, in the absence of any technological chang e, t he resource based processing sectors are not competitive enough to sustain the positions they had prior to APEC trade liberalisation. The results raise doubts about Government development plans to support structural change from agricultural production towards the manufacturing sector, including agricultural processing. The results show that Indonesia, as an agricultural based country, has a comparative advantage in producing the raw products that are needed as intermediate inputs into agricultural processing. Agricultural processing would be left behind without that support. Howver, many believe it is beneficial for Indonesia to develop the agricultural processing sector because this would provide increased local demand for the products of the agricultural sector. For example, Sunderlin (1999) argues that the agricultural sector and the agricultural processing sector provide an attractive option to solve the problems of the monetary crisis because they are relatively independent of imported inputs, provide basic needs and absorb a large number of employees

(Table 1.11). Although the results obtained here do not support this, the results are based on assumptions and these need to be kept in mind. For example, the simulation assumed fixed aggregate employment and considerable labor mobility. If unemployment is a problem, in aggregate or for particular types of labor, these assumptions would need to be changed. Agricultural processing, because of its intensive labor usage, may then provide the benefits that others have suggested.

In relation to the other sectors, namely the various mining and manufacturing and service sectors, output typically increases as a result of APEC trade liberalisation. Export and import volumes generally both increase, with the larger increase being in exports. These are positive impacts of APEC trade liberalisation for Indonesia. In some commodities (paddy rice, rubber and coffee), the changes in import volumes are zero. These are commodities which had no initial imports in the database. With zero initial shares, and therefore zero coefficient values, they would necessarily remain at zero in the computations. To allow them to change if economically warranted, zero import entries in the database have been replaced by a tiny value (0.00000001). However, the results confirm that imports of these commodities remain uncompetitive even after trade liberalisation.

In summary, the impacts of full APEC trade liberalisation on Indonesia are varied with the estate crops and mining being amongst the biggest gainers in terms of industry output. Estate crops processing experiences a significant decline as do textiles and fish processing to a lesser extent. Amongst traditional export industries, most experience increases in exports, as would be expected. Estate crops processing, textiles and fish processing are again the main exceptions. Indonesia's comparative advantage appears to lie with producing and exporting raw primary products rather than in processing them. In relation to imports, all industries experience increases.

To this point, only the sectoral impacts of full APEC trade liberalisation have been discussed. These effects are now compared to those for the more limited trade liberalisation by the APEC developed countries alone. The results will be different for two reasons. First, the price and tariff shocks are different. Second, the time period over which capital accumulates is different. The full APEC liberalisation relates to a

30 year period accumulation through to 2020. The more limited liberalisation relates to a 20 year accumulation through to 2010. This difference affects the capital-investment relationship in the model since the *M* coefficient in Equation 16.1 differs, though the difference is not great (M goes from 5.6 to 6.8 as T goes from 20 to 30).

Compared to the impacts of full APEC liberalisation, the changes in output, exports and imports of the various commodities under partial trade liberalisation are generally of the same sign, smaller in magnitude when the change is positive and larger when negative. The traditional exports from the resource based sectors, including the estate crops sub-sector, also still expand output and export volumes.

For the vegetable and fruit, livestock, fishery, livestock processing and other food processing industries, output increases under full APEC trade liberalisation but decreases under developed country trade liberalisation. These sectors will not fare as well under partial trade liberalisation. The precise reasons for this are not clear, but lie in the relative price and tariff rate shocks. The relative price changes under the two forms of liberalisation differ. This is because initial tariff rates vary between developed and developing countries and by commodity. The different time horizons assumed for the two runs, imposing a slightly different aggregate capital stock-investment condition may also be a factor. Regardless of the reason for the differences, these industries have an interest in seeing full APEC trade liberalisation rather than the more limited liberalisation.

As in the case under full APEC trade liberalisation, some commodities (paddy, sugarcane, and coffee) that have not been imported historically continue to not be imported after APEC developed countries trade liberalisation. In relation to export changes, some figures have a same percentage change in both simulations. This result because the commodities are classified as a non-traditional export (see section 4.1.2 block 8). Therefore the exports only change because of the direct proportion to the aggregate of the group of non-traditional export.

The explanation for the small differences in the impact of APEC trade liberalisation and trade liberalisation by only the APEC developed countries does not lie entirely in the small export and import share of Indonesia in the world economy (see Table 7.3). These trade shares only define the initial position before trade liberalisation, that is when trade is restricted. These shares would be expected to alter differently under different forms of liberalisation.

Trade liberalisation will be implemented over time to 2010 and 2020. During this time, other macroeconomic and microeconomic changes in addition to trade liberalisation are likely to occur. These changes will affect the economic performance and potentially the impacts of liberalisation. APEC trade liberalisation together with other possible changes will be analysed in the next chapter.

7.6 Conclusions

In this chapter, GTAP simulations have been used to derive world market price changes in response to APEC trade liberalisation. Compensating Indonesian tariff rate changes to isolate Indonesia from these price changes have also been calculated. The standard GTAP model and Post-NAFTA databases do not satisfy long run steady state conditions. To deal with this, the databases were first adjusted to a steady state, with the inclusions of risk premium for use in the long run closure of GTAP. In the steady state, trade liberalisation is found to be generally beneficial in enhancing growth. It is found in this study and Walmsley (1998) that changes in capital stock and real GDP working from a steady state database tend to be bigger than those simulated from the standard benchmark database.

The GTAP results for Indonesia were used as shocks in the Indonesia Forecasting Model to assess in more detail the impacts of trade liberalisation on Indonesia. With interest in the long run impacts of liberalisation in the wake of developments in the Indonesian economy in the 1990s, the Indonesia Forecasting Model, incorporating the ORANI-F specification, was first used to update the 1990 Indonesian database to 1997 making use of historical macroeconomic changes as exogenous shocks. Other endogenous macroeconomic variables, namely real investment and real GDP, calculated in the simulation, were compared to the historical data in order to validate the 1997 updated database.

The principal analyses in the chapter are based on an ORANI-F investment specification and allowed land mobility among estate crops and food crops. Simulations were made with both the 1997 database and the 1990 database for comparison purposes, but the choice of database appeared to have relatively little effect on the measured impacts of trade liberalisation. Most analyses used the 1990 database. Detailed results were obtained under two alternative specifications of trade liberalisation and three scenarios of tariff rate changes within Indonesia.

For a given Indonesian tariff change scenario, the impacts on Indonesia's macroeconomy of full APEC trade liberalisation and of trade liberalisation by only the APEC developed countries are generally in the same direction. Full APEC trade liberalisation induces larger impacts. For a given version of trade liberalisation, the various scenarios for Indonesia's tariff response lead to quite different impacts. One implication is that the Indonesian government should avoid over-reductions in tariff barriers if it seeks investment and private consumption based development.

The sectoral impacts of full APEC trade liberalisation on vary, with the estate crops and mining sectors, which are established export industries, being amongst the biggest gainers in terms of industry output. Estate crop processing experiences a significant decline as do textiles and fish processing to a lesser extent. Most traditional exports expand, as expected. Estate crops processing, textiles and fish processing are again the main exceptions. Imports by all industries increase. Assuming no technical change occurs in the economy, the results suggest that Indonesia's comparative advantage under liberalised trading conditions will lie more in agricultural production and export than in agricultural processing.

The impacts of APEC and APEC developed country trade liberalisation are generally in the same direction. For vegetable and fruit, livestock, fishery, livestock processing, and other food processing, however, output responds negatively to the limited liberalisation but positively to full APEC trade liberalisation. The pattern of winners and losers from trade liberalisation is complex, varying both across sectors and across time and extent of liberalisation.

CHAPTER 8

IMPLICATIONS OF APEC TRADE LIBERALISATION AND OTHER CHANGES FOR THE INDONESIAN ECONOMY

The long run impacts of APEC trade liberalisation on the Indonesian economy have been analysed in section 7.5. Besides facing APEC trade liberalisation, Indonesia also will experience various other exogenous macroeconomic and microeconomic developments as liberalisation is implemented. In this chapter, the effects of a number of possible macroeconomic and microeconomic developments, with and without trade liberalisation, are simulated. The 1997 updated database is used as the starting point in simulating the Indonesian economy through to 2020 using an ORANI-F investment specification. While trade liberalisation may benefit the Indonesian economy, not all sectors and economic agents benefit equally. Some, indeed, will lose. The overall performance of the economy and the performance of individual sectors in response to trade liberalisation depend on these other economic developments.

8.1 Exchange Rate Policy

Exchange rates can be manipulated in order to correct any imbalance in the balance of payments, to support the process of industrialisation, and to help in controlling inflation (Bank Indonesia, 1993). There are two extreme options of exchange rate policy that can be applied by a country, namely flexible and fixed exchange rates. Under a flexible exchange rate regime, the value of the exchange rate is determined by the equilibrium of the demand and supply of foreign currency (Roubini, 1999). To maintain a fixed exchange rate, the government must intervene to sell (buy) foreign reserves when the market demand for foreign currency is greater (smaller) than the market supply at the desired rate of exchange.

Exchange rate policy in Indonesian has evolved from a first stage of fixed exchange rates to a managed float system in a second stage and to a third stage with minimal intervention of the managed float system (Bank Indonesia, 1993). Fixed exchange rates, with the Rupiah linked to the US$, were applied between 1971 and November 1978 in support of what was an inward looking economic strategy. The managed float system applied between November 1978 and September 1986, supporting a more outward looking economic strategy. Under the managed float, the Rupiah exchange rate was linked to a basket of her trading partners' currencies. Since September 1986, the government has continued to operate a managed float exchange rate system but with relatively little intervention. In this system, the exchange rate is mainly determined by the difference between the domestic inflation rate and the inflation rate in trading partner. The exchange rate will be devalued if the domestic inflation rate is higher than that of Indonesia's trading partners.

Exchange rate policy is likely to influence the national economics in the face of trade liberalisation and to be a sensitive decision. Simulations with the Indonesian Forecasting Model were done to examine how sensitive the macroeconomy was, under APEC trade liberalisation, to changes in the real exchange rate. In these simulations, the real exchange rate was set as an exogenous variable. The trade balance was allowed to adjust endogenously. In each simulation, the changes in world prices associated with full APEC trade liberalisation were imposed. Indonesia's tariffs were shocked in accordance with the GTAP results. No other exogenous macro or microeconomic shocks were imposed. Because the Indonesian CGE model is non-linear, simulations were done for several levels of change of the real exchange rate, ranging from –30 to 150 per cent. Examination of the results (see Table 8.1) shows that the effect on the macroeconomy of changing the real exchange rate is essentially linear.

The simulations provide some information for government in determining a setting for the real exchange rate and the devaluation suited to the country's economic objectives. Knowing a target percentage change in the real exchange rate, the government can determine a target for the nominal exchange rate. In the model, the percentage change of the real exchange rate is defined as the difference between the percentage change of the import price index and the GDP price index (see section 4.1.2 block 14). The percentage change of the import price index can be adjusted through the percentage change of nominal exchange rate and the GDP price index through the consumer price index. This adjustment is the same as the one which is calculated by Vincent *et al.* (1990). The real exchange rate is related by definition to the difference between the nominal exchange rate and the consumer price index. If the consumer price index is already predicted, the necessary nominal exchange rate change can be calculated from the desired real exchange rate. The government can buy or sell foreign reserves in order to maintain the fixed exchange rate, at least in the short term.

Table 8.1 Combined Effects of Changes in the Real Exchange Rate and APEC Trade Liberalisation on the Indonesian Economy

Macroeconomic Variables	Percentage change of the real exchange rate from the 1997 base			
Real exchange rate (p0realdev)	-30	0	30	150
Real GDP (xogdp)	5.78	4.81	3.84	-0.04
Export volume (x4tot)	-11.75	27.98	67.7	226.59
Import volume (x0imp_c)	3.5	-14.06	-31.62	-101.84
Terms of trade (p0toft)	5.44	-1.24	-7.92	-34.64
Balance of trade/GDP (delB)	-0.02	0.08	0.18	0.57
Average capital rental (p1cap_I)	-41.28	-23.56	-5.83	65.06
Aggregate real investment (x2tot_I)	-59.96	-61.04	-62.12	-66.46
Aggregate consumption (x3tot)	38.93	20.61	2.3	-70.95
Aggregate government expenditure (x5tot)	0	0	0	0
Levels debt/GDP ratio (levDebt_Ratio)	1.29	-0.15	-1.59	-7.35

As the exchange rate is varied, so too do the macro variables. Table 8.1 reveals the sensitivity of real GDP, international trade and investment performance. Real GDP is relatively insensitive to the real exchange rate percentage change. There can be a devaluation of the Rupiah against US$ of up to 150 per cent and real GDP will still be increased as a result of full APEC trade liberalisation. Devaluation of the domestic currency brings about an increase in export volume and a decrease in import volume, and an increase in real GDP. However, the average capital rental increases as the devaluation becomes larger, which can cause a decrease of the aggregate real investment. Under appreciation of the Rupiah, the opposite effects occur. GDP is relatively insensitive to the real exchange rate because of the latter's positive impact on net exports and its negative impact on investment expenditure.

The ratio of the balance of trade to GDP, *delB*, is also not sensitive to changes in the real exchange rate. Because the measurement of GDP is affected by net export value, a large net export value can contribute to a large GDP. Unless other components of GDP (consumption, investment and government expenditure) change significantly in the opposite direction from net exports, the *delB* variable will not be sensitive to the changes in real exchange rate.

These simulations give some information for the choices by government in pursuing a target nominal exchange rate. The government policies can be related to the real sector or the monetary sector. In the real sector, the government can apply some policies to affect investment (for example the low interest of credit for agriculture), consumption (for example the healthy food campaign), and government expenditures (for example road development in eastern Indonesia), and the trade balance (for example export promotion). These variables can affect the ratio of trade balance and GDP and the latter can influence the real exchange rate as well as the nominal exchange rate. In the monetary sector, the government can buy or sell the foreign currency in order to maintained the target nominal exchange rate.

In Table 8.1, the column headed "0" percentage change in the real exchange rate shows the macroeconomic changes which occur under trade liberalisation when the real exchange rate is held fixed at its level in the 1997 database. These results can be compared with the comparative statics results in Table 7.12 in which the effects of full APEC trade liberalisation are reported for the 1997 database under the assumption that the trade balance is unchanged. Even though both simulations use the same database, the results are quite different because of their different closures and simulations. Both simulations are for a 23 year period, but the analysis in Chapter 7 did not enforce the accumulation equations between investment and capital or between trade deficits and foreign debt. That is, variable *delFudge* = 0 in the comparative statics simulation but is set equal to one here to force investment and capital stocks in year 2020 to be consistent. Capital stocks will have expanded much more under accumulation than under the comparative statics case with the result that real GDP in the current simulation is much larger than in the comparative static ones.

Both sets of results need to be interpreted with care. The results from the present simulation show the combined effect of forcing the economy to adjust not only to trade liberalisation but in moving to a position in which investment and the growth in capital stocks over the 23 years are consistent. Much of the observed endogenous change is due to the latter rather than to trade liberalisation *per se*. On the other hand, the results in Chapter 7 also have limitations. Trade liberalisation is imposed over 20 years from 1997, but there is no effort made to ensure consistency in capital (or trade balance) accumulation.

8.2 Effects of Trade Liberalisation Given Exogenous Changes in Key Macroeconomic Variables and Technological Change

The Indonesian macroeconomy will evolve over the period 1997 to 2020 during which full APEC trade liberalisation is to be accomplished. Improvements in primary input technology in each sector and expansion in macroeconomic variables such as employment, population, government expenditure and shifts in the consumer price index, all of which can be regarded as exogenous to the workings of the Indonesian Forecasting Model need to be recognized in assessing the impacts of trade liberalisation and Indonesia's policy responses. The analysis in section 7.6 was comparative static in nature and not only did it not impose consistency in capital and debt accumulations, it did not account for this inevitable economic evolution.

In the simulations described in this section, exogenous changes in macroeconomic variables and primary input technology change are allowed for in examining the effects of trade liberalisation. There are seven simulations. Except for the final one, they all incorporate full APEC trade liberalisation through to the year 2000 applied to the updated 1997 database. Of the seven simulations, four examine trade liberalisation along with changes in only one of or two of the exogenous macroeconomic/technology variables. One (the first) involves none of these exogenous changes and the sixth includes all of the forecast changes. The seventh and final run involves all of the forecast changes but no trade liberalisation. It therefore provides a base against which the effects of the additional imposition of trade liberalisation can be measured. The simulations are:

1. APEC trade liberalisation with no changes to the macroeconomic variables and technology.
2. APEC trade liberalisation with population and consumer price index changes.
3. APEC trade liberalisation with employment change.
4. APEC trade liberalisation with government expenditure change.
5. APEC trade liberalisation with technological change.
6. APEC trade liberalisation with all these macroeconomic and technological changes.
7. All macroeconomic and technological changes but no APEC trade liberalisation.

Being a simulation of the effects of trade liberalisation under forecast changes of those aspects of the economy exogenous to the model, the sixth run is arguably of the most interest. However, the runs incorporating only one or two of these exogenous changes are interesting for comparison with the run(the first) involving no changes because they provide estimates of the impacts of particular factors that government may wish to control via policy settings in the face of trade liberalisation. Only some of the six runs are discussed in detail here. The seventh simulation is also interesting when compared to the first and to the sixth simulation as it provides a comparison of the economic impact of the exogenous developments an of trade liberalisation itself.

The assumed changes in the exogenous macroeconomic variables from 1997 to 2020 are given in Table 8.2. These are forecasts based on previous research as identified in the footnotes to that table.

8.2.1 Forecast Changes in Macroeconomic Variables and Technology

Because the Indonesian Forecasting Model is not a complete model of the economy, some aspects of the economy have to be set exogenously . The reasons for specifying five variables exogenously are outlined below.

Table 8.2 Forecast Macroeconomic Variables and Technological Change from 1997 to 2020 (per cent per annum)

No	Variables	1998	1999	2000	2001-2010	2011-2020	1998-2020
1.	Number of household (q)[1)]	1.49	1.49	1.49	1.20	0.98	26.27
2.	Consumer Price Index (p3tot)[2)]	60.7	28.2	10.0	10.0	10.0	298.9
3.	Aggregate employment (employ_I)[3)]	-2.2	-2.2	-2.2	4.8	4.8	89.4
4.	Input factor productivity (a1prim)[4)]	0.8	0.8	0.8	0.8	0.8	18.4
5.	Government Consumption (f5tot)[5)]	-13.7	-4	2.5	4.1	4.0	65.8

1) Population Projections, United Nation (1996) in OECD (1997)

2) IMF (1999) for 1998, 1999 and 2000 data. The annual growth for the period of 2001-2020 is assumed the same as for the year 2000 annual growth.

3) Anderson and Strutt (1998). In this paper, there are two types of labor (unskilled and skilled labor). The aggregate employment is the weighted average from these types of labor. Share of unskilled labor = 0.56 and skilled labor = 0.44 is calculated from Indonesian Social Accounting Matrix (1993).

4) Crafts (1998). The total factor productivity is assumed as input factor productivity.

5) The government consumption rate is assumed as same as the GDP growth rate. GDP growth rate in 1998, 1999 and 2000 is from IMF, 1999, and in 2001-2010, 2011-2020 from OECD estimates, OECD, 1997.

Source: OECD (1997); IMF (1999); Anderson and Strutt (1998); Nicholas (1998).

The aspects to be treated as exogenous are those that the model is not designed to determine endogenously. This specification problem is not trivial. Even though the model may not be designed to explain these variables, it will usually be the case that their actual levels in the economy are influenced to some degree by the variables treated as endogenous in the model. For example, population might reasonably be viewed as exogenous. However, economic performance will impact on fertility levels and perhaps on the demand for children through the income level (Foster, 1992). For a poor family, an increase of income might increase the opportunity to marry earlier and might expand the woman's fertile period; or it might encourage use of bottle-feeding instead of breast-feeding with some consequent increase in fertility. For the high-income family, an increase of their income tends to decrease the fertility rate because they tend to be more focused on the quality than the number of children. While these are endogenous effects, it can be argued on the other hand that government may be able to directly influence population through family planning campaigns. To the extent that they can do this and "control" population independently of variables in the Indonesian Forecasting Model, it is appropriate to treat population as exogenous.

Indonesia has the fourth largest population in the world after China, India and the USA. In 1997, the population was 203 million people. The United Nations (1996) has estimated the population growth to be 1.49 per cent per annum during the 1990s, and has projected it would reduce to 1.20 per cent per annum during the period of 2001-2010, reducng further to 0.98 per cent per annum for 2011-2020 (OECD, 1997). The model includes the number of households and not population itself. Even though the growth in the two may differ, because of limited data relating specifically to households, in the analysis here it is assumed that the household growth rate is the same as the population growth rate.

The population growth will have implications for employment in the economy. The employment growth rate is assumed to be larger than the population growth. The improving health and nutrition conditions in Indonesia and other developing countries support the prediction that the proportion of population in the workforce (between 16 and 65 years) will increase and more so than in developed countries (Foster, 1992). In the model, the exogenous changes in the levels of employment will be achieved by wage rate adjustments.

While economic growth is brought about by increases in the supply of primary factors of production, improvements in technology and in input factor productivity also contribute to the growth in economies (Sarel, 1997). Trade liberalisation will add to growth through the more efficient resource allocation associated with exploiting comparative advantage. Because trade barriers constrain resource allocation from adjusting to make the most efficient use of technology, the benefits of trade liberalisation will depend in part on the state of technology in the economy. Improvements in factor productivity are likely to add to the inefficiencies created by trade barriers and so the benefits of trade liberalisation are likely to be greater in the presence of technological change.

For this reason it is appropriate to examine APEC trade liberalisation in the presence of technological change. The possibility also exists that trade liberalisation will itself affect technological change. If technological change is induced by economic conditions, under changed conditions associated with trade liberalisation, the technological change potentially will be different. Recent developments of trade theory establish that gains from trade liberalisation arise not only from improved allocation of the resource endowment but also from the dynamic efficiencies of more innovation, faster productivity gains, greater investment and higher output growth (Baldwin, 1989). Nevertheless, as for population, it seems not unreasonable in the first instance to consider changes in productivity to be exogenous in studying trade liberalisation.

An improvement in input technology, especially for agricultural commodities is a significant matter for Indonesia given its dependence on the agricultural sector. A first stage (twenty five-years) of modern Indonesian economic development started in 1969. Agricultural development was given priority. The economic development achieved rice self-sufficiency in 1984. In a second twenty-five years plan for development, that started in 1994, the government has focussed on developing manufacturing to accelerate a structural transformation in the Indonesian economy. Also, having achieved rice self-sufficiency, the government has sought to encourage the development of other food crops. The recent history of production for selected food crops commodities is reported in Table 8.3.

Paddy production has doubled from 1990 to 1998. The increase is largely due to an increase of yield per hectare (almost double) rather than an expansion in harvested area. The large increase in yield per hectare was encouraged through rice price stabilisation, large fertiliser subsidies, and heavy investment in irrigation, research and extension (Rosegrant *et al.*, 1998). Corn production has increased less significantly, from approximately 6.7 million tons in 1990 to 10.1 million tons in 1998. The increase is associated with small increases in both harvested area and yield per hectare. The production of the other two crops (cassava and soybean) has declined slightly from 1990 to 1998. In both cases, the decline is due to a decrease of harvested area and in both cases there has been a slight increase in yield per hectare. To meet growing domestic demand, imports of soybean have increased significantly from 475 000 tons in 1990 to 700 000 tons in 1998 (Suryana and Bahri, 1999). The economic performance of these food crops suggests there has been some effort to increase their yields per hectare, especially for rice, to fulfil the domestic demand.

Table 8.3 Production Statistics for Selected Food Crops

Type of Crops	1990	1995	1996	1997	1998
Production (000 ton)					
Paddy	29 366	49 744	51 102	49 377	48 472
Corn (Kernel)	6 734	8 246	9 307	9 182	10 058
Cassava	15 830	15 441	17 002	16 186	14 728
Soybean	1 487	1 680	1 517	1 459	1 306
Harvested Area (000 ha)					
Paddy	10 502	11 439	11 570	11 035	11 163
Corn (Kernel)	3 158	3 652	3 744	3 567	3 843
Cassava	1 312	1 324	1 415	1 315	1 205
Soybean	1 334	1 477	1 279	1 198	1 091
Yield (ton/ha)					
Paddy	2.80	4.97	5.11	4.91	4.17
Corn (Crenel)	2.13	2.26	2.49	2.57	2.62
Cassava	12.07	11.66	12.02	12.31	12.20
Soybean	1.11	1.14	1.19	1.22	1.20

Source: Bank Indonesia, 1992/1993, 1997/1998; Indonesian Central Bureau of

The growth in productivity in other industries within the agricultural sector, such as estate crops, has not been as good as for rice. As can be seen in Table 8.4 the yields per hectare of rubber, sugarcane, oil palm, coffee and tea have fluctuated and in some commodities have tended to decline. As mentioned in section 1.1, the Indonesian Government has several development programs for estates and smallholders to improve productivity of estate crops. However, only the planted areas and production of palm oil has increased significantly. Future productivity growth in agriculture will depend on the efforts not only by government to promote it but also by the farmers to adopt it.

It is interesting to examine how the economy will be affected by APEC trade liberalisation under assumed exogenous productivity increases. Past productivity of both the food crops and the estate crops groups increased slowly except for rice and palm oil. Because there is no data on productivity or projections of productivity for most individual commodities, in the simulations here, the productivity growth in every sector is assumed to be the same as for total factor productivity. Crafts (1998) has projected a small increase in total factor productivity. This seems reasonable given the slow growth of productivity in the past period, and is used here.

Table 8.4 Production Statistics for Selected Estate Crops

Type of Crops	1990	1995	1996	1997	1998
Production (000 ton)					
Rubber	315.3	341	334.6	309.8	335.2
Sugarcane	2173.2	2104.7	2160.1	2166.7	2282.7
Oil Palm	2096.9	2476.4	2569.5	2980.9	3197.3
Coffee	25.5	20.8	28.5	23	22.3
Tea	129.1	111.1	132	118.4	136.1
Harvested Area (000 ha)					
Rubber	534	471.9	538.3	568.8	526.6
Sugarcane	375.2	413.0	400.0	378.4	406.0
Oil Palm	773.8	992.4	1245.3	1296.8	1504.4
Coffee	55.7	49.3	46.7	48.2	47.8
Tea	79.3	81.0	88.8	90.5	91.4
Yield (ton/ha)					
Rubber	0.59	0.72	0.62	0.54	0.64
Sugarcane	5.79	5.10	5.40	5.73	5.62
Oil Palm	2.71	2.50	2.06	2.30	2.13
Coffee	0.46	0.42	0.61	0.48	0.47
Tea	1.63	1.37	1.49	1.31	1.49

Source: Indonesian Central Bureau of Statistics Home Page: http://www.bps.go.id/statbysector/agri/pangan/, 10 May 1999.

The final macroeconomic variable to be set exogenously is government expenditure. Clearly, government can manage and control this with a view to altering the effects of trade liberalisation. Being a macro aggregate however, the differential and important effects of specific types or areas of government expenditure are not addressed through changes to the government expenditure variable.

As previously defined, the first simulation involves only APEC trade liberalisation, with no changes in the exogenous variables from their levels in 1997. In the next four, the impact of APEC trade liberalisation is analysed under forecast changes in one or two macroeconomic variables and technological change. A comparison of the results of these simulations identifies the dominant exogenous factors and potential areas in which government might apply policy to adjust the macroeconomic or productivity variables in order to do better from trade liberalisation.

The macroeconomic results from each simulation are reported in Table 8.5. Sectoral impacts are reported in Table 8.6.

8.2.2 APEC Trade Liberalisation with no Other Exogenous Changes

The impacts (Table 8.5, column 1) of APEC trade liberalisation simulated over 1997-2020 using the forecasting simulation are slightly different from the impacts derived in the long run comparative static simulation in Chapter 7 (see Table 7.12). The change of real GDP from the 1997 base case is 6 per cent here, larger than the 1 per cent in the comparative static simulation. The principal reason relates to the enforcement of the accumulation equations in this here via *delFudge* being set to one. Capital accumulates much more significantly once this condition is enforced, and the added capital serves to support more activity in the economy in general.

From the income side of GDP, trade liberalisation will generally encourage a reduction in the capital cost because of the reductions in tariff barriers on imported capital goods. Because there is a zero percentage change in the rate of return in the long run closure, reducing the average capital rental implies reducing the capital cost. This was observed in the comparative static analysis and the same holds true for the present simulation, with average capital rental falling by –38 per cent.

Even though capital cost decreases following APEC trade liberalisation with no change in employment and technology, the decrease is not enough to encourage equilibrium investment to grow. Therefore, the investment expenditure decreases with the small increase on capital growth. A decrease in investment with enforced "zero change" in the balance of trade and in government expenditure, requires an increase in private consumption to increase the real GDP.

Table 8.5. Changes in Macroeconomic Variables from the 1997 Base because of APEC Trade Liberalisation and Forecast Exogenous Changes (Percentage Change)

No	Variable	(1) APEC	(2) q, p3tot and APEC	(3) employ_i and APEC	(4) f5tot and APEC	(5) a1prim and APEC	(6) Macro, a1prim and APEC	(7) Macro and a1prim
1	Net Foreign debt/GDP (lev Debt-Ratio)	1.06	1.07	1.07	1.06	1.07	1.08	1.08
2	Change in Trade balance/GDP ratio (delB)	0	0	0	0	0	0	0
3	Percentage real devaluation(p0realdev)	-25.16	-46.24	-39.1	-21.97	-26.37	-58.73	-56.05
4	Real hourly wage rate (f1lab_io)	-32.87	-62.86	-128.01	-24.1	-2.97	-120.1	-120.11
5	Aggregate employment (employ_i)	0	0	89.4	0	0	89.4	89.4
6	Capital stock (x1cap_i)	11.18	0.22	73.08	8.52	63.25	111.74	109.66
7	Land rental (w1lnd_I)	69.96	425.73	211.88	54.27	115.82	599.37	594.93
8	Average capital rental (p1cap_I)	-38.42	231.62	-100.36	-29.81	-46.61	169.23	170.93
9	Real GDP (x0gdpexp)	5.63	-0.1	60.18	4.18	50.04	97.52	96.48
10	Real private consumption (x3tot)	35.97	31.44	94.55	28.12	83.01	130.01	128.53
11	Real public consumption (x5tot)	0	0	0	65.8	0	65.8	65.8
12	Real investment (x2tot_i)	-60.13	-68.2	-4.92	-62.59	-13.9	29.32	27.51
13	Import volumes (x0imp_i)	0.66	-5.63	59.74	-1.63	49.57	99.98	95.99
14	Export volumes (x4tot)	-5.34	-14.54	59.53	-7.55	48.89	102.17	100.13
15	Import price index(p0cif_c)	-36.97	231.43	-73.27	-30.89	-41.84	195.55	198.37
16	Duty-paid import price index(p0imp_c)	-38.36	230.05	-74.65	-32.28	-43.23	194.17	198.37
17	Export price index(p4tot)	-32.61	236.99	-75.55	-26.47	-42.45	189.61	190.43
18	Consumer price index (p3tot)	0	298.9	0	0	0	298.9	298.9
19	GDP price deflator (p0gdpexp)	-11.81	277.67	-34.16	-8.92	-15.47	254.28	254.42
20	Investment price deflator (p2tot_i)	-37.82	232.17	-98.91	-29.41	-45.67	170.78	172.54
21	Term of trade (p0toft)	4.36	5.56	-2.28	4.42	-0.6	-5.94	-7.94
22	Nominal exchange (phi)	-37.57	230.84	-73.86	-31.48	-42.44	194.96	198.37

Table 8.6. Changes in Sectoral Output from the 1997 Base because of APEC Trade Liberalisation and Forecast Exogenous Changes (Percentage Change)

No	Variable	(1) APEC	(2) q, p3tot and APEC	(3) employ_i and APEC	(4) f5tot and APEC	(5) a1prim and APEC	(6) Macro, a1prim and APEC	(7) Macro and a1prim
1	Paddy	4.19	22.73	14.62	3.23	13.51	41.62	41.43
2	Maize	5.22	15.78	21.62	3.7	21.46	47.03	47.26
3	CerOthGrain	-29.31	-54.58	-37.54	-25.38	-15.06	-45.24	-42.08
4	RootCrop	12.9	22.84	35.97	10.03	33.77	64.19	63.66
5	Beans	-5.43	-15.92	-9.7	-4.52	14.83	0.85	1.35
6	VegFruit	11.41	16.46	33.3	8.81	34.46	59.08	58.68
7	Rubber	12.83	-0.57	92.09	8.22	64.94	126.53	128.61
8	Sugarcane	0.31	-4.9	44.39	-2.99	35.43	71.18	78.91
9	Coconut	14.12	16.63	51.82	10.04	44.61	81.13	83.01
10	OilPalm	-13.3	-4.17	-95.07	-7.46	-44.82	-112.22	-124.15
11	Coffee	-5.27	2.81	-49.63	-2.84	-18.4	-52.46	-56.83
12	Tea	-1.85	1.79	-1.9	-1.23	-17.34	-13.42	-23.41
13	OthEstate	28.33	19.78	88.65	21.47	77.12	122.69	122.35
14	OthAgr	12.37	13.49	47.19	10.55	40.13	74.56	75.07
15	Livestock	15.22	13.39	51.95	11.6	48.48	80.1	79.57
16	Forestry	4.33	-4.47	66.29	2.73	53.09	104.68	101
17	Fishery	16.53	11.25	55.5	12.53	53.74	83.82	83.28
18	CoalOthMin	7.37	-4.08	92.74	4.31	65.45	136.46	134.98
19	OilGas	10.77	-0.38	80.75	7.46	84	139.71	137.5
20	LivProc	13.56	8.8	47.34	10.18	46.91	72.87	72.6
21	FoodProc	15.79	8.71	53.24	11.83	52.49	79.28	78.84
22	FishProc	-15.67	-14.61	-19.63	-12.91	0.74	0.25	1.19
23	EstateProc	-0.97	-6.41	43.89	-4.27	34.49	70.78	79.29
24	Rice	4.25	23.05	14.32	3.27	13.29	41.28	41.1
25	OthFoodProc	8.41	-4.24	43	5.85	46.42	66.01	66.09
26	BevTob	37.38	26.49	110.37	28.92	94.92	149.4	147.23
27	TxtLthr	1.33	-9.4	92.92	-2.94	55.24	131.92	135.16
28	WoodPrd	3.17	-5.5	67.93	1.26	53.32	107.43	101.79
29	Chemical	13.07	-0.17	92.56	8.51	63.79	125.82	126.91
30	Fertiliser	24.69	27.61	117.51	18.65	92.34	182.52	178.81
31	Pesticide	9.32	3.47	72.55	6.11	60.37	114.67	111.12
32	MinMet	-0.38	-11.27	85.03	-2.05	58.09	130.89	128.97
33	OthManufac	-0.29	-11.5	87.12	-3.56	55.33	128.26	127.93
34	TradTrans	20.29	7.47	92.59	15.43	76.77	131.84	130.46
35	Service	-11.13	-19.78	47.05	-6.98	33.28	86.69	85.58

A decrease in investment expenditure and an increase in consumption can bring about a decrease in import volume because investment is more import intensive than consumption. On the other hand, a reduction in the tariff barriers can encourage an increase in import volume because the duty-paid import price index decrease more than the import price index. The net effect is that the import volume decreases by only a small amount (0.66 per cent) from the 1997 base. Export volume decreases by 5 per cent. There has to be an appreciation of the Rupiah against US$ to enforce the trade balance in the economy.

At the sectoral level, the output of all agricultural products increase except for cereal and other grain, beans, oil palm, coffee and tea. The appreciation of the Rupiah alters the competitiveness of agricultural export and will act to discourage the production of oil palm, coffee and tea, the traditional Indonesian exports. If these sectors are to maintain their positions, they will need to achieve productivity increases, or to benefit from other exogenous changes, or to receive some form of assistance.

8.2.3 APEC Trade Liberalisation under all Forecast Developments in the Economy

In the simulation just discussed, only the changes in import prices, export prices and the tariff variables associated with APEC trade liberalisation act as shocks to the Indonesian economy. The results give an indication of how the economy will change under APEC trade liberalisation. Though obtained assuming no other exogenous developments in the economy, the results provide one set of estimates of the impact trade liberalisation will have if there were concurrent exogenous changes. When additional shocks are added to capture all the forecast exogenous changes through to 2020, the simulation provides forecasts of how the Indonesian economy will have altered by 2020. The results for macroeconomic variables are reported in the sixth column of Table 8.5.

Not surprisingly, the inclusion of changes in population, consumer price index, employment, technology and government expenditure leads to quite different results from those when these do not change. Real GDP is forecast to grow by 98 per cent from its level in 1997. In the absence of exogenous economic developments, GDP grew by only 6 per cent over the period. Clearly, the future growth in Indonesia's economy is, as expected, largely reliant on growth in factors of production and improvement in productivity. The effect of APEC trade liberalisation is relatively minor at the macro level, though it does have more significant sectoral affects as discussed later. The growth in GDP is somewhat greater than the exogenous growth in employment (89 per cent) and similar to the endogenously determined growth in capital stocks (112 per cent). The capital-labor ratio thus rises only marginally. Investment increases, but since the initial 1997 investment-capital ratio is more than enough to maintain capital stocks, the percentage increase in investment (29 per cent) is much less than for capital. The relatively small increase in annual investment facilitates a large increase (130 per cent) in private consumption. Consumption per capita rises since population increases exogenously only by 26 per cent.

The world price changes associated with APEC trade liberalisation affect the terms of trade change. The decline in terms of trade leads to a smaller increase in the GDP deflator (which includes exports but not imports) than in CPI (which includes imports but not exports). On the income side of real GDP, a decline in terms of trade can affect the change in wages. The average rental on capital as well as the land rental both increase faster than the GDP deflator does, because of a decrease in the wage rate.

An appreciation of the Rupiah against the US$ is necessary to maintain the balance of trade under APEC trade liberalisation and the macroeconomic variable and technological changes. The appreciation and the reductions in the tariff barriers increase the import volume. At the same time, an increase of employment, capital and technology contribute to a large increase in domestic product and in export volume.

All agricultural industries except for cereal other grain crops, oil palm, coffee and tea are forecast to expand their output (see Table 8.6, column 6). So too do most other industries. Even though the input technology of these traditional export sectors is assumed to improve, it is still not enough to achieve an increase of their output. There is a shift away from export sectors to domestically oriented activity. The other agricultural products, which are mainly consumed domestically, expand due to higher demand associated with increased private consumption, macroeconomic and technology changes.

Non agricultural sectors (manufacturing and services) experience large increases compared to the agricultural and agricultural processing sectors. This provides a clear sign that Indonesia will face continuing structural changes from agricultural related sector towards the manufacturing and service sectors.

The sectoral changes using the forecasting simulations with APEC trade liberalisation and the other forecast exogenous changes are larger than the comparative statics results (see section 7.5, Table 7.15). For some agricultural commodities such as maize, coconut, beans and sugarcane, the changes are now positive instead of negative as before. The differences are not only because of the enforcement of the investment-capital accumulation and foreign debt accumulation in the forecasting model. They are due in part to the difference in the databases (1997 here and 1990 in Table 7.15), and also because of the exogenous changes in the macroeconomy and productivity. These latter changes are the more important as revealed below.

8.2.4 All Forecast Developments in the Economy without APEC Trade Liberalisation

In the preceding two sections, the impacts of the APEC trade liberalisation combined with all the exogenous economic developments and without any of them have been examined. Both simulations enforce accumulation conditions and the measured impacts include the effects of this enforcement. Not surprisingly, the endogenous changes are much greater when the other exogenous changes to the economy are included. It can be concluded that the macroeconomic and technology changes make a major contribution to the economic changes in Indonesia, both at the macro and sectoral level. In the final simulation (scenario 7), the impact of all economic development without APEC trade liberalisation is examined. The results from this run can be compared to the results of the previous section (that is, column 7 vs. column 6 in Tables 8.5 and 8.6) to gain a measure of the impact that APEC trade liberalisation *per se* has on the future Indonesian economy.

It is clear from the tables that there is not much difference between the two sets of results. Thus the position of the Indonesian economy under forecast macroeconomic and productivity developments is almost the same with or without APEC trade liberalisation. APEC trade liberalisation appears to have relatively little direct impact.

As discussed in section 8.2.2, column 1 of Table 8.5 (and Table 8.6) also provides a set of estimates of the impact of trade liberalisation, as does the comparative statics run reported in Table 7.12. Inspection of the differences between columns 6 and 7 shows that these differences are virtually identical to the estimates in Table 7.12 of the effects of trade liberalisation . Thus the effects of APEC trade liberalisation, measured in this section as the additional effect beyond the impact of exogenous developments to the economy, are the same as the estimates from the comparative statics analysis. This means there is no observed interaction between the other developments in the economy and trade liberalisation. This is what would be expected in a linear model, but is not generally expected in a non-linear model. Since the simulations have used multi-step Johansen solution methods to allow for any non-linearity, it seems that, over the range of the changes being encountered by the simulated Indonesian economy, the non-linearities are not significant. By contrast, the estimates of the impacts of APEC trade liberalisation in column 1 of Table 8.5 (and Table 8.6) are different. As noted in section 8.2.2, these results show more than the effect of liberalisation: they include the effects of enforcing capital and debt accumulation conditions.

Based on these simulations and comparisons, it is clear that the forecast macroeconomic and technology developments for Indonesia dominate trade liberalisation in terms of their impacts on Indonesia's future economic changes. This does not mean that Indonesia would wish to or could either ignore or avoid trade liberalisation agreements. Indonesia will be affected and will still gain from liberalisation. The following sections examine the impact of several individual exogenous factors.

8.2.5 APEC Trade Liberalisation with Growth in Public Consumption

Growth in public consumption (see column 4 of Tables 8.5 and 8.6) increases the labor intensity in the economy. It leads to a small increase in the capital stock and real GDP, smaller than for APEC trade liberalisation alone (column 1). are larger than in column 4. The small increase in capital growth requires, under the capital accumulation condition, a large decrease in investment (-63 per cent) from its initial levels, larger than in column 1. As a result the private consumption growth (28 per cent) is less than that associated with APEC trade liberalisation alone (36 per cent). Reduction in investment, which is sourced relatively more from imports, brings about a reduction in import volume. Therefore an appreciation of the Rupiah against the US$ is necessary to maintain the balance of trade. The real appreciation leads to a fall in export volume. The terms of trade improve and the investment price deflator declines.

The sectoral impact of this simulation is roughly similar to or worse than the impact of APEC trade liberalisation alone. An increase in public consumption with APEC trade liberalisation will not create conditions for producers to increase their output. Action by the government to raise public consumption in itself would seem to be not very fruitful from a growth perspective.

8.2.6 APEC Trade Liberalisation with an Increase of Factor Productivity

Improvements in productivity have made a substantial contribution to the economic growth of national economies, including Indonesia (Sarel, 1997). For this simulation, an increase of factor productivity means that output can be produced with less of the aggregate primary factor that is created out of capital, labor and land. In terms of the production structure in the model, it is the CES production function, and in particular the parameter *a1prim*, that is altered to capture productivity changes. The forecast improvement is assumed to apply uniformly in all sectors.

Because the real rate of return is held fixed, the increased productivity of the aggregate primary factor will lead to an increase in the wage rate relative to the rental earned by capital. This causes producers to substitute capital for labor. With aggregate employment and land fixed, the capital stock must increase; and the increase (63 per cent) is much more than for APEC trade liberalisation alone. The significant growth of capital stock along with the greater productivity ensures a high growth of real GDP (50 per cent) Comparing the results to those for the all-forecast-changes simulation (column 6), it appears this level of productivity improvement would account for 40-50% of Indonesia's forecast macroeconomic expansion.

On the expenditure side, the increase in real GDP is associated with increased private consumption while public consumption is held constant. Whereas investment declines by 60 per cent as a result of APEC trade liberalisation in the absence of changes in other exogenous factors, when there is an increase in primary factor productivity alongside APEC trade liberalisation, investment decreases by only 14 per cent. Again, the accumulation relationship between investment and capital stocks drives this change: with the large increase in capital stocks, investment does not need to decline much relative to its initial 1997 level. There is an increase in private consumption under the higher GDP. Imports and exports both increase, but with the Indonesian economy effectively now more competitive as a result of its productivity improvements, there must be an appreciation in the Rupiah to maintain the balance of trade.

The sectoral impact of this simulation is similar to the impact of APEC trade liberalisation together with an increase of employment (column 3). Both simulations capture increases in the effective supplies of factors. An increase of technology will increase the productivity of all sectors and will increase the output of all sectors except for fish processing sector. For some sectors, such as beans and vegetable and fruit, the productivity change has a larger effect than the exogenous aggregate employment. For other sectors, such as tea and other estate crops, employment growth has a greater impact. Those that have high capital-labor ratios would tend to gain more from productivity increases, while those with low capital-labor ratios would tend to gain more from employment increases. However, the actual size of the changes depends on the size of the exogenous changes. If the aggregate employment increases large enough, probably all sectors would expand more for that simulation than for the productivity one.

8.3 Concluding Comments

APEC trade liberalisation will not be introduced in a vacuum. It will take place over a period of time during which the Indonesian economy is expected to be changing for other reasons. In this chapter, some investigations of how the Indonesian economy would be affected if particular exogenous macroeconomic and productivity changes occurred together with APEC trade liberalisation have been reported. The range of possible future scenarios is large, and only a few simulations have been done and reported here. While there is scope for a more focussed investigation than here, the simulations nevertheless show two things:

(1) First, the impacts of APEC trade liberalisation *per se* are relatively small compared to changes in key macroeconomic variables and productivity that have been forecast by other researchers. This is both good and bad news. It is good in that Indonesia will likely cope relatively easily with the economic implications of trade liberalisation since these impacts are dominated by other changes. The bad news is that the gains for Indonesia from better exploitation of its comparative advantage are seemingly relatively minor. However, there may be greater gains in dynamic efficiency then the static efficiency benefits measured here.

(2) The improvement of productivity or employment together with APEC trade liberalisation increase the Indonesian real GDP more than the forecast increases in other macroeconomic variables with APEC trade liberalisation. At the sectoral level, increased output can be achieved by either an increase of productivity or employment. Government can encourage either or both. With some knowledge of the differential sensitivity of the sectors to both types of changes, government can better focus it efforts in accommodating APEC trade liberalisation. Further analysis of the sensitivity of each sector to both variables may be useful to government in forming policy implications for influencing the development of various sectors.

CHAPTER 9

CONCLUSION

9.1 Introduction

In an integrated world market, changing global and regional trade policies can influence the economic performance of any given country. In the Asia Pacific region, the APEC forum has become an important vehicle for cooperation among member nations. Indonesia is a member country. The principal objectives of this study were to assess the impacts of APEC trade liberalisation on the Indonesian economy, both the impacts on the macroeconomy and the impacts on individual sectors of the Indonesian economy, especially the agricultural sector and the estate-crops sub-sector. In the previous chapters, four tasks have been completed: (1) the development of an Indonesian Forecasting Model; (2) the specification of procedures for linking this model to the GTAP model of the global economy; (3) the construction of appropriate global and Indonesian steady-state databases; and (4) the simulation and analysis of APEC trade liberalisation under various scenarios and assumptions. This final chapter draws conclusions from the study.

Research activity has multiple outputs. The study has not only provided estimates of the impacts of trade liberalisation and thereby some insights into the implications and consequences for Indonesia but has also provided learning experiences for the writer relating to economic research. There are lessons here for other economics researchers. The study too has weaknesses that mean that it is only partially successful in accomplishing the objectives. These weaknesses have been explicitly recognised in earlier chapters, but some of the more important are recalled here as caveats on the conclusions. Some suggestions are made for further research.

9.2 Conclusions and Implications of the Empirical Results

The impacts of trade liberalisation

Two versions of trade liberalisation have been considered: the removal of intra-APEC tariffs by developed APEC countries by 2010; and the removal of intra-APEC tariffs by all APEC countries by 2020. The results for APEC countries from the GTAP simulations can be summarised as follows. Most APEC members experience positive impacts resulting from the elimination of tariffs in all APEC countries. Real GDP increases in all APEC countries in the short run (0.03 - 5 per cent) and more in the long run (up to 20 per cent for ASEAN countries), except in North America. Unlike other APEC countries, household consumption decreases in North America. Together with a decrease on net exports, this brings about a decrease in GDP expenditure. This finding is similar to those of Murtough *et al.* (1994), Hertel *et al.* (1995) and Walmsley (1998) and relates to relatively high initial tariffs. The larger improvement of GDP in the long run may be caused by an increase in the expected global rate of return on capital, reflecting increased capital productivity in the long run.

Given the focus of this study on Indonesia, the results for other APEC members of trade liberalisation by only the APEC developed countries have not been reported in detail in the thesis. The results are, however, similar to those in Murtough *et al.* (1994), namely small gains. APEC members as a group will be better off by not delaying trade liberalisation.

Estimates of the impacts of trade liberalisation depend on the nature of the database used. In particular, the GDP increases are bigger when a steady state database is used rather than the standard or benchmark Post-NAFTA GTAP (version 3) database. If equality of regional capital growth rates is taken to be a requirement of long run equilibrium, as seems reasonable, the long run impacts of trade liberalisation need to be assessed as a shift in such an equilibrium. In the benchmark database, the capital growth rates are not the same in all countries and such a database therefore needs to be adjusted to equalize the growth rates before assessing the impacts of trade liberalisation. As well, a long run steady state, with capital mobile between regions, requires that regional rates of return be equal, except for long run risk premiums which, arguably, may persist. In this study, the average of the regional growth rates in the database is assumed to be the steady state growth rate of capital; and the observed differences in rates of return are assumed in the study to reflect long-run risk premiums.

With capital mobile in the long run steady state simulation, the estimated impacts of trade liberalisation are significantly bigger than those estimated using the initial non-equilibrium database. For example, real GDP in Australia-New Zealand increases by 3.1 per cent using the steady state database but only 1.59 per cent under the benchmark database. The relative and absolute differences are even greater for some other regions. These differences suggest it is important in long run CGE analysis to use a properly adjusted database. If the long run requires rates of return to be equal, then those studies that have not used a steady state database are likely to have wrongly estimated, and probably underestimated, the impacts of the exogenous changes analysed. The results of most long-run CGE studies would be subject to this qualification.

The impacts of trade liberalisation on Indonesia were further examined by simulating the economy using the Indonesian Forecasting Model. GTAP results for Indonesian trading prices and tariffs, based on a long run closure and a risk adjusted steady state database, become exogenous shocks in the Indonesia Forecasting Model. The extent of these GTAP predicted changes differ depending on the extent of trade liberalisation. For most commodities, the changes in the average cif and fob prices and tariffs are greater under full APEC trade liberalisation than liberalisation by developed countries alone. Of the agricultural commodities, paddy rice and non-grain crops experience the highest percentage increases in fob prices, 25 and 19 per cent, respectively. This is encouraging for Indonesia as an agricultural exporting country, particularly since non-grain crops represent the main agricultural export commodities.

Three different scenarios for Indonesia's tariff rate changes were studied. One scenario is the set of tariff rate changes generated by the GTAP simulations. The second is that of the shocks needed to eliminate Indonesia's implicit tariff rates as calculated from the GTAP database updated after all APEC countries (except Indonesia) have removed their tariffs. The third set of shocks are the changes needed to eliminate tariff rates as calculated from the Post-NAFTA database before trade liberalisation. Taking the second set as corresponding to the elimination of Indonesian tariffs along with other liberalising countries, the first scenario can be viewed as a less-than-full reduction in tariff rates. The third corresponds to an over-reduction in tariffs, effectively the introduction of import subsidies. As would be expected, the impacts of APEC trade liberalisation depend both on the extent of participation by APEC countries in liberalisation and on the changes Indonesia makes to her own tariffs.

The macroeconomic results for Indonesia can be summarised as follows. For a given tariff rate change scenario, the impacts of the two cases of trade liberalisation are found to be generally in the same direction. The impacts of full APEC trade liberalisation are more positive (or less negative) than the impacts of trade liberalisation by only the APEC developed countries. The extent of the impacts, however, can be regarded as relatively minor, with the rise in real GDP due to full APEC trade liberalisation with Indonesia eliminating her tariffs being as little as 1.32 per cent. Indonesia gains more if she precisely eliminates the implied barriers existing after trade liberalisation by *other* APEC members than if she under-adjusts or over-adjusts (3.65 vs. 1.32 vs. 2.84 per cent. Furthermore, Indonesia benefits from participating in trade liberalisation, even if other developing countries do not participate, though the effects are small. The results suggest the Indonesian government needs to avoid over-reductions in tariff barriers if it seeks development focussed on increasing investment and on increasing private consumption.

While there are other studies based on different models, different scenarios and different aggregations of the sectors (for example, Trewin *et al.*, 1993) there are none against which these results can be directly compared. Nevertheless, the macroeconomic impacts on Indonesia seem quite small. As noted in the next section, the impacts are certainly small relative to the effects of other potential developments in the economy. The estimates should probably be regarded as being at the low end of possible impacts since the models do not allow for gains in dynamic efficiency.

The impacts of trade liberalisation at the sectoral level were examined only for the tariffs rate changes (and terms of trade changes) that occurred in the GTAP simulations, that is the first of the three tariff rate change scenarios. While these changes only partially remove Indonesia's implicit post-liberalisation tariff rates, they parallel the sets of changes used in other trade liberalisation studies, eg. Adams *et al.* (1997). Under this scenario, the impacts of full APEC trade liberalisation on Indonesia are varied with the estate crops and mining being amongst the biggest gainers in terms of industry output. Amongst traditional export industries, most experience an increase in exports, as would be expected. Estate crops processing, textiles and fish processing are the main exceptions. Indonesia's comparative advantage appears to lie with producing and exporting raw primary products rather than in processing them. The Indonesian government has been encouraging economic activity to shift away from agricultural production towards manufacturing and processing, including agricultural processing, in the hope of gaining added value. The simulation results suggest that this policy should be pursued selectively. In relation to imports, all industries experience increases. A similar result was obtained in a GTAP-based study that used more highly aggregated sectors than here (Erwidodo and Feridhanusetyawan, 1997).

The extent of participation by APEC members in trade liberalisation affects the results for two reasons. First, the price and tariff shocks to Indonesia generated by liberalisation are different. Second, the time period over which liberalisation is implemented differs and so, in the model, capital accumulates for different time periods, eg. 1997 to 2010 vs. 1997 to 2020, so altering the ORANI-F relationship between capital stocks and investment. This latter effect is the less important one. The changes in output, exports and imports of the various commodities are generally of the same sign under both versions of trade liberalisation. Full APEC trade liberalisation causes a larger change when the change is positive and smaller when negative. The traditional export commodities from the resource based sectors, including the estate crops sub-sector, expand in output and export volumes in both trade liberalisations.

For the vegetable and fruit, livestock, fishery, livestock processing and other food processing industries, output responds positively under full APEC trade liberalisation but negatively under developed country trade liberalisation. These sectors will not fare as well in the early years in the new millennium if the developing countries do not join with the developed countries in trade liberalisation. The precise reasons for this are not clear, but lie in the relative price and tariff rate shocks created by liberalisation. The relative price changes under the two forms of liberalisation differ because initial tariff rates vary between developed and developing countries and by commodity. The different time horizons assumed for the two runs, imposing a slightly different aggregate capital stock-investment condition may also be a factor. Regardless of the precise reasons for the differences, the listed industries have an interest in seeking full APEC trade liberalisation rather than the more limited liberalisation. These industries and government need to be aware of their longer term strengths. When consideration is given to the adjustment costs of reducing size and then re-expanding, ignored in the simulations here, it may be economically sensible to maintain or expand these industries even in the short term. To the extent that other developing country members of APEC are like Indonesia and gain from joining in liberalisation even if not all others do, then the actual participation by developing countries may exceed their formal APEC commitments. Then these processing industries, which might otherwise contract in the short run, may in reality expand even in the short run.

Trade liberalisation vis à vis other economic developments

Trade liberalisation will be implemented over time to 2010 by the developed APEC member countries and to 2020 for full APEC liberalisation. During this time, other exogenous macroeconomic and microeconomic changes in addition to trade liberalisation are likely to occur. These changes will affect Indonesia's economic performance and their impacts provide a benchmark against which to compare the impacts of trade liberalisation.

The major developments that will occur and that can be treated as exogenous relate to population, employment, productivity improvements and government expenditure. Changes to the rest of the economy, in response to one of more of these changes along with APEC trade liberalisation, were forecast with the Indonesian Forecasting Model. These added changes, in combination, contribute to much greater changes in the Indonesian economy than does APEC trade liberalisation alone. In fact, the effects of forecast macroeconomic and technology developments dominate those of trade liberalisation. For example, real GDP is estimated to increase by 6 per cent because of full APEC trade liberalisation alone but is forecast to rise by 96 per cent in the face of APEC trade liberalisation together with all other forecast economic developments.

The gains for Indonesia from better exploitation of its comparative advantage as a result of trade liberalisation are relatively minor. This does not mean that pursuing trade liberalisation is not worthwhile or not of significance to Indonesia. One of the limitations of the present study is that, like many studies of trade liberalisation, it does not address the potential improvements in dynamic efficiency associated with closer links with trading partners. That is, there is improved access not only to their markets but also to the spill-over effects of their know-how and ideas. The latter should not be ignored. From this perspective the estimated impacts of trade liberalisation are best seen as lower bounds of the likely actual impacts. Even so, it seems clear that trade liberalisation will have only a relatively minor impact. The one positive aspect of this is that it can be concluded that Indonesia will likely cope easily with the few negative sectoral economic implications of trade liberalisation.

Improvements in productivity and increases in employment are the dominant macroeconomic variables in terms of their effects both on the macroeconomy and at the sectoral level. Those sectors which have high capital-labor ratios would tend to gain more from productivity increases, while those with low capital-labor ratios tend to gain more from employment growth. With some knowledge of the differential sensitivity of the sectors to both types of changes, government can better focus its efforts in accommodating APEC trade liberalisation.

APEC trade liberalisation with the forecast population increases, but no other exogenous developments, leads to the worst outcomes. Real GDP actually declines marginally. In this case, aggregate investment spending is projected to decline, with the investment-related sectors, eg oil and gas, coal and other mining, reducing output. Trade liberalisation is not the cause of the poor economic performance; indeed performance is worse without it. Increases in population, when not accompanied with employment growth or other exogenous macroeconomic developments, are not good for the economy.

The results from the simulations of these exogenous changes should be interpreted with care. First, they rely on forecasts which have limited reliability. Results from varying the size of exogenous shocks suggest the model is not highly non-linear and consequently, as an approximation, an x per cent shift in an exogenous has an effect x times as large as a 1 per cent shift. However, while it is easy to see the impacts of a different rate of growth ion population, it is not so easy to see the effects of different productivity assumptions. The productivity improvements are assumed to apply equally to all sectors. This is unlikely to be the case in reality. Second, the simulations of individual factors with trade liberalisation do not represent forecasts of what will happen: other exogenous changes are expected. It is unlikely that population would expand significantly without employment or government expenditure also growing. Third, though treated as exogenous, all of these factors would in reality depend to some extent on the performance of the economy, and therefore should be endogenous in the simulations. In particular, trade liberalisation may alter these factors, for example enhancing employment, or through improved economic conditions, altering population growth rates. Given that the effects of trade liberalisation have been estimated to be relatively small, these errors can reasonably be assumed to be relatively small.

Most of the simulations of the Indonesian economy assumed that the balance of trade had to be maintained. The real exchange rate adjusted to achieve this. Because exchange rates are commonly used in managing economies, and Indonesia has followed a variety of policies, the implications of fixing the exchange rate at various levels was examined. Appreciation of the domestic currency erodes the country's external competitiveness. and cause falls in the current account balance. With APEC trade liberalisation, economic growth as measured by real GDP changes was quite robust to appreciation and devaluation of the Rupiah against the US$. There can be a devaluation of the Rupiah against the US$ of up to 150 per cent and real GDP will still increase as a result of full APEC trade liberalisation.

Lessons for CGE modellers

CGE studies have been made much easier in the past decade with the development of relatively standard CGE models and through the availability of commonly used CGE software. Nevertheless CGE modelling and analysis remains sophisticated and challenging. It involves integrating several fields of economic knowledge: microeconomic behaviour, trade theory and macroeconomic theory. It requires knowledge of linear algebra and numerical procedures; and it requires skills in computing and in managing databases and the numerous intermediate and final result files associated with the many simulations to be done.

Using thousands of equations to integrate all economic activities, with many variables to examine in the results, there is a high probability of making mistakes and of these mistakes going unrecognised, particularly if the research is undertaken alone. When two models are linked with one dependent on the results from the other, as in this study, the problems are magnified: an error in the first, detected too late, can mean that much of the analysis with the second is questionable.

Personal experience in the present study, in which the writer was the only researcher actively working on CGE modelling, was that it was necessary to retreat on several occasions to recover from initially undetected but subsequently identified errors. This strongly suggests that, for CGE modelling and analysis to be done efficiently and well, several researchers need to be actively working together on the study and ideally there needs to be a wider group of collaborators, with different knowledge and capabilities, all working actively on CGE studies. With the power of CGE analysis to generate results, successful, CGE analysis requires close familiarity with the economy being modelled.

The difficulties of undertaking CGE studies in relative isolation are reduced by access to CGE modelling support groups such as the GTAP and Impact Project teams. Access to analytical support for CGE modelling has improved with the advent of e-mail discussion groups allowing rapid communication with modellers anywhere in the world. This would seem to be particularly important for developing countries that typically have relatively few people trained in CGE analysis. Nevertheless, on-site collaboration would appear to be highly desirable and it would seen desirable that researchers with these skills be based together and work actively with CGE modelling to avoid losing their skills through lack of use.

9.3 Limitations of the Study and Suggestions for Further Research

In this study, the effects of trade liberalisation on Indonesia are determined by shocking an Indonesian national model with the changes predicted to occur in its international trading prices following liberalisation. These changes are themselves determined through a simulation of liberalisation using the GTAP model of the world economy. This linking of the two models is important; but represents a significant weakness of the study in fulfilling its objectives.

One aspect of linkage which might be questioned is that Indonesia is assumed to be a small country with no significant impacts of its activities on the world economy. The global economy can then be simulated ignoring any changes that might occur in Indonesian activity. Feedback effects from Indonesia to the world would only need to be taken into account if Indonesia had a significant share or market power in the world market for a commodity. The assumption that it does not have power is seemingly confirmed by comparisons of world prices simulated with Indonesia first being allowed to respond to price changes and second not being allowed to respond. There are no significant differences in the prices.

However, the global GTAP model operates with a high degree of sectoral and commodity aggregation, in particular a higher degree of aggregation than wanted for a study of individual estate crops. The possibility arises that an aggregation of commodities for which Indonesia's market share or power differs may hide this power.

The difficulty is that the price changes that are generated in the global model are generated for an aggregated commodity but have to be applied to more disaggregated commodities in the national model. In reality, the global price changes that occur following trade liberalisation (or other exogenous shocks) for narrowly defined goods are potentially different. Once the national model is subjected to unreliable estimates of the effect of trade liberalisation on the global price changes for disaggregated commodities, the results from the national model necessarily have also to be regarded as suspect as estimates of the detailed effects of trade liberalisation.

As noted in section 4.3.5, linkage would be avoided if the national model were included within the global model itself. However, it is difficult to build into a single global model a more detailed component for the particular country of interest. The global model would need to fully recognise commodities at the most disaggregated level of interest. Disaggregation becomes more difficult for the global model because multiple data sources must be used and some compromise must be involved in obtaining and including the sectoral detail for many different countries (Hertel, 1999).

Simulating the world economy with the GTAP model should be viewed as one way of efficiently estimating the trading price changes a country will face under trade liberalisation. The limitations of these estimates must be recognised. Better estimates of price changes might be obtained by amending the global model estimates on the basis of partial equilibrium analysis for particular commodities. With the ultimate aim being to determine the impacts of trade liberalisation on particular sectors in a domestic economy, such additional studies might be completed for the key and focal commodities and industries of the particular country before undertaking national general equilibrium analysis. The effects of altered estimates could be significant. In relation to estate crops, for example, if there were to be changes in the relative prices of estate crops, there could be much greater diversity in the impacts of liberalisation on these crops and their related processing sectors than apparent in the results of this study. Studies along these lines would seem worthwhile undertaking.

Besides the differences in commodity aggregations, there is a further related difference between the global and national models: the national model does not distinguish between Indonesia's individual trading partners whereas the GTAP model does. Recalling that the GTAP simulations determine both trading price changes and the Indonesian tariff rate changes to isolate Indonesia from trade liberalisation, it should be the case that, when these changes are applied exogenously in the Indonesian national model, there are no changes in Indonesia's trading activities as simulated by the national model. In reality, the simulations with the Indonesian model do not show zero changes, suggesting inconsistency between the two models or between the scenarios examined. Differences in commodity aggregation are partly responsible. But there are at least two other reasons. First, in the Indonesian model, the exogenously applied terms of trade and tariff changes for a given product are the average of the GTAP price changes for this product, averaged across the different countries of origin or destination. This could mean that trading opportunities recognised in the GTAP model are hidden in the national model. Second, in the GTAP model, at least for the forms of APEC trade liberalisation under study here, participating countries only eliminate import barriers. On the other hand, the endogenous GTAP model determinations of the changes in barriers needed to isolate Indonesia include changes to both her import and exports barriers. Since the scenario encountered by Indonesia in the national simulation is then not the same as Indonesia's hypothetical situation in the GTAP model, it would not be expected that the changes in trading activities in the national simulation would be zero as in the GTAP simulation.

It is not the fact that the two scenarios and the results are different that is important. The more important question is whether the tariff rate changes imposed in a national model simulation are relevant. Since they are not the changes in tariffs that Indonesia must make as a participant in trade liberalisation, they are of only secondary interest. A number of the simulations in this study, and in other studies, are to be recognised as having this limited relevance. Simulations should properly address removal or specified reductions of the implicit barriers. Further work on trade liberalisation needs also to explore the effects of changes in export support (or barriers) along with changes to import barriers.

With the benefit of hindsight it is easy to recognise weaknesses or even errors. In this study, the production and investment of the estate crop sectors have been modelled identically to other sectors. However, with long-lived and immobile biological capital, more refined production and investment models are desirable, especially when these sectors are a primary focus of the study. Capital modelling for estate crops similar to the approach used by Dee (1991) for the Indonesian forestry sector warrants further study.

Data availability, including that for capital stocks and investment, is also a problem. Sector 303 in the Indonesian I-O Table contains data on the value of investment goods of type i, that is goods produced by sector i for investment. The sum of these values is the total investment over all industries. However, there is no data on where sectors source their inputs for investment. With the Indonesian model, which can capture different types of investment, the lack of this data limits the immediate use of the model, especially the opportunity to exploit the features offered by the Walmsley specification of investment behaviour which includes risk. In the absence of explicit data on risk premiums, it was necessary to assume that differences in rates of return across sectors represented long-run risk premiums. Thus in relation to the long run equilibrium condition of equality of rates of return across sectors, the Indonesian data were assumed to define an economy already in equilibrium. Further, in the absence of data on sectoral capital stocks, it was assumed that the capital-investment ratio was the same across all sectors. With no sound reason to assume different rates of depreciation for different sectors, these too were all assumed to be the same. With equal depreciation rates and capital investment ratios, it follows that the growth rates in all sectors must be equal. Then, in the Walmsley investment specification, the economy is initially in a steady state: no adjustments are needed to the data to achieve a steady-state. Two rather arbitrary assumptions therefore mean that an incomplete database becomes a steady-state database.

This is a less than fully satisfactory situation, particularly when it is known from the results of the GTAP simulations that the use of a steady-state database leads to very different estimates of the impacts of shocks from those based on the standard database. Informal and unreported experimentation during this research, using alternative assumptions about depreciation rates and about the allocation of investment across sectors, confirmed that the simulation results from the Indonesian model would vary under different assumptions. Future research effort is needed to identify the most appropriate assumptions or sources for specifying the initial investment and capital stocks in each industry.

There are many other areas of the Indonesian Forecasting Model where improvements in data are needed. In particular, most of the parameters have not been formally estimated specifically for Indonesia. This study has relied on other research to define the values of the parameters. Because the national model is related with the global model (GTAP), most of the parameters in the Indonesian model have been drawn from the GTAP model parameter set and others from national models used in other countries, including the Philippines and Australia. Further efforts to determine the parameter values for Indonesian model, especially for more dissagregated levels of agriculture, are likely to be useful. Although some argue that it is difficult to get adequate data to estimate the needed CGE parameters for developing countries, it can be done as demonstrated by Kapuscinski and Warr's (1999) estimates of Armington elasticities for the Philippines.

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APPENDIX 1. Economic Performance of Estate Crops

Appendix 1.1 Planted Areas of Estates by Crops in Indonesia 1973-1993 (1 000 ha)

Year	Rubber	tea	Coffee	Palm Oil	Cocoa
1973	455.50	61.80	38.60	155.70	8.50
1974	440.00	61.00	37.50	164.30	11.00
1975	428.60	60.70	37.30	170.90	11.00
1976	408.40	59.60	37.40	179.90	12.00
1977	465.60	67.70	38.00	181.70	13.00
1978	437.10	67.90	38.40	206.60	12.30
1979	443.40	66.60	38.30	229.20	14.60
1980	443.80	70.70	39.70	252.90	15.50
1981	450.00	70.60	42.20	262.10	20.90
1982	429.90	62.70	42.80	292.00	28.00
1983	446.30	61.70	42.30	328.10	26.60
1984	471.50	60.10	43.10	381.10	28.50
1985	492.10	61.50	45.30	419.20	33.20
1986	513.00	69.70	46.20	463.90	36.60
1987	500.10	59.70	47.80	458.30	35.80
1988	487.60	70.20	53.10	525.90	56.90
1989	482.00	74.50	42.30	569.70	94.30
1990	534.80	79.30	55.70	773.80	109.30
1991	526.30	97.20	55.30	779.30	127.60
1992	518.40	87.30	52.70	819.80	131.50
1993	490.80	69.00	48.00	903.20	126.70

Source : Central Bureau of Statistics, 1977-1978, 1980/1981, 1984, 1987, 1989, 1993, 1994

Appendix 1.2 Planted Areas of Smallholders by Crops in Indonesia 1973-1993 (1 000 ha)

Year	Rubber	Tea	Coffee	Palm Oil	Cocoa
1973	1856.60	33.30	340.50		4.80
1974	1868.40	34.00	346.60		6.10
1975	1864.20	34.20	361.30		5.70
1976	1857.10	35.40	402.00		5.80
1977	1858.60	36.00	454.30		7.70
1978	1870.60	35.20	477.10		8.70
1979	1925.40	37.10	579.80		9.10
1980	1959.35	39.70	664.80		12.00
1981	1994.20	42.30	749.80	5.70	14.90
1982	2035.80	45.40	759.20	8.50	18.00
1983	2117.90	45.90	766.10	37.60	25.90
1984	2235.70	50.80	837.50	40.60	39.20
1985	2315.70	52.70	874.30	118.60	51.80
1986	2369.00	65.30	888.90	129.90	53.40
1987	2362.40	50.30	908.60	203.00	114.90
1988	2462.30	50.80	969.80	196.30	165.10
1989	2555.40	52.20	984.20	223.80	212.40
1990	2639.40	51.20	1014.10	291.30	252.20
1991	2667.90	51.50	1063.30	384.60	300.00
1992	2690.10	51.60	1087.40	439.50	306.20
1993	2698.20	51.70	1104.90	534.90	257.70

Source : Central Bureau of Statistics, 1977-1978, 1980/1981, 1984, 1987, 1989, 1993, 1994

Appendix 1.3 Total Planted Areas of Main Estate Crops in Indonesia in 1973 - 1993 (1 000 ha)

Year	Rubber	Tea	Coffee	Palm Oil	Cocoa
1973	2312.10	95.10	379.10	155.70	13.30
1974	2308.40	95.00	384.10	164.30	17.10
1975	2292.80	94.90	398.60	170.90	16.70
1976	2265.50	95.00	439.40	179.90	17.80
1977	2324.20	103.70	492.30	181.70	20.70
1978	2307.70	103.10	515.50	206.60	21.00
1979	2368.80	103.70	618.10	229.20	23.70
1980	2403.15	110.40	704.50	252.90	27.50
1981	2444.20	112.90	792.00	267.80	35.80
1982	2465.70	108.10	802.00	300.50	46.00
1983	2564.20	107.60	808.40	365.70	52.50
1984	2707.20	110.90	880.60	421.70	67.70
1985	2807.80	114.20	919.60	537.80	85.00
1986	2882.00	135.00	935.10	593.80	90.00
1987	2862.50	110.00	956.40	661.30	150.70
1988	2949.90	121.00	1022.90	722.20	222.00
1989	3037.40	126.70	1026.50	793.50	306.70
1990	3174.20	130.50	1069.80	1065.10	361.50
1991	3194.20	148.70	1118.60	1163.90	427.60
1992	3208.50	138.90	1140.10	1259.30	437.70
1993	3189.00	120.70	1152.90	1438.10	384.40

Source : Central Bureau of Statistics, 1977-1978, 1980/1981, 1984, 1987, 1989, 1993, 1994

Appendix 1.4 Production of Estates by Crops in Indonesia 1973-1993 (1 000 m ton)

Year	Rubber	tea	Coffee	Palm Oil	Cocoa
1973	246.50	53.10	10.10	290.00	1.30
1974	248.70	50.10	16.20	351.10	2.60
1975	244.10	55.30	15.30	411.40	3.20
1976	246.80	59.70	15.20	433.90	3.00
1977	252.20	62.80	17.10	497.40	3.90
1978	269.40	71.70	16.60	525.00	4.30
1979	273.60	71.80	16.40	559.90	7.40
1980	278.60	78.20	20.20	691.00	8.20
1981	300.80	85.00	23.40	752.30	11.20
1982	301.80	73.60	19.50	833.80	13.20
1983	308.50	88.70	16.80	891.40	13.60
1984	313.70	102.10	25.70	1079.50	21.80
1985	320.80	105.10	21.20	1159.10	24.80
1986	332.10	98.40	26.70	1195.60	21.20
1987	327.30	100.70	20.80	1340.90	21.60
1988	321.80	104.30	27.30	1394.90	25.80
1989	327.00	122.20	32.40	1860.40	39.10
1990	315.30	129.10	25.50	2096.90	41.50
1991	330.10	125.00	26.40	1843.60	30.60
1992	335.00	113.00	23.90	2186.00	39.50
1993	335.00	98.80	20.90	2288.30	42.70

Source : Central Bureau of Statistics, 1977-1978, 1980/1981, 1984, 1987, 1989, 1993, 1994

Appendix 1.5 Production of Smallholders by Crops in Indonesia 1973-1993 (1 000 m ton)

Year	Rubber	tea	Coffee	Palm Oil	Cocoa
1973	597.90	14.30	140.30		0.50
1974	571.00	13.80	142.90		0.80
1975	542.70	14.10	155.40		0.80
1976	610.20	13.30	178.00		0.80
1977	590.30	17.30	177.90		0.90
1978	612.40	17.40	205.60		0.90
1979	673.10	19.00	236.10		0.70
1980	657.70	21.40	263.30		1.05
1981	642.30	23.80	290.40	1.00	1.40
1982	585.60	16.50	262.20	3.00	3.90
1983	673.60	22.90	287.20	3.50	5.40
1984	715.40	24.00	303.40	4.00	6.20
1985	733.80	27.20	391.50	43.00	9.00
1986	763.20	31.10	334.20	89.80	8.80
1987	795.20	25.40	367.80	165.20	25.80
1988	838.90	25.60	362.30	156.10	39.80
1989	853.20	24.60	376.60	183.70	68.30
1990	913.40	31.40	384.50	377.00	97.50
1991	971.40	27.90	399.10	413.30	119.30
1992	999.80	28.00	409.50	699.60	124.00
1993	1009.80	28.90	418.50	833.70	126.90

Source : Central Bureau of Statistics, 1977-1978, 1980/1981, 1984, 1987, 1989, 1993, 1994

Appendix 1.6 Production of Estates Crops in Indonesia 1973-1993 (1 000 m ton)

	Rubber	tea	Coffee	Palm Oil	Cocoa
1973	844.40	67.40	150.40	290.00	1.80
1974	819.70	63.90	159.10	351.10	3.40
1975	786.80	69.40	170.70	411.40	4.00
1976	857.00	73.00	193.20	433.90	3.80
1977	842.50	80.10	195.00	497.40	4.80
1978	881.80	89.10	222.20	525.00	5.20
1979	946.70	90.80	252.50	559.90	8.10
1980	936.30	99.60	283.50	691.00	9.25
1981	943.10	108.80	313.80	753.30	12.60
1982	887.40	90.10	281.70	836.80	17.10
1983	982.10	111.60	304.00	894.90	19.00
1984	1029.10	126.10	329.10	1083.50	28.00
1985	1054.60	132.30	412.70	1202.10	33.80
1986	1095.30	129.50	360.90	1285.40	30.00
1987	1122.50	126.10	388.60	1506.10	47.40
1988	1160.70	129.90	389.60	1551.00	65.60
1989	1180.20	146.80	409.00	2044.10	107.40
1990	1228.70	160.50	410.00	2473.90	139.00
1991	1301.50	152.90	425.50	2256.90	149.90
1992	1334.80	141.00	433.40	2885.60	163.50
1993	1344.80	127.70	439.40	3122.00	169.60

Source : Central Bureau of Statistics, 1977-1978, 1980/1981, 1984, 1987, 1989, 1993, 1994

Appendix 1.7 Productivity of Smallholders by Crops in Indonesia 1973-1993 (ton/ha)

Year	Rubber	tea	Coffee	Palm Oil	Cocoa
1973	0.32	0.43	0.41		0.10
1974	0.31	0.41	0.41		0.13
1975	0.29	0.41	0.43		0.14
1976	0.33	0.38	0.44		0.14
1977	0.32	0.48	0.39		0.12
1978	0.33	0.49	0.43		0.10
1979	0.35	0.51	0.41		0.08
1980	0.34	0.54	0.40		0.09
1981	0.32	0.56	0.39	0.18	0.09
1982	0.29	0.36	0.35	0.35	0.22
1983	0.32	0.50	0.37	0.09	0.21
1984	0.32	0.47	0.36	0.10	0.16
1985	0.32	0.52	0.45	0.36	0.17
1986	0.32	0.48	0.38	0.69	0.16
1987	0.34	0.50	0.40	0.81	0.22
1988	0.34	0.50	0.37	0.80	0.24
1989	0.33	0.47	0.38	0.82	0.32
1990	0.35	0.61	0.38	1.29	0.39
1991	0.36	0.54	0.38	1.07	0.40
1992	0.37	0.54	0.38	1.59	0.40
1993	0.37	0.56	0.38	1.56	0.49

Source : Central Bureau of Statistics, 1977-1978, 1980/1981, 1984, 1987, 1989, 1993, 1994

Appendix 1.8 Productivity of Estates by Crops in Indonesia 1973-1993 (ton/ha)

Year	Rubber	tea	Coffee	Palm Oil	Cocoa
1973	0.54	0.86	0.26	1.86	0.15
1974	0.57	0.82	0.43	2.14	0.24
1975	0.57	0.91	0.41	2.41	0.29
1976	0.60	1.00	0.41	2.41	0.25
1977	0.54	0.93	0.45	2.74	0.30
1978	0.62	1.06	0.43	2.54	0.35
1979	0.62	1.08	0.43	2.44	0.51
1980	0.63	1.11	0.51	2.73	0.53
1981	0.67	1.20	0.55	2.87	0.54
1982	0.70	1.17	0.46	2.86	0.47
1983	0.69	1.44	0.40	2.72	0.51
1984	0.67	1.70	0.60	2.83	0.76
1985	0.65	1.71	0.47	2.77	0.75
1986	0.65	1.41	0.58	2.58	0.58
1987	0.65	1.69	0.44	2.93	0.60
1988	0.66	1.49	0.51	2.65	0.45
1989	0.68	1.64	0.77	3.27	0.41
1990	0.59	1.63	0.46	2.71	0.38
1991	0.63	1.29	0.48	2.37	0.24
1992	0.65	1.29	0.45	2.67	0.30
1993	0.68	1.43	0.44	2.53	0.34

Source : Central Bureau of Statistics, 1977-1978, 1980/1981, 1984, 1987, 1989, 1993, 1994

Appendix 1.9 Exports volume of estate crops from Indonesia in 1973 - 1994 (1 000 m ton)

Year	Rubber	Tea	Palm Oil	Coffee
1973	890.20	39.60	262.70	
1974	840.40	55.70	301.20	
1975	788.30	45.90	386.50	
1976	811.50	47.50	405.60	
1977	800.20	51.30	404.60	
1978	861.50	56.30	412.20	215.80
1979	861.00	53.60	351.30	220.20
1980	976.10	74.20	502.90	238.90
1981	808.70	71.30	196.40	210.80
1982	797.60	63.70	259.50	227.30
1983	938.00	68.60	345.80	241.60
1984	1009.50	85.70	127.90	294.90
1985	1000.90	90.10	518.80	285.90
1986	958.70	79.00	566.90	298.50
1987	1033.40	89.90	404.90	291.10
1988	1131.90	92.60	731.10	298.90
1989	1151.80	125.30	781.80	357.60
1990	1077.30	111.00	815.40	422.60
1991	1220.00	110.90	1167.70	381.50
1992	1267.80	121.60	1030.30	270.60
1993	1214.30	124.60	1372.10	352.30
1994	1283.60	81.00	1894.60	319.70
Mean	987.40	79.06	601.83	289.89
St. dev	164.83	26.81	432.01	61.94

Source : Central Bureau of Statistics, 1977-78, 1980/81, 1984, 1987, 1989, 1993, 1994

Appendix 1.10. Export value of Estate Crops and Total Exports excluding Petroleum and Gas (US$ 1 000 000) and the share of Exports Revenue from Estate Crops

Year	Rubber	Tea	Palm Oil	Coffee	Total	Exc. P&G	% share *
1973	391.40	26.10	70.20		487.70	1602.10	30.44
1974	479.20	46.30	157.30		682.80	2214.90	30.83
1975	358.20	51.50	151.60		561.30	1791.70	31.33
1976	530.80	56.60	135.50		722.90	2542.40	28.43
1977	588.30	118.50	183.60		890.40	3474.50	25.63
1978	716.50	94.70	208.80	491.30	1511.30	3657.80	41.32
1979	936.80	83.40	204.40	614.50	1839.10	5426.40	33.89
1980	1165.30	112.70	254.70	658.30	2191.00	6168.80	35.52
1981	828.20	100.80	106.90	347.80	1383.70	4501.30	30.74
1982	602.10	89.50	96.20	343.60	1131.40	3929.20	28.79
1983	843.50	120.40	111.50	429.90	1505.30	5005.30	30.07
1984	948.60	226.30	63.30	567.90	1806.10	5869.70	30.77
1985	716.60	149.10	189.40	561.90	1617.00	5868.80	27.55
1986	711.50	99.10	112.90	821.70	1745.20	6528.40	26.73
1987	847.40	115.80	109.90	541.80	1614.90	8579.50	18.82
1988	1243.10	125.70	275.50	551.90	2196.20	11536.90	19.04
1989	1007.60	163.10	244.60	491.10	1906.40	13480.10	14.14
1990	846.90	181.00	203.50	379.00	1610.40	14604.20	11.03
1991	1056.60	143.40	335.50	375.90	1911.40	18247.50	10.47
1992	1036.70	141.00	356.50	242.00	1776.20	23296.10	7.62
1993	976.80	156.00	472.40	351.90	1957.10	27077.20	7.23
1994	1184.20	93.30	712.10	827.60	2817.20	30341.70	9.28
Mean	818.92	113.38	216.20	505.77	1654.27		
St. Dev	254.20	47.08	149.85	164.42	615.54		

Source : Central Bureau of Statistics, 1977-78, 1980/81, 1984, 1987, 1989, 1993, 1994.

*) % share of Export Revenue from Estate Crops to Total Export Revenue excluding petroleum and gas

Appendix 1. 11. Nominal Price of Estate Crops (Value/Volume) from Indonesia in 1973-1994 (US$/ton)

Year	Rubber	Tea	Palm Oil	Coffee
1973	0.44	0.66	0.27	
1974	0.57	0.83	0.52	
1975	0.45	1.12	0.39	
1976	0.65	1.19	0.33	
1977	0.74	2.31	0.45	
1978	0.83	1.68	0.51	2.28
1979	1.09	1.56	0.58	2.79
1980	1.19	1.52	0.51	2.76
1981	1.02	1.41	0.54	1.65
1982	0.75	1.41	0.37	1.51
1983	0.90	1.76	0.32	1.78
1984	0.94	2.64	0.49	1.93
1985	0.72	1.65	0.37	1.97
1986	0.74	1.25	0.20	2.75
1987	0.82	1.29	0.27	1.86
1988	1.10	1.36	0.38	1.85
1989	0.87	1.30	0.31	1.37
1990	0.79	1.63	0.25	0.90
1991	0.87	1.29	0.29	0.99
1992	0.82	1.16	0.35	0.89
1993	0.80	1.25	0.34	1.00
1994	0.92	1.15	0.38	2.59

Source : Central Bureau of Statistics, 1977-78, 1980/81, 1984, 1987, 1989, 1993, 1994.

APPENDIX 2 Equations of Indonesian Forecasting Model

No	Equation	Subscript range	Description
1	Skill specific demand for labour		
1.1	$x1lab_{io} = x1lab_{i\_o} - \sigma 1LAB_i(p1lab_{io} - p1lab_{i\_o})$	$i \in IND$ $o \in OCC$	Industry's demand for labour by skill group
1.2	$p1lab_{i\_o} = \frac{1}{V1LAB_{i\_o}} \sum_{o \in OCC}(V1LAB_{io} \times p1lab_{io})$	$i \in IND$	Price to each industry of labour composite
2.	Demand for Primary Factors		
2.1	$x1lab_{i\_o} - a1lab_{i\_o} = x1prim_i - \sigma 1PRIM_i(p1lab_{i\_o} + a1lab_{i\_o} - p1prim_i)$	$i \in IND$	Demand for labour by industry i
2.2	$x1cap_i - a1cap_i = x1prim_i - \sigma 1PRIM_i(p1cap_i + a1cap_i - p1prim_i)$	$i \in IND$	Demand for capital by industry i
2.3	$x1\ln d_i - a1\ln d_i = x1prim_i - \sigma 1PRIM_i(p1\ln d_i + a1\ln d_i - p1prim_i)$	$i \in IND$	Demand for land by industry i
2.4	$p1prim_i = \frac{1}{V1PRIM} \left\{ \begin{array}{l} V1LAB_{i\_o} \times (p1lab_{i\_o} + a1lab_{i\_o}) \\ + V1CAP_i \times (p1cap_i + a1cap_i) \\ + V1LND_i \times (p1\ln d + a1\ln d_i \end{array} \right\}$ where $V1PRIM_i = V1LAB_{i\_o} + V1LND_i + V1CAP_i$	$i \in IND$	Effective price term for factor demand equation
3	Source specific intermediate input demand		
3.1	$x1_{csi} - a1_{csi} = x1_{ci\_s} - \sigma 1_c(p1_{csi} + a1_{csi} - p1_{ci\_s})$	$c \in COM$ $s \in SRC$ $i \in IND$	Source specific commodity demand
3.2	$p1_{ci\_s} = \frac{1}{V1PUR_{ci\_s}} \sum_{s \in SRC} V1PUR_{csi}(p1_{csi} + a1_{csi})$	$c \in COM$ $i \in IND$	Effective price of commodity composite
4	Demand for composite primary factor and intermediate input		
4.1	$x1_{ci\_s} - (a1_{ci\_s} + a1tot_i) = x1tot_i$	$i \in IND$	Demand for commodity composite

4.2	$x1prim_i - (a1prim_i + a1tot_i) = x1tot_i$	$i \in IND$	Demand for primary factor composite
4.3	$x1oct_i - (a1oct_i + a1tot_i) = x1tot_i$	$i \in IND$	Demand for other cost ticket
4.4	$p1tot_i - a1tot_i = \frac{1}{V1TOT_i}\{\sum_{c \in COM} V1PUR_{ci\_s}(p1_{ci\_s} + a1_{ci\_s}) + V1PRIM_i \times (p1prim_i + a1prim_i) + V1OCT_i \times (p1oct_i + a1oct_i)\}$ Where: $V1TOT_i = V1PUR_{i\_cs} + V1PRIM_i + V1OCT_i$	$i \in IND$	Zero pure profit in production

5	Commodity Composition of Industry Output		
5.1	$q1_{ci} = x1tot_i + \sigma 1OUT_i(p0dom_c - p1tot_i),$	$c \in COM$ $i \in IND$	Supply of commodities by industry i
5.2	$p1tot_i = \frac{1}{MAKE_{i\_c}} \sum_{c \in COM}(MAKE_{ci} \times p0dom_c),$	$i \in IND$	Average price received by industry i

6	Demand for Investment Goods Equations		
6.1	$x2_{csi} - a2_{csi} = x2_{ci\_s} - \sigma 2_c(p2_{csi} + a2_{csi} - p2_{ci\_s})$	$c \in COM$ $s \in SRC$ $i \in IND$	Source specific demand
6.2	$p2_{ci\_s} = \frac{1}{V2PUR_{ci\_s}} \sum_{s \in SRC} V2PUR_{csi}(p2_{csi} + a2_{csi})$	$c \in COM$ $i \in IND$	Effective price of commodity
6.3	$x2_{cs\_s} - (a2_{ci\_s} + a2tot_i) = x2tot_i$	$c \in COM$ $i \in IND$	Demand for commodities
6.4	$p2tot_i - a2tot_i = \frac{1}{V2PUR_{i\_cs}} \sum_{c \in COM} V2PUR_{ci\_s} \times (p2_{ci\_s} + a2_{ci\_s})$	$i \in IND$	Zero pure profits in investment

7	Household Demand		
7.1	$x3_{cs} = a3_{cs} + x3_{s\_c} - \sigma 3_c(p3_{cs} + a3_{cs} - p3_{c\_s})$	$c \in COM$ $s \in SRC$	Source specific commodity demands

7.2	$p3_{c\_s} = \frac{1}{V3PUR_{c\_s}} \sum_{s \in SRC} V3PUR_{cs}(p3_{cs} + a3_{cs})$	$c \in COM$	Effective price of commodity composite
7.3	$x3sub_c = q + a3sub_c$	$c \in COM$	Subsistence demand for composite commodities
7.4	$x3lux_c = w3lux_c + a3lux_c - p3_{c\_s}$	$c \in COM$	Luxury demand for composite commodities
7.5	$x3_{c\_s} = B3LUX_c \times x3lux_c + [(1 - B3LUX_c) \times x3sub_c]$	$c \in COM$	Total household demand for composite commodities
7.6	$utility = -q + \sum_{c \in COM}(S3LUX_c \times x3lux_c)$	1	Change in utility disregarding taste change term
7.7	$a3lux_c = a3sub_c - \sum_{k \in COM}(S3LUX_k \times a3sub_k),$	$c \in COM$	Default setting for luxury taste shifter
7.8	$a3sub_c = a3_{c\_s} - \sum_{k \in COM}(S3_{k\_s} \times a3_{k\_s})$	$c \in COM$	Default setting for subsistence taste shifter

8 Export and Other Final Demand

8.1	$x4_c = f4q_c + EXP\_ELAST_c[p4_c - phi - f4p_c]$	$c \in TRADEXP$	Traditional export demand function
8.2	$x4_c = x4\_ntrad$	$c \in NTRADEXP$	Non traditional Export Demand fuction
8.3	$x4\_ntrad = EXP\_ELAST\_NT \times [p4\_ntrad - phi - f4\_ntrad]$	1	Demand for non trad. Export aggregate
8.4	$p4\_ntrad = \frac{1}{V4PUR\_c} \sum_{c \in COM}(V4PUR_c \times p4_c)$	1	Average price of non trad. export
8.5	$x5_{cs} = f5_{cs} + f5tot$	$c \in COM$ $s \in SRC$	"Other" demands
8.6	$f5tot = x3tot + f5tot2$	1	Overall other demand shift

9\. Demands for Margin

9.1	$x1mar_{csim} = x1_{csi} + a1mar_{csim}$	$c \in COM$ $s \in SRC$ $i \in IND$ $m \in MAR$	Margin to producers
9.2	$x2mar_{csim} = x2_{csi} + a2mar_{csim}$	$c \in COM$ $s \in SRC$ $i \in IND$ $m \in MAR$	Margin to capital creator

9.3	$x3mar_{csm} = x3_{cs} + a3mar_{csm}$	$c \in COM$ $s \in SRC$ $i \in IND$ $m \in MAR$	Margin to household
9.4	$x4mar_{cm} = x4_{c} + a4mar_{cm}$	$c \in COM$ $m \in MAR$	Margin to export
9.5	$x5mar_{csm} = x5_{cs} + a5mar_{csm}$	$c \in COM$ $s \in SRC$ $m \in MAR$	Margin to "other" user

10 Purchaser's Prices

10.1	$\{V1PUR_{csi} + TINY\} \times p1_{csi} = \{V1BAS_{csi} + V1TAX_{csi}\} \times (p0_{csi} + t1_{csi}) + \sum_{m \in MAR} V1MAR_{csim} \times (p0dom_{m} + a1mar_{csim})$	$c \in COM$ $i \in IND$	Purchasers prices producers
10.2	$\{V2PUR_{csi} + TINY\} \times p2_{csi} = \{V2BAS_{csi} + V2TAX_{csi}\} \times (p0_{csi} + t2_{csi}) + \sum_{m \in MAR} V2MAR_{csim} \times (p0dom_{m} + a2mar_{csim})$	$c \in COM$ $i \in IND$	Purchasers prices capital creative
10.3	$\{V3PUR_{csi} + TINY\} \times p3_{csi} = \{V3BAS_{csi} + V3TAX_{csi}\} \times (p0_{csi} + t3_{csi}) + \sum_{m \in MAR} V3MAR_{csim} \times (p0dom_{m} + a3mar_{csim})$	$c \in COM$ $i \in IND$	Purchasers prices household
10.4	$\{V4PUR_{csi} + TINY\} \times p4_{csi} = \{V4BAS_{csi} + V4TAX_{csi}\} \times (p0_{csi} + t4_{csi}) + \sum_{m \in MAR} V4MAR_{csim} \times (p0dom_{m} + a4mar_{csim})$	$c \in COM$ $i \in IND$	Zero profit in exporting
10.5	$\{V5PUR_{csi} + TINY\} \times p5_{csi} = \{V5BAS_{csi} + V5TAX_{csi}\} \times (p0_{csi} + t5_{csi}) + \sum_{m \in MAR} V5MAR_{csim} \times (p0dom_{m} + a5mar_{csim})$	$c \in COM$ $i \in IND$	Zero pure profits in distribution of other
10.6	$p0imp_{cs=imp} = pf0cif_{c} + phi + t0imp_{c}$	$c \in COM$ $i \in IND$	Zero profit in importing

11. Market – Clearing Equations

11.1	$x0dom_{c} = \frac{1}{MAKE_{c\_i}} \sum_{i \in IND} MAKE_{ci} \times q1_{ci}$	$c \in COM$	Total output of domestic commodities

11.2	$x0dom_n = \frac{1}{SALES_n}\left\{ \sum_{i=IND}\begin{pmatrix} V1BAS_{ns=dom}\times x1_{ns=domi} \\ +V2BAS_{ns=domi}\times x2_{ns=domi}\end{pmatrix} + V3BAS_{ns=dom}\times x3_{ns=dom} + V4BAS_n \times x4_n + V5BAS_{ns=dom}\times x5_{ns=dom} + 100\times P0DOM_n \times delx6_n \right\}$	$n\in nonmargin$	Demand equals supply for non margin commodity
11.3	$SALES_m \times x0dom_m = \sum_{i=IND}\begin{pmatrix} V1BAS_{ms=dom}\times x1_{ms=domi} \\ +V2BAS_{ms=domi}\times x2_{ms=domi}\end{pmatrix} + V3BAS_{ms=dom}\times x3_{ms=dom} + V4BAS_m \times x4_m + V5BAS_{ms=dom}\times x5_{ms=dom} + 100\times P0DOM_m \times delx6_m + \sum_{c=com}\left(V4MAR_{cm}\times x4mar_{cm} + \sum_{s=src}\left(V3MAR_{csm}\times x3mar_{csm} + V5MAR_{csm}\times x5mar_{csm} + \sum_{i=IND}\begin{matrix} V1MAR_{csim}\times x1mar_{csim} \\ +V2MAR_{csim}\times x2mar_{csim}\end{matrix} \right)\right)$	$m\in margin$	Demand equals supply for margin commodity
11.4	$x0imp_c = \frac{1}{V0IMP_c}\left(\sum_{i\in IND}\begin{pmatrix} V1BAS_{cs=impi}\times x1_{csi} \\ +V2BAS_{cs=impi}\times x2_{cs=impi}\end{pmatrix} + V3BAS_{cs=imp}\times x3_{cs=imp} + V5BAS_{cs=imp}\times x5_{cs=imp} \right)$	$c\in COM$	Import volume
11.5	$x1lab_{o\_i} = \frac{1}{V1LAB_{o\_i}} \sum_{i\in IND} V1LAB_{io}\times x1lab_{io}$	$o\in OCC$	Demand equals supply for labour of each skill
11.6	$x1\ln d_{\_i} = \frac{1}{V1LND_{\_i}} \sum_{i\in IND} V1LND_i \times x1\ln d_i$	$i\in IND$	Demand equals supply for land
11.7	$x1\ln d_{\_e} = \frac{1}{V1LND_{\_e}} \sum_{i\in ESTATE} V1LND_i \times x1\ln d_i$	$i\in ESTATE$	Demand equals supply for estate crops land
11.8	$x1\ln d_{\_r} = \frac{1}{V1LND_{\_r}} \sum_{i\in CROPS} V1LND_i \times x1\ln d_i$	$I\in CROPS$	Demand equals supply for food crops land

11.9	$x1\ln d_{\_h} = \frac{1}{V1LND_{\_h}} \sum_{i \in OTHIND} V1LND_i \times x1\ln d_i$	$h \in OTHIND$	Demand equal supply in other industries land
11.10	$p1\ln d_i = f1\ln d_{\_e} + f1\ln d_i + f1\ln d\_i$	$i \in ESTATE$	Land rent in each estate crops industry
11.11	$p1\ln d_i = f1\ln d_{\_r} + f1\ln d_i + f1\ln d\_i$	$I \in CROPS$	Land rent in each food crops industry
11.12	$p1\ln d_i = f1\ln d_{\_h} + f1\ln d_i + f1\ln d\_i$	$I \in OTHIND$	Land rent in each industry other than estate crops and food crops

12. Indirect Taxes

12.1	$t1_{csi} = f0tax_{c\_s} + f1tax_{\_csi}$	$c \in COM$ $s \in SRC$ $i \in IND$	Power of tax on sales to intermediate
12.2	$t2_{csi} = f0tax_{c\_s} + f2tax_{\_csi}$	$c \in COM$ $s \in SRC$ $i \in IND$	Power of tax on sales to investment
12.3	$t3_{cs} = f0tax_{c\_s} + f3tax_{\_cs}$	$c \in COM$ $s \in SRC$	Power of tax on sales to household
12.4	$t4_c = f0tax_{c\_s} + f4tax_{-trad}$	$c \in TRADEXP$	Power of tax on sales to trad. exp.
12.5	$t4_c = f0tax_{c\_s} + f4tax_{-ntrad}$	$c \in TRADEXP$	Power of tax on sales to non trad. Exp
12.6	$t5_{cs} = f0tax_{c\_s} + f5tax_{\_cs}$	$c \in COM$	Power of tax on sales to other
12.7	$w1tax_{\_csi} = \frac{1}{V1TAX_{csi}} \sum_{c=COM} \sum_{s=SRC} \sum_{i=IND} \begin{pmatrix} V1TAX_{csi} \times \\ (p0_{cs} + x1_{csi}) \\ + \begin{pmatrix} V1TAX_{csi} \\ + V1TAX_{csi} \end{pmatrix} \\ \times t1_{csi} \end{pmatrix}$	1	Revenue from indirect taxes on flows to intermediate
12.8	$w2tax_{\_csi} = \frac{1}{V2TAX_{csi}} \sum_{c=COM} \sum_{s=SRC} \sum_{i=IND} \begin{pmatrix} V2TAX_{csi} \times \\ (p0_{cs} + x2_{csi}) \\ + \begin{pmatrix} V2TAX_{csi} \\ + V2TAX_{csi} \end{pmatrix} \\ \times t2_{csi} \end{pmatrix}$	1	Revenue from indirect taxes on flows to investment

12.9	$$w3tax_{\_cs} = \frac{1}{V3TAX_{\_cs}} \sum_{c=COM} \sum_{s=SRC} \begin{pmatrix} V3TAX_{cs} \times \\ (p0_{cs} + x3_{cs}) \\ + \begin{pmatrix} V3TAX_{cs} \\ + V3TAX_{cs} \end{pmatrix} \\ \times t3_{cs} \end{pmatrix}$$	1	Revenue from indirect taxes on flows to household
12.10	$$w4tax_{\_c} = \frac{1}{V4TAX_{\_c}} \sum_{c=COM} \begin{pmatrix} V4TAX_{c} \times \\ (p0_{c} + x4_{c}) \\ + \begin{pmatrix} V4TAX_{c} \\ + V4TAX_{c} \end{pmatrix} \\ \times t4_{c} \end{pmatrix}$$	1	Revenue from indirect taxes on export
12.11	$$w5tax_{\_cs} = \frac{1}{V5TAX_{\_cs}} \sum_{c \in COM} \begin{pmatrix} \sum_{s \in SRC} V5TAX_{cs} \\ \times (p0_{cs} + x5_{cs}) \\ + (V5TAX_{cs} + V5BAS_{cs}) \\ \times t5_{cs}) \end{pmatrix}$$	1	Revenue from indirect taxes on flows to other
12.12	$$w0tar_{\_c} = \frac{1}{V0TAR_{\_c}} \sum_{c \in COM} \begin{pmatrix} V0TAR_{c} \times \begin{pmatrix} pf0cif_{c} \\ + phi + x0imp_{c} \end{pmatrix} \\ + V0IMP_{c} \times t0imp_{c}) \end{pmatrix}$$	1	Tariff revenue

13. GDP from the income and expenditure sides

13.1	$$w1\ln d_{\_i} = \frac{1}{V1LND_{\_i}} \sum_{i \in IND} V1LND \times (x1\ln d_{\_i} + p1\ln d_{\_i})$$	$i \in IND$	Aggregate payment to land
13.2	$$w1lab_{\_io} = \frac{1}{V1LAB_{\_io}} \sum_{i \in IND} \sum_{o \in OCC} V1LAB_{\_io} \times \begin{Bmatrix} x1lab_{\_io} \\ + p1lab_{\_io} \end{Bmatrix}$$	$i \in IND$ $o \in OCC$	Aggregate payment to labor
13.3	$$w1cap_{\_i} = \frac{1}{V1CAP_{\_i}} \sum_{i \in IND} V1CAP \times \{x1cap_{\_i} + p1cap_{\_i}\}$$	$i \in IND$	Aggregate payment to capital
13.4	$$w1oct_{\_i} = \frac{1}{V1OCT_{\_i}} \sum_{i \in IND} V1OCT \times \{x1oct_{\_i} + p1oct_{\_i}\}$$	$i \in IND$	Aggregate payment to other cost

13.5	$$w1tax_{\_csi} = \frac{1}{V1TAX_{\_csi}}\begin{pmatrix} V1TAX_{\_csi} \times w1tax_{\_csi} + \\ V2TAX_{\_csi} \times w2tax_{\_csi} + \\ V3TAX_{\_cs} \times w3tax_{\_cs} + \\ V4TAX_{\_c} \times w4tax_{\_c} + \\ V5TAX_{\_cs} \times w5tax_{\_cs} + \\ V0TAR_{\_c} \times w0tar_{\_c} \end{pmatrix}$$	$c \in COM$ $s \in SRC$ $i \in IND$	Aggregate value of indirect tax
13.6	$$w0gdpinc = \frac{1}{V0GDPINC}\begin{pmatrix} V1LND_{\_i} \times w1\ln d_{\_i} + \\ V1CAP_{\_i} \times w1cap_{\_i} + \\ V1LAB_{\_io} \times w1lab_{\_io} + \\ V1OCT_{\_i} \times w1oct_{\_i} + \\ V0TAX_{\_csi} \times w0tax_{\_csi} \end{pmatrix}$$	$c \in COM$ $i \in IND$ $o \in OCC$	Aggregate nominal GDP from income side
13.7	$$x2tot_{\_i} = \frac{1}{V2TOT_{\_i}} \sum_{i \in IND} V2TOT_i \times x2tot_i$$	$i \in IND$	Total real investment
13.8	$$p2tot_{\_i} = \frac{1}{V2TOT_{\_i}} \sum_{i \in IND} V2TOT_i \times p2tot_i$$	$i \in IND$	Investment price index
13.9	$$w2tot_{\_i} = x2tot_{\_i} + p2tot_{\_i}$$	$i \in IND$	Total nominal investment
13.10	$$x3tot = \frac{1}{V3TOT} \sum_{c \in COM} \sum_{s \in SRC} V3PUR_{cs} \times x3_{cs}$$	$c \in COM$ $s \in SRC$ $i \in IND$	Real consumption
13.11	$$p3tot = \frac{1}{V3TOT} \sum_{c \in COM} \sum_{s \in SRC} V3PUR_{cs} \times p3_{cs}$$	1	Consumer price index
13.12	$$w3tot = x3tot + p3tot$$	1	Household budget constraint
13.13	$$x4tot = \frac{1}{V4TOT} \sum_{c \in COM} V4PUR_c \times x4_c$$	1	Export volume index
13.14	$$p4tot = \frac{1}{V4TOT} \sum_{c \in COM} V4PUR_c \times p4_c$$	1	Export price index (Rp)
13.15	$$w4tot = x4tot + p4tot$$	1	Aggregate nominal value of export
13.16	$$x5tot = \frac{1}{V5TOT} \sum_{c \in COM} \sum_{s \in SRC} V5PUR_{cs} \times x5_{cs}$$	1	Aggregate real other demands
13.17	$$p5tot = \frac{1}{V5TOT} \sum_{c \in COM} \sum_{s \in SRC} V5PUR_{cs} \times p5_{cs}$$	1	Other demand price index
13.18	$$w5tot = x5tot + p5tot$$	1	Aggregate nominal value of other demand

13.19	$x6tot=\left\{\frac{1}{V6TOT}\sum_{c\in COM} p0DOM_c \times delx6_c\right\}\times 100$	1	Inventories volume index base period Rp
13.20	$p6tot=\frac{1}{V6TOT}\sum_{c\in COM} V6BAS_c \times p0_{cs=dom}$	1	Inventories price index
13.21	$w6tot = x6tot + p6tot$	1	Aggregate nominal value of inventories
13.22	$x0cif\_{}_c=\frac{1}{V0CIF\_{}_c}\sum_{c\in COM} V0CIF_c \times x0imp_c$	$c\in COM$	CIF Import volume index
13.23	$p0cif\_{}_c=\frac{1}{V0CIF\_{}_c}\sum_{c\in COM} V0CIF_c \times \{phi + pf0cif_c\}$	$c\in COM$	CIF weights Rp import price index
13.24	$w0cif\_{}_c = x0cif\_{}_c + p0cif\_{}_c$	$c\in COM$	Rp CIF value of imports
13.25	$x0gdp\exp=\frac{1}{V0GDPEXP}(V3TOT\times x3tot + V2TOT\_{}_i \times x2tot\_{}_i + V5TOT\times x5tot + V4TOT\times x4tot + V6tot\times x6tot - V0CIF\_{}_c\times x0cif\_{}_c)$	1	Real GDP expenditure side
13.26	$p0gdp\exp=\frac{1}{V0GDPEXP}(V3TOT\times p3tot + V2TOT\_{}_i\times p2tot\_{}_i + V5TOT\times p5tot + V4TOT\times p4tot + V6tot\times p6tot - V0CIF\_{}_c\times p0cif\_{}_c)$	1	Price index for GDP expenditure side
13.27	$w0gdp\exp = x0gdp\exp + p0gdp\exp$	1	Nominal GDP from expenditure side
13.28	$gne=\frac{1}{V0GNE}(V3TOT\times x3tot + V2TOT\_{}_i\times x2tot\_{}_i + V5TOT\times x5tot + V6tot\times x6tot)$		Gross National Expenditure change

14. The Trade Balance and Other Aggregates

14.1	$delB=\frac{1}{100\times V0GDPEXP}\begin{pmatrix} V4TOT\times w4tot - V0CIF\_{}_c \\ \times w0cif\_{}_c - \begin{pmatrix} V4TOT \\ -V0CIF\_{}_c \end{pmatrix} \\ \times w0gdp\exp \end{pmatrix}$	1	Balance of trade/GDP

14.2	$x0imp\_c = \frac{1}{V0IMP\_c} \sum_{c\in COM} V0IMP_c \times x0imp_c$	$c\in COM$	Import volume index, duty paid weights
14.3	$p0imp\_c = \frac{1}{V0IMP\_c} \sum_{c\in COM} V0IMP_c \times p0imp_{cs=imp}$	$c\in COM$	Duty paid import price index
14.4	$w0imp\_c = x0imp\_c + p0imp\_c$	$c\in COM$	Value of imports (duty paid)
14.5	$p0toft = p4tot - p0cif\_c$	1	Terms of trade
14.6	$p0realdev = p0cif\_c - p0gdp\exp$	1	Real exchange rate
14.7	$employ_i = \frac{1}{V1LAB_{i\_o}} \sum_{o\in OCC} V1LAB_{io} \times x1lab_{io}$	$i\in IND$	Employment by industry
14.8	$employ\_i = \frac{1}{V1LAB\_{io}} \sum_{i\in IND} V1LAB_{i\_o} \times employ_i$	$i\in IND$	Aggregate employment, wage bill weights
14.9	$x1prim\_i = \frac{1}{V1PRIM\_i} \sum_{i\in IND} V1PRIM_i \times x1tot_i$	$i\in IND$	Aggregate output: value added weights
14.10	$x1cap\_i = \frac{1}{V1CAP\_i} \sum_{i\in IND} V1CAP_i \times x1cap_i$	$i\in IND$	Aggregate usage of capital, rental weights
14.11	$p1cap\_i = \frac{1}{V1CAP\_i} \sum_{i\in IND} V1CAP_i \times p1cap_i$	$i\in IND$	Average capital rental

15. Rates of Return and Wage Indexation

15.1	$r1cap_i + 100 \times RISKFLAG / R1CAP_i * delr1rsk_i = QCOEF_i * (p1cap_i - p2tot_i)$	$i\in IND$	Definition of net rates of return to capital
15.2a	$delr1rsk\_i = \sum_{i=IND} S2INVEST_i \times delr1rsk_i$	$i\in IND$	Change in the average risk premium
15.3a - Simple	$r1cap_i - r1capf_i = BETA\_R_i \times x1grow_i + slackorwalm_i$	$i\in IND$	Capital growth rates related to rates of return for ORANI and Walmsley
15.3a	$r1cap_i - r1capf_i = BETA\_R_i \times (x1grow_i - WALMFLAG \times x1grow\_i) + slackorwalm_i$	$i\in IND$	Capital growth rates related to rates of return for ORANI and Walmsley

15.3b	$rlcap_i - rlcap\_{}_i = BETA\_R_i(xlcap_i - xlcap\_{}_i) + flret_i$	$i \in IND$	Capital growth rates related to rates of return
15.4	$rlcapf_i - rlcapf\_{}_i = E1CAPF_i/(1 + E1CAPF_i) \times slackcapf_i + slackcapf2_i$	$i \in IND$	Discrepancy –lack of equality of future rates of return
15.5	$xlgrow_i = xlcapf_i - xlcap_i$	$i \in IND$	Power of growth rates in each industry
15.6	$xlgrow\_{}_i = \sum_{i=IND} \frac{V0CAPF_i}{V0CAPF\_{}_i} \times (xlcap_i + plcap_i + xlgrow$ $- \sum_{i=IND} \frac{V0CAP_i}{V0CAP\_{}_i} \times (xlcap_i + plcap_i) + slackgrow\_{}_i$	$i \in IND$	The power of the net growth
15.7	$xlgrow_i - xlgrow\_{}_i = E1GROW_i/(1 + E1GROW_i) \times slackgrow_i + slackgrow2_i$	$i \in IND$	Discrepaancy – lack of equality of capital growth
15.8	$xlcapf_i - xlcap_i = E1STAT_i/(1 + E1STAT_i) * slackstat_i + slackstat2_i$	$i \in IND$	Discrepancy – lack of stationary
15.9	$R1CAPRSK_i \times rlcaprsk_i = R1CAP_i \times rlcap_i + 100 \times RISKFLAG \times delrlrsk_i$	$i \in IND$	Relation of rates of return with/without risk
15.10	$R1CAPRSKF_i \times rlcaprskf_i = R1CAPF_i \times rlcapf_i + 100 \times RISKFLAG \times delrlrskf_i$	$i \in IND$	Expected rate of return with risk
15.11	$rlcap\_{}_i = \left(\sum_{i=IND} \frac{V0CAP_i}{V0CAP\_{}_i} \times rlcap_i \right) + slackautor\_{}_i$	$i \in IND$	Current average risk-free rate of return
5.12	$rlcapf\_{}_i = \left(\sum_{i=IND} \frac{V0CAPf_i}{V0CAPf\_{}_i} \times rlcapf_i \right) + slackautorf\_{}_i$	$i \in IND$	Future average risk-free rate of return
15.13	$delrlfrsk\_i = \sum_{i=IND} S2INVEST_i \times delrlfrsk_i$	$i \in IND$	Change in the average future risk
15.14	$delrlrsk_i = delrlfrsk_i + slackrisk_i$	$i \in IND$	Equal change in the risk premium
15.15	$xlcapf_i = (1 - G_i) \times xlcap_i + G_i \times x2tot_i$	$i \in IND$	capital in the next period
15.16	$pllab_{io} = p3tot + fllab\_{}_{io} + fllab_{i\_o} + fllab_{o\_i} + fllab_{io}$	$i \in IND$ $o \in OCC$	Flexible setting of money wages
15.17	$ploct_i = p3tot + floct_i$	$i \in IND$	Indexing of prices of "other cost" ticket

16 Investment-Capital Accumulation Equations

16.1	$x1cap_i = K_i \times delFudge + M_i \times R\_T_i \times x2tot_i + f\_accum_i$	$i \in IND$	Investment capital accumulation
17	Debt Accumulation Equations		
17.1	$delBT = \frac{1}{100 \times P\_GLOBAL} \left(VOCIF_{\_c} \times \begin{pmatrix} w0cif_{\_c} \\ - p0cif_{\_c} \end{pmatrix} - V4TOT \times \begin{pmatrix} w4tot \\ - p0cif_{\_c} \end{pmatrix} \right)$	1	Ordinary change in real trade deficit
17.2	$delDebt\_Ratio = \left(\frac{DEBT\_RATIO}{DEBT} \right) \times delDebt - \left(\frac{DEBT\_RATIO}{100} \right) \times (w0gdp\exp - p0cif\_c)$	1	Change in Debt/GDP ratio
17.3	$levDebt\_Ratio = DEBT\_RATIO\_0 \times delUnity + delDebt\_Ratio$	1	Level debt/GDP ratio
17.4	$delDebt = (debt_0 \times R\_WORLD^{T-t} + B_0 N\_DEBT) \times delFudge + M\_Debt \times delBT$: where : $B_0 = B_T$ At initial period $N\_DEBT = \sum_{t=1}^{T} R\_WORLD^{T-t}$ $M\_DEBT = \sum_{t=1}^{T} \frac{t-1}{T} R\_WORLD^{T-1}$	1	Change in foreign debt

APPENDIX 3. Database of Indonesian model

Appendix 3.1 Content of the Database

No	Header	Size	Name
1	0TAR	35	Tariff Revenue
2	1ARM	35	Intermediate Armington
3	1BAS	35x2x35	Intermediate Basic
4	1CAP	35	Capital
5	1LAB	35x4	Labour
6	1LND	35	Land
7	1-Mar	35x2x35	Intermediate Margins
8	1-Oct	35	Other Costs
9	1TAX	35x2x35	Intermediate Tax
10	2ARM	35	Investment Armington
11	2BAS	35x2x35	Investment Basic
12	2BS_	35x2	Investment Basic
13	2-Mar	35x2x35	Investment Margins
14	2TAX	35x2x35	Investment Tax
15	2TOT	35	Investment (by Ind)
16	2TX_	35x2	Investment Tax
17	3ARM	35	Households Armington
18	3BAS	35x2	Households Basic
19	3-Mar	35x2	Households Margins
20	3TAX	35x2	Households Tax
21	4BAS	35	Exports Basic
22	4-Mar	35	Exports Margins
23	4TAX	35	Exports Tax
24	5BAS	35x2	Government Basic
25	5-Mar	35x2	Government Margins
26	5TAX	35x2	Government Tax
27	6BAS	35	Inventory Changes
28	BETR	35	Investment Parameter
29	CSTM	35x8	Cost Matrix
30	DGDP	1	Debt/GDP ratio
31	DPRC	35	Depreciation Factor
32	ETO2	1	final average Engel
33	ETOT	1	initial average Engel
34	EXNT	1	Non-Traditional Export Elasticities
35	LDEP	35	VDEP
36	MAKE	35x35	Multiproduct Matrix
37	P018	35	Traditional Export Elasticities
38	P021	1	Frisch Parameter
39	P027	35	Gross/Net Rate of Return

Appendix 3.1 (Continued)

No	Header	Size	Name
40	P028	35	Primary Factor Sigma
41	P044	35	Marginal Budget Shares
42	PURE	35	Pure Profits
43	RREF	35	R1CAPF
44	RWLD	1	World Interest Rate Factor
45	SCET	35	Output Sigma
46	SLAB	35	Labour Sigma
47	SLSM	35x8	Sales Matrix
48	XPEL	35	Expenditure Elasticities
52	YBYK	35	Investment/Capital Ratios

Appendix 3.2 1990 Database of Indonesian Model (billion Rupiah)*)

No	Commodity	V1BAS		V1MAR		V1TAX		V2BAS	
		Domestic	Import	Domestic	Import	Domestic	Import	Domestic	Import
1	Paddy	13955.3	0.0	131.6	0.0	106.7	0.0	0.0	0.0
2	Maize	552.2	2.6	36.4	0.1	7.2	0.0	0.0	0.0
3	CerOthGrain	19.3	220.3	2.1	16.2	0.1	0.0	0.0	0.0
4	RootCrop	292.4	0.0	18.2	0.0	1.6	0.0	0.0	0.0
5	Beans	874.7	261.4	42.6	9.8	7.2	0.2	0.0	0.0
6	VegFruit	605.0	3.4	63.5	0.4	3.2	0.0	0.0	0.0
7	Rubber	853.9	1.1	49.3	0.2	8.9	0.0	0.0	0.0
8	Sugarcane	898.6	0.0	49.1	0.0	14.2	0.0	0.0	0.0
9	Coconut	423.1	0.0	35.7	0.0	0.9	0.0	0.0	0.0
10	OilPalm	741.6	0.5	60.5	0.0	5.4	0.0	0.0	0.0
11	Coffee	385.7	0.0	25.1	0.0	8.4	0.0	0.0	0.0
12	Tea	106.1	6.3	9.4	0.5	0.4	0.1	0.0	0.0
13	OthEstate	1130.2	62.9	88.1	5.0	8.7	0.1	0.0	0.0
14	OthAgr	228.9	1.0	18.5	0.1	0.4	0.0	0.0	0.0
15	Livestock	3392.9	7.7	204.7	1.0	25.4	0.0	0.6	1.6
16	Forestry	3034.5	3.8	481.7	0.3	31.8	0.0	0.0	0.0
17	Fishery	1355.2	0.3	274.3	0.1	7.8	0.0	0.0	0.0
18	CoalOthMin	11651.0	1311.1	1640.9	182.1	143.5	25.3	0.0	0.0
19	OilGas	8613.0	2175.9	111.4	21.3	13.9	0.1	0.0	0.0
20	LivProc	1225.9	60.2	139.6	6.2	21.8	1.4	0.0	0.0
21	FoodProc	888.9	206.6	98.1	26.9	5.2	1.0	0.0	0.0
22	FishProc	113.5	5.6	13.3	0.5	4.9	0.0	0.0	0.0
23	EstateProc	1558.8	94.8	155.8	10.4	103.6	1.2	0.0	0.0
24	Rice	1210.1	0.3	126.9	0.0	2.8	0.0	0.0	0.0
25	OthFoodProc	1112.6	261.9	136.4	33.1	8.1	4.0	0.0	0.0
26	BevTob	1038.2	15.7	87.5	1.6	99.3	0.5	0.0	0.0
27	TxtLthr	4982.5	1677.7	287.0	109.4	76.2	21.6	4.3	34.1
28	WoodPrd	3462.2	20.0	563.2	2.8	62.2	0.4	194.1	0.0
29	Chemical	5216.5	5462.3	580.8	571.3	224.3	138.4	0.0	0.0
30	Fertiliser	1560.2	144.1	81.1	10.5	21.1	3.0	0.0	0.0
31	Pesticide	309.0	17.1	17.9	1.2	4.2	0.4	0.0	0.0
32	MinMet	8767.7	5197.3	1399.1	843.7	244.9	215.2	458.8	193.6
33	OthManufac	8823.0	6829.0	1081.5	653.4	300.0	156.1	3766.1	13158.6
34	TradTrans	6361.0	192.3	228.1	8.7	1159.0	0.0	1067.4	0.0
35	Service	21056.1	2516.8	2212.4	238.7	339.2	9.8	36452.4	0.0
	Total	116799.6	26760.0	10551.8	2755.5	3072.5	578.9	41943.8	13387.9

Appendix 3.2 (Continued)

No	V2MAR		V2TAX		V3BAS		V3MAR		V3TAX	
	Domestic	Import	Domestic	Import	Domestic	Import	Domestic	Import	Domestic	Import
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	997.7	0.5	86.0	0.0	13.1	0.0
3	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	2327.6	0.4	200.6	0.0	12.6	0.0
5	0.0	0.0	0.0	0.0	1547.7	11.4	133.4	1.0	8.7	0.1
6	0.0	0.0	0.0	0.0	7110.7	66.2	612.7	5.7	40.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	1.2	0.0	0.1	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	710.6	0.2	61.2	0.0	1.5	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	185.6	0.0	16.0	0.0	4.0	0.0
12	0.0	0.0	0.0	0.0	16.5	0.0	1.4	0.0	0.1	0.0
13	0.0	0.0	0.0	0.0	123.1	9.6	10.6	0.8	0.5	0.1
14	0.0	0.0	0.0	0.0	367.4	7.3	31.7	0.6	0.7	0.0
15	0.0	0.1	0.0	0.1	1829.9	8.2	157.7	0.7	10.3	0.0
16	0.0	0.0	0.0	0.0	341.2	26.9	29.4	2.3	2.9	0.0
17	0.0	0.0	0.0	0.0	1771.3	1.4	152.6	0.1	11.1	0.0
18	0.0	0.0	0.0	0.0	1433.4	386.8	123.5	33.3	8.2	8.9
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	3032.3	128.1	261.3	11.0	68.9	2.9
21	0.0	0.0	0.0	0.0	3217.3	184.1	277.2	15.9	44.7	1.9
22	0.0	0.0	0.0	0.0	1718.6	4.3	148.1	0.4	25.3	0.0
23	0.0	0.0	0.0	0.0	3173.1	273.1	273.4	23.5	207.6	4.0
24	0.0	0.0	0.0	0.0	14306.6	25.7	1232.8	2.2	32.5	0.0
25	0.0	0.0	0.0	0.0	607.9	36.6	52.4	3.2	5.2	1.0
26	0.0	0.0	0.0	0.0	4114.2	36.6	354.5	3.2	2229.8	1.0
27	0.3	2.0	0.1	0.6	3940.8	783.6	339.6	67.5	52.7	16.0
28	11.5	0.0	2.1	0.0	329.6	15.5	28.4	1.3	4.3	0.8
29	0.0	0.0	0.0	0.0	2751.8	593.4	237.1	51.1	96.4	20.4
30	0.0	0.0	0.0	0.0	49.5	76.8	4.3	6.6	0.7	1.6
31	0.0	0.0	0.0	0.0	30.2	1.7	2.6	0.2	0.4	0.0
32	27.1	11.4	20.2	8.8	236.5	249.5	20.4	21.5	13.4	8.1
33	222.2	776.5	115.8	177.4	4245.1	1143.1	365.8	98.5	138.5	24.6
34	0.0	0.0	301.1	0.0	19218.7	1469.8	907.5	50.2	1362.2	0.0
35	2151.1	0.0	598.0	0.0	22799.8	2307.2	1964.7	198.8	622.5	2.6
Total	2412.1	790.0	1037.2	186.9	102536.2	7848.1	8087.2	599.9	5018.6	94.2

Appendix 3.2 (Continued)

No	V4BAS	V4MAR	V4TAX	V5BAS		V5MAR		V5TAX		V6BAS
	Domestic	Domestic	Domestic	Domestic	Import	Domestic	Import	Domestic	Import	Domestic
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.9
2	28.3	2.7	0.4	0.0	0.0	0.0	0.0	0.0	0.0	1.5
3	52.3	5.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	2.4
4	19.4	1.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	3.0
5	9.2	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	77.3
6	14.7	1.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	60.5	5.9	0.6	0.0	0.0	0.0	0.0	0.0	0.0	8.5
8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.8
9	3.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.9
10	311.5	30.2	2.3	0.0	0.0	0.0	0.0	0.0	0.0	2.0
11	97.4	9.4	2.1	0.0	0.0	0.0	0.0	0.0	0.0	45.5
12	62.2	6.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	-0.6
13	350.6	33.9	0.4	0.0	0.0	0.0	0.0	0.0	0.0	12.7
14	39.7	3.8	0.1	20.8	0.0	0.5	0.0	0.0	0.0	30.4
15	42.8	4.1	0.2	0.0	0.3	0.0	0.0	0.0	0.0	38.9
16	49.5	4.8	0.5	0.0	0.0	0.0	0.0	0.0	0.0	15.8
17	192.3	18.6	1.1	0.0	0.0	0.0	0.0	0.0	0.0	45.7
18	3588.7	347.5	123.7	49.4	67.1	1.1	1.5	0.3	1.5	405.5
19	18567.5	1798.2	31.7	0.0	0.0	0.0	0.0	0.0	0.0	3041.6
20	37.4	3.6	2.1	0.0	0.0	0.0	0.0	0.0	0.0	25.1
21	218.9	21.2	1.7	0.0	0.0	0.0	0.0	0.0	0.0	-54.0
22	1056.7	102.3	57.5	0.0	0.0	0.0	0.0	0.0	0.0	-70.0
23	1428.6	138.4	38.5	0.0	0.0	0.0	0.0	0.0	0.0	27.6
24	3.7	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.5
25	74.1	7.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0	39.7
26	118.3	11.5	53.2	0.0	0.0	0.0	0.0	0.0	0.0	-78.4
27	5170.3	500.7	61.6	50.0	24.0	1.1	0.5	0.9	0.5	-163.6
28	5133.2	497.1	101.2	2.9	0.2	0.1	0.0	0.1	0.0	-261.4
29	2538.1	245.8	49.0	71.3	84.8	1.6	1.9	1.5	2.8	-420.3
30	324.2	31.4	4.4	33.5	0.0	0.8	0.0	0.5	0.0	-62.9
31	42.7	4.1	0.6	0.4	0.1	0.0	0.0	0.0	0.0	-19.0
32	1754.0	169.9	35.5	40.4	41.8	0.9	0.9	2.2	1.4	-375.0
33	1270.2	123.0	35.9	503.7	179.3	11.3	4.0	16.2	4.8	-712.3
34	2557.9	103.2	420.9	1048.1	385.4	14.7	6.5	61.0	0.0	0.0
35	2514.8	243.5	51.6	15305.4	184.5	344.3	4.2	65.8	0.0	31.4
Total	47732.7	4478.1	1078.0	17126.0	967.6	376.4	19.6	148.5	11.0	1755.9

Appendix 3.2 (Continued)

No	Industry	V1OCT	V2TOT
1	Paddy	0.2	23.185
2	Maize	0.2	2.523
3	CerOthGrain	0.2	0.027
4	RootCrop	0.4	5.017
5	Beans	0.6	4.068
6	VegFruit	0.4	13.941
7	Rubber	0.2	17.218
8	Sugarcane	0.2	23.992
9	Coconut	0.2	57.672
10	OilPalm	0.2	38.045
11	Coffee	0.2	22.873
12	Tea	0.2	6.011
13	OthEstate	0.8	63.411
14	OthAgr	0.2	27.498
15	Livestock	0.8	56.406
16	Forestry	0.4	617.304
17	Fishery	0.4	160.832
18	CoalOthMin	2.2	2995.242
19	OilGas	0.6	13017.82
20	LivProc	0.8	299.803
21	FoodProc	1.2	487.482
22	FishProc	0.4	171.91
23	EstateProc	1	1093.782
24	Rice	0.2	467.924
25	OthFoodProc	0.4	262.941
26	BevTob	0.8	763.169
27	TxtLthr	1.6	1634.587
28	WoodPrd	1.2	1521.483
29	Chemical	2.4	863.564
30	Fertiliser	-1150.2	749.092
31	Pesticide	0.2	80.047
32	MinMet	2.6	1523.745
33	OthManufac	4.6	2044.168
34	TradTrans	1.6	16694.8
35	Service	4.4	13946.46
	Total	-1118.2	59758.03

*) Some of the Indonesian database are already described in Chapter 5
V1OCT and V2TOT are displayed by industry

Appendix 3.3 1997 Updated Database of Indonesian Model (billion Rupiah)*)

No	Commodity	V1BAS		V1MAR		V1TAX		V2BAS	
		Domestic	Import	Domestic	Import	domestic	Import	Domestic	Import
1	Paddy	46076.4	0.0	252.0	0.0	352.3	0.0	0.0	0.0
2	Maize	1639.5	10.5	77.6	0.4	21.5	0.0	0.0	0.0
3	CerOthGrain	25.7	444.2	5.0	34.0	0.1	0.0	0.0	0.0
4	RootCrop	1583.0	0.1	40.5	0.0	8.8	0.0	0.0	0.0
5	Beans	2545.7	1162.0	68.5	44.9	20.4	1.1	0.0	0.0
6	VegFruit	2506.2	20.8	145.6	2.3	13.2	0.0	0.0	0.0
7	Rubber	1968.6	2.5	102.3	0.4	20.4	0.0	0.0	0.0
8	Sugarcane	2588.3	0.0	102.6	0.0	40.8	0.0	0.0	0.0
9	Coconut	1463.1	0.0	76.8	0.0	3.1	0.0	0.0	0.0
10	OilPalm	2053.1	1.6	125.9	0.1	14.9	0.0	0.0	0.0
11	Coffee	1195.4	0.0	52.3	0.0	25.9	0.0	0.0	0.0
12	Tea	229.0	14.6	19.3	1.3	0.8	0.3	0.0	0.0
13	OthEstate	2837.4	173.0	213.4	14.3	22.1	0.1	0.0	0.0
14	OthAgr	707.7	4.2	39.4	0.5	1.3	0.0	0.0	0.0
15	Livestock	13450.9	40.2	465.4	5.1	100.5	0.2	0.8	5.4
16	Forestry	9656.1	16.1	1036.4	1.4	101.3	0.1	0.0	0.0
17	Fishery	4777.3	1.7	526.6	0.3	27.7	0.0	0.0	0.0
18	CoalOthMin	23974.8	2417.8	3893.8	351.5	292.9	46.3	0.0	0.0
19	OilGas	18987.8	4630.9	265.0	47.1	30.6	0.2	0.0	0.0
20	LivProc	4087.1	248.0	321.2	26.1	73.2	5.8	0.0	0.0
21	FoodProc	2085.9	526.5	204.2	70.7	12.7	2.7	0.0	0.0
22	FishProc	262.9	12.1	31.3	1.1	11.6	0.0	0.0	0.0
23	EstateProc	3392.1	213.1	353.9	24.5	226.6	2.6	0.0	0.0
24	Rice	4243.2	1.5	296.8	0.1	9.6	0.0	0.0	0.0
25	OthFoodProc	2349.8	559.3	293.1	73.6	17.1	8.6	0.0	0.0
26	BevTob	2387.1	33.1	215.4	3.5	223.0	1.0	0.0	0.0
27	TxtLthr	11206.3	3602.1	691.2	245.1	171.6	46.2	10.7	81.4
28	WoodPrd	8893.0	60.5	1300.0	8.8	160.1	1.2	538.2	0.0
29	Chemical	11563.2	12609.1	1244.4	1376.6	509.2	319.0	0.0	0.0
30	Fertiliser	2337.9	188.5	164.1	16.4	31.7	4.0	0.0	0.0
31	Pesticide	507.9	28.0	36.6	2.0	6.9	0.6	0.0	0.0
32	MinMet	19511.6	11570.6	3242.4	1954.7	545.4	479.7	1103.2	466.0
33	OthManufac	20023.5	15676.1	2559.2	1548.1	680.6	357.2	9113.7	31520.5
34	TradTrans	14635.0	462.0	529.6	21.8	2659.6	0.0	2661.8	0.0
35	Service	49036.1	6108.2	5125.2	604.0	795.5	23.3	91780.3	0.0
	Total	294788.6	60838.8	24116.8	6480.7	7233.1	1300.3	105208.9	32073.2

Appendix 3.3 (Continued)

No	V2MAR		V2TAX		V3BAS		V3MAR		V3TAX	
	Domestic	Import	Domestic	Import	Domestic	Import	Domestic	Import	Domestic	Import
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	2677.3	1.9	157.6	0.2	35.1	0.0
3	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	11894.4	3.5	373.9	0.3	64.4	0.0
5	0.0	0.0	0.0	0.0	5531.7	59.7	273.5	5.2	31.1	0.5
6	0.0	0.0	0.0	0.0	27561.3	390.6	1222.7	34.2	155.2	0.2
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	3.4	0.0	0.2	0.0	0.1	0.0
9	0.0	0.0	0.0	0.0	2432.9	1.2	128.3	0.1	5.2	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	583.7	0.0	34.1	0.0	12.7	0.0
12	0.0	0.0	0.0	0.0	38.5	0.0	3.2	0.0	0.1	0.0
13	0.0	0.0	0.0	0.0	283.9	24.0	23.5	2.2	1.1	0.1
14	0.0	0.0	0.0	0.0	1135.8	30.7	66.4	2.7	2.1	0.0
15	0.0	0.3	0.0	0.3	6981.3	46.7	328.7	4.1	39.3	0.1
16	0.0	0.0	0.0	0.0	1160.8	139.2	69.5	12.2	10.0	0.2
17	0.0	0.0	0.0	0.0	7010.5	9.2	368.8	0.8	43.9	0.1
18	0.0	0.0	0.0	0.0	4001.2	943.5	383.4	84.3	22.8	21.6
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	9823.6	646.7	571.5	56.7	223.3	14.6
21	0.0	0.0	0.0	0.0	7888.9	518.1	606.7	46.1	109.5	5.4
22	0.0	0.0	0.0	0.0	3829.5	9.8	334.7	0.9	56.4	0.0
23	0.0	0.0	0.0	0.0	6942.1	601.1	619.0	53.9	454.2	8.9
24	0.0	0.0	0.0	0.0	43254.8	116.9	2247.2	10.7	98.3	0.0
25	0.0	0.0	0.0	0.0	1340.1	82.1	118.3	7.4	11.5	2.1
26	0.0	0.0	0.0	0.0	9523.1	78.7	881.2	7.1	5161.4	2.2
27	0.7	5.0	0.2	1.4	9062.4	1741.2	837.0	156.1	121.1	35.6
28	28.6	0.0	5.8	0.0	986.9	55.6	77.1	4.9	12.7	2.9
29	0.0	0.0	0.0	0.0	7858.7	1782.2	652.0	158.2	275.3	61.2
30	0.0	0.0	0.0	0.0	125.6	171.9	12.9	15.4	1.7	3.6
31	0.0	0.0	0.0	0.0	69.3	3.7	6.9	0.3	0.9	0.1
32	67.5	28.5	48.5	21.3	587.5	620.3	52.4	55.4	33.3	20.2
33	561.0	1929.5	280.3	425.0	10513.6	2804.0	944.1	250.4	342.9	60.4
34	0.0	0.0	750.9	0.0	53695.6	4216.5	2535.6	148.6	3805.9	0.0
35	5364.1	0.0	1505.6	0.0	58285.8	6094.7	4975.2	543.0	1591.3	6.9
Total	6021.8	1963.3	2591.2	447.9	295084.5	21193.5	18905.8	1661.1	12722.6	247.1

Appendix 3.3 (Continued)

No	V4BAS	V4MAR	V4TAX	V5BAS		V5MAR		V5TAX		V6BAS	V1OCT
	Domestic	Domestic	Domestic	Domestic	Import	Domestic	Import	Domestic	Import	Domestic	Domestic
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.7	0.5
2	60.4	3.5	0.8	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.5
3	10.8	6.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.4
4	87.9	2.4	0.3	0.0	0.0	0.0	0.0	0.0	0.0	14.6	0.9
5	25.7	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	246.7	1.3
6	46.6	1.8	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
7	-18.7	-3.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	15.9	0.5
8	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.6	0.5
9	7.8	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	161.6	0.5
10	1247.8	100.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	4.7	0.6
11	321.6	21.6	7.0	0.0	0.0	0.0	0.0	0.0	0.0	121.8	0.5
12	85.9	7.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	-1.0	0.4
13	26.1	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.3	1.8
14	90.6	4.9	0.2	59.7	0.0	0.9	0.0	0.1	0.0	81.0	0.5
15	129.0	5.3	0.6	0.0	0.5	0.0	0.0	0.0	0.0	132.2	2.1
16	115.0	6.2	1.3	0.0	0.0	0.0	0.0	0.0	0.0	42.8	1.0
17	543.6	23.9	3.0	0.0	0.0	0.0	0.0	0.0	0.0	146.7	1.0
18	6711.7	758.7	231.3	77.2	119.9	2.1	2.8	0.4	2.7	549.7	6.1
19	40105.7	4191.0	68.5	0.0	0.0	0.0	0.0	0.0	0.0	4554.8	1.6
20	87.4	4.7	4.9	0.0	0.0	0.0	0.0	0.0	0.0	68.2	2.1
21	339.1	27.3	2.7	0.0	0.0	0.0	0.0	0.0	0.0	-104.4	3.0
22	1092.1	109.0	59.4	0.0	0.0	0.0	0.0	0.0	0.0	-114.6	0.9
23	1989.8	203.2	53.6	0.0	0.0	0.0	0.0	0.0	0.0	43.9	2.5
24	9.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	98.9	0.5
25	91.2	9.2	0.8	0.0	0.0	0.0	0.0	0.0	0.0	64.0	1.0
26	260.6	27.2	117.3	0.0	0.0	0.0	0.0	0.0	0.0	-117.4	2.3
27	10934.4	1141.6	130.3	85.6	42.9	2.1	1.0	1.5	0.8	-246.0	4.5
28	11148.7	940.8	219.8	6.3	0.4	0.1	0.0	0.2	0.0	-509.0	3.0
29	3532.7	316.0	68.1	141.3	151.5	3.0	3.6	3.0	5.0	-745.8	6.0
30	1544.4	165.0	20.9	46.4	0.0	1.4	0.0	0.6	0.0	-74.0	-3437.3
31	153.0	16.2	2.1	0.6	0.3	0.0	0.0	0.0	0.0	-25.2	0.5
32	2611.3	267.8	52.9	72.3	74.7	1.7	1.8	3.9	2.5	-592.7	6.9
33	2059.8	212.3	58.2	892.4	320.3	21.3	7.6	28.7	8.6	-1114.2	13.0
34	3288.2	132.6	541.1	1966.2	688.5	27.5	12.3	114.4	0.0	0.0	4.5
35	3293.4	313.1	67.6	29081.0	329.7	646.0	7.8	125.1	0.0	53.1	12.1
Total	92033.3	9018.2	1722.1	32429.2	1728.6	706.1	36.8	278.0	19.6	2872.2	-3352.9

Appendix 3.3 (Continued)

No	Industry	V1LAB				V1CAP	V1LND	V1OCT
		Farmer	Operator	Administration	Professional			
1	Paddy	6677.7	9.8	2.6	1.0	128.4	36219.4	0.5
2	Maize	555.9	0.8	0.2	0.1	11.4	3347.7	0.5
3	CerOthGrain	8.6	0.0	0.0	0.0	0.0	19.3	0.4
4	RootCrop	970.2	1.4	0.4	0.1	41.9	12215.7	0.9
5	Beans	719.1	1.1	0.3	0.1	22.3	6758.1	1.3
6	VegFruit	3399.8	5.0	1.3	0.5	88.7	25257.0	1.0
7	Rubber	809.7	59.0	7.6	1.0	59.6	532.2	0.5
8	Sugarcane	809.0	58.9	7.6	1.0	125.5	1111.7	0.5
9	Coconut	550.8	40.1	5.1	0.7	329.1	2904.4	0.5
10	OilPalm	514.7	37.5	4.8	0.7	214.2	1893.1	0.6
11	Coffee	321.9	23.5	3.0	0.4	121.0	1072.1	0.5
12	Tea	129.0	9.4	1.2	0.2	17.5	158.6	0.4
13	OthEstate	623.3	45.4	5.8	0.8	196.3	1758.8	1.8
14	OthAgr	505.3	36.8	4.7	0.6	140.9	1248.3	0.5
15	Livestock	2559.8	11.2	3.2	0.9	431.5	13545.7	2.1
16	Forestry	1163.7	184.5	158.1	27.5	3540.0	4813.2	1.0
17	Fishery	1684.0	10.3	6.2	6.2	1072.5	8401.1	1.0
18	CoalOthMin	0.0	3113.1	842.0	440.5	10377.0	0.0	6.1
19	OilGas	0.0	943.9	255.3	133.6	50207.8	0.0	1.6
20	LivProc	0.0	777.8	48.4	18.7	1276.4	162.8	2.1
21	FoodProc	0.0	710.2	44.2	17.0	1430.4	0.0	3.0
22	FishProc	23.7	0.1	0.1	0.1	118.2	211.9	0.9
23	EstateProc	0.0	868.5	54.1	20.8	2620.9	0.0	2.5
24	Rice	0.0	527.7	32.9	12.7	1020.7	0.0	0.5
25	OthFoodProc	0.0	147.0	9.2	3.5	619.3	0.0	1.0
26	BevTob	0.0	741.0	46.1	17.8	2906.2	0.0	2.3
27	TxtLthr	0.0	2603.6	134.0	75.6	6368.6	0.0	4.5
28	WoodPrd	0.0	1954.1	184.6	69.4	5946.6	0.0	3.0
29	Chemical	0.0	1706.1	915.8	177.2	3902.4	0.0	6.0
30	Fertiliser	0.0	305.3	163.9	31.7	3246.8	0.0	-3437.3
31	Pesticide	0.0	24.5	13.2	2.5	242.3	0.0	0.5
32	MinMet	0.0	1316.4	492.4	111.9	6172.7	0.0	6.9
33	OthManufac	0.0	3633.7	885.8	253.9	8624.1	0.0	13.0
34	TradTrans	0.0	5712.4	11965.1	440.6	72613.0	0.0	4.5
35	Service	0.0	26218.3	31726.8	7245.9	63051.3	0.0	12.1
	Total	22026.1	51838.3	48026.2	9115.1	247285.3	121631.0	-3352.9

*) V1LAB, V1CAP, V1LND and V1OCT data are displayed by industry

APPENDIX 4. Additions for the Flexibility of the Investment and Land Used Variables, Modified from Horridge *et al.* (1993)

```
! Excerpt 33 of TABLO input file: !

Variable
 (All,i,IND)(Change)delr1rsk(i);
 (All,i,IND)(Change)delr1frsk(i);
 (change)delr1rsk_i;
 (change)delr1frsk_i;
 (All,i,IND)r1caprsk(i);
 (All,i,IND)r1capfrsk(i);
 (All,i,IND)r1capfi(i);
  r1capfi_i;
 (All,i,IND) (change)slackcapf(i);
 (All,i,IND) slackcapf2(i);
 (All,i,IND) x1grow(i);
  x1grow_i;
 (All,i,IND) x1capf(i);
 slackgrow_i;
 (All,i,IND)slackorwalm(i);
 (All,i,IND)(change)slackgrow(i);
 (All,i,IND) slackgrow2(i);
 (All,i,IND) slackstat(i);
 (All,i,IND) slackstat2(i);
 (All,i,IND) slackrisk(i);
 slackautorf_i;
 slackautor_i;

Coefficient                                          RISKFLAG;
Coefficient                                          WALMFLAG;
Coefficient                                          ORANIFLAG;

FILE(TEXT) RSKFLAG #A file containing RISKFLAG#;
FILE(TEXT) WLMFLAG # A file containing WALMFLAG#;
FILE(TEXT) ORNIFLAG # A file containing ORANIFLAG#;

READ RISKFLAG FROM FILE RSKFLAG;
READ WALMFLAG FROM FILE WLMFLAG;
READ ORANIFLAG FROM FILE ORNIFLAG;

Coefficient (All,i,IND) R1CAPRISK(i) # NET rate of return, including risk#;
Coefficient (All,i,IND) QCOEF(i) # ratio, gross to net rate of return #;
Coefficient (All,i,IND) R1TCAPF(i) # the future rate of return-temporary#;
!Note: Although these are always read in, these apply only!
!in case of RISKFLAG=1. That is, then the expected future!
!rates of return may be equal, but actual rates!
!differ because of risk!
! On other hand, when RISKFLAG = 0, the read-in rates are!
!ignored, and future rates are calculated from actual current!
!rates, and all may differ because of non-equilibrium in the!
!database.!
!Initial Formula for R1CAPF either uses or not uses R1ICAPF.!

Coefficient (All,i,IND) R1CAPF(i) # the future rate of return#;
```

```
READ (all,i,IND)    R1TCAPF(i)
from file mdata header "RREF";
Update (CHANGE)(All,i,IND) R1TCAPF(i) = -R1TCAPF(i) +
(1+r1capfi(i)/100)*R1CAPF(i);

Coefficient (All,i,IND)S2INVEST(i)#Share of investment in each industry#;
Formula (All,i,IND)
  S2INVEST(i)=(V2TOT(i))/(V2TOT_i);

Coefficient (All,i,IND) R_T(i) # real investment/capital ratio #;
Read R_T From File MDATA Header "YBYK"; ! numbers like 0.07 !
Update (Change) (All,i,IND)
 R_T(i) = R_T(i)*[x2tot(i)-x1cap(i)]/100;

Coefficient (All,i,IND) DEP(i) # depreciation factors #;
Read DEP From File MDATA Header "DPRC"; ! numbers like 0.95 !

Coefficient (all,i,IND) BETA_R(i);
Read BETA_R From File MDATA Header "BETR";

! let's work with and update the real investment-capital ratio.!
! This ratio should apply to values as well, so knowing!
!updated investment from earlier FORMULA, can calculate updated!
!capital value!

!Coefficient (all,i,IND) VDEP(i);
Read VDEP from File MDATA header "LDEP";
Update (all,i,IND) VDEP(i) = x1cap(i)*p2tot(i);!

Coefficient (all,i,IND) V0CAP(i);
Formula (All,i,IND)V0CAP(i)=V2TOT(i)/R_T(i);
!Formula (All,i,IND) V0CAP(i)=VDEP(i)/(1-DEP(i));!

Coefficient V0CAP_i;
Formula V0CAP_i=Sum(i,IND,V0CAP(i));

Coefficient (All,i,IND) V0CAPF(i);
Formula (All,i,IND) V0CAPF(i)=DEP(i)*V0CAP(i)+V2TOT(i);

Coefficient (All,i,IND) X1GROWI(i);
Formula (All,i,IND) X1GROWI(i)=V0CAPF(i)/V0CAP(i);

!Note: an alternative would be to update XIGROWI(i) directly!
!from its percentage change,and then calculate the new VOCAPF(i)!
!These would be:!
!Update (all,i,IND) X1GROWI(i) = x1grow(i);!
!Formula V0CAPF(i) = V0CAP(i)*X1GROWI(i);!

Coefficient X1GROWI_i;
Formula X1GROWI_i=SUM(i,IND,(V0CAP(i)/V0CAP_i)*X1GROWI(i));

Coefficient (All,i,IND) GROSSRR(i) # Gross rate of return, including risk#;
Formula (all,i,IND) GROSSRR(i) = V1CAP(i)/V2TOT(i)*(X1GROWI(i)-DEP(i));

!Using GROSSRR and read-in QCOEFF, can calculate Risk premiums!
!for RISKFLAG=1 case. For RISKFLAG=0 case, this!
```

```
!info allows us calculate the R1CAPI values directly.!

! Following is not used when QCOEF is initially calculated from
database itself!

Coefficient (ALL,i,IND)R1CAPI(i)#net rate of return, risk free#;
!Next should only apply when RISKFLAG=1, ie when we use R1CAPF!
!values as read in. We find separate estimates of R1CAPRISK and R1CAP!
! and find premium as difference!
!First do formulas for RISKFLAG=1!
Formula (All,i,IND) R1CAPI(i)=R1TCAPF(i)*((V0CAPF(i)/V0CAP(i)/(WALMFLAG
*X1GROWI_i+(1-WALMFLAG)*1))^BETA_R(i));
!Can get R1CAPRISK either using depreciation rate or QCOEF!
!Using read-in and updated QCOEF is generally not consistent
with other info...!
!Formula (all,i,IND)R1CAPRISK(i) =QCOEF(i)*R1CAPI(i) - (1-DEP(i));!
Formula (all,i,IND) R1CAPRISK(i) =GROSSRR(i) - (1-DEP(i));

!Now do RISKFLAG=0!
!Here we calculate R1CAPRISK as usual above, but then set R1CAP to also
equal this. Then finally calculate R1CAPF rather than use
the read-in values.!
Formula (All,i,IND) R1CAPI(i) = IF(RISKFLAG=1,R1CAPI(i)) +IF(RISKFLAG=0, R1CAPRISK(i));

!Following applies in all cases. Could alternatively use an actual
formula here instead of update and above Formula(initial!
Formula (Initial) (All,i,IND) R1CAPF(i) = IF(RISKFLAG=1,R1TCAPF(i))
+IF(RISKFLAG=0,R1CAPI(i)*((V0CAPF(i)/V0CAP(i)/(WALMFLAG
*X1GROWI_i+(1-WALMFLAG)*1)^-BETA_R(i))));
Update(All,i,IND)R1CAPF(i)=r1capfi(i);

Coefficient (All,i,IND) R1RISK(i) # Risk premium#;
! could update directly!
!Formula (initial) (all,i,IND) R1RISK(i) = R1CAPRISK(i) - R1CAPI(i);!
!UPDATE (all,i,IND) R1RISK(i) = r1rsk(i);!
Formula (all,i,IND) R1RISK(i) = R1CAPRISK(i) - R1CAPI(i);

!Following is only used when QCOEF is not read in but is calculated!
!Formula (initial) (all,i,IND)  QCOEF(i) = GROSSRR(i)/R1CAPI(i);
 Update (CHANGE) (all,i,IND)
 QCOEF(i) = QCOEF(i)*(1-QCOEF(i)) *[p1cap(i) -p2tot(i)]/100
  + delr1rsk(i)/R1CAPRISK(i));!
! Altern, when not read in, can calculate QCOEF every time from data base!
Formula (all,i,IND) QCOEF(i) = GROSSRR(i)/R1CAPI(i);

!Could update next!
Coefficient R1CAPI_i;
!Formula (Initial) R1CAPI_i=SUM(i,IND,V0CAP(i)/V0CAP_i*R1CAPI(i));
Update R1CAPI_i= r1cap_i;!
Formula R1CAPI_i=SUM(i,IND,V0CAP(i)/V0CAP_i*R1CAPI(i));

Coefficient (All,i,IND) R1FRISK(i);
Formula (Initial)(All,i,IND) R1FRISK(i)=R1RISK(i);

! Could update next. Note in formulka, here, it is assumed that the
risk preimum now and in future arte the same.!
```

```
Coefficient (All,i,IND) R1CAPFRISK(i);
!Formula (Initial) R1CAPFRISK(i)=R1CAPF(i)+R1RISK(i);
Update R1CAPFRISK(i)= r1capfrsk(i);!
Formula (all,i,IND) R1CAPFRISK(i)=R1CAPF(i)+R1RISK(i);

Coefficient V0CAPF_i;
Formula V0CAPF_i=Sum(i,IND,V0CAPF(i));

! Could update next!
Coefficient R1CAPF_i;
!Formula R1CAPF_i=SUM(i,IND,V0CAP(i)/V0CAP_i*R1CAPI(i));
Update R1CAPF_i= r1capfi_i;!
Formula R1CAPF_i=SUM(i,IND,(V0CAPF(i)/V0CAPF_i)*R1CAPF(i));

!ADD!
! Do weighted average risk premium!
!could update this average!
Coefficient R1RISK_i;
!Formula (Initial) R1RISK_i=SUM(i,IND,(V0CAPF(i)/V0CAPF_i)*R1RISK(i));!
!Update (Change) R1RISK_i= delr1rsk_i;!
Formula R1RISK_i=SUM(i,IND,(V0CAPF(i)/V0CAPF_i)*R1RISK(i));

Coefficient (All,i,IND) G(i);
Formula (All,i,IND) G(i)=1-DEP(i)/X1GROWI(i);

Coefficient (All,i,IND) E1CAPF(i) # Discrepancy in rates of return over time#;
Coefficient (All,i,IND) E1GROW(i) # Discrepancy in growth rates#;
Coefficient (All,i,IND) E1STAT(i) # Discrepancy in stationarity over time#;
Formula (initial)(all,i,IND) E1CAPF(i) = R1CAPF(i) / R1CAPF_i -1.0;
Formula (initial)(all,i,IND)E1GROW(i) = X1GROWI(i) / X1GROWI_i -1.0;
Formula (initial)(all,i,IND)E1STAT(i) = X1GROWI(i) -1.0;

Display
        S2INVEST;
        R1CAPI;
        R1CAPI_i;
        R1RISK;
        !R1RISK_i;!
        R1CAPRISK;
        R1CAPF;
        R1CAPF_i;
        !GROSSRR;!
        V0CAP;
        V0CAP_i;
        V0CAPF;
        V0CAPF_i;
        V2TOT;
        !VDEP;!
        E1CAPF;
        X1GROWI;
        X1GROWI_i;
        E1GROW;
        E1STAT;
        G;
        QCOEF;
Equation E_r1caprisk #relation of rates of return with/without risk#
```

```
(All,i,IND)R1CAPRISK(i)*r1caprsk(i)=R1CAPI(i)*r1cap(i)+RISKFLAG
*100*delr1rsk(i);

Equation E_r1capfrsk #expected rate of return with risk#
(All,i,IND) R1CAPFRISK(i)*r1capfrsk(i)=R1CAPF(i)*r1capfi(i)
+RISKFLAG*100*delr1frsk(i);

Equation E_p1cap# definition of rates of return to capital #
(All,i,IND) r1cap(i)+RISKFLAG/R1CAPI(i)*100*delr1rsk(i)=
QCOEF(i)*(p1cap(i)-p2tot(i));

Equation E_r1rsk #change in the average risk premium#
delr1rsk_i=Sum(i,IND,S2INVEST(i)*delr1rsk(i));

Equation E_r1frsk #change in the average future risk premium#
delr1frsk_i=Sum(i,IND,S2INVEST(i)*delr1frsk(i));

Equation E_r1rsksme #equal change in the risk premiums#
(All,i,IND) delr1rsk(i)=delr1frsk(i) + slackrisk(i);

Equation E_r1cap # capital growth rates related to rates of return - ORANI-F #
(All,i,IND)(r1cap(i) - r1cap_i) = BETA_R(i)*[x1cap(i) - x1cap_i] + f1ret(i);

Equation E_rcapi # capital growth realtionship for ORANI and Walmsley#
(All,i,IND) r1cap(i)-r1capfi(i)=BETA_R(i)*(x1grow(i)
-WALMFLAG*x1grow_i)+slackorwalm(i);

Equation E_x1growi # definition: power of growth rates in each industry#
(All,i,IND)x1grow(i)=x1capf(i)-x1cap(i);

Equation E_x1grow #the power of the net growth#
 x1grow_i=Sum(i,IND,V0CAPF(i)/V0CAPF_i*(x1cap(i)+p2tot(i)+x1grow(i)))
 -Sum(i,IND,V0CAP(i)/V0CAP_i*(x1cap(i)+p2tot(i)))+slackgrow_i;

Equation E_r1capfi #discrepancy - lack of equality of future rates of return#
(All,i,IND)r1capfi(i)-r1capfi_i=(E1CAPF(i)/(1+E1CAPF(i)))*slackcapf(i) +slackcapf2(i);

 !(All,i,IND)r1capfi(i)-r1capfi_i=slackcapf2(i);!

Equation E_slackgrow #discrepancy - lack of equality of capital growth rates#
 (All,i, IND)x1grow(i)-x1grow_i=(E1GROW(i)/(1+E1GROW(i)))*slackgrow(i)+slackgrow2(i);

 !(All,i, IND)x1grow(i)-x1grow_i=slackgrow2(i);!

Equation E_slackstat #discrepancy - lack of stationary#
(All,i,IND)x1capf(i)-x1cap(i)=E1STAT(i)/(1+E1STAT(i))*slackstat(i)+slackstat2(i);

Equation E_x1capf # definition: capital in the next period #
(All,i,IND)x1capf(i)=(1-G(i))*x1cap(i)+G(i)*x2tot(i);

Equation E_r1cap_i#definition of the current average risk-free rate of return#
r1cap_i=sum(i,IND,(V0CAP(i))/V0CAP_i*r1cap(i))+slackautor_i;

Equation E_r1capfi_i#definition of the future average risk-free rate of return#
!To follow Walmsley, should focus on investmetn, not total capital.
Coefficient here is wrong since need sum of net investment in denominator!
```

```
!r1capfi_i=sum(i,IND,(V2TOT(i)-VDEP(i))/V2TOT_i*r1capfi(i));!
r1capfi_i=sum(i,IND,(V0CAPF(i))/V0CAPF_i*r1capfi(i))+slackautorf_i;

! Excerpt 35 of TABLO input file: !
! Investment/capital accumulation equations !

Coefficient (INTEGER) T # number of years covered by simulation #;
Read T From Terminal;   ! entered by user at runtime !

Set YEARS MAXIMUM SIZE 100 SIZE T;

Coefficient (all,y,YEARS) ORD(y) # = y for y = 1 to T #;
Read ORD From Terminal; ! entered by user at runtime !

Coefficient (All,i,IND) Z(i) # K(T)/K(0)#;
Formula (Initial) (All,i,IND) Z(i) = 1;
Update (All,i,IND) Z(i) = x1cap(i);

Coefficient (All,i,IND) R_0(i) # Y(0)/K(0)#;
Formula (Initial) (All,i,IND) R_0(i) = R_T(i);

Coefficient (All,i,IND) DEP_T(i) # DEP to the power of T #;
Formula (Initial) (All,i,IND) DEP_T(i) = DEP(i)^T;

Coefficient (All,i,IND) N_term(i) # useful constant #;
Formula(Initial)(All,i,IND)N_term(i) =Sum(y,YEARS, DEP(i)^{T -ORD(y)} );!note y takes values 1 to T!

Coefficient (All,i,IND) M_term(i) # useful constant #;
Formula (Initial) (All,i,IND) M_term(i) =Sum(y,YEARS,([ORD(y)-1]/T)*DEP(i)^{T -ORD(y)} );

Coefficient (All,i,IND) K_TERM(i) # delFudge coefficient  #;
Formula (All,i,IND) K_TERM(i) = 100 *[DEP_T(i) - 1 + R_0(i)*N_term(i)] /Z(i);

Equation E_x2tot # investment/capital accumulation #
(All,i,IND)x1cap(i) = K_TERM(i)*delFudge + M_term(i)*R_T(i)*x2tot(i) + f_accum(i);

! Excerpt 37 of TABLO input file: !
! Land mobility equations !
Set ESTATE # estate crops commodity #    !e!
(Rubber,Sugarcane,Coconut,OilPalm,Coffee,Tea,OthEstate,Forestry);

Subset ESTATE is subset of IND;

Set CROPS # crops commodity #                    !r! (Maize,CerOthGrain,RootCrop,Beans);

Subset CROPS is subset of IND;

Set OTHIND # other industries #                  !h!
 (Paddy,VegFruit,OthAgr,Livestock,Fishery,CoalOthMin,
 OilGas,LivProc,FoodProc,FishProc,EstateProc,Rice,OthFoodProc,BevTob,TxtLthr,
WoodPrd,Chemical,Fertiliser,Pesticide,MinMet,OthManufac,TradTrans,Service);

Subset OTHIND is subset of IND;

Coefficient !Total payment!
  V1LND_E  # total payment to land over estate crops and forestry#;
```

```
 V1LND_R  # total payment to land over food crops#;
 V1LND_H  # total payment to land over other sector #;

Formula
 V1LND_E  = Sum(i,ESTATE,V1LND(i));
 V1LND_R  = Sum(i,CROPS,V1LND(i));
 V1LND_H  = Sum(i,OTHIND,V1LND(i));

Variable
x1lnd_i      # Aggregate land #;
f1lnd_i      # Overall land rental shifter#;
x1lnd_e      # Aggregate land over estate crop and forestry#;
x1lnd_r      # Aggregate land over food crops #;
x1lnd_h      # Aggregate land over other industries #;
f1lnd_e      # Aggregate estate crop's land rental shifter#;
f1lnd_r      # Aggregate food crop's land rental shifter#;
f1lnd_h      # Aggregate other industry's land rental shifter#;

(All,i,IND)f1lnd(i) #industry's land shifter#;
!(All,i,ESTATE)f1lnde(i)#estate crop's land shifter#; !
!(All,i,CROPS)f1lndr(i)#food crop's land shifter#; !
!(All,i,OTHIND)f1lndh(i)#other industry's land shifter#; !

Equation E_x1lnd_i #Aggregate land#
V1LND_I*x1lnd_i=sum(i,IND,(V1LND(i)*x1lnd(i)));

Equation E_x1lnd_e # Aggregate land over estate crops and forestry #
V1LND_E*x1lnd_e=sum(i,ESTATE,(V1LND(i)*x1lnd(i)));

Equation E_x1lnd_r # Aggregate land over food crops #
V1LND_R*x1lnd_r=sum(i,CROPS,(V1LND(i)*x1lnd(i)));

Equation E_x1lnd_h # Aggregate land over other industries #
V1LND_H*x1lnd_h=sum(i,OTHIND,(V1LND(i)*x1lnd(i)));

!Equation E_p1lnd # land rent in each industry #!
!(All,i,IND) p1lnd(i) = f1lnd_i+f1lnd(i) ; !

Equation E_f1lnde # estate crop's land rent shifter #
(All,i,ESTATE) p1lnd(i) = f1lnd_e+f1lnd(i)+f1lnd_i ;

Equation E_f1lndr # food crop's land shifter #
(All,i,CROPS) p1lnd(i) = f1lnd_r+f1lnd(i)+f1lnd_i ;

Equation E_f1lndh # other industry's land shifter #
(All,i,OTHIND) p1lnd(i) = f1lnd_h+f1lnd(i)+f1lnd_i

! end of file !
```

APPENDIX 5. Additions for the Long Run Steady State Simulations Variables, Modified from Walmsley (1998)

VARIABLE (All,r,REG) kbgrow(r) # Growth Rate of Capital in region r #
! This variable is exogenously equal to zero in long run closure and endogenous in short run closure.! ;

VARIABLE avgrow
Average growth rate of Capital across all regions
! This variable is endogenous in both the short run and long run closures which are based on an initial steady state database. In the treatments of the long run which use the steady state database as their initial database, growthav will equal zero. In treatments of the long run which use the standard benchmark database as their initial database growthav must be set exogenously equal to zero.! ;

VARIABLE growth
Single Growth Rate of Capital
! Usually exogenous, unless the user wishes to shock the expected rates of return to equate the expected rates of return in the levels, when it is swapped with the global rate of return. ! ;

VARIABLE (all,r,REG) growslack(r)
slack variable in the equation to equate kbgrow(r) and growth
! Usually endogenous unless the user wishes to shock the expected rates of return to equate them in the levels. ! ;

VARIABLE growavslack
slack variable in equation determing the average growth rate
! This variable is exogenous in both the short run and long run treatments with steady state databases. It is endogenous in the long run treatment with standard benchmark data. ! ;

VARIABLE kb_tot
Global stock of capital #;

VARIABLE pkb
Price of Global stock of capital #;

VARIABLE (All,r,REG) rsk(r)
Risk premia.
! Usually exogenously equal to zero, unless user wants to alter risk premium. ! ;

VARIABLE (all, r, REG) rorcrisk(r)
Current risk rate of return on capital stock, in r # ;

VARIABLE (all, r, REG) rorerisk(r)
Expected risk rate of return on capital stock, in r # ;

!VARIABLE rorgrisk!
! # Global risk-free rate of return expected on capital # ;!

```
!-----------------------------------------------------------------------!
!          Additions for the Long Run simulations                       !
!                   Database                !
!-----------------------------------------------------------------------!
```

FILE (TEXT) GTAPRISK # The file containing behavioral parameters. # ;

```
COEFFICIENT                          RISKFLAG
 ! RISKFLAG is a binary coefficient which determines whether the risk adjusted or non risk adjusted
method is being used. When RISKFLAG = 1, rates of return are adjusted for risk.  When RISKFLAG = 0,
rates of return are not adjusted for risk ! ;

READ RISKFLAG FROM FILE GTAPRISK ;

FILE (TEXT) GTAPRECOG # The file containing behavioral parameters. # ;

COEFFICIENT                              RISKRECOG
! RISKRECOG is a binary coefficient which determines whether risk premium (RISK(r)) is recognise in
the model or not.  When RISKRECOG = 0, the risk premia is not recognised.  When RISKRECOG=1, the
risk premia is recognised!;

READ RISKRECOG FROM FILE GTAPRECOG ;

COEFFICIENT (all,r,REG)             ROREXP(r) ! Expected rate of return  ! ;
UPDATE (all,r,REG) ROREXP(r) = rore(r) ;

READ
   (all,r,REG)                     ROREXP(r)
         FROM FILE GTAPDATA HEADER "RREF" ;

!-------------------------------------------------------------------------!
!  Additions for the Long Run simulations   Derivatives of Database                  !
!-------------------------------------------------------------------------!

COEFFICIENT (All,r,REG)                       DEPRATE(r) ;
! Depreciation rate in region r !
FORMULA (All,r,REG) DEPRATE(r) = VDEP(r)/VKB(r)  ;

COEFFICIENT (All,r,REG)                       KBGROWTH(r) ;
! Growth rate of capital in region r. !
FORMULA (All,r,REG) KBGROWTH(r) = 1 + (NETINV(r)/VKB(r))  ;

COEFFICIENT                              GLOBKB
           ! global capital stocks ! ;
            ! here, GLOBKB is computed as sum of VKB(r) !
FORMULA GLOBKB = sum(r,REG, VKB(r));

COEFFICIENT (All,r,REG)                      SHR_VKE(r);
! Share of regional net investment in total real net investment !
FORMULA (All,r,REG)
        SHR_VKE(r) = (VKB(r)+NETINV(r))/sum(s,REG, VKB(s)+NETINV(s)) ;

COEFFICIENT (All,r,REG)                      SHR_VKB(r) ;
FORMULA (All,r,REG) SHR_VKB(r) = VKB(r)/GLOBKB ;

COEFFICIENT                              AVGROWTH ;
FORMULA AVGROWTH = sum(r,REG,SHR_VKB(r)*KBGROWTH(r)) ;

COEFFICIENT (all,r,REG)                      RORCURISK(r) ;
! Current rate of return in region r. !
FORMULA (all,r,REG)
RORCURISK(r)  = [(sum(h,ENDWC_COMM, VOA(h,r))/(VKB(r))) - (VDEP(r)/VKB(r))] ;
```

```
COEFFICIENT (all,r,REG)                         RORCUR(r);
        ! Current risk free rate of return !
FORMULA (all,r,REG) !RORCUR(r) = RORCURISK (r) ;!

RORCUR(r)  = (1-RISKRECOG)*(RORCURISK(r))+RISKRECOG*[ROREXP(r) *
        [(VKB(r)+NETINV(r))/(VKB(r)*(AVGROWTH))]^(RORFLEX(r))] ;

COEFFICIENT (all,r,REG)                         RISK(r) ;
! Risk premium. !
FORMULA (all,r,REG) RISK(r) = (RORCURISK(r) - RORCUR(r));

COEFFICIENT (all,r,REG)                         ROREXPRISK(r) ;
! Expected rate of return in region r. !
FORMULA (all,r,REG) ROREXPRISK(r)  = [[RORCURISK(r) *
        [(VKB(r)+NETINV(r))/(VKB(r)*(AVGROWTH))]^(-RORFLEX(r))]];

COEFFICIENT (all,r,REG)                                   GNRATIO(r);
!Ratio of (risk affected) gross returns to risk free current return!
FORMULA (all,r,REG)GNRATIO(r)=(RORCUR(r)+RISKFLAG*RISK(r)+DEPRATE(r))/RORCUR(r) ;
DISPLAY

        RISK ;
        KBGROWTH ;
        DEPRATE ;
        AVGROWTH ;
        RORCUR ;
        RORCURISK ;
        ROREXP ;
        ROREXPRISK ;
        GLOBKB ;

!------------------------------------------------------------------------ !
!  Additions for the Long Run simulations  Equations                      !
!------------------------------------------------------------------------ !

EQUATION E_KBGROW
! Expected rate of return depends on the current rate of return and growth rates in the non risk adjusted
method (RISKADJ=0). In the risk adjusted method the expected risk free rate of return depends on the
current risk-free rate of return and the growth rates. This equation replaces an existing equation in the
model (HT#58)!
(all, r, REG) rore(r) ={rorc(r) - RORFLEX(r) * [ kbgrow(r)- avgrow]} ;

EQUATION E_KE
! Growth relationship between end-of-period capital and beginning-of-period capital !
(all, r, REG) ke(r) = kb(r) + kbgrow(r) ;

EQUATION E_RORE
! This equation computes alternatively the global supply of capital
goods or the global rental rate on investment. This equation replaces an existing equation (HT#59) !
(all,r,REG) {RORDELTA * [rore(r)] +[1 - RORDELTA] * {[REGINV(r)/NETINV(r)] * qcgds(r) -
[VDEP(r)/NETINV(r)] * kb(r)}} = {RORDELTA * rorg +[1 - RORDELTA] * globalcgds + cgdslack(r)};

EQUATION E_GLOBALCGS
! This equation computes: either the change in global investment (when RORDELTA=1), or the change
 in the expected global rate of return on capital (when RORDELTA=0). This equation replaces an existing
equation (HT#11') !
```

```
{RORDELTA * globalcgds + [1 - RORDELTA] * rorg} = RORDELTA * [ sum(r,REG,
{REGINV(r)/GLOBINV} * qcgds(r) - {VDEP(r)/GLOBINV} * kb(r))] + [1 - RORDELTA] *
[ sum(r,REG, {NETINV(r)/GLOBINV} * rore(r)) ];

EQUATION E_KB_TOT
!This equation calculates the percentage change in global capital stocks !
        Sum(r,REG,VKB(r))*kb_tot = Sum(r,REG,VKB(r)*kb(r)) ;

EQUATION E_PKB
!This equation calculates the percentage change in global capital stocks !
        pkb = Sum(r,REG,SHR_VKB(r)*pcgds(r)) ;

EQUATION E_GROWSLACK
! Equates the percentage change in the growth rates of capital to the average growth rate of capital. Used
when shocks are applied to equate the expected rates of return across regions !
 (all,r,REG) kbgrow(r) = growth + growslack(r) ;

EQUATION E_AVGROW
! This equation equates the change in growth rates across regions !
avgrow = sum(r,REG, SHR_VKE(r) * (kb(r)+pcgds(r)+kbgrow(r))) - (kb_tot+pkb) + growavslack ;

EQUATION E_ROCURISK
! Equates Absolute changes in the current risk and current
rate of return.!
(all, r, REG) (RORCURISK(r) * rorcrisk(r)) = (RORCUR(r) * rorc(r) + RISKFLAG*RISK(r) * rsk(r)) ;

EQUATION E_ROREXPRISK (All,r,REG)
! Equates absolute changes in the current and current risk free
rate of return !
(ROREXPRISK(r) * rorerisk(r)) = (ROREXP(r) * rore(r) + RISKFLAG*RISK(r) * rsk(r)) ;
!EQUATION E_RORGRISK!
!Equates percentage change in global expected rate of return!
!RISKFLAG*rorgrisk+(1-RISKFLAG)*rorg = sum(r,REG,(RISKFLAG)*(NETINV(r)/GLOBINV)!
!* rorerisk(r)+(1-RISKFLAG)*(NETINV(r)/GLOBINV)*rore(r));!

Equation E_RORCUR (All,r,REG)

rorc(r)+(RISKFLAG*RISK(r)/RORCUR(r))*rsk(r) =(GNRATIO(r)*(rental(r)-pcgds(r))) ;

VARIABLE (change) (all,r,REG)                    flows(r);

EQUATION GDP_TO_GNP (all,r,REG)
! Computes FDI income by region, assuming that initial holdings of global capital indexed by returns equal
the domestic capital stock. This can be changed with more data. Marginal changes
in the income flow from increased savings will be equal to qsave, while changes related to the rate of return
will be rorg. The difference between this and the closed economy analogue is then calculated as a net
inflow or outflow affecting the current account and showing up in income.!

flows(r) = sum(h,ENDWC_COMM,VOA(h,r)*  (qsave(r)-qo(h,r)))  - (INCOME(r) * incomeslack(r));


! ------------------------------------------------------------------------ !
!                    END OF FILE                    !
! ------------------------------------------------------------------------ !
```